

**PLENARY MEETING**

**Document CPM19-2/1-E**  
**17 September 2018**  
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**Director, Radiocommunication Bureau**

**DRAFT CPM REPORT**

Attached please find the draft CPM Report to WRC-19 for consideration during the second session of the 2019 Conference Preparatory Meeting (CPM19-2) to be held in Geneva, 18-28 February 2019 (see Administrative Circular [CA/271](#) of 16 July 2018). The draft CPM Report has been prepared on the basis of draft CPM texts developed by the responsible ITU-R groups involved in the preparation for WRC-19, according to its agenda as contained in ITU Council Resolution 1380 (C16, amended C17).

The structure of the Report is in accordance with the decisions of the first session of the 2019 Conference Preparatory Meeting (CPM19-1), (Geneva, 30 November to 1 December 2015), as reported in Administrative Circular [CA/226](#) of 23 December 2015 and complemented by its Addendum 1 of 19 September 2016 with corrigenda issued subsequently to take into account some requested changes agreed by the CPM-19 Management Team.

In accordance with Resolution ITU-R 2-7, the draft CPM Report was consolidated and compiled at the CPM Management Team meeting (Geneva, 6-7 September 2018). In the process of the consolidation and compilation, modifications were made to the texts to make the draft CPM Report clear and drafted in a consistent and unambiguous manner, with care taken to maintain the intent/meaning of the original texts. Secretarial support was provided by the Radiocommunication Bureau.

The following points should be taken into account in particular while preparing contributions to CPM19-2:

- the abbreviations used in the draft CPM Report are listed at the beginning of the draft CPM Report; radiocommunication services are normally referred to using the acronym provided in the abbreviation list;
- the Annex to the draft CPM Report provides a complete list of the ITU-R Recommendations and ITU-R Reports referred to within the draft CPM Report. Several of these Recommendations and Reports are indicated as being in draft form, either new or revised. Once approved, the final designation of these draft Recommendations and Reports will be brought to the attention of CPM19-2 or, at the latest, WRC-19. Similarly, any case in which the approval process has not been successfully completed will be reported;
- to limit the number of pages in contributions to CPM19-2, it is recommended not to reproduce any parts of the draft CPM Report in the contributions, but simply to refer to the relevant section(s) of that Report. Text from the draft CPM Report should be

reproduced in contributions only to indicate proposed changes, using revision marks with track changes as appropriate. More detailed information on how to present these changes are provided in the “[Guidelines for the Preparation of Contributions](#)” available on the [CPM webpage](#);

- in general, subjective value statements (great, huge, modest, etc.) should be avoided in completing CPM text;
- in general, consideration needs to be given to shortening the length of text for some agenda items;
- in general, the word “frequency” has to be used in references to bands or ranges.

The CPM-19 Management Team identified the following issues:

- For Chapter 1, agenda item 1.14, in the proposed new footnotes RR Nos. **5.A114[-6400B1-O1]** and **5.A114[-6400B1-O2]**, the first sentence indicates that “... the allocation to the fixed service in the band 6 440-6 520 MHz is designated for worldwide use by ... high-altitude platform stations (HAPS).” Another wording would need to be considered to align with RR No. **4.23** terminology (i.e. identified instead of designated).
- For Chapter 1, agenda item 1.15, the square brackets around “[identified/designated]” in Sections 1/1.15/4.2 and 1/1.15/5.1 would need to be addressed, taking into account the terminology used in the text of WRC-19 agenda item 1.15, in Resolution **767 (WRC-15)**, and agreed at WRC-12 in RR No. **5.565**.
- For Chapter 2, agenda item 1.13:
  - The description of the “Carrier #...” mentioned in Section 2/1.13/3.2.4.1, as well as of the other system parameters and propagation models used in the sharing and compatibility studies, can be found in the input contributions to Task Group 5/1 from the involved ITU-R Working Parties as listed in Annex 1 to the TG 5/1 Chairman’s Report (see Document [5-1/478](#)).
  - During the CPM Management Team meeting, the presentation of the results of the compatibility studies between IMT and EESS (passive) was editorially converted to table format in order to facilitate the understanding and provide consistent format in the different sections of the draft CPM text dealing with this issue, i.e. Sections 2/1.13/3.2.1.2.1, 2/1.13/3.2.7.3 and 2/1.13/3.2.11.1.
- For Chapter 2, agenda item 1.16, the use of the terms “WAS/RLAN”, “MS/RLAN” or just “RLAN” was noted and may need to be reviewed depending on the context of the titles or sentences in which they are used.
- For Chapter 2, agenda item 9.1, issue 9.1.1, some editorial changes were made to clarify the terms “IMT satellite” or “IMT satellite system(s)” which are not defined in Resolution **212 (Rev.WRC-15)**, taking into account the potential interference scenarios described in the figure in Section 2/9.1.1/3.
- For Chapter 3, there would be a need to ensure that the different modifications to Annex 2 of RR Appendix **4**, which are proposed under the different issues, are consistent. It was noted that the Radiocommunication Bureau is preparing a compilation of all the proposed modifications.
- For Chapter 3, agenda item 1.4, the following views were expressed during the study cycle:

Some administrations are of the view that proposed revisions of Annex 7 limitations should be limited only to revisions of the text of Annex 7 to

Appendix **30** of the Radio Regulations, and revisions to Annexes 1 and 4 to Appendix **30** of the Radio Regulations would fall outside the scope of WRC-19 agenda item 1.4. The Bulgarian delegation stated that giving in the part of the BSS frequency band for Regions 1 and 3, in part of the orbital sector over Regions 1 and 3 and for part of the BSS networks the protection other than this specified in RR Appendix **30** which is based on the reference parameters values, is completely in contradiction to the principle of equitable access and violates the rights of all other administrations. The study of the protection of less than 60 cm BSS receiving antennas have to be considered separately as a contribution to a recommendation which could be used by the time of a decision for revision of RR Appendix **30**.

Some administrations consider that issues related to intra-BSS service protection are outside the scope of WRC-19 agenda item 1.4.

Some administrations are of the view that according to the Resolution **557 (WRC-15)** additional measures are required to ensure the protection of, and without imposing additional constraints on assignments in the Plan and in the List implemented in accordance with the current provisions of Annex 7 to RR Appendix **30**.

- For Chapter 3, agenda item 7, issue C, appropriate action may be necessary on the reference to former “Resolution **905 (WRC-07)**” in footnote 11 to the title of Article 8 of RR Appendix **30B**, in order to address the “*Note by the Secretariat*” indicating that “This Resolution was abrogated by WRC-12”.
- For Chapter 5, agenda item 1.8:
  - In the proposed modifications of RR No. **5.79** in Section 5/1.8/5.1.2, attention is drawn to a possible consequential inconsistency with the method described in Section 5/1.8/4.1.2.
  - The proposed suppression of Resolution **359 (Rev.WRC-15)** in Section 5/1.8/5.1.2 was understood as a suppression of *resolves* 1 of that Resolution, while the proposed suppression of that Resolution in Section 5/1.8/5.2.5 was understood as a suppression of *resolves* 2.
- For Chapter 5, agenda item 1.9.2:
  - Some questions of substance on the draft CPM text were raised during the CPM-19 Management Team meeting but could not be answered. It was agreed to bring them to the attention of the next Working Party 5B meeting in preparation for CPM19-2.
  - The numbering used for the new RR Article **5** footnotes proposed under this agenda item may need to be reviewed, taking into account the guidelines provided for the preparation of the draft CPM texts, in order to avoid any misunderstanding.



# **D R A F T**

**CPM Report on  
technical, operational and regulatory/procedural  
matters to be considered by  
the 2019 World Radiocommunication Conference**

GENEVA, 2018



## Cross-reference between the WRC-19 agenda items and the chapters of the draft CPM Report

WRC-19 agenda item		Chapter of the draft CPM Report to WRC-19
1	on the basis of proposals from administrations, taking account of the results of WRC-15 and the Report of the Conference Preparatory Meeting, and with due regard to the requirements of existing and future services in the frequency bands under consideration, to consider and take appropriate action in respect of the following items:	–
1.1	to consider an allocation of the frequency band 50-54 MHz to the amateur service in Region 1, in accordance with Resolution <b>658 (WRC-15)</b> ;	5
1.2	to consider in-band power limits for earth stations operating in the mobile-satellite service, meteorological-satellite service and Earth exploration-satellite service in the frequency bands 401-403 MHz and 399.9-400.05 MHz, in accordance with Resolution <b>765 (WRC-15)</b> ;	4
1.3	to consider possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a possible primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz, in accordance with Resolution <b>766 (WRC-15)</b> ;	4
1.4	to consider the results of studies in accordance with Resolution <b>557 (WRC-15)</b> , and review, and revise if necessary, the limitations mentioned in Annex 7 to Appendix <b>30 (Rev.WRC-15)</b> , while ensuring the protection of, and without imposing additional constraints on, assignments in the Plan and the List and the future development of the broadcasting-satellite service within the Plan, and existing and planned fixed-satellite service networks;	3
1.5	to consider the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service and take appropriate action, in accordance with Resolution <b>158 (WRC-15)</b> ;	3
1.6	to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), in accordance with Resolution <b>159 (WRC-15)</b> ;	3
1.7	to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution <b>659 (WRC-15)</b> ;	4
1.8	to consider possible regulatory actions to support Global Maritime Distress Safety Systems (GMDSS) modernization and to support the introduction of additional satellite systems into the GMDSS, in accordance with Resolution <b>359 (Rev.WRC-15)</b> ;	5

WRC-19 agenda item		Chapter of the draft CPM Report to WRC-19
1.9	to consider, based on the results of ITU-R studies:	–
1.9.1	regulatory actions within the frequency band 156-162.05 MHz for autonomous maritime radio devices to protect the GMDSS and automatic identifications system (AIS), in accordance with Resolution <b>362 (WRC-15)</b> ;	5
1.9.2	modifications of the Radio Regulations, including new spectrum allocations to the maritime mobile-satellite service (Earth-to-space and space-to-Earth), preferably within the frequency bands 156.0125-157.4375 MHz and 160.6125-162.0375 MHz of Appendix <b>18</b> , to enable a new VHF data exchange system (VDES) satellite component, while ensuring that this component will not degrade the current terrestrial VDES components, applications specific messages (ASM) and AIS operations and not impose any additional constraints on existing services in these and adjacent frequency bands as stated in <i>recognizing d) and e)</i> of Resolution <b>360 (Rev.WRC-15)</b> ;	5
1.10	to consider spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System (GADSS), in accordance with Resolution <b>426 (WRC-15)</b> ;	5
1.11	to take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands to support railway radiocommunication systems between train and trackside within existing mobile service allocations, in accordance with Resolution <b>236 (WRC-15)</b> ;	1
1.12	to consider possible global or regional harmonized frequency bands, to the maximum extent possible, for the implementation of evolving Intelligent Transport Systems (ITS) under existing mobile-service allocations, in accordance with Resolution <b>237 (WRC-15)</b> ;	1
1.13	to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution <b>238 (WRC-15)</b> ;	2
1.14	to consider, on the basis of ITU-R studies in accordance with Resolution <b>160 (WRC-15)</b> , appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations;	1
1.15	to consider identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz, in accordance with Resolution <b>767 (WRC-15)</b> ;	1
1.16	to consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution <b>239 (WRC-15)</b> ;	2
2	to examine the revised ITU-R Recommendations incorporated by reference in the Radio Regulations communicated by the Radiocommunication Assembly, in accordance with Resolution <b>28 (Rev.WRC-15)</b> , and to decide whether or not to update the corresponding references in the Radio Regulations, in accordance with the principles contained in Annex 1 to Resolution <b>27 (Rev.WRC-12)</b> ;	6
3	to consider such consequential changes and amendments to the Radio Regulations as may be necessitated by the decisions of the conference;	Not in scope of CPM
4	in accordance with Resolution <b>95 (Rev.WRC-07)</b> , to review the resolutions and recommendations of previous conferences with a view to their possible revision, replacement or abrogation;	6
5	to review, and take appropriate action on, the Report from the Radiocommunication Assembly submitted in accordance with Nos. 135 and 136 of the Convention;	Not in scope of CPM
6	to identify those items requiring urgent action by the radiocommunication study groups in preparation for the next world radiocommunication conference;	Not in scope of CPM



WRC-19 agenda item		Chapter of the draft CPM Report to WRC-19
7	to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution <b>86 (Rev.WRC-07)</b> , in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit;	3
8	to consider and take appropriate action on requests from administrations to delete their country footnotes or to have their country name deleted from footnotes, if no longer required, taking into account Resolution <b>26 (Rev.WRC-07)</b> ;	Not in scope of CPM
9	to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:	–
9.1	on the activities of the Radiocommunication Sector since WRC-15;	–
9.1.1 <sup>a)</sup>	Res. <b>212 (Rev.WRC-15)</b> – <i>Implementation of International Mobile Telecommunications in the frequency bands 1 885-2 025 MHz and 2 110-2 200 MHz</i>	2
9.1.2 <sup>a)</sup>	Res. <b>761 (-15)</b> – <i>Compatibility of International Mobile Telecommunications and broadcasting-satellite service (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3</i>	3
9.1.3 <sup>a)</sup>	Res. <b>157 (WRC-15)</b> – <i>Study of technical and operational issues and regulatory provisions for new non-geostationary-satellite orbit systems in the 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz and 6 725-7 025 MHz frequency bands allocated to the fixed-satellite service</i>	3
9.1.4 <sup>a)</sup>	Res. <b>763 (WRC-15)</b> – <i>Stations on board sub-orbital vehicles</i>	5
9.1.5 <sup>a)</sup>	Res. <b>764 (WRC-15)</b> – <i>Consideration of the technical and regulatory impacts of referencing Recommendations ITU-R M.1638 1 and ITU R M.1849 1 in Nos. 5.447F and 5.450A of the Radio Regulations</i>	2
9.1.6 <sup>a)</sup>	Issue 1) in the Annex to Resolution <b>958 (WRC-15)</b> – <i>Urgent studies required in preparation for the 2019 World Radiocommunication Conference</i> 1) <i>Studies concerning Wireless Power Transmission (WPT) for electric vehicles:</i> a) <i>to assess the impact of WPT for electric vehicles on radiocommunication services;</i> b) <i>to study suitable harmonized frequency ranges which would minimize the impact on radiocommunication services from WPT for electrical vehicles.</i> <i>These studies should take into account that the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO) and the Society of Automotive Engineers (SAE) are in the process of approving standards intended for global and regional harmonization of WPT technologies for electric vehicles.</i>	6
9.1.7 <sup>a)</sup>	Issue 2) in the Annex to Resolution <b>958 (WRC-15)</b> – <i>Urgent studies required in preparation for the 2019 World Radiocommunication Conference</i> 2) <i>Studies to examine:</i> a) <i>whether there is a need for possible additional measures in order to limit uplink transmissions of terminals to those authorized terminals in accordance with No. 18.1;</i> b) <i>the possible methods that will assist administrations in managing the unauthorized operation of earth station terminals deployed within its territory, as a tool to guide their national spectrum management programme, in accordance with Resolution ITU-R 64 (RA 15).</i>	6

a) Issue identified by CPM19-1 under WRC-19 agenda item 9.1 (see Administrative Circular [CA/226](#) of 23 December 2015).

WRC-19 agenda item		Chapter of the draft CPM Report to WRC-19
	9.1.8a) Issue 3) in the Annex to Resolution <b>958 (WRC-15)</b> – <i>Urgent studies required in preparation for the 2019 World Radiocommunication Conference</i> 3) <i>Studies on the technical and operational aspects of radio networks and systems, as well as spectrum needed, including possible harmonized use of spectrum to support the implementation of narrowband and broadband machine-type communication infrastructures, in order to develop Recommendations, Reports and/or Handbooks, as appropriate, and to take appropriate actions within the ITU Radiocommunication Sector (ITU-R) scope of work.</i>	2
	9.1.9a) Res. <b>162 (WRC-15)</b> – <i>Studies relating to spectrum needs and possible allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space)</i>	3
9.2	on any difficulties or inconsistencies encountered in the application of the Radio Regulations <sup>*</sup> ; and	–
9.3	on action in response to Resolution <b>80 (Rev.WRC-07)</b> ;	–
10.	to recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, in accordance with Article 7 of the Convention,	6

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\* This agenda item is strictly limited to the Report of the Director on any difficulties or inconsistencies encountered in the application of the Radio Regulations and the comments from administrations.

## Draft CPM Report

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If the users of this document have any questions please contact the Chapter Rapporteurs as listed in the table below (see contact details at: [www.itu.int/en/ITU-R/study-groups/rcpm/Pages/CPM-19-chp-rapporteurs.aspx](http://www.itu.int/en/ITU-R/study-groups/rcpm/Pages/CPM-19-chp-rapporteurs.aspx)).

Chapter	Rapporteur	WRC-19 agenda items and issues <sup>a)</sup>
1 Land mobile and fixed services	Ms Keer ZHU	1.11, 1.12, 1.14, 1.15
2 Broadband applications in the mobile service	Mr José De Jesús ARIAS FRANCO	1.13, 1.16, 9.1 (issues <sup>a)</sup> 9.1.1, 9.1.5, 9.1.8)
3 Satellite services	Mr Nikolay VARLAMOV	1.4, 1.5, 1.6, 7, 9.1 (issues <sup>a)</sup> 9.1.2, 9.1.3, 9.1.9)
4 Science services	Mr Vincent MEENS	1.2, 1.3, 1.7
5 Maritime, aeronautical and amateur services	Mr Wael SAYED	1.1, 1.8, 1.9, 1.10, 9.1 (issue <sup>a)</sup> 9.1.4)
6 General issues	Mr Peter N. NGIGE	2, 4, 9.1 (issues <sup>a)</sup> 9.1.6, 9.1.7), 10

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a) Issue(s) identified by CPM19-1 under WRC-19 agenda item 9.1 (see the Radiocommunication Bureau Administrative Circular [CA/226](#) of 23 December 2015).

## Lists of abbreviations used in the draft CPM Report

Abbreviations	Radio services	RR definition
AMS	aeronautical mobile service	No. <b>1.32</b>
AM(R)S	aeronautical mobile (route) service	No. <b>1.33</b>
AMS(OR)S	aeronautical mobile-satellite (off-route) service	No. <b>1.34</b>
AMSS	aeronautical mobile-satellite service	No. <b>1.35</b>
AMS(R)S	aeronautical mobile-satellite (route) service	No. <b>1.36</b>
ARNS	aeronautical radionavigation service	No. <b>1.46</b>
ARNSS	aeronautical radionavigation-satellite service	No. <b>1.47</b>
ARS	amateur service	No. <b>1.56</b>
ARSS	amateur-satellite service	No. <b>1.57</b>
BS*	broadcasting service	No. <b>1.38</b>
BSS	broadcasting-satellite service	No. <b>1.39</b>
EESS	Earth exploration-satellite service	No. <b>1.51</b>
FS	fixed service	No. <b>1.20</b>
FSS	fixed-satellite service	No. <b>1.21</b>
ISS	inter-satellite service	No. <b>1.22</b>
LMS	land mobile service	No. <b>1.26</b>
LMSS	land mobile-satellite service	No. <b>1.27</b>
MetAids	meteorological aids service	No. <b>1.50</b>
MetSat	meteorological-satellite service	No. <b>1.52</b>
MMS	maritime mobile service	No. <b>1.28</b>
MMSS	maritime mobile-satellite service	No. <b>1.29</b>
MRNS	maritime radionavigation service	No. <b>1.44</b>
MRNSS	maritime radionavigation-satellite service	No. <b>1.45</b>
MS	mobile service	No. <b>1.24</b>
MSS	mobile-satellite service	No. <b>1.25</b>
RAS	radio astronomy service	No. <b>1.58</b>
RDS	radiodetermination service	No. <b>1.40</b>
RDSS	radiodetermination-satellite service	No. <b>1.41</b>
RLS	radiolocation service	No. <b>1.48</b>
RLSS	radiolocation-satellite service	No. <b>1.49</b>
RNS	radionavigation service	No. <b>1.42</b>
RNSS	radionavigation-satellite service	No. <b>1.43</b>
SOS	space operation service	No. <b>1.23</b>
SFTSS	standard frequency and time signal service	No. <b>1.53</b>
SFTSSS	standard frequency and time signal-satellite service	No. <b>1.54</b>
SRS	space research service	No. <b>1.55</b>

\* In the draft CPM texts on WRC-19 agenda items 1.13 and 9.1 issue 9.1.1, this abbreviation stands for “base station” (see RR No. 1.71) and is not used to refer to the “broadcasting service” therein.

**Other abbreviations:**

<b>Abbreviations</b>	<b>Description</b>
3GPP	Third-Generation Project Partnership
AAS	active antenna system
ACM	adaptive coding and modulation
AES	aircraft earth station
A-ESIM	Aeronautical ESIM
AIS	automatic identification system
AM	Amplitude modulation
AMRD	autonomous maritime radio devices
API	advance publication information
APSK	Amplitude phase shift keying
ARIB	Association of Radio Industries and Businesses
ASM	application specific messages
ATC	ancillary terrestrial component
AtoN	aid to navigation
ATS	Automatic Train Stop
BBIU	bringing back into use
BFWA	Broadband Fixed Wireless Access
BIU	bringing into use
BR	Radiocommunication Bureau
BR IFIC	Radiocommunication Bureau International Frequency Information Circular
CDF	cumulative distribution function
CCTV	Closed Circuit Television
CEN	European Committee for Standardization
CEPT	Conférence Européenne des Administrations des Postes et Télécommunications (European Conference of Postal and Telecommunications Administrations)
CGC	complementary ground component
Ch.	channel
<i>C/I</i>	carrier-to-interference ratio
<i>C/N</i>	carrier-to-noise ratio
<i>C/(N+I)</i>	carrier to noise plus interference ratio
CISPR	International Special Committee on Radio Interference (abbreviation for the French name: “Comité International Spécial des Perturbations Radioélectriques”)
CISPR/.../CDV	CISPR/.../Committee Draft for Vote
COMPAT	Compatibility
ConOps	concept of operations
CPE	customer premises equipment
CPM	conference preparatory meeting
CPMS	continuous tone coded squelch systems
CR/C	coordination request

Abbreviations	Description
CTDRS	Chinese data relay satellite
D&S-OPS	distress and safety operations
DCP	data collection platform
DCS	data collection systems
DF	Deployment Factor
DFS	dynamic frequency selection
DN	draft new
DR	draft revision
DRS	data relay satellite
DSC	differential scanning calorimetry
ECDIS	electronic display and information system
EDRS	European data relay satellite
e.i.r.p.	equivalent isotropically radiated power (see RR No. <b>1.161</b> )
EIRP	Equivalent Isotropically Radiated Power
eMBB	enhanced mobile broadband
EPM	equivalent protection margin
epfd	equivalent power flux-density
EPIRB	emergency position indicating radio beacon
ERA	European Railway Agency
E-s	Earth-to-space
E/S or ES	earth station
ESIM	earth stations in motion
ETC	Electronic Toll Collection
ETSI	European Telecommunications Standards Institute
ETSI EN	ETSI European Standard
FDD	frequency-division duplex
FL	feeder link
FM	Frequency Modulation
GADSS	Global Aeronautical Distress and Safety System
Gbit/s	Gigabits per second
GE89	Plan for VHF/UHF television broadcasting in the African Broadcasting Area and neighbouring countries, Geneva, 1989 Rev. 2006
GIMS	Graphical Interference Management System
GLONASS	Global Navigation Satellite System
GMDSS	global maritime distress and safety system
GMPCS	Global Mobile Personal Communications by Satellite
GSM-R	Global system for mobile communications – railway
GSO	geostationary-satellite orbit (see RR No. <b>1.190</b> )
GSO	Geosynchronous orbit
GW	Gateway
HAPS	high altitude platform station
HDFSS	high density fixed satellite systems

Abbreviations	Description
HEO	highly elliptical Earth orbit
HF	high frequency
HTS	high throughput satellite
IARU	International Amateur Radio Union
ICAO	International Civil Aviation Organization
IDCS	International Data Collection System
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IFOV	instantaneous field of view
IMF	interplanetary magnetic field
IMO	International Maritime Organization
IMT	International Mobile Telecommunications
$I_{new}$	interference power
$I/N$	interference to noise ratio
IoT	Internet of Things
IP	Internet Protocol
ISM	industrial, scientific and medical (see RR No. <b>1.15</b> )
ISO	International Organization for Standardization
ITS	intelligent transportation systems
ITU	International Telecommunication Union
ITU CS	ITU Constitution
ITU-R	ITU Radiocommunication Sector
IUCAF	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science
LEO	Low Earth Orbit / low Earth orbit
L-ESIM	Land ESIM
LF	low frequency
LTAN	Local Time of the Ascending Node
LTE	long-term evolution
LTE-R	Long Term Evolution-Railway
M2M	machine-to-machine
MCL	minimum coupling loss
MEO	medium Earth orbit
MES(s)	mobile earth station(s)
M-ESIM	Maritime ESIM
MF	medium frequency
<i>MF</i>	final milestone (abbreviation used in italic only in the draft CPM texts on WRC-19 agenda item 7 issue A where “ <i>MF</i> ” is not used to refer to “medium frequency”)
MGWS	Multiple Gigabit Wireless Systems
MIFR	Master International Frequency Register (or Master Register)
MIMO	multiple-input and multiple-output
MMSI	Maritime Mobile Service Identity
mMTC	massive machine-type communications



<b>Abbreviations</b>	<b>Description</b>
MOB	man over-board
MR	regular milestone-based approach
MT	transitional milestone-based approach
MTC	Machine-Type Communication
MWI	microwave imaging
N/A	not applicable
NAVDAT	navigational data
NAVTEX	Navigational text
NBDP	narrow-band direct printing
NCMC	Network Control and Monitoring Centre
NGSO / non-GSO	non-geostationary-satellite orbit
NGSO SD	non-GSO satellites with short duration
No.	number
OFDM	Orthogonal frequency division multiplexing
OOBE	out-of-band emission
PDN	preliminary draft new
PDR	preliminary draft revision
pdf	power flux-density
P-MP	point-to-multipoint
P-P	point-to-point
PSD	power spectrum density
PSTN	public switched telephone network
RAC	Rural Area Coverage
QPSK	Quadrature Phase-Shift Keying
RAAN	right ascension of the ascending node
RA	Radiocommunication Assembly
Rec.	Recommendation
Rep.	Report
Res.	Resolution
RF	radio frequency
RF CSA	radio-frequency mesh network central alarm
RFI	radio-frequency interference
RLAN	radio local area network
RoP	Rule of Procedure
RR	Radio Regulations
RRB	Radio Regulations Board
RSTT	Railway radiocommunication Systems between Train and Trackside
RTTT	Road Transport and Traffic Telematics
SAC	Suburban Area Coverage
SAE	Society of Automotive Engineers
SAR	search and rescue
SARPs	standards and recommended practices

<b>Abbreviations</b>	<b>Description</b>
SART	Search And Rescue Transmitter
SAT-COM	Satellite Communications
s-E	space-to-Earth
SDOs	standards developing organizations
SM	Spectrum Management
SNR	signal-to-noise ratio
SOLAS	International Convention for the Safety of Life at Sea
SRD	Short Range Device
SSB	Single Side Band
SSCS	Space-to-Space Communication System
ST61	Plan for television and sound broadcasting in the European broadcasting area, Stockholm, 1961 Rev. 2006
TBD	to be defined/determined/developed (according to the context, used as a placeholder)
TDD	time-division duplex
TDRS	Tracking and data relay satellite
TETRA	Terrestrial Trunked Radio
TRP	total radiated power
TT&C	tracking, telemetry and command
UAC	Urban Area Coverage
UE	user equipment
UHDTV	ultra high definition television
UHF	ultra high frequency
UIC	International Union of Railways
UN	United Nations
URLLC	ultra-reliable and low-latency communications
V2I	vehicle-to-infrastructure
V2N	vehicle-to-network
V2P	vehicle-to-pedestrian
V2V	vehicle-to-vehicle
V2X	vehicle-to-anything
VDE	VHF data exchange
VDE-SAT	VDE Satellite component
VDE-TER	VDE – Terrestrial specific
VDES	VHF data exchange system
VHF	very high frequency
VLBI	very long baseline interferometry
VoWiFi	voice-over-Wi-Fi
WARC	World Administrative Radio Conference
WAS	Wireless Access System
WAVE	Wireless Access in Vehicular Environment
WD	Working document
WDPDN	Working document towards a preliminary draft new

<b>Abbreviations</b>	<b>Description</b>
Wi-Fi	a trademarked term meaning IEEE 802.11x
WIA	Wireless Industrial Automation
WPR	Wind Profiler Radar
WPT	Wireless Power Transmission
WPT-EV	WPT for electric vehicles
WRC	World Radiocommunication Conference
X-QAM	quadrature amplitude modulation (X states)

## CHAPTER 1

### Land mobile and fixed services

(Agenda items 1.11, 1.12, 1.14, 1.15)

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## Agenda item 1.11

**(WP 5A / WP 4A, WP 4B, WP 4C, WP 5B, WP 5C, WP 5D, WP 7D,  
(WP 3K), (WP 6A), (WP 7B), (WP 7C))**

*1.11 to take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands to support railway radiocommunication systems between train and trackside within existing mobile service allocations, in accordance with Resolution 236 (WRC-15);*

**Resolution 236 (WRC-15) – Railway radiocommunication systems between train and trackside**

### **1/1.11/1 Executive summary**

Resolution 236 (WRC-15) invites WRC-19, based on the results of ITU-R studies, to take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands, to the extent possible, for the implementation of railway radiocommunication systems between train and trackside (RSTT), within existing mobile service allocations.

To address this agenda item, ITU-R has undertaken studies towards the development of two ITU-R Reports and one Recommendation (see section 1/1.11/3).

Three methods have been proposed to satisfy this agenda item:

- Method A: No change to the RR except suppression of Resolution 236 (WRC-15);
- Method B: Add a new Resolution [A111-METHOD B] (WRC-19) and consequently suppress Resolution 236 (WRC-15);
- Method C: Add a new Resolution [B111-METHOD C] (WRC-19) with references to the Recommendation ITU-R M.[RSTT\_FRQ] and consequently suppress the Resolution 236 (WRC-15).

### **1/1.11/2 Background**

The evolving radiocommunication technologies facilitate the railway transportation, which contributes to global economic and social development, especially for developing countries. As one of the core infrastructures, RSTT are vital to provide improved railway traffic control, passenger safety and improved security for train operations.

The implementation of RSTT varies in different countries, leading to high operational costs for international railway transportation. International standards and harmonized spectrum will improve interoperability of RSTT, reducing the railway infrastructure investment and providing for economies of scale.

### **1/1.11/3 Summary and analysis of the results of ITU-R studies**

ITU-R studied the generic architecture, main applications, current technologies, generic operating scenarios of RSTT and developed Report [ITU-R M.2418-0](#). ITU-R circulated a questionnaire (see Circular Letter [5/LCCE/60](#)) to administrations of Member States, gathering information on the usage of RSTT. Responses from 37 administrations and one regional organization were received and are included in PDN Report ITU-R M.[RSTT.USAGE] which also includes the detailed characteristics, implementations of current and planned RSTT and the spectrum needs of RSTT. ITU-R commenced development of Recommendation ITU-R M.[RSTT\_FRQ], which provides possible harmonization of frequency ranges and frequency arrangements for RSTT on global or regional basis. These study results provide useful elements to facilitate global or regional harmonization of frequency bands to support RSTT within existing mobile service allocations.

Some frequency bands are reported to be harmonized already in most of the CEPT countries within Region 1, especially for RSTT train radio applications.

### **1/1.11/3.1 Summary and analysis on spectrum needs of RSTT**

One case study on spectrum needs of RSTT in PDN Report ITU-R M.[RSTT.USAGE] shows that the total spectrum needs of train radio applications of RSTT in a typical scenario would be 11.9 MHz to 14.04 MHz (for uplink), and 4.7 MHz to 8.37 MHz (for downlink).

### **1/1.11/3.2 Summary and analysis on technical and operational characteristics and implementation of RSTT**

Report [ITU-R M.2418](#) addresses the architecture, applications, technologies and operational scenarios of RSTT. Four main categories of RSTT applications were identified, which are:

- train radio (for voice dispatching, signalling and traffic management with the aim to safe train operation),
- train positioning information (gathering train positioning information relevant to train operations),
- train remote (data communication between locomotive and ground to control the engine), and
- train surveillance (capture and transmission of video of the public and trackside areas etc.).

Report ITU-R M.2418-0 also contains five generic operating scenarios of RSTT which are railway line, railway station, shunting yard, maintenance base and railway hub.

Recommendation ITU-R P.1411-9 contains the propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz, includes, *inter alia*, a section dealing with RSTT scenarios.

### **1/1.11/3.3 Summary and analysis on spectrum usage of RSTT**

Based on the input provided in the development of PDN Report ITU-R M. [RSTT.USAGE], it is recognized that spectrum currently used for RSTT varies among administrations. Analysis of the available data led to the following general conclusions regarding spectrum used by the responding administrations for the four main categories of RSTT:

- radiocommunication systems for train radio and train remote applications of RSTT are mostly deployed in the frequency bands below 1 GHz;
- radiocommunication systems for train positioning information applications mainly use frequency bands: below 1 MHz for axle counter, 4 MHz (uplink) and 27 MHz (downlink) for balise and millimetric bands for radar;
- radiocommunication systems for train surveillance applications are currently realized by different technical approaches, using frequency bands above 5 GHz.

Radiocommunication systems for train radio and train remote applications are within existing mobile service allocations.

However, some radiocommunication systems for the application of train positioning and train surveillance are not within the existing mobile service allocations. For instance, some are within the radiolocation service.

## **1/1.11/4 Methods to satisfy the agenda item**

Regulatory procedures associated with some of the methods as described below are provided by those proponents of the methods in question, reflect the view of the proponents, and were presented and discussed by ITU-R.

In various parts of the draft CPM text, reference is made to the prevailing situation in certain countries or regions in regard to the use of certain frequency bands for RSTT which reflects the situation in those countries or regions and thus should not be generalized to give the impression that these conditions would be applicable to other countries or regions.

### **1/1.11/4.1 Method A: No change to the RR except suppression of Resolution 236 (WRC-15)**

**Reasons:** Harmonization of frequencies for RSTT can be achieved through the course of ITU-R study group work by applicable ITU-R Recommendations and/or Reports (e.g. Recommendation ITU-R M.[RSTT\_FRQ]).

### **1/1.11/4.2 Method B: Add a new Resolution [A111-METHOD B] (WRC-19) and consequently suppress Resolution 236 (WRC-15)**

A new WRC Resolution specifying frequency ranges for RSTT provides a regulatory framework for global and/or regional harmonization for RSTT, and provides guidance to administrations when making frequency plans for RSTT.

### **1/1.11/4.3 Method C: Add a new Resolution [B111-METHOD C] (WRC-19) with references to the Recommendation ITU-R M.[RSTT\_FRQ] and consequently suppress Resolution 236 (WRC-15)**

A new WRC Resolution specifying frequency ranges for RSTT can provide a regulatory framework to guide the harmonization process. At the same time, an ITU-R Recommendation can recommend possible global and/or regional harmonization of frequency arrangements for RSTT and can provide flexibility.

## **1/1.11/5 Regulatory and procedural considerations**

Note: The regulatory examples below were proposed by the proponents of the different methods. Frequency ranges listed in Method B and Method C in this section were not sufficiently discussed and agreed.

### **1/1.11/5.1 For Method A**

NOC

## **ARTICLES**

NOC

## **APPENDICES**



**SUP**

**RESOLUTION 236 (WRC-15)**

**Railway radiocommunication systems between  
train and trackside**

**1/1.11/5.2 For Method B**

**ADD**

**DRAFT NEW RESOLUTION [A111-METHOD B] (WRC-19)**

**Harmonization of frequency bands for railway radiocommunication systems  
between train and trackside (RSTT)**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a)* that railway transportation contributes to global economic and social development, especially for developing countries;
- b)* that the term “Railway radiocommunication systems between train and trackside (RSTT)” refers to radiocommunication systems providing improved railway traffic control, passenger safety and improved security for train operations;
- c)* that the main categories of applications of RSTT are train radio, train positioning information, train remote and train surveillance;
- d)* that spectrum harmonization of train radio applications of RSTT may have the top priority because train radio applications provide for train dispatching, train control and other important railway services which is used to ensure the safety for train operations and passenger, and require high reliability and high quality of services;
- e)* that the technologies for RSTT are evolving and international or regional organizations such as 3GPP, UIC, ETSI, ERA etc. are developing specifications for technologies and new functions to evolve RSTT;
- f)* that the implementation of future RSTT needs to take account of the development of the railway industry;
- g)* that the evolving safety-related applications of railway transportation may require more spectrum;
- h)* that the harmonization of frequency bands for RSTT does not preclude the use of these bands by any applications of the primary services to which they are allocated;
- i)* that many administrations wish to facilitate RSTT interoperability in particular for cross-border operations, for effectively using spectrum resources and for minimizing the risk of interference;

j) that international/regional standards and harmonized spectrum facilitate deployment of RSTT based on readily available cost-effective technologies that would help to provide economies-of-scale for the railway industry,

*recognizing*

- a) that Report ITU-R M.2418 provides the generic architecture, main applications, current technologies and generic operating scenarios of RSTT;
- b) that Report ITU-R M.[RSTT.USAGE] provides detailed characteristics of RSTT and also provides spectrum usage of current and planned RSTT by some administrations;
- c) that RSTT are composed of categories of applications and systems, which operate in various frequency bands not limited to mobile service allocations;
- d) that radiocommunication systems for train radio and train remote applications are within the existing mobile service allocations;
- e) that radiocommunication systems for train radio and train remote applications are widely deployed in the frequency bands below 1 GHz, and higher frequency bands such as millimetric bands are used for train radio and train surveillance applications of RSTT in some countries;
- f) that national spectrum planning for RSTT may need to have regard for cooperation and bilateral/multilateral consultation with other concerned administrations and railway organizations, in order to facilitate greater levels of spectrum harmonization;
- g) that the amount of spectrum needed for RSTT differs significantly between countries, and that certain amounts of spectrum are already in use in various countries for RSTT,

*noting*

- a) that among various technologies, two global standardized technologies, namely GSM-R and TETRA, are currently widely used for RSTT train radio applications, and that LTE-based RSTT is being deployed for train radio and train remote applications in some countries;
- b) that Report ITU-R M.[RSTT.USAGE] indicates that several particular frequency bands are in common use for train radio applications of RSTT by many administrations and this may form the basis for global or regional spectrum harmonization for the train radio applications;
- c) that some administrations in Region 1 have already implemented several harmonized frequency bands for some applications of RSTT;
- d) that lower frequency bands are generally preferred for those RSTT applications requiring large coverage areas,

*resolves*

- 1 to encourage administrations to use harmonized frequency bands for RSTT to the extent possible;
- 2 to encourage administrations to consider parts of the following frequency ranges, for achieving the global frequency harmonization for RSTT, in particular for train radio applications, within existing land mobile service allocations: [138-174 MHz, 335.4-470 MHz, 873-915 MHz, 918-960 MHz];

3 to encourage administrations to consider the following frequency ranges, or parts thereof, for achieving regional frequency harmonization for RSTT, in particular for train radio applications, within existing land mobile service allocations:

- a) in Region 1: [TBD];
- b) in Region 2: [TBD];
- c) in Region 3: [138-174 MHz, 335.4-470 MHz, 703-748 MHz, 758-803 MHz, 873-915 MHz, 918-960 MHz, 1 770-1 880 MHz, 43.5-45.5 GHz, 92-109.5 GHz],

*invites administrations*

1 to consider consulting with relevant administrations when developing national RSTT so as to support global or regional harmonized frequency bands for RSTT;

2 to encourage railway agencies and organizations to utilize relevant ITU-R publications in implementing channelling arrangements, technologies and systems supporting RSTT,

*invites ITU-R*

to continue technical studies and to make recommendations concerning technical and operational implementation of RSTT, taking into account the evolution of RSTT, to facilitate the implementation of this Resolution in a timely manner,

*invites Member States, Sector Members, Associates and Academia*

to participate actively in the study by submitting contributions to ITU-R,

*instructs the Secretary-General*

to bring this Resolution to the attention of the International Union of Railways (UIC) and other relevant international and regional organizations.

**SUP**

## RESOLUTION 236 (WRC-15)

### **Railway radiocommunication systems between train and trackside**

**1/1.11/5.3 For Method C**

**ADD**

**DRAFT NEW RESOLUTION [B111-METHOD C] (WRC-19)**

**Harmonization of frequency bands for railway radiocommunication systems  
between train and trackside (RSTT)**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that railway transportation contributes to global economic and social development, especially for developing countries;
- b) that the term “railway radiocommunication systems between train and trackside (RSTT)” refers to radiocommunication systems providing improved railway traffic control, passenger safety and improved security for train operations;
- c) that the main categories of applications of RSTT are train radio, train positioning information, train remote and train surveillance;
- d) that spectrum harmonization of train radio application of RSTT may have the top priority because train radio applications provide for train dispatching, train control and other important railway services which is used to ensure the safety for train operations and passenger, and require high reliability and high quality of services;
- e) that the technologies for RSTT are evolving and international or regional organizations such as 3GPP, UIC, ETSI, ERA etc. are developing specifications for technologies and new functions to evolve RSTT;
- f) that the implementation of future RSTT needs to take account of the development of the railway industry;
- g) that the evolving safety-related applications of railway transportation may require more spectrum;
- h) that the harmonization of frequency bands for RSTT does not preclude the use of these bands by any applications of the primary services to which they are allocated;
- i) that many administrations wish to facilitate RSTT interoperability in particular for cross-border operations, for effectively using spectrum resources and for minimizing the risk of interference;
- j) that international/regional standards and harmonized spectrum facilitate deployment of RSTT based on readily available cost-effective technologies that would help to provide economies-of-scale for the railway industry,

*recognizing*

- a) that Report ITU-R M.2418 provides the generic architecture, main applications, current technologies and generic operating scenarios of RSTT;
- b) that Report ITU-R M.[RSTT.USAGE] provides detailed characteristics of RSTT and also provides spectrum usage of current and planned RSTT by some administrations;

- c) that Recommendation ITU-R M.[RSTT\_FRQ] contains harmonized RSTT frequency arrangements, as well as frequency arrangements of individual administrations;
- d) that RSTT are composed of categories of applications and systems which operate in various frequency bands not limited to mobile service allocations;
- e) that radiocommunication systems for train radio and train remote applications are widely deployed in the frequency bands below 1 GHz, and higher frequency bands such as millimetric bands are used for train radio and train surveillance applications of RSTT in some countries,

*noting*

- a) that among various technologies, two global standardized technologies, namely GSM-R and TETRA, are currently widely used for RSTT train radio applications, and that LTE-based RSTT is being deployed for train radio and train remote applications in some countries;
- b) that Report ITU-R M.[RSTT.USAGE] indicates that several particular frequency bands are in common use for train radio applications of RSTT by many administrations and this may form the basis for global or regional spectrum harmonization for the train radio applications;
- c) that some administrations in Region 1 have already implemented several harmonized frequency bands for some applications of RSTT;
- d) that lower frequency bands are generally preferred for those RSTT applications requiring large coverage areas, while higher frequency bands could provide *inter alia* higher capacity for high data volume applications of RSTT,

*emphasizing*

that flexibility must be afforded to administrations to determine:

- how much spectrum to make available at national level for RSTT from the ranges in the *resolves* part of this Resolution in order to meet their particular national requirements;
- the need and timing of availability as well as the conditions of usage of the bands used for RSTT, including those covered in this Resolution and in Recommendation ITU-R M.[RSTT\_FRQ], in meeting specific regional or national situations; and
- whether existing RSTT systems using other bands will continue in operation and require ongoing support,

*resolves*

- 1 to encourage administrations to use harmonized frequency bands for RSTT to the extent possible;
- 2 to encourage administrations to consider parts of the following frequency ranges, for achieving the global frequency harmonization for RSTT, in particular for train radio applications, within existing land mobile service allocations: [138-174 MHz, 335.4-470 MHz, 873-915 MHz, 918-960 MHz];
- 3 to encourage administrations to consider the following frequency ranges, or parts thereof, for achieving regional frequency harmonization for RSTT, in particular for train radio applications, within existing land mobile service allocations:
  - a) in Region 1: [TBD];
  - b) in Region 2: [TBD];

c) in Region 3: [138-174 MHz, 335.4-470 MHz, 703-748 MHz, 758-803 MHz, 873-915 MHz, 918-960 MHz, 1 770-1 880 MHz, 43.5-45.5 GHz, 92-109.5 GHz];

4 to encourage administrations to consider frequency arrangements within the frequency ranges specified in *resolves* 2 and *resolves* 3, as well as countries' frequency arrangements for RSTT, with the view for including them in the most recent version of Recommendation ITU-R M.[RSTT\_FRQ],

*invites ITU-R*

1 to continue technical studies and to make recommendations concerning technical and operational implementation of RSTT, taking into account the spectrum needs and the evolution of RSTT, to facilitate the implementation of this Resolution in a timely manner;

2 to review and revise Recommendation ITU-R M.[RSTT\_FRQ] and other relevant ITU-R Recommendations and ITU-R Reports, as appropriate,

*invites administrations*

to encourage railway agencies and organizations to utilize relevant ITU-R publications in implementing channelling arrangements, technologies and systems supporting RSTT,

*invites Member States, Sector Members, Associates and Academia*

to participate actively in the study by submitting contributions to ITU-R,

*instructs the Secretary-General*

to bring this Resolution to the attention of the International Union of Railways (UIC) and other relevant international and regional organizations.

**SUP**

## RESOLUTION 236 (WRC-15)

### **Railway radiocommunication systems between train and trackside**

## Agenda item 1.12

**(WP 5A / WP 4A, WP 4B, WP 4C, WP 5B, WP 5C, WP 5D, WP 7D,  
(WP 3K), (WP 6A), (WP 7B), (WP 7C))**

*1.12 to consider possible global or regional harmonized frequency bands, to the maximum extent possible, for the implementation of evolving Intelligent Transport Systems (ITS) under existing mobile-service allocations, in accordance with Resolution 237 (WRC-15);*

**Resolution 237 (WRC-15) – Intelligent Transport Systems applications**

### **1/1.12/1 Executive summary**

There is a need to consider harmonization of frequency bands for the implementation of evolving Intelligent Transport Systems (ITS).

Evolving ITS are being deployed to assist safe driving and to support transportation system efficiency and environmental sustainability. It is recognized that the frequency bands within existing mobile service allocations being used by evolving ITS may also be utilized by other applications and services.

Several ITU-R Reports and Recommendations have been developed in support of this agenda item, as listed in section 1/1.12/3.

ITU-R studies indicated that some administrations throughout the three Regions have designated the frequency band of 5 850-5 925 MHz, or parts thereof, for the deployment of ITS. Preliminary draft new Recommendation ITU-R M.[ITS\_FRQ], “Harmonization of frequency bands for Intelligent Transport Systems in the mobile service” recommends that several frequency bands, in whole or in part, be used for current and future ITS.

Three methods have been proposed to satisfy this agenda item:

- Method A: No change to the Radio Regulations because ITS continue to operate within existing mobile service allocations and the required harmonization of frequencies for ITS can be achieved through ITU-R Recommendations and Reports.
- Method B: No change to the Table of Frequency Allocations in the Radio Regulations, and add a new WRC Resolution to encourage administrations to use globally and regionally harmonized frequency bands for ITS applications.
- Method C: No change to the Table of Frequency Allocations in the Radio Regulations, and add a new WRC Resolution to encourage administrations to use globally and regionally harmonized frequency bands for ITS applications by referring to the most recent version of Recommendation ITU-R M.[ITS\_FRQ].

For all Methods, Resolution 237 (WRC-15) should be suppressed.

### **1/1.12/2 Background**

Since 1995, research and development activities have been conducted in infocommunication systems as core technologies of ITS. ITS, including legacy ITS, systems have been deployed in some countries. Evolving ITS, including vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-network (V2N) and vehicle-to-pedestrian (V2P) communications have been deployed in some countries to assist with safer driving. Communicating with moving vehicles is one of the typical use cases for radiocommunications, and a variety of ITS applications rely on radiocommunication technologies including the next generation of ITS applications.

Evolving ITS also become important in helping to reduce road traffic problems such as congestion and accidents. To address road safety and efficiency-related matters, the ITS with vehicle-to-everything communication (e.g. WAVE, ETSI ITS-G5, LTE based V2X, ITS Connect) are studied in ITU-R.

Recognizing that harmonized spectrum and international standards would facilitate deployment of ITS radiocommunications, agenda item 1.12 was approved by WRC-15 and Resolution **237 (WRC-15)** requested to study the possible global or regional harmonized frequency bands for the implementation of evolving ITS under existing mobile service allocations. The mobile service bands being used by the evolving ITS may also be utilized by other applications and services and some of the frequency bands are also being considered under other agenda items.

### **1/1.12/3 Summary and analysis of the results of ITU-R studies**

Technical and operational studies performed by ITU-R in relation to agenda item 1.12 have indicated that the frequency band 5 850-5 925 MHz, or parts thereof, have been designated for the implementation of ITS by some administrations encompassing Regions 1, 2 and 3. Consequently, the ITU-R has developed preliminary draft new Recommendation ITU-R M.[ITS\_FRQ], “Harmonization of frequency bands for Intelligent Transport Systems in the mobile service” and preliminary draft new Report ITU-R.[ITS USAGE], “Intelligent transport systems (ITS) usage in ITU Member States”.

View #1: It was indicated that there is potential harmful interference from FSS earth station uplinks into ITS receivers. Consequently, some administrations in Region 1 have concluded that ITS stations cannot claim protection from FSS earth station uplinks in the 5 850-5 925 MHz frequency band. In these cases, any coexistence issues between ITS stations and FSS earth station uplinks, may be mitigated by ITS equipment design which would take into account the potential harmful interference from FSS earth stations.

View #2: Other views were also expressed that the frequency band 5 850-5 925 MHz is shared between the MS and FSS on a co-primary basis and any coexistence issues in this band should be a national matter.

View #3: In regard with coordination between various services on a national basis, it is to emphasize that national issues are not dealt with by ITU-R due to the fact that national policy of a given administration on how to manage the use of radiocommunication services associated with spectrum is a national matter and shall not be discussed internationally.

View #4: Some views were expressed that the probability of interference from ITS stations to FSS space receivers may be negligible.

#### **1/1.12/3.1 ITU-R Recommendations and Reports**

In ITU-R, several documents have been published, as follows: Recommendations [ITU-R M.1452-2](#), [ITU-R M.1453-2](#), [ITU-R M.1890\[-1\]](#), [ITU-R M.2084\[-1\]](#), and ITU-R M.[ITS\_FRQ], and Reports [ITU-R M.2228-1](#) and ITU-R M.[ITS USAGE].

### **1/1.12/4 Methods to satisfy the agenda item**

#### **1/1.12/4.1 Method A – No change to the Radio Regulations and suppress Resolution 237 (WRC-15)**

No change to the Radio Regulations other than to suppress Resolution **237 (WRC-15)**.



**Reasons:** ITS operate within existing mobile service allocations. Harmonization of frequencies for ITS pertaining to the exchange of information to improve traffic management and to assist driving safety can be achieved through the course of ITU-R Study Group work by applicable ITU-R Recommendations and/or Reports (e.g., Recommendation ITU-R M.[ITS\_FRQ]).

#### **1.12/4.2 Method B – Add a new WRC Resolution**

No change to the RR Table of Frequency Allocations and to add a new WRC Resolution to encourage administrations to use globally or regionally harmonized frequency bands for ITS applications. Suppress Resolution **237 (WRC-15)**.

This method provides a regulatory framework for global harmonization for ITS applications through a new WRC Resolution.

#### **1/1.12/4.3 Method C – Add a new WRC Resolution and non-mandatory reference to ITU-R Recommendation**

No change to the RR Table of Frequency Allocations and to add a new WRC Resolution to encourage administrations to use globally and regionally harmonized frequency bands for ITS applications through reference to ITU-R Recommendation(s). Suppress Resolution **237 (WRC-15)**.

This method provides a regulatory framework for worldwide or regional harmonization for ITS applications through a new WRC Resolution and the most recent version of Recommendation ITU-R M.[ITS\_FRQ].

### **1/1.12/5 Regulatory and procedural considerations**

#### **1/1.12/5.1 For Method A**

**NOC**

## **ARTICLES**

**NOC**

## **APPENDICES**

**SUP**

### **RESOLUTION 237 (WRC-15)**

### **Intelligent Transport Systems applications**

**1/1.12/5.2 For Methods B and C**

**ADD**

**DRAFT NEW RESOLUTION [A112] (WRC-19)**

**Frequency bands for evolving Intelligent Transport Systems applications  
under mobile service allocations**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that information and communication technologies are integrated in a vehicle system to provide evolving Intelligent Transport Systems (ITS) communication applications for the purpose of improving traffic management and assisting safer driving;
- b) that there is a need for consideration of spectrum harmonization for evolving ITS applications, which are being used globally or regionally;
- c) that there is a need to integrate various technologies, including radiocommunications, into land transportation systems;
- d) that many new connected vehicles use intelligent technologies in the vehicles' combined advanced traffic management, advanced traveller information, advanced public transportation management systems and/or advanced fleet management systems to improve traffic management;
- e) that future vehicular radiocommunication technologies and ITS broadcast systems are emerging;
- f) that some administrations have harmonized frequency bands for ITS radiocommunication applications;
- g) that under certain circumstances FSS earth stations and ITS stations may have operational issues while in close proximity;
- h) that the compatibility between ITS stations and FSS space stations is achievable for certain ITS stations as an interferer,

*recognizing*

- a) that harmonized spectrum and international standards would facilitate worldwide deployment of ITS radiocommunications and provide for economies of scale in bringing ITS equipment and services to the public;
- b) that the designation of those harmonized frequency bands, or parts thereof, for ITS does not preclude the use of these bands/frequencies by any other application of the services to which they are allocated and does not establish priority in applying and using the Radio Regulations;
- c) that a certain country in Region 3 operates an ITS system around 5.8 GHz as described in Recommendation ITU-R M.1453,

*noting*

- a) that the guidelines for radio interface requirements of ITS are described in Recommendation ITU-R M.1890;

- b) that outlines of technologies and characteristics for dedicated short-range communications at 5.8 GHz are described in Recommendation ITU-R M.1453;
  - c) that some administrations in each of the three Regions have deployed radiocommunication local area networks in the frequency band 5 725-5 850 MHz and some administrations are considering allowing radiocommunication local area networks in the frequency band 5 850-5 925 MHz;
  - d) that studies, feasibility tests, and actual operation of advanced ITS radiocommunications have been actively conducted towards the realization of traffic safety and a reduction of environmental impact as described in Report ITU-R M.2228;
  - e) that radio interface standards of vehicle-to-vehicle and vehicle-to-infrastructure communications for ITS applications are described in Recommendation ITU-R M.2084;
  - f) that ITS usage in ITU Member States is described in Report ITU-R M.[ITS USAGE];
  - g) that some administrations in Region 1, in the spirit of Article 6, have applied a coordinated approach by which when they deploy ITS stations, protection cannot be claimed from FSS earth station uplinks in 5 850-5 925 MHz;
  - h) that the latest version of Recommendation ITU-R M.[ITS\_FRQ] provides frequency bands for ITS systems,
- emphasizing*
- a) that the provisions of Nos. **1.59** and **4.10** do not apply to ITS applications under mobile-service allocations,

*resolves*

*For Method B*

to encourage administrations to use the frequency band 5 850-5 925 MHz, or parts thereof, when deploying ITS applications, taking into account *recognizing b)* while considering *recognizing c)* above,

*For Method C*

to encourage administrations to consider globally or regionally harmonized frequency bands or parts thereof, which are listed in the most recent version of Recommendation ITU-R M.[ITS\_FRQ], when planning and deploying ITS applications, taking into account *recognizing b)* above,

*For both Methods B and C*

*invites Member States and Sector Members*

to take into account, as necessary, possible coexistence issues between ITS stations and FSS earth stations operating in the 5 850-5 925 MHz frequency band,

*invites Member States, Sector Members, Associates and Academia*

to actively contribute to the ITU-R studies on ITS,

*instructs the Secretary-General*

to bring this Resolution to the attention of relevant international and regional organizations dealing with ITS.

*[Note: Upon the selection of Methods B or C, only the relevant parts should be kept in the draft new Resolution above.]*

**SUP**

## RESOLUTION 237 (WRC-15)

### **Intelligent Transport Systems applications**

## Agenda item 1.14

(WP 5C / WP 4A, WP 4C, WP 5A, WP 5D, WP 7B, WP 7C, WP 7D, (WP 3M))

*1.14 to consider, on the basis of ITU-R studies in accordance with Resolution 160 (WRC-15), appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations;*

**Resolution 160 (WRC-15) – Facilitating access to broadband applications delivered by high-altitude platform stations**

### **1/1.14/1 Executive summary**

WRC-19 agenda item 1.14 considers additional spectrum needs for gateway and fixed terminal links for HAPS to provide broadband connectivity in the fixed service pursuant to Resolution 160 (WRC-15).

Section 1/1.14/2 provides background for agenda item 1.14.

Section 1/1.14/3 describes:

- The results of studies that estimate the total spectrum needs for HAPS systems to be:
  - in the range of 396 (for lower user density setting) to 2 969 MHz (for higher user density setting) for the ground-to-HAPS platform links;
  - in the range of 324 (for lower user density setting) to 1 505 MHz (for higher user density setting) for the HAPS platform to ground links.
- The sharing studies conducted by ITU-R considering the following frequency ranges:
  - 6 440-6 520 MHz and 6 560-6 640 MHz;
  - 21.4-22 GHz (Region 2 only);
  - 24.25-27.5 GHz (Region 2 only);
  - 27.9-28.2 GHz and 31-31.3 GHz;
  - 38-39.5 GHz;
  - 47.2-47.5 GHz and 47.9-48.2 GHz.

Section 1/1.14/4 includes the following generic methods to satisfy the agenda item, and describes the way the methods are applied to the above-mentioned frequency bands, as appropriate:

- Method A – No change.
- Method B – Designation of bands for HAPS, in accordance with Resolution 160 (WRC-15) with options:
  - Method B1 – Revision of the regulatory provisions for HAPS in the fixed service (FS) with a primary status in bands already designated for HAPS.
  - Method B2 – Add new designation(s) for HAPS in bands already allocated to the FS with a primary status.
  - Method B3 – Add a primary allocation to the FS and a new designation for HAPS in the band 24.25-25.25 GHz (Region 2) not already allocated to the FS.
- Method C – Suppress the existing HAPS designation, pursuant to *resolves* 3 of Resolution 160 (WRC-15).

Section 1/1.14/5 includes the regulatory and procedural considerations.

## 1/1.14/2 Background

The technological innovations and the growing urgency to expand the availability of broadband led to a review of the current regulatory environment for delivery platforms such as HAPS. Stations operating in the stratosphere are high enough to provide service to a large area. Recent test deployments of stations delivering broadband from approximately 20 km above ground have demonstrated their maturity to provide connectivity to underserved communities with minimal ground-level infrastructure.

More options for broadband delivery are better, especially for countries with less-developed infrastructures. HAPS can drive broadband rollout by providing an additional platform which provides service that could augment the capacity of other providers using innovative and easily deployable platforms positioned in the upper atmosphere. WRC-15 adopted Resolution **160** to study how to facilitate access to global broadband applications delivered by HAPS in the FS.

## 1/1.14/3 Summary and analysis of the results of ITU-R studies

### 1/1.14/3.1 Relevant ITU-R Recommendations and Reports

The relevant ITU Recommendations are:

ITU-R [F.699-8](#), ITU-R [F.758-6](#), ITU-R [F.1500-0](#), ITU-R [F.1501-0](#), ITU-R [F.1569-0](#), ITU-R [F.1570-2](#), ITU-R [F.1607-0](#), ITU-R [F.1608-0](#), ITU-R [F.1609-1](#), ITU-R [F.1612-0](#), ITU-R [F.1764-1](#), ITU-R [F.1819-0](#), ITU-F.1891-0, ITU-R [F.2011-0](#), ITU-R [F.1820-0](#), ITU-R [P.1409-1](#), ITU-R [SF.1601-2](#), ITU-R [SF.1843-0](#), ITU-R [RS.1813-0](#), ITU-R [RS.1861-0](#), ITU-R [RS.2017-0](#), ITU-R [RS.1858-0](#), ITU-R [SM.1541-6](#), ITU-R [SA.1396-0](#), ITU-R [SA.1811-0](#), ITU-R [SA.509-3](#), ITU-R [SA.609-2](#), ITU-R [SA.1014-3](#), ITU-R [SA.1155-2](#), ITU-R [SA.1276-5](#), ITU-R [SA.1414-2](#), ITU-R M.2101-0, ITU-R M.2114-0, ITU-R P.525-3.

PDN Recommendation ITU-R F.[BROADBAND HAPS CHARACTERISTICS] provides deployment and technical characteristics of broadband HAPS systems.

The relevant ITU Reports are: ITU-R [F.2240-0](#).

To perform the studies under Resolution **160 (WRC-15)**, ITU-R developed the following Reports:

PDN Report ITU-R F.[HAPS-SPECTRUM-NEEDS] provides spectrum needs of HAPS systems;

The documents that are providing the results of the sharing studies conducted under this agenda item are:

- PDN Report ITU-R F.[HAPS-6 GHz] on sharing and compatibility studies for HAPS broadband systems in the 6 400-6 520 MHz frequency range ([Annex 15](#) to Document 5C/[531](#));
- PDN Report ITU-R F.[HAPS-21 GHz] on sharing and compatibility studies for HAPS broadband systems in the 21.4-22 GHz frequency range ([Annex 16](#) to Document 5C/[531](#));
- PDN Report ITU-R F.[HAPS-25GHZ] on sharing and compatibility studies for HAPS broadband systems in the 24.25-27.5 GHz frequency range ([Annex 17](#) to Document 5C/[531](#));
- PDN Report ITU-R F.[HAPS-31 GHz] on sharing and compatibility studies for HAPS broadband systems in the 27.9-28.2 and 31-31.3 GHz frequency ranges ([Annex 18](#) to Document 5C/[531](#));

- PDN Report ITU-R F.[HAPS-39GHZ] on sharing and compatibility studies for HAPS broadband systems in the 38-39.5 GHz frequency range ([Annex 19](#) to Document 5C/531);
- PDN Report ITU-R F.[HAPS-47GHz] on sharing and compatibility studies for HAPS broadband systems in the 47.2-47.5 GHz and 47.9-48.2 GHz frequency range ([Annex 20](#) to Document 5C/531).

### **1/1.14/3.2 HAPS deployment and technical characteristics, and spectrum needs for broadband applications**

#### **1/1.14/3.2.1 Deployment and technical characteristics of HAPS FS systems**

The technical and operational characteristics of HAPS for delivering broadband applications for the purpose of sharing and compatibility studies were determined. These characteristics were provided for deploying HAPS for broadband applications in the existing designations listed in *recognizing c*) of Resolution **160 (WRC-15)** and the additional potential HAPS designations in the FS bands at 38-39.5 GHz (worldwide) and 21.4-22 GHz and 24.25-27.5 GHz (Region 2 only).

#### **1/1.14/3.2.2 Broadband HAPS applications**

Broadband HAPS applications will serve several use cases, providing Internet access to users on a medium (days to weeks) to long-term basis. It can be a direct-to-home fixed access, a link to an access point, or a backhaul connection for remote networks. Capacity may vary for connectivity and specific use cases (e.g., for disaster relief missions, commercial use, etc.). Regardless, HAPS provide fixed service connections between an airborne platform and temporary or permanent FS ground stations. During the development of ITU-R studies under WRC-19 agenda item 1.14, several different HAPS implementations for commercial use cases were presented.

Because the different platform implementations for HAPS are assumed to be in accordance with the HAPS definition in RR No. **1.66A**, there is no considerable impact to the sharing analysis for the different use cases described here.

#### **1/1.14/3.2.3 HAPS and ground station descriptions**

A high-altitude platform station is a station that operates in accordance with No. **1.66A** in the Radio Regulations.

The gateway (GW) link connects HAPS with terrestrial based networks for voice, data and video communications and to connect HAPS with public switched telephone network (PSTN), cell-phone providers, worldwide providers of broadband communications, and television and sound broadcasters.

The customer premises equipment (CPE) for HAPS applications is understood to be equipment (fixed terminals) for ground-based fixed links which communicate with the HAPS and redistribute their connectivity to end users by other wired or wireless means (e.g., international mobile telecommunications (IMT), wireless access systems (WAS) including radio local area networks (WAS/RLAN), etc.). CPE can be direct to home access or it can be a link to an access point.

#### **1/1.14/3.2.4 HAPS spectrum needs summary**

##### **1/1.14/3.2.4.1 Existing HAPS designations in FS bands**

The existing HAPS designations have not been fully utilized in the past partly due to physical, technical and regulatory constraints. The available aggregated bandwidth as shown in Table 1/1.14/1 below for all current HAPS designations would not have sufficient spectrum,

geographic reach, or optimal technical conditions to deliver or backhaul multi-gigabit broadband applications.

Resolution **160 (WRC-15)** suggests that further modifications to the existing HAPS designation footnotes could be considered, such as the revision of technical conditions and/or geographic constraints, to facilitate better utilization and efficiency of the existing designations for HAPS. ITU-R studies responding to Resolution **160 (WRC-15)** *resolves to invite ITU-R 2* and 3 demonstrate that broadband HAPS applications can utilize some of the existing HAPS designations, provided that they are extended worldwide. The bands 6 GHz and 28 GHz for the HAPS downlink and the band 31 GHz for HAPS uplink and downlink are of particular interest for broadband applications. Worldwide designations for HAPS are desirable in order to improve and harmonize utilization of the spectrum.

TABLE 1/1.14/1

**Existing HAPS designations in FS bands**

Frequency band	Use	Direction	Bandwidth	Designation
6 440-6 520 MHz	GW	↓	80 MHz	5 Admins (R1, R3)
6 560-6 640 MHz	GW	↑	80 MHz	5 Admins (R1, R3)
27.9-28.2 GHz	GW, CPE	↓	300 MHz	23 Admins (R1, R3)
31-31.3 GHz	GW, CPE	↑	300 MHz	23 Admins (R1, R3)
47.2-47.5 GHz	GW, CPE	↑↓	300 MHz	Worldwide
47.9-48.2 GHz	GW, CPE	↑↓	300 MHz	Worldwide
GW: Gateway CPE: fixed terminal customer premises equipment				

**1/1.14/3.2.4.2 Spectrum needs for HAPS for broadband applications**

Given the existing designations for HAPS and the HAPS spectrum needs, additional candidate bands were studied for the delivery of broadband via HAPS links in the FS.

The spectrum needs for HAPS operating in the FS to provide broadband connectivity presented in this document are taken into account in the studies called for in *resolves to invite ITU-R 2, 3 and 4* of Resolution **160 (WRC-15)**.

The spectrum needs are summarized in Table 1/1.14/2 below based on the system characteristics and descriptions for a variety of HAPS systems for broadband applications used in sharing and compatibility studies in support of WRC-19 agenda item 1.14. These assumed system characteristics show that the spectrum needs for HAPS are in the range from 396 MHz to 2 969 MHz for the uplink and 324 MHz to 1 505 MHz for downlink, for both GW and CPE links, which would need to be considered within existing and/or new HAPS designations. These ranges include the spectrum needs to cover those of specific applications (e.g. disaster relief missions) plus that for connectivity applications (e.g. commercial broadband).



TABLE 1/1.14/2

Summary of spectrum needs for a variety of system characteristics

Capacity for		Forward		Return	
		GW to HAPS Ground-to-HAPS	HAPS to CPE HAPS-to-ground	CPE to HAPS Ground-to-HAPS	HAPS to GW HAPS-to-ground
Specific applications	MHz	110	15	15	110
Connectivity applications*	MHz	247-2 727	164-938	24-240	35-480

\* The ranges are covering several possible use cases with different targeted markets.

Additional details of the analysis conducted on the spectrum needs for HAPS are available in PDN Report ITU-R F.[HAPS-SPECTRUM-NEEDS] (see also Table 1/1.14/3 below).

TABLE 1/1.14/3

Spectrum needs for a variety of system characteristics

Type of HAPS system		GW to HAPS Ground-to-HAPS	HAPS to CPE HAPS-to-ground	CPE to HAPS Ground-to-HAPS	HAPS to GW HAPS-to-ground	Total uplink	Total downlink
Connectivity 1	MHz	1 800	900	240	480	2 040	1 380
Connectivity 2	MHz	2 727	938	117	341	2 844	1 279
Connectivity 3	MHz	1 114	576	213	371	1 327	947
Connectivity 4	MHz	1 424	200	59	310	1 483	510
Connectivity 5	MHz	247	164	24	35	271	199
Minimum	MHz					271	199
Maximum	MHz					2 844	1 380
Specific	MHz	110	15	15	110	125	125
Minimum (including specific applications)	MHz					<b>396</b>	<b>324</b>
Maximum (including specific applications)	MHz					<b>2 969</b>	<b>1 505</b>

The above spectrum needs are based on assumed HAPS throughputs, user densities and single HAPS platform over a given coverage area. Different assumptions would result in spectrum needs that would differ from those provided.

Given the regulatory provisions in the existing designations for HAPS and the current demand for multi-gigabit broadband, the existing designations associated with HAPS are not sufficient to support broadband HAPS applications. Accordingly, additional frequency bands were studied for possible designation for HAPS links in existing FS allocations to facilitate broadband delivery services, in accordance with *resolves* 4 of Resolution **160 (WRC-15)**.

### 1/1.14/3.3 Summary and analysis of sharing studies between broadband HAPS and other services (inband/adjacent bands)

Some studies regarding interference to HAPS from existing services were also undertaken on compatibility between HAPS and existing services.

Divergent views were expressed with regard to the inclusion of the summary of these studies in the CPM Report. No consensus was reached on this matter.

However there were consensus on adding the summary of the sharing studies regarding interference from HAPS to existing services.

#### 1/1.14/3.3.1 Sharing and compatibility studies of HAPS systems in the 6 440-6 520 MHz and 6 560-6 640 MHz frequency ranges

Studies were performed for the HAPS-to-ground direction in the 6 440-6 520 MHz.

No studies were performed for the 6 440-6 520 MHz in the ground-to-HAPS direction.

No studies were performed for the 6 560-6 640 MHz in either direction as no systems were proposed.

##### 1/1.14/3.3.1.1 Sharing and compatibility of FS and HAPS systems (HAPS-to-ground) operating in the 6 440-6 520 MHz frequency range

#### HAPS platform station transmitting towards the HAPS GW/CPE stations

Several studies have shown that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the FS by meeting its long-term protection criteria:

$$\begin{aligned} pfd_{mask}(El) &= -160 && \text{for } 0^\circ \leq El < 6^\circ \\ pfd_{mask}(El) &= 3.75 \times El - 182.5 && \text{for } 6^\circ \leq El < 10^\circ \\ pfd_{mask}(El) &= -152.5 + 25.5 \times \log_{10}(El - 8) && \text{for } 10^\circ \leq El < 56^\circ \\ pfd_{mask}(El) &= -109.63 && \text{for } 56^\circ \leq El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the pfd level shown above is derived from a maximum interference level of  $-149.5$  dBW/MHz (i.e.,  $I/N = -10$  dB not to be exceeded for more than 20% of the time) for the FS long-term protection criteria. The FS parameters and deployment density are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. Gaseous atmospheric attenuation is not considered for this frequency range.

To verify that the pfd produced by HAPS platform does not exceed the proposed pfd mask, the following equation was used:

$$pfd(El) = e.i.r.p. \frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2(El)} \right)$$

where:

*e.i.r.p.*: is the maximum HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);

*d*: is the distance between the HAPS and the ground (elevation angle dependent).

## **FS transmitting towards HAPS GW/CPE stations (HAPS platform station to HAPS GW/CPE)**

Several studies show that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

### **1/1.14/3.3.1.2 Sharing and compatibility of FSS (Earth-to-space) and HAPS systems (HAPS-to-ground) operating in the 6 440-6 520 MHz frequency range**

#### **HAPS platform to FSS satellite receiver**

Two studies show that, in order to protect FSS space station receivers, the e.i.r.p. per HAPS platform transmitter should be limited to  $-17.8$  dBW/MHz towards the GSO arc. The studies also show that it is possible to design a HAPS system compliant with the above proposed e.i.r.p. limit and protect FSS satellite with large margin.

#### **FSS earth station to HAPS ground station receiver**

One study considered the potential emissions from FSS earth stations received by the HAPS GW or CPE receiver. This analysis also compared the level of emissions at the HAPS receivers to those that would be received by a FS receiver.

The analysis performed shows that the required separation distance of HAPS GW or CPE receivers and FSS earth stations is less than the required separation distance between an FSS earth station and FS terminal.

### **1/1.14/3.3.1.3 Sharing and compatibility of MS and HAPS systems operating in the 6 440-6 520 MHz frequency range**

#### **HAPS platform station transmitting towards the HAPS GW/CPE stations**

Several studies have shown that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the MS receivers from a single HAPS emission:

$$pfd_{max}(El) = (0.35 \times El - 120) \text{ for } El \leq 40^\circ$$

$$pfd_{max}(El) = -106 \text{ for } 40^\circ < El \leq 90^\circ$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that gaseous atmospheric loss was not considered for this frequency range as it is negligible.

To verify that the pfd produced by HAPS platform does not exceed the proposed pfd mask, the following equation was used:

$$pfd(El) = e.i.r.p.\frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2_{(El)}} \right)$$

where:

*e.i.r.p.*: is the maximum HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);

*d*: is the distance between the HAPS and the ground (elevation angle dependent).

### **HAPS GW/CPE stations transmitting towards the HAPS platform station**

HAPS uplink is not considered.

### **MS transmitting towards HAPS GW/CPE stations (HAPS platform station to HAPS GW/CPE)**

One study performed two different percentages of time, i.e., 20% and 0.01%, using propagation model Recommendation ITU-R P.452-16. The study showed that for both cases, the impact of MS station emissions into HAPS ground station receivers is in the order of 0-10 km depending on the probability considered compared to 0-43 km between the MS and conventional FS station for the same probabilities. In addition, the required separation distance can be further reduced by appropriate site configuration, due to HAPS antenna directivity. Therefore, protection between HAPS ground stations and MS stations can be managed on a case-by-case basis by coordination amongst administrations at national level.

### **MS transmitting towards HAPS platform (HAPS GW/CPE to HAPS platform station)**

HAPS uplink is not considered.

#### **1/1.14/3.3.1.4 Compatibility of EESS (passive) and HAPS systems operating in the 6 440-6 520 MHz frequency range**

##### **HAPS-to-ground**

Both studies provided to ITU-R provide consistent results, showing that in order to protect EESS (passive) the e.i.r.p. of HAPS platforms would have to be limited to  $-34.9$  dBW/200 MHz ( $-30.4$  dBW/200 MHz in band power – 4.5 dB exceedance) above  $35^\circ$  elevation.

Such e.i.r.p. limit can be met when considering the actual parabolic antenna pattern as well as the additional attenuation provided by the HAPS structure and should only apply to operation of HAPS over the oceans or over the land at a distance lower than 29 km from the ocean coast line (distance between the sub-HAPS point and the ocean coast line).

#### **1/1.14/3.3.1.5 Compatibility of RAS stations performing observations in the 6 650-6 675.2 MHz frequency range and HAPS systems operating in the 6 440-6 520 MHz frequency ranges**

##### **HAPS-to-ground**

A study has addressed HAPS to gateway links in the band 6 440-6 520 MHz with regard to RAS in the band 6 650-6 675.2 MHz. The band 6 650-6 675.2 MHz is not allocated to the RAS but is included in RR No. **5.149** which urges administrations to take all practicable steps to protect RAS.

The RAS station performing observations in the band 6 650-6 675.2 MHz can be protected from HAPS platforms downlink transmissions in the band 6 440-6 520 MHz provided that such HAPS platforms meet unwanted emission pfd values of  $-228$  dBW/m<sup>2</sup>/50 kHz for spectral line observations in the 6 650-6 675.2 MHz band at the RAS station location. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model.

#### **1/1.14/3.3.2 Sharing and compatibility studies of HAPS systems in the 21.4-22 GHz frequency range**

HAPS uplink is not considered for 21.4-22 GHz frequency range.

### 1/1.14/3.3.2.1 Sharing and compatibility of FS and HAPS systems operating in the 21.4-22 GHz frequency range

#### HAPS platform station transmitting towards the HAPS GW/CPE stations

Several studies have shown that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the fixed service by meeting its long-term protection criteria:

$$\begin{aligned} pfd_{max}(El) &= 0.7 \times El - 135 \text{ for } 0 \leq El < 10^\circ \\ pfd_{max}(El) &= 2.4 \times El - 152 \text{ for } 10^\circ \leq El < 20^\circ \\ pfd_{max}(El) &= 0.45 \times El - 113 \text{ for } 20^\circ \leq El < 60^\circ \\ pfd_{max}(El) &= -86 \text{ for } 60^\circ \leq El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the pfd level shown above is derived from a maximum interference level of  $-143$  dBW/MHz (i.e.,  $I/N = -10$  dB not to be exceeded more than 20% of the time) for the FS long-term protection criteria. The FS parameters and deployment density are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. The FS antenna pattern is based on Recommendation ITU-R F.1245-2 and gaseous atmospheric attenuation is considered (Recommendation ITU-R SF.1395-0).

This study made the assumption that to compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading but limited to a maximum of 20 dB.

To verify that the pfd produced by HAPS platform does not exceed the proposed pfd mask the following equation was used:

$$pfd(El) = e.i.r.p.\frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2(El)} \right)$$

where:

$e.i.r.p.$ : is the nominal HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);

$d$ : is the distance between the HAPS and the ground (elevation angle dependent).

The impact of the gas attenuation is not included in the verification formula since it is already taken into account in the pfd mask.

#### FS stations transmitting towards HAPS platform (HAPS GW/CPE to HAPS platform station)

Several studies show that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

### 1/1.14/3.3.2.2 Sharing and compatibility of MS and HAPS systems operating in the 21.4-22 GHz frequency range

For this frequency range, an aeronautical mobile service (AMS) study was presented.

### **HAPS platform station transmitting towards the HAPS GW/CPE stations**

Preliminary studies between HAPS systems and AMS in the 21.2-22 GHz frequency range have been performed. These analyses need to be reviewed taking into account the latest parameters available for HAPS systems. The conclusions of the studies will be amended correspondingly.

### **HAPS GW/CPE stations transmitting towards the HAPS platform station**

Preliminary studies between HAPS systems and AMS in the 21.2-22 GHz frequency range have been performed. These analyses need to be reviewed taking into account the latest parameters available for HAPS systems. The conclusions of the studies will be amended correspondingly.

### **MS stations transmitting towards HAPS GW/CPE stations (HAPS platform station to HAPS GW/CPE)**

No studies were presented for this scenario.

### **MS stations transmitting towards HAPS platform (HAPS GW/CPE to HAPS platform station)**

No studies were presented for this scenario.

### **1/1.14/3.3.2.3 Compatibility of EESS (passive) in the adjacent band 21.2-21.4 GHz and HAPS systems operating in the 21.4-22 GHz frequency range**

#### **HAPS-to-ground**

Three independent studies show that compatibility between EESS (passive) sensors and HAPS platform downlinks is feasible provided that the unwanted emission e.i.r.p. from the HAPS platform in the band 21.2-21.4 GHz is below the following values:

$$\begin{aligned} e.i.r.p. &= -0.76 \text{ El} - 9.5 \text{ dBW}/100 \text{ MHz for } -4.53^\circ \leq \text{El} < 35.5^\circ \\ e.i.r.p. &= -36.5 \text{ dBW}/100 \text{ MHz for } 35.5^\circ \leq \text{El} < 90^\circ \end{aligned}$$

where  $El$  is the elevation angle ( $^\circ$ ) at the platform height.

This e.i.r.p. mask would cover all the transmissions from the HAPS platform (i.e. towards CPE and/or gateways) that could also have emissions in the direction of the EESS satellite. No apportionment of the EESS (passive) protection criterion was considered.

It was shown that at least one of the HAPS systems can meet such an e.i.r.p. limit, based on the assumptions taken.

#### **Ground-to-HAPS**

One study shows that the EESS (passive) sensors would be protected from HAPS CPE uplinks if the unwanted emission input power of the CPE is limited to  $-55$  dBW/100 MHz in the band 21.2-21.4 GHz. While HAPS GW stations were not studied, if they use the same spectrum as the HAPS CPE and are located within the service area, further suppression of the out-of-band emissions would be necessary. This study did not use any apportionment of the EESS (passive) protection criterion and used a set of CPE characteristics that are based on parameters proposed for System 6.

#### **1/1.14/3.3.2.4 Compatibility of EESS (passive) in the band 22.21-22.5 GHz and HAPS systems operating in the 21.4-22 GHz frequency range**

##### **HAPS-to-ground**

Three independent studies show that compatibility between EESS (passive) sensors and HAPS platform downlinks is feasible provided that the unwanted emission e.i.r.p. from the HAPS platform in the band 21.2-21.4 GHz is below the following values:

Two independent studies propose to consider the same unwanted emission e.i.r.p. mask as for the 21.2-21.4 GHz for the protection of EESS (passive) in the band 22.21-22.5 GHz from the HAPS platform:

$$e.i.r.p. = -0.76 El - 9.5 \text{ dBW}/100 \text{ MHz} \quad \text{for } -4.53^\circ \leq El < 35.5^\circ$$

$$e.i.r.p. = -36.5 \text{ dBW}/100 \text{ MHz} \quad \text{for } 35.5^\circ \leq El < 90^\circ$$

where  $El$  is the elevation angle ( $^\circ$ ) at the HAPS platform height.

This e.i.r.p. mask would cover all the transmissions from the HAPS platform (i.e. towards CPE and/or gateways) that could also have emissions in the direction of the EESS satellite. No apportionment of the EESS (passive) protection criterion was considered.

It was shown that at least one of the HAPS systems can meet such an e.i.r.p. limit, based on the assumptions taken. Another study indicates that, in order to protect EESS (passive), the unwanted emission e.i.r.p. of each beam from the HAPS platform towards the HAPS CPE should be below  $-37.2 \text{ dBW}/100 \text{ MHz}$  in the direction of the EESS satellite, and the unwanted emission e.i.r.p. of each beam from the HAPS platform towards the HAPS gateway should be below  $-42.1 \text{ dBW}/100 \text{ MHz}$  in the direction of the EESS satellite. This is assuming 5 dB apportionment of the EESS (passive) protection criterion. This study considered the aggregate effect of HAPS to CPE and GW downlinks and applied the same attenuation to both links. It will be revised in order to assess the individual contribution of HAPS downlinks towards CPE and GW to the interference level, which might lead to different attenuations for both links and might change the e.i.r.p. values proposed. The study also addressed only one type of EESS (passive) sensor.

##### **Ground-to-HAPS**

One study indicates that, in order to protect EESS (passive), the unwanted emission e.i.r.p. of HAPS CPE should be below  $-32.6 \text{ dBW}/100 \text{ MHz}$ , and the unwanted emission e.i.r.p. of HAPS gateways should be below  $-26.3 \text{ dBW}/100 \text{ MHz}$ . This is assuming 5 dB apportionment of the EESS (passive) protection criterion. This study considered the aggregate effect of CPE and GW uplinks and applied the same attenuation to both links. It will be revised in order to assess the individual contribution of CPE and gateway uplinks to the interference level, which might lead to different attenuations for both links and might change the e.i.r.p. values proposed.

#### **1/1.14/3.3.2.5 Compatibility of RAS in the 22.21-22.5 GHz frequency range and HAPS systems operating in the 21.2-21.4 GHz frequency range**

##### **Ground-to-HAPS**

Studies have shown that the RAS station performing observations in the band 22.21-22.5 GHz can be protected from HAPS CPE and GW uplink transmissions in the band 21.4-22 GHz provided that those stations meet an unwanted emission pfd value of  $-146 \text{ dBW}/\text{m}^2/290 \text{ MHz}$  for continuum observations and  $-162 \text{ dBW}/\text{m}^2/250 \text{ kHz}$  for spectral line observations in the 22.21-22.5 GHz band at the RAS station location at a height of 50 m. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model. The possibilities for placement of

HAPS ground stations may be affected by their situation with respect to the RAS station and HAPS platform.

### **HAPS-to-ground**

Studies have shown that The RAS station performing observations in the band 22.21-22.5 GHz can be protected from HAPS platform downlink transmissions in the band 21.4-22 GHz provided that such HAPS platforms meet unwanted emission pfd values of  $-176 \text{ dBW/m}^2/290 \text{ MHz}$  for continuum observations and  $-192 \text{ dBW/m}^2/250 \text{ kHz}$  for spectral line observations in the 22.21-22.5 GHz band at the RAS station location. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model.

#### **1/1.14/3.3.3 Sharing and compatibility studies of HAPS systems in the 24.25-27.5 GHz frequency range**

##### **1/1.14/3.3.3.1 Sharing and compatibility study of FS and HAPS systems operating in the 25.25-27.5 GHz frequency range**

### **HAPS platform station transmitting towards the HAPS GW/CPE stations**

Several studies have shown that the following pfd mask in  $\text{dBW/m}^2/\text{MHz}$ , to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the FS by meeting its long-term protection criteria:

$$\begin{aligned} pfd_{max}(El) &= 0.39 \times El - 132.12 && \text{for } 0 \leq El < 13^\circ \\ pfd_{max}(El) &= 2.715 \times El - 162.3 && \text{for } 13^\circ \leq El < 20^\circ \\ pfd_{max}(El) &= 0.45 \times El - 117 && \text{for } 20^\circ \leq El < 60^\circ \\ pfd_{max}(El) &= -90 && \text{for } 60^\circ \leq El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the pfd level shown above is derived from a maximum interference level of  $-146 \text{ dBW/MHz}$  (i.e.,  $I/N = -10 \text{ dB}$  not to be exceeded more than 20% of the time) for the FS long-term protection criteria. The FS parameters and deployment density are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. The FS antenna pattern is based on Recommendation ITU-R F.1245-2 and gaseous atmospheric attenuation is considered (Recommendation ITU-R SF.1395-0).

This study made the assumption that to compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading but limited to a maximum of 20 dB.

To verify that the pfd produced by HAPS platform does not exceed the proposed pfd mask, the following equation was used:

$$pfd(El) = e.i.r.p.\frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2(El)} \right)$$

where:

*e.i.r.p.*: is the nominal HAPS e.i.r.p. density level in  $\text{dBW/MHz}$  (dependent to the elevation angle);

*d*: is the distance between the HAPS and the ground (elevation angle dependent).

The impact of the gas attenuation is not included in the verification formula since it is already taken into account in the pfd mask.



### **HAPS GW/CPE stations transmitting towards the HAPS platform station**

Several studies show that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

### **FS stations transmitting towards HAPS GW/CPE stations (HAPS platform station to HAPS GW/CPE)**

Several studies show that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

### **FS stations transmitting towards HAPS platform (HAPS GW/CPE to HAPS platform station)**

No studies were presented for this scenario.

### **1/1.14/3.3.3.2 Sharing and compatibility study of MS and HAPS systems operating in the 24.25-27.5 GHz frequency range**

#### **HAPS platform station transmitting towards the HAPS GW/CPE stations**

Several studies have shown that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the MS receivers from a single HAPS emission:

for MS base station receiver:

$$\begin{aligned} pfd_{max}(El) &= 0.95 \times El - 114 && \text{for } 0 \leq El < 20^\circ \\ pfd_{max}(El) &= -95 && \text{for } 20^\circ \leq El < 90^\circ \end{aligned}$$

for MS user equipment receiver:

$$\begin{aligned} pfd_{max}(El) &= 0.6 \times El - 112 && \text{for } 0 \leq El < 20^\circ \\ pfd_{max}(El) &= -100 && \text{for } 20^\circ \leq El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that for the pfd level above, polarization and gaseous atmospheric (Recommendation ITU-R SF.1395-0) losses are considered. In addition, body loss is considered for the user equipment pfd level calculation.

Option 1: Automatic transmit power control may be used to increase the e.i.r.p. density in these frequency ranges to compensate for rain attenuation, to the extent that the pfd at the surface of the Earth, at the mobile station location, does not exceed the value resulting from use by a HAPS station of an e.i.r.p. meeting the above limits in clear-sky conditions.

Option 2: This study made the assumption that to compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading.

To verify that the pfd produced by HAPS platform does not exceed the proposed pfd mask, the following equation was used:

$$pfd(El) = e.i.r.p.\frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2(El)} \right)$$

where:

*e.i.r.p.*: is the nominal HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);

*d*: is the distance between the HAPS and the ground (elevation angle dependent).

The impact of the gas attenuation, body loss (for user equipment), and polarization loss are not included in the verification formula since it is already taken into account in the pfd mask.

One study has shown that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied at the surface of the Earth, should be feasible to protect the IMT-2020 from HAPS systems. And in case that IMT-2020 system is coexisted with HAPS and FS in the same geographical area, 3 dB apportionments should be considered additionally to the pfd mask below to ensure this protection.

$$pfd_{mask\_IMT2020}(\theta) = \begin{cases} 0.6 \times El - 114, & [0^\circ, 12^\circ] \\ -107, & [12^\circ, 90^\circ] \end{cases}$$

where  $\theta$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the attenuations are not considered in the pfd mask above, but in the compliance analysis stage.

To verify the compliance of the aggregated interference, from multiple beams of single HAPS platform, with the proposed pfd mask, the following equations are used:

$$pfd_b(\theta) = P^H(b) + G_{tx}^H(\varphi(b)) - FSL - CL - AL$$

$$pfd(\theta) = 10 \log \left( \sum_{b=1}^{b_n} 10^{pfd_b(\theta)/10} \right)$$

where:

$P^H(b)$ : maximum transmit power of beam b generated by the HAPS (dBW/MHz/m<sup>2</sup>);

$\varphi(b)$ : discrimination angle (degrees) at the HAPS between the pointing direction of a HAPS spot beam b and the MS receiver;

$G_{tx}^H(\varphi(b))$ : transmitter antenna pattern gain (dBi) of the HAPS for off-axis angle  $\varphi(b)$ ;

FSL: free-space loss (dB) between the MS receiver and the HAPS;

AL: atmospheric loss (dB) between the MS receiver and the HAPS, based on Recommendation ITU-R P.619-3;

CL: clutter loss (dB) between the MS receiver and the HAPS, based on Recommendation ITU-R P.2108-0;

$b_n$ : number of co-frequency beams.

In addition, assuming a worst-case scenario of main-beam coupling between the two systems, this study proposed that in order to meet the protection of IMT-2020 stations in the HAPS-to-ground link, HAPS e.i.r.p. should be reduced by [11.1] dB or a protection distance between HAPS nadir and IMT-2020 stations of [52.1] km should be applied. When considering 3 dB interference apportionment, the transmitter e.i.r.p. should be reduced by [14.1] dB, or a protection distance between HAPS nadir and IMT-2020 stations of [55.0] km should be applied. Note that section 3.1 of clutter model of Recommendation ITU-R P.2108-0 was used. Therefore, the study requires further revision, taking into account section 3.3 of clutter model of Recommendation ITU-R

P.2108-0 and also the latest parameters available for HAPS systems. The conclusions of this study will be amended.

### **HAPS GW/CPE stations transmitting towards the HAPS platform station**

One study has shown that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied under clear-sky conditions, at the surface of the Earth, ensures the protection of the MS receivers from a single HAPS emission:

for the MS base station receiver:

$$pfd_{max}(El) = \begin{cases} 1.14 \times El - 111, & 0^\circ < El < 12^\circ \\ -97.3, & 0^\circ \leq El < 40^\circ \end{cases}$$

for the MS user equipment receiver:

$$pfd_{max}(El) = -103.9, \quad 0^\circ < El < 60^\circ$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

The impact of the gas attenuation, body loss (for user equipment), and polarization loss are not included in the pfd mask since it is already taken into account in the verification formula.

Note that such pfd mask could be used for coordination between administrations.

To verify that the pfd produced by HAPS platform does not exceed the proposed pfd mask, the following equation was used:

$$pfd(El) = e.i.r.p.\frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{\lambda^2}{4\pi} \right) - P_{452}(d) - C_{loss} - L_{pol} - B_{loss}$$

where:

*e.i.r.p.*: is the nominal HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);

*d*: is the distance between the HAPS and the ground (elevation angle dependent);

*L<sub>pol</sub>*: is the polarization discrimination in dB;

*C<sub>loss</sub>*: is the clutter loss (Recommendation ITU-R P.2108-0) in dB;

*P<sub>452</sub>*: is the propagation loss based on Recommendation ITU-R P.452-16 in dB

*B<sub>loss</sub>*: is the body loss (dB), only applicable to the user equipment.

It is noteworthy to mention that, in real deployments, it is necessary to evaluate the overall performance of protection measures (e.g. pfd masks, separation distances, etc.) that are jointly applied in order to mitigate harmful interference between services.

### **MS stations transmitting towards HAPS GW/CPE stations (HAPS platform station to HAPS GW/CPE)**

No studies were presented for this scenario.

### **MS stations transmitting towards HAPS platform (HAPS GW/CPE to HAPS platform station)**

No studies were presented for this scenario.

**1/1.14/3.3.3.3      Sharing and compatibility study of RNS and HAPS systems operating in the 24.25-24.65 GHz frequency range**

No RNS systems have been identified using this band nor RNS technical characteristics have been made available. Therefore, no sharing and compatibility studies have been performed.

**1/1.14/3.3.3.4      Sharing and compatibility study of RLSS and HAPS systems operating in the 24.65-24.75 GHz frequency range**

No RLSS systems have been identified using this band nor RLSS technical characteristics have been made available. Therefore, no sharing and compatibility studies have been performed.

**1/1.14/3.3.3.5      Sharing and compatibility study of ISS and HAPS systems operating in the 24.45-24.75 and 25.25-27.5 GHz**

**HAPS GW or CPE into ISS space station receiver**

One study was performed on sharing between HAPS and ISS in the 25.25-27.5 GHz band. This study examined interference HAPS uplinks into data relay satellite (DRS) inter-orbit return links. Calculations were performed to determine the minimum off-pointing angle from the GSO arc for CPE-HAPS and GW-HAPS uplinks in order to satisfy the protection criteria. Using e.i.r.p density values of 35.9 and 23.2 dBW/MHz for the GW and CPE (1.2 m) links respectively, the required separation angles between the DRS orbit location and the GW and CPE antenna pointing were found to be 0.85 degrees and 0.65 degrees respectively.

**HAPS platform into ISS space station receiver (24.45-24.75 GHz)**

One study was performed on sharing between HAPS and ISS in the 24.45-24.75 GHz band. This single-entry study concludes that the e.i.r.p. from a single HAPS should be limited to 13.2 dBW/MHz under clear-sky conditions (10.2 dBW/MHz per polarization) in order to protect the ISS non-GSO systems from a single HAPS. This study does not address dynamic, multiple entry scenarios. A first approximation on aggregate interference shows that e.i.r.p. from HAPS ground stations may be limited to 10.2 dBW/MHz under clear-sky conditions (7.2 dBW/MHz per polarization).

**HAPS platform into ISS space station receiver (25.25-27.5 GHz)**

One study considered the potential emissions into the ISS space station receiver. The study included assessment for satellite receiver *Io/No* values of -10 dB. No assumption on the percentage of time associated to that interference level was needed.

The analysis performed shows that HAPS system downlink emissions will not impact the ISS receivers if the e.i.r.p. per HAPS platform transmitter is limited to -70.7 dBW/Hz for off nadir angle higher than 90°.

**1/1.14/3.3.3.6      Sharing and compatibility study of FSS (Earth-to-space) and HAPS systems operating in the 24.75-25.25 and 27-27.5 GHz frequency range**

**HAPS GW or CPE into FSS space station receiver**

One study considers the potential emissions into the FSS space station receiver. The study included assessment for satellite receiver *I/N* values of -6, -10, and -12.2 dB.

The study notes that HAPS is identified in the FS allocation and HAPS ground terminals are similar to a FS station. Therefore, HAPS can comply with the limits stated in Article 21 of the Radio Regulations, the limits in RR Table 21-1, No. 21.3, No. 21.4, and No. 21.5.

In addition, the proposed combined set of limits to meet the FSS  $I/N$  value of  $-12.2$  dB with the associated time percentage of 20% are the following:

- 1 Power spectral density limit:
  - For the CPE uplink:  $-36.7$  dBW/MHz;
  - For the GW uplink:  $-33$  dBW/MHz.
- 2 e.i.r.p. spectral density limit:
  - For the CPE uplink:  $11.5$  dBW/MHz;
  - For the GW uplink:  $20.3$  dBW/MHz.

One study undertakes aggregated interference simulations from HAPS ground terminal and platform towards FSS GSO space station has been performed in the 24.25-27.5 GHz frequency band.

The results show that for the HAPS system, the aggregate  $I/N$  level will always meet the FSS satellite receiver  $I/N$  values of  $-10$  dB (20% of time) and  $-6$  dB (0.6% of time), based on the assumptions and input parameters used in this study.

### **HAPS platform into FSS space station receiver**

Two studies considered the potential emissions into the FSS space station receiver. The study included assessment for satellite receiver  $I/N$  values of  $-12.2$  dB. No assumption on the percentage of time associated to that interference level was needed.

The analysis performed shows that HAPS system downlink emissions will not impact the FSS receivers if the e.i.r.p. per HAPS platform transmitter is limited to  $-10.8$  dBW/MHz for elevation angle more than  $5^\circ$  above the horizon.

One study undertakes aggregated interference simulations from HAPS ground terminal and platform towards FSS GSO space station in the 24.25-27.5 GHz frequency band.

The results show that for the HAPS system, the aggregate  $I/N$  level will always meet the FSS satellite receiver  $I/N$  values of  $-10$  dB (20% of time) and  $-6$  dB (0.6% of time), based on the assumptions and input parameters used in this study.

### **FSS earth station into HAPS GW and/or CPE receiver**

Two studies considered the potential emissions from FSS earth stations received by the HAPS CPE receiver. These analyses also compared the level of emissions at the HAPS CPE receiver to those that would be received by a FS receiver.

It was shown that the required separation distance between HAPS ground terminal and FSS earth station is much less compared to FSS earth station and FS terminal. This single-entry analysis was presented only to show that HAPS can coexist with FSS.

This study did not include consideration of potential deployment density of either FSS earth stations or HAPS gateway or CPE receivers.

One study focused on the sharing and compatibility of FSS earth stations interference into HAPS GW in the frequency band 24.25-27.5 GHz. The study assumed two cases of interference criteria which indicates a probability of the  $I/N$  criterion of  $-6$  dB should not be exceeded more than either 20% and 0.001% of time. The results using worst-case antenna pointing scenarios and specific terrain assumptions indicate that HAPS GW requires separation distances from transmitting FSS earth stations which vary from 0.62 km to 41.7 km and from 0.71 km to 74.1 km for the band 24.25-27.5 GHz (for the 20% and 0.001% of time, respectively) and from 0.39 km to 34 km and

from 0.41 km to 57.3 km for the band 27.9-28.2 GHz (for the cases of 20% and 0.001% of time, respectively).

This study provides a range for the required separation distance between FSS earth stations and HAPS ground stations. The percentage of occurrence tied to each of the possible separation distances would depend upon the deployment scenarios for FSS earth stations and HAPS ground stations.

### 1/1.14/3.3.3.7 Sharing and compatibility study of EESS/SRS and HAPS systems operating in the 25.5-27 GHz frequency range

#### (HAPS-to-ground and ground-to-HAPS)

Studies have shown that in order to ensure the protection of in-band SRS/EESS from the HAPS platform or from the HAPS ground station in the band 25.5-27.0 GHz, the pfd of a HAPS should not exceed the sets of values below. The pfd limits applied to HAPS platforms are established to be met under clear-sky conditions 100% of the time, at the location of the SRS/EESS earth station. For the case of the HAPS ground station towards an SRS/EESS earth station path case there will be a need to consider HAPS and SRS/EESS antenna heights in order to apply attenuation using Recommendation ITU-R P.452-16, using the following percentages: 1) SRS: 0.001%; 2) EESS non-GSO: 0.005%; 3) EESS GSO: 20%.

The SRS interference protection criteria are derived from Recommendation ITU-R SA.609-2. The EESS non-GSO interference protection criteria are derived from the Recommendation ITU-R SA.1027-5 short-term criterion. The EESS GSO interference protection criteria are derived from the Recommendation ITU-R SA.1161-2 long-term criterion. The EESS and SRS pfd values calculated are shown below, which should be considered and acted upon, as appropriate.

- **SRS:**

$$pfd \left( \frac{dBW}{m^2 * MHz} \right) = \begin{cases} -138.8 + 25 * \log_{10}(5 - \varphi) & 0 \leq \varphi < 4.925 \\ -166.9 & 4.925 \leq \varphi < 5 \\ -183.9 & 5 \leq \varphi \leq 90 \end{cases}$$

Where these equations are based on the SRS antenna gain towards the HAPS platform or the HAPS ground station following the Recommendation ITU-R SA.509-3 antenna pattern for an angle of arrival ( $\varphi$ ) of the interfering signal above the local horizontal plane at the SRS antenna.

- **EESS – non-GSO:**

$$pfd \left( \frac{dBW}{m^2 * MHz} \right) = \begin{cases} -108.8 + (25 * \log_{10}(3 - \varphi)) & 0 \leq \varphi < 2.808 \\ -126.7 & 2.808 \leq \varphi < 3 \\ -143.4 & 3 \leq \varphi \leq 90 \end{cases}$$

Where these equations are based on the EESS antenna gain towards the HAPS platform or the HAPS ground station following RR Appendix 8, Annex 3 antenna pattern for an angle of arrival ( $\varphi$ ) of the interfering signal above the local horizontal plane at the EESS antenna.

- **EESS – GSO:**

$$pfd \left( \frac{dBW}{m^2 * MHz} \right) = \begin{cases} -140.5 + 25 * \log_{10}(3 - \varphi) & 0 \leq \varphi < 2.808 \\ -158.4 & 2.808 \leq \varphi < 3 \\ -178.5 & 3 \leq \varphi \leq 90 \end{cases}$$

Where these equations are based on the EESS antenna gain towards the HAPS platform or the HAPS ground station following RR Appendix 8, Annex 3 antenna pattern for an angle of arrival ( $\varphi$ ) of the interfering signal above the local horizontal plane at the EESS antenna.

**1/1.14/3.3.3.8 Sharing and compatibility study of AMS and HAPS systems operating in the 25.25-27.5 GHz frequency range**

Under this section no text has been developed yet and it may be proposed in contributions to CPM19-2.

**1/1.14/3.3.3.9 Compatibility study of RAS in the 23.6-24 GHz band and HAPS systems operating in the 24.25-27.5 GHz frequency range**

**Ground-to-HAPS**

Studies have shown that the RAS station performing observations in the band 23.6-24 GHz can be protected from HAPS CPE and GW uplink transmissions in the band 24.25-27.5 GHz provided that those stations meet an unwanted emission pfd value of  $-147 \text{ dBW/m}^2/290 \text{ MHz}$  for continuum observations and  $-161 \text{ dBW/m}^2/250 \text{ kHz}$  for spectral line observations in the 23.6-24 GHz band at the RAS station location at a height of 50 m. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model. The possibilities for placement of HAPS ground stations may be affected by their situation with respect to the RAS station and HAPS platform.

**HAPS-to-ground**

Studies have shown that the RAS station performing observations in the band 23.6-24 GHz can be protected from HAPS platform downlink transmissions in the band 24.25-27.5 GHz provided that such HAPS platforms meet unwanted emission pfd values of  $-177 \text{ dBW/m}^2/290 \text{ MHz}$  for continuum observations and  $-191 \text{ dBW/m}^2/250 \text{ kHz}$  for spectral line observations in the 23.6-24 GHz band at the RAS station location. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model.

**1/1.14/3.3.3.10 Compatibility study of EESS (passive) service in the 23.6-24 GHz band and HAPS systems operating in the 24.25-27.5 GHz frequency range**

**HAPS-to-ground**

Three independent studies show that compatibility between EESS (passive) and HAPS platform downlinks is feasible provided that the unwanted emission e.i.r.p. from the HAPS platform in the band 23.6-24 GHz is below the following values:

$$e. i. r. p. = -0.7714 El - 16.5 \text{ dBW}/200 \text{ MHz for } -4.53^\circ \leq El < 35^\circ$$

$$e. i. r. p. = -43.5 \text{ dBW}/200 \text{ MHz for } 35^\circ \leq El < 90^\circ$$

where  $El$  is the elevation angle ( $^\circ$ ) at the platform height.

This e.i.r.p mask would cover all the transmissions from the HAPS platform (i.e. towards CPE and/or gateways) that could also have emissions in the direction of the EESS satellite. An apportionment of 5 dB of the EESS (passive) protection criterion was considered.

It was shown that at least one of the HAPS systems can meet such e.i.r.p. limits, based on the assumptions taken. Another study indicates that, in order to protect EESS (passive), the unwanted emission e.i.r.p. of each beam from the HAPS platform towards the HAPS CPE should be below  $-31.3 \text{ dBW}/100 \text{ MHz}$  in the direction of the EESS satellite, and the unwanted emission e.i.r.p. of each beam from the HAPS platform towards the HAPS GW should be below  $-36.2 \text{ dBW}/100 \text{ MHz}$  in the direction of the EESS satellite. This is assuming 5 dB apportionment of the EESS (passive)

protection criterion. This study considered one single EESS (passive) sensor, as well as the aggregate effect of HAPS to CPE and GW downlinks and applied the same attenuation to both links. It will be revised in order to assess the individual contribution of HAPS downlinks towards CPE and GW to the interference level, which might lead to different attenuations for both links and might change the e.i.r.p. values proposed. The study also addressed only one type of EESS (passive) sensor.

### **Ground-to-HAPS**

One study indicates that, in order to protect EESS (passive), the unwanted emission e.i.r.p. of HAPS CPE should be below  $-31.8$  dBW/200 MHz, and the unwanted emission e.i.r.p. of HAPS GW should be below  $-19.1$  dBW/200 MHz. This is assuming 5 dB apportionment of the EESS (passive) protection criterion. This study considered one single type of EESS sensor, as well as the aggregate effect of CPE and GW uplinks and applied the same attenuation to both links. It will be revised in order to assess the individual contribution of CPE and GW uplinks to the interference level, which might lead to different attenuations for both links and might change the e.i.r.p. values proposed.

Another study considered only CPE uplinks and shows that an unwanted emission e.i.r.p. limit of  $-36$  dBW/200 MHz would be required in order to protect EESS (passive) in the band 23.6-24 GHz. This is assuming 5 dB apportionment of the EESS (passive) protection criterion. This study considered all types of EESS sensors for this frequency band.

#### **1/1.14/3.3.4 Sharing and compatibility studies of HAPS systems in the 27.9-28.2 GHz and 31-31.3 GHz frequency ranges**

##### **1/1.14/3.3.4.1 Sharing and compatibility of FS and HAPS systems operating in the 27.9-28.2 GHz and 31-31.3 GHz frequency ranges**

##### **1/1.14/3.3.4.1.1 Sharing and compatibility of FS and HAPS systems operating in the 27.9-28.2 GHz frequency range**

### **HAPS platform station transmitting towards the HAPS GW/CPE stations**

Several studies have shown that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the FS by meeting its long-term protection criteria:

$$\begin{aligned} pfd_{max}(El) &= (3 \times El - 140) \quad \text{for } El \leq 10^\circ \\ pfd_{max}(El) &= (0.57 \times El - 115.7) \quad \text{for } 10^\circ < El \leq 45^\circ \\ pfd_{max}(El) &= -90 \quad \text{for } 45 < El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the pfd level shown above is derived from a maximum interference level of  $-146$  dBW/MHz (i.e.,  $I/N = -10$  dB not to be exceeded more than 20% of the time) for the FS long-term protection criteria. The FS parameters and deployment density are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. The FS antenna pattern is based on Recommendation ITU-R F.1245-2 and gaseous atmospheric attenuation is considered (Recommendation ITU-R SF.1395-0).

This study made the assumption that to compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading but limited to a maximum of 20 dB.



To verify that the pfd produced by HAPS platform does not exceed the proposed pfd mask, the following equation was used:

$$pfd(El) = e.i.r.p.\frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2_{(El)}} \right)$$

where:

*e.i.r.p.*: is the nominal HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);

*d*: is the distance between the HAPS and the ground (elevation angle dependent).

The impact of the gas attenuation is not included in the verification formula since it is already taken into account in the pfd mask.

### **HAPS GW/CPE stations transmitting towards the HAPS platform station**

HAPS uplink is not considered for the 27.9-28.2 GHz frequency band.

### **FS stations transmitting towards HAPS GW/CPE stations (HAPS platform station to HAPS GW/CPE)**

Several studies show that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

### **FS stations transmitting towards HAPS platform (HAPS GW/CPE to HAPS platform station)**

HAPS uplink is not considered for the 27.9-28.2 GHz frequency band.

### **1/1.14/3.3.4.1.2 Sharing and compatibility of FS and HAPS systems operating in the 31-31.3 GHz frequency range**

#### **HAPS platform station transmitting towards the HAPS GW/CPE stations**

Several studies have shown that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the FS by meeting its long-term protection criteria:

$$\begin{aligned} pfd_{max}(El) &= 0.875 \times El - 143 && \text{for } El \leq 8^\circ \\ pfd_{max}(El) &= (2.58 \times El - 156.6) && \text{for } 8^\circ < El \leq 15^\circ \\ pfd_{max}(El) &= (0.375 \times El - 112.5) && \text{for } 20 < El \leq 60^\circ \\ pfd_{max}(El) &= -90 && \text{for } 60 < El \leq 90^\circ \end{aligned}$$

where *El* is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the pfd level shown above is derived from a maximum interference level of -148 dBW/MHz (i.e., *I/N* = -10 dB not to be exceeded more than 20% of the time) for the FS long-term protection criteria. The FS parameters and deployment density are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. The FS antenna pattern is based on Recommendation ITU-R F.1245-2 and gaseous atmospheric attenuation is considered (Recommendation ITU-R SF.1395-0).

This study made the assumption that to compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading but limited to a maximum of 20 dB.

To verify that the pfd produced by HAPS platform does not exceed the proposed pfd mask, the following equation was used:

$$pfd(El) = e.i.r.p.\frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2} \right)$$

where:

*e.i.r.p.*: is the nominal HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);

*d*: is the distance between the HAPS and the ground (elevation angle dependent).

The impact of the gas attenuation is not included in the verification formula since it is already taken into account in the pfd mask.

### **HAPS GW/CPE stations transmitting towards the HAPS platform station**

No studies were presented for this scenario.

### **FS stations transmitting towards HAPS GW/CPE stations (HAPS platform station to HAPS GW/CPE)**

Several studies show that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

### **FS stations transmitting towards HAPS platform (HAPS GW/CPE to HAPS platform station)**

No studies were presented for this scenario.

## **1/1.14/3.3.4.2 Sharing and compatibility of FSS (Earth-to-space) and HAPS systems operating in the 27.9-28.2 GHz**

### **HAPS platform into FSS space station receiver**

Two studies considered the potential emissions into the FSS GSO and non-GSO space station receivers. The study included assessment for satellite receiver *I/N* values of -12.2 dB. No assumption on the percentage of time associated to that interference level was needed.

The analysis performed shows that HAPS system downlink emissions will not impact the FSS receivers if the e.i.r.p. per HAPS platform transmitter is limited to -9.7 dBW/MHz for elevation angles more than 5° above the horizon.

One study analysed the impact of emissions from both the HAPS platform CPE and GW beams into the FSS GSO and non-GSO space station receivers. The study included assessment for satellite receiver *I/N* values of -12.2 dB.

A worst-case deterministic analysis indicates that the aggregate interference from beams of HAPS GW does not cause interference to FSS GSO and non-GSO satellites. A similar analysis indicates that the aggregate interference from HAPS CPEs does not cause interference to FSS GSO satellites.

A worst-case Monte Carlo analysis is performed to evaluate the aggregate interference at FSS non-GSO satellite receivers from beams of HAPS CPEs. The probability of exceeding the  $I/N$  value of  $-12.2$  dB at the non-GSO satellite receiver is 0%.

### **FSS earth station into HAPS GW and/or CPE receiver**

One study considered the potential emissions from FSS earth stations received by the HAPS CPE receiver. This analysis also compared the level of emissions at the HAPS CPE receiver to those that would be received by an FS receiver.

It was shown that the required separation distance between HAPS ground terminal and FSS E/S is much less compared to FSS E/S and FS terminal. This single-entry analysis was presented only to show that HAPS can coexist with FSS.

This study did not include consideration of potential deployment density of either FSS earth stations or HAPS GW or CPE receivers.

One study considered the potential emissions from FSS earth stations received by the HAPS GW or CPE receiver. This analysis also compared the level of emissions at the HAPS receivers to those that would be received by a FS receiver.

The analysis performed shows that the required separation distance of HAPS GW or CPE receivers and FSS earth stations is less than the required separation distance between an FSS earth station and FS terminal.

One study focused on the sharing and compatibility of FSS earth station interference into HAPS GW in the frequency band 27.9-28.2 GHz. The study assumed two cases of interference criteria which indicates a probability of the  $I/N$  criterion of  $-6$ dB should not be exceeded more than either 20% and 0.001% of time. The results using worst-case antenna pointing scenarios and specific terrain assumptions indicate that HAPS GW requires separation distances from transmitting FSS earth stations which vary from 0.39 km to 34 km and from 0.41 km to 57.3 km for the band 27.9-28.2 GHz (for the cases of 20% and 100%, respectively).

This study provides a range for the required separation distance between FSS earth stations and HAPS ground stations. The percentage of occurrence tied to each of the possible separation distances would depend upon the deployment scenarios for FSS earth stations and HAPS ground stations.

One study, using an  $I/N$  value of  $-12.2$  dB for the HAPS receivers shows the following:

For GSO FSS earth station to HAPS receivers, the worst-case separation distance is at least 200 m, considering 20 dB shielding at the HAPS GW receiver and 204 m for CPE receivers (without shielding).

For non-GSO FSS earth station to HAPS receivers, the worst-case separation distance is at least 4.1 km, considering 20 dB shielding at the HAPS GW receiver and 2.58 km for CPE receivers (without shielding).

The above results demonstrate that short separation distances will be required between FSS earth stations and HAPS ground terminals. Further, straightforward mitigation techniques such as, RF shielding around the HAPS GW and polarization isolation could reduce the separation distances even further, depending on the elevation and azimuth angle of the respective links.

**1/1.14/3.3.4.3 Sharing and compatibility of MS and HAPS systems operating in the 27.9-28.2 GHz and 31-31.3 GHz frequency ranges**

**1/1.14/3.3.4.3.1 Sharing and compatibility of MS and HAPS systems operating in the 27.9-28.2 GHz frequency range**

**HAPS platform station transmitting towards the HAPS GW/CPE stations**

One study shows that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the MS receivers from a single HAPS emission:

$$\begin{aligned} pfd_{max}(El) &= El - 120 & El \leq 13^\circ \\ pfd_{max}(El) &= -107 & 13^\circ < El \leq 65^\circ \\ pfd_{max}(El) &= 0.68 \times El - 151.2 & 65^\circ < El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that for the pfd level above, polarization and gaseous atmospheric (ITU-R SF.1395-0) losses are considered. In addition, body loss is considered for the user equipment pfd level calculation.

Option 1: Automatic transmit power control may be used to increase the e.i.r.p. density in these frequency ranges to compensate for rain attenuation, to the extent that the pfd at the surface of the Earth, at the mobile station location, does not exceed the value resulting from use by a HAPS station of an e.i.r.p. meeting the above limits in clear-sky conditions.

Option 2: This study made the assumption that to compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading.

To verify that the pfd produced by HAPS platform does not exceed the proposed pfd mask, the following equation was used:

$$pfd(El) = e.i.r.p.\frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2(El)} \right)$$

where:

*e.i.r.p.*: is the nominal HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);

*d*: is the distance between the HAPS and the ground (elevation angle dependent).

The impact of the gas attenuation, body loss (for user equipment), and polarization loss are not included in the verification formula since it is already taken into account in the pfd mask.

Another study shows that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied at the surface of the Earth, should be feasible to protect the MS from HAPS systems. And in case that MS is coexisted with HAPS and FS in the same geographical area, 3 dB apportionments should be considered additionally to the pfd mask below to ensure this protection.

$$pfd_{mask}(\theta) = \begin{cases} 1.5 \times El - 121.3, & [0^\circ, 5^\circ] \\ -113.7, & [5^\circ, 90^\circ] \end{cases}$$

where  $\theta$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

Note that the attenuations are not considered in the pfd mask above, but in the compliance analysis stage.

To verify the compliance of the aggregated interference, from multiple beams of single HAPS platform, with the proposed pfd mask, the following equations are used:

$$pfd_b(\theta) = P^H(b) + G_{tx}^H(\varphi(b)) - FSL - CL - AL$$

$$pfd(\theta) = 10 \log \left( \sum_{b=1}^{b_n} 10^{pfd_b(\theta)/10} \right)$$

where:

- $P^H(b)$ : maximum transmit power of beam  $b$  generated by the HAPS (dBW/MHz/m<sup>2</sup>);
- $\varphi(b)$ : discrimination angle (degrees) at the HAPS between the pointing direction of a HAPS spot beam  $b$  and the MS receiver;
- $G_{tx}^H(\varphi(b))$ : transmitter antenna pattern gain (dBi) of the HAPS for off-axis angle  $\varphi(b)$ ;
- $FSL$ : free-space loss (dB) between the MS receiver and the HAPS;
- $AL$ : atmospheric loss (dB) between the MS receiver and the HAPS, based on Recommendation ITU-R P.619-3;
- $CL$ : clutter loss (dB) between the MS receiver and the HAPS, based on Recommendation ITU-R P.2108-0;
- $b_n$ : number of co-frequency beams.

In addition, assuming a worst-case scenario of main-beam coupling between the two systems, this study proposed that in order to meet the protection of mobile stations in the HAPS-to-ground link, HAPS e.i.r.p. should be reduced by [28.8] dB or a protection distance between HAPS nadir and mobile stations of [92.6] km should be applied. When considering 3 dB interference apportionment, the transmitter e.i.r.p. reduction required is [31.8] dB, or a protection distance between HAPS nadir and mobile stations of [102.1] km should be applied. Note that section 3.1 of clutter model of Recommendation ITU-R P.2108-0 was used. Therefore, the study requires further revision, taking into account section 3.3 of clutter model of Recommendation ITU-R P.2108-0 and also the latest parameters available for the HAPS system. The conclusions of this study will be amended.

#### **HAPS GW/CPE stations transmitting towards the HAPS platform station**

HAPS uplink is not considered.

#### **MS stations transmitting towards HAPS GW/CPE stations (HAPS platform station to HAPS GW/CPE)**

No studies were presented.

#### **MS stations transmitting towards HAPS platform (HAPS GW/CPE to HAPS platform station)**

HAPS uplink is not considered.

#### **1/1.14/3.3.4.3.2 Sharing and compatibility of MS and HAPS systems operating in the 31-31.3 GHz frequency range**

Under this section no text has been developed yet and it may be proposed in contributions to CPM19-2.

#### 1/1.14/3.3.4.4 **Compatibility study of EESS (passive) in the adjacent band 31.3-31.8 GHz and HAPS systems operating in the 31-31.3 GHz frequency range**

##### **HAPS-to-ground**

Three independent studies show that compatibility between EESS (passive) and HAPS platform downlinks is feasible provided that unwanted emission e.i.r.p. from the HAPS platform in the band 31.3-31.8 GHz is below the following values:

$$e.i.r.p. = -El - 13.1 \text{ dBW}/200 \text{ MHz for } -4.53^\circ \leq El < 22^\circ$$

$$e.i.r.p. = -35.1 \text{ dBW}/200 \text{ MHz for } 22^\circ \leq El < 90^\circ$$

where  $El$  is the elevation angle ( $^\circ$ ) at the platform height.

This e.i.r.p. mask would cover all the transmissions from the HAPS platform (i.e. towards CPE and/or gateways) that could also have emissions in the direction of the EESS satellite. An apportionment of 5 dB of the EESS (passive) protection criterion was considered.

It was shown that at least one of the HAPS systems can meet such an e.i.r.p. limit, based on the assumptions taken. Another study indicates that, in order to protect EESS (passive), the unwanted emission e.i.r.p. of each beam from the HAPS platform towards the HAPS CPE should be below  $-29.1 \text{ dBW}/100 \text{ MHz}$  in the direction of the EESS satellite, and the unwanted emission e.i.r.p. of each beam from the HAPS platform towards the HAPS GW should be below  $-35.1 \text{ dBW}/100 \text{ MHz}$  in the direction of the EESS satellite. This is assuming 5 dB apportionment of the EESS (passive) protection criterion. This study considered one single EESS (passive) sensor, as well as the aggregate effect of HAPS to CPE and GW downlinks and applied the same attenuation to both links. It will be revised in order to assess the individual contribution of HAPS downlinks towards CPE and GW to the interference level, which might lead to different attenuations for both links and might change the e.i.r.p. values proposed. The study also addressed only one type of EESS (passive) sensor.

##### **Ground-to-HAPS**

The two studies addressing uplinks propose to either keep the unwanted emission input power limit of  $-106 \text{ dBW}/\text{MHz}$  currently in RR No. **5.543A**, or convert it in a 200 MHz bandwidth, i.e.  $-83 \text{ dBW}/200 \text{ MHz}$ . This limit would apply to both HAPS CPE and gateways, considering clear-sky conditions.

#### 1/1.14/3.3.4.5 **Compatibility of RAS in the adjacent band 31.3-31.8 GHz and HAPS systems operating in the 31-31.3 GHz frequency range**

##### **Ground-to-HAPS**

Studies have shown that the RAS station performing observations in the band 31.3-31.8 GHz can be protected from HAPS CPE and GW uplink transmissions in the band 31-31.3 GHz provided that those stations meet an unwanted emission pfd value of  $-141 \text{ dBW}/\text{m}^2/500 \text{ MHz}$  in the 31.3-31.8 GHz band at the RAS station location at a height of 50 m. This pfd value shall be verified considering a percentage of time of 2% in the relevant propagation model. The possibilities for placement of HAPS ground stations may be affected by their situation with respect to the RAS station and HAPS platform.

##### **HAPS-to-ground**

Studies have shown that the RAS station performing observations in the band 31.3-31.8 GHz can be protected from HAPS platform downlink transmissions in the band 31-31.3 GHz provided that such HAPS platforms meet unwanted emission pfd values of  $-171 \text{ dBW}/\text{m}^2/500 \text{ MHz}$  in the

31.3-31.8 GHz band at the RAS station location. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model.

**1/1.14/3.3.5 Sharing and compatibility studies of HAPS systems in the 38-39.5 GHz frequency range**

**1/1.14/3.3.5.1 Sharing and compatibility study of FS and HAPS systems operating in the 38-39.5 GHz frequency range**

**HAPS platform station transmitting towards the HAPS GW/CPE stations**

One study has shown that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the FS by meeting its long-term protection criteria:

$$\begin{aligned}
 pfd_{max}(El) &= -137 && \text{for } El \leq 13^\circ \\
 pfd_{max}(El) &= (-137 + 3.125(El - 13)) && \text{for } 13^\circ < El \leq 25^\circ \\
 pfd_{max}(El) &= (-99.5 + 0.5(El - 25)) && \text{for } 25 < El \leq 50^\circ \\
 pfd_{max}(El) &= -87 && \text{for } 50 < El \leq 90^\circ
 \end{aligned}$$

where  $El$  is the elevation angle in degrees (angle of arrival above the horizontal plane).

Note that the pfd level shown above is derived from on a maximum interference level of  $-147$  dBW/MHz (i.e.,  $I/N = -10$  dB not to be exceeded more than 20% of the time) for the FS long-term protection criteria. The FS parameters and deployment density are taken from Recommendations ITU-R F.758-6 and ITU-R F.2086-0, respectively. Note that gaseous atmospheric attenuation was taken into account (Recommendation ITU-R SF.1395-0).

This study made the assumption that to compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading but limited to a maximum of 20 dB.

To verify that the pfd produced by the HAPS platform does not exceed the proposed pfd mask, the following equation was used:

$$pfd(El) = e.i.r.p.\frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2_{(El)}} \right)$$

where:

- $d$ : distance between the HAPS and the FS station (m);
- $e.i.r.p.$ : under clear-sky conditions: nominal HAPS platform e.i.r.p. spectral density in at a specific elevation angle (dBW/MHz);<sup>1</sup>
  - under raining conditions: maximum HAPS platform e.i.r.p. spectral density in at a specific elevation angle (dBW/MHz).

The impact of the gas attenuation is not included in the verification formula since it is already taken into account in the pfd mask.

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<sup>1</sup> This corresponds to the maximum e.i.r.p. at which the system operates under clear-sky conditions.

### **HAPS GW/CPE stations transmitting towards the HAPS platform station**

Several studies show that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

### **FS stations transmitting towards HAPS GW/CPE stations (HAPS platform station to HAPS GW/CPE)**

One study shows that the antennas used for both HAPS ground terminals and FS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection between HAPS ground stations and conventional FS stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

### **FS stations transmitting towards HAPS platform (HAPS GW/CPE to HAPS platform station)**

One study shows that the HAPS platform gateway beam station short-term protection criteria ( $I/N = +10$  dB) is never exceeded. The long-term ( $I/N = -10$  dB) is exceeded for less than 1 over 900 deployment scenarios in the case of HAPS gateway beam and less than 1 over 2 000 deployment scenarios in case of HAPS CPE beam.

### **1/1.14/3.3.5.2 Sharing and compatibility study of MS and HAPS systems operating in the 38-39.5 GHz frequency range**

#### **HAPS platform station transmitting towards the HAPS GW/CPE stations**

One study shows that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied under clear-sky conditions at the surface of the Earth, ensures the protection of the MS receivers from a single HAPS emission:

$$\begin{aligned} pfd_{max}(El) &= -102 && \text{for } El \leq 5^\circ, \\ pfd_{max}(El) &= -102 + 0.25(El - 5) && \text{for } 5 \leq El < 25^\circ \\ pfd_{max}(El) &= -97 && \text{for } 25^\circ \leq El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angle of arrival above the horizontal plane).

Note that for the pfd level above, polarization and gaseous atmospheric (Recommendation ITU-R SF.1395-0) losses are considered. In addition, body loss is considered for the user equipment pfd level calculation.

Option 1: Automatic transmit power control may be used to increase the e.i.r.p. density in these frequency ranges to compensate for rain attenuation, to the extent that the power flux-density at the surface of the Earth, at the mobile station location, does not exceed the value resulting from use by a HAPS station of an e.i.r.p. meeting the above limits in clear-sky conditions.

Option 2: This study made the assumption that to compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading.

To verify that the pfd produced by HAPS platform does not exceed the proposed pfd mask, the following equation was used:

$$pfd(El) = e.i.r.p. \frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2(El)} \right)$$



where:

*e.i.r.p.*: is the nominal HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);

*d*: is the distance between the HAPS and the ground (elevation angle dependent).

The impact of the gas attenuation, body loss (for user equipment), and polarization loss are not included in the verification formula since it is already taken into account in the pfd mask.

Another study shows that the following pfd mask in dBW/m<sup>2</sup>/MHz, to be applied at the surface of the Earth, should be feasible to protect the IMT-2020 from HAPS systems. And in case that IMT-2020 system is coexisted with HAPS and FS in the same geographical area, 3 dB apportionments should be considered additionally to the pfd mask below to ensure this protection.

$$pfd_{mask\_IMT2020}(\theta) = \begin{cases} 0.6 \times El - 109, & [0^\circ, 10^\circ] \\ -101.8, & [10^\circ, 90^\circ] \end{cases}$$

$\theta$  is the elevation angle in degrees (angles of arrival above the horizontal plane). Note that the attenuations are not considered in the pfd mask above, but in the compliance analysis stage. To verify the compliance of the aggregated interference, from multiple beams of single HAPS platform, with the proposed pfd mask, the following equations are used:

$$pfd_b(\theta) = P^H(b) + G_{tx}^H(\varphi(b)) - FSL - CL - AL$$

$$pfd(\theta) = 10 \log \left( \sum_{b=1}^{b_n} 10^{pfd_b(\theta)/10} \right)$$

where:

$P^H(b)$ : maximum transmit power of beam b generated by the HAPS (dBW/MHz/m<sup>2</sup>);

$\varphi(b)$ : discrimination angle (degrees) at the HAPS between the pointing direction of a HAPS spot beam b and the MS receiver;

$G_{tx}^H(\varphi(b))$ : transmitter antenna pattern gain (dBi) of the HAPS for off-axis angle  $\varphi(b)$ ;

*FSL*: free-space loss (dB) between the MS receiver and the HAPS;

*AL*: atmospheric loss (dB) between the MS receiver and the HAPS, based on Recommendation ITU-R P.619-3;

*CL*: clutter loss (dB) between the MS receiver and the HAPS, based on Recommendation ITU-R P.2108-0;

$b_n$ : number of co-frequency beams.

In addition, assuming a worst-case scenario of main-beam coupling between the two systems, this study proposed that in order to meet the protection of IMT-2020 stations in the HAPS-to-ground link, HAPS e.i.r.p. should be reduced by [11.7] dB, or a protection distance between HAPS nadir and IMT-2020 stations of [49.5] km should be applied. And when considering 3 dB interference apportionment, the transmitter HAPS e.i.r.p. should be reduced by [14.7] dB, or a protection distance between HAPS nadir and IMT-2020 stations of [52.1] km should be applied. Note that section 3.1 of clutter model Recommendation ITU-R P.2108-0 was used. Therefore, the study requires further revision, taking into account section 3.3 of clutter model Recommendation ITU-R P.2108-0 and also the latest parameters available for HAPS system. The conclusions of this study will be amended.

Another study proposes that a separation distance of 63 km (to HAPS nadir) is required to protect the communications of these two systems, when both systems are pointing towards each other in azimuth.

### **HAPS GW/CPE stations transmitting towards the HAPS platform station**

One study concluded that HAPS ground stations (CPE/GW) can share with MS stations (BS and UE) as the maximum required separation distance is less than 400 m for  $p=20\%$  and 500 m for  $P=0.01\%$ .

Another study concluded that the HAPS CPE/GW to IMT-2020, a separation distance of 0.5 km is required to guarantee the coexistence of two systems.

### **MS stations transmitting towards HAPS GW/CPE stations (HAPS platform station to HAPS GW/CPE)**

One study performed two different percentages of time, i.e. 20% and 0.01%, using propagation model Recommendation ITU-R P.452-16. The study showed that for both cases, the impact of MS user equipment emissions into HAPS ground station receivers is in the order of 4-14 km depending on the probability considered compared to 28-75 km between the MS and conventional FS station for the same probabilities. The impact of MS base-station emissions into HAPS ground-station receivers is of the order of 2-17 km depending on the probability considered compared to 30-60 km between the MS and conventional FS station for the same probabilities. In addition, the required separation distance can be further reduced by appropriate site configuration, due to HAPS antenna directivity. Therefore, protection between HAPS ground stations and MS stations can be managed on a case-by-case basis by coordination amongst administrations at national level.

### **MS stations transmitting towards HAPS platform (HAPS GW/CPE to HAPS platform station)**

One study shows that the minimum separation distance of 65 km should be obeyed to avoid the interference and guarantee the quality of service when both systems are pointing towards each other in azimuth.

## **1/1.14/3.3.5.3 Sharing and compatibility study of FSS and HAPS systems operating in the 38-39.5 GHz frequency range**

### **HAPS GW or CPE into FSS earth station receiver**

One study presented a deterministic approach to analyse the interference from HAPS uplink to FSS earth station receivers. For the long-term protection of FSS earth station receiver, a required  $I/N$  value was assumed as  $-15.2$  dB ( $-12.2$  dB with a 3 dB apportionment). The separation distances between HAPS ground terminals and FSS earth stations were calculated. To comply with the required long-term  $I/N$  value, HAPS GW would need to be located at a minimum distance of 4.7 km from FSS earth stations, and HAPS CPEs would need to be located at a minimum distance of 15 km. This study considered the interference from an individual HAPS GW/CPE towards an individual FSS ES. The case of aggregate interference from all co-frequency HAPS GWs and HAPS CPEs was not addressed in this study.

One study presented two analyses. The first analysis provides pfd limits to ensure protection of FSS GSO and non-GSO earth station receivers. A range of pfd limits are provided for FSS earth station receiver  $I/N$  values of  $-6$  dB,  $-10$  dB and  $-12.2$  dB.

**Pfd limits in dBW/m<sup>2</sup>/MHz at the FSS earth station receivers**

FSS <i>I/N</i> values	GSO earth station	non-GSO earth station
<i>I/N</i> = -6 dB	-104.6	-106.8
<i>I/N</i> = -10 dB	-108.6	-110.8
<i>I/N</i> = -12.2 dB	-110.8	-113

Taking the worst-case assumption of an *I/N* value of -12.2 dB, a pfd level of -113 dBW/m<sup>2</sup>/MHz should not be exceeded to protect the FSS earth station receivers. A separation distance of 400 metres between HAPS GW and CPE transmitters and satellite receivers is required when using an *I/N* value of -12.2 dB for the satellite receivers.

The second analysis uses a statistical methodology to determine a separation distance between HAPS GW and CPE transmitters and satellite receivers. This second analysis shows that the separation distance between an FS terminal and an FSS earth station is greater compared to the separation between a HAPS ground terminal and an FSS earth station.

One study provides an assessment of potential interference from HAPS system ground stations using the same process that would be used in assessing interference from an FS station. The study shows that the impact of HAPS ground-station emissions is less than the impact of an FS emitting station into FSS receiving earth station.

The antennas used for both HAPS GW transmitters and FSS stations are directional, therefore, the required separation distance between the two systems can be reduced by appropriate site configuration. Protection by HAPS ground stations of FSS earth stations can be managed on a case-by-case basis by coordination amongst administrations or usual link/planning method and procedures used at national level for conventional FS stations.

One study considers the effects of aggregated interference from HAPS ground terminals towards FSS GSO earth station. The study uses *I/N* values for satellite receivers of -6 dB and -10 dB. The results show that the aggregate *I/N* value will always meet the FSS protection criteria (with and without an allowance for apportionment of 3 dB).

One study shows that 280 m is a sufficient separation distance between a HAPS GW uplink and a FSS earth station receiver. For the HAPS CPE uplinks, the studies show 2.5 km separation distance is sufficient between a CPE and a FSS earth station. These results are based on the use of satellite earth station receiver *I/N* value of -12.2 dB.

### **HAPS platform into FSS earth station receiver**

One study provides pfd limits to ensure protection of FSS GSO and non-GSO earth station receivers in the 38-39.5 GHz band.

To achieve protection of the GSO earth station receiver, the power flux-density over any point of an administration's border should not exceed the following values:

$-169.9 + 1954 \alpha^2$	dB(W/(m <sup>2</sup> /MHz))	for $0 \leq \alpha < 0.136^\circ$
-133.9	dB(W/(m <sup>2</sup> /MHz))	for $0.136^\circ \leq \alpha < 1^\circ$
$-133.9 + 25 \log \alpha$	dB(W/(m <sup>2</sup> /MHz))	for $1^\circ \leq \alpha < 47.9^\circ$
-91.9	dB(W/(m <sup>2</sup> /MHz))	for $47.9^\circ \leq \alpha \leq 180^\circ$

where  $\alpha$  is the minimum angle at the border between the line to the HAPS platform and the lines to the GSO arc in degrees.

To verify the compliance with the proposed pfd mask the following equation should be used:

$$pfd_{I/N} = e.i.r.p. - 10 \log_{10}(4\pi d^2) - Att_{gaz}$$

where:

- d*: distance between the HAPS and the GSO FSS earth station (m);
- Att<sub>gaz</sub>*: attenuation to atmospheric gazes on the HAPS to GSO FSS earth station path (dB);
- pfd<sub>I/N</sub>*: required pfd at the GSO FSS earth station location to meet the FSS protection criteria (dB(W/(m<sup>2</sup> · MHz)));
- e.i.r.p.*: e.i.r.p. spectral density in the direction of the GSO FSS earth station (dBW/MHz) under clear-sky conditions to the nominal HAPS platform e.i.r.p. spectral density in the direction of the GSO FSS earth station.

HAPS technology can also coexist with non-GSO FSS in the 38-39.5 GHz band when taking into account the statistics of the non-GSO FSS earth station pointing directions relative to the HAPS platform, and on the tracking strategy of the satellites by the non-GSO FSS earth stations.

For the purpose of protecting non-GSO FSS earth stations from co-channel interference, coordination of a transmitting HAPS station should be undertaken when the distance between the HAPS nadir and any point of an administration's border is less than 100 km.

One deterministic study provides a minimum coupling loss analysis based on a single HAPS platform and FSS GSO/non-GSO earth station pair. The analysis assumes that the HAPS transmitter is pointing directly towards the FSS earth station receiver in azimuth. Note, the FSS earth station receive antenna (both GSO and non-GSO) is pointing with maximum gain towards the HAPS platform. The required separation distance between HAPS nadir and FSS earth station receiver (GSO and non-GSO) was calculated based on the FSS threshold *I/N* values of -6, dB, -10 dB, and -12.2 dB).

For the GW downlinks from the HAPS platform, the studies show that for a satellite earth station receiver with an *I/N* value of -12.2 dB, the required separation distance from the HAPS nadir is 60 km for both GSO and non-GSO satellite earth station receivers.

For the CPE downlinks from the HAPS platform, the studies show that for a satellite earth station receiver with an *I/N* value of -12.2 dB, the required separation distance from the HAPS nadir is 74 km for both GSO and non-GSO satellite earth station receivers.

### **FSS satellite into HAPS platform receiver**

One study provides an analysis to determine whether the *I/N* value at the HAPS platform receiver is exceeded by emissions from FSS (GSO and non-GSO) satellites. The calculated *I/N* value at the platform receiver does not exceed -27.92 dB and the calculated *I/N* value at the CPE receiver does not exceed -42.24 dB.

The analysis shows that the *I/N* value is below the HAPS protection criteria of *I/N* = -6 dB for worst-case analysis.

One study shows that HAPS platform receivers will not be impacted and can accept interference from FSS downlink that are compliant with Table 21-4 of RR Article 21.

A further study calculates the *I/N* value to be below a threshold *I/N* value of -12.2 dB of the HAPS platform receiver for both non-GSO and GSO satellite cases.

### **FSS satellite into HAPS GW or CPE receiver**

One study shows that HAPS receiving ground stations can coexist with FSS space stations emissions in the 38-39.5 GHz band given the percentage of HAPS service area where there could be potentially a problem and given mitigation techniques that could be implemented by HAPS.

One study, using an  $I/N$  value of  $-12.2$  dB for the HAPS receiver shows the following:

For the FSS GSO and non-GSO satellite transmitting to HAPS GW and CPE, at worst case:

- The  $I/N$  threshold is exceeded for any elevation higher than 85.5 degrees.
- An off-axis angular separation of 2.4 degrees between the satellite beam and the HAPS beam is required in order to satisfy the threshold at the HAPS receiver.

This analysis assumes there is no azimuth off-axis for the HAPS link and the FSS link.

By employing appropriate mitigation, HAPS GW or CPE receivers can coexist with FSS transmissions that are at the RR Article 21 pfd levels.

#### **1/1.14/3.3.5.4 Compatibility study of SRS in the adjacent band 37-38 GHz frequency range and HAPS systems operating in 38-39.5 GHz frequency range**

##### **Ground-to-HAPS and HAPS-to-ground**

The studies show that the protection of sensitive receiving earth stations operating in the SRS in the band 37-38 GHz may be achieved through a combination of separation distance and attenuation of unwanted emissions for HAPS stations operating in the band 38-39.5 GHz.

An unwanted emission pfd mask to be applied at the SRS earth station location at the relevant earth station antenna height has also been proposed to address the protection of SRS in the adjacent band:

$$pfd \left( \frac{dBW}{m^2 * Hz} \right) = \begin{cases} -198 + 21 * \log_{10} (5 - \phi) & 0 \leq \phi < 5 - \theta_1 \\ -250 & 5 - \theta_1 \leq \phi \leq 90 \end{cases}$$

where the corner angle  $\theta_1 = 10^{-52/21} \approx 0.003$  deg and  $\phi$  is the interference arrival angle above the horizontal plane. The interference pfd should be calculated using propagation losses for  $p = 0.001\%$ .

#### **1/1.14/3.3.6 Sharing and compatibility studies of HAPS systems in the 47.2-47.5 GHz and 47.9-48.2 GHz frequency ranges**

Preliminary studies between HAPS systems and MS in the 47.2-47.5 GHz and 47.9-48.2 GHz frequency ranges have been performed. These analyses need to be reviewed taking into account the latest parameters available for HAPS systems. The conclusions of the studies will be amended correspondingly.

### **1/1.14/4 Methods to satisfy the agenda item**

With respect to methods to satisfy the agenda item, as a first step generic methods are briefly described and as a second step, when considering the band-by-band approach, the relevant methods that could be considered as applicable to a given frequency band are indicated.

The following methods are considered under this agenda item and may be applied to potential candidate frequency bands. In the options below, changes to existing designations to HAPS are proposed on a global basis and do not prejudice the consideration of these options on a regional basis (according to the definition of Regions in the Radio Regulations) or country footnotes, where applicable. These are:

**Method A** – No change

The existing provisions in the Radio Regulation remain unchanged in the corresponding frequency band.

**Method B** – Designation of bands, in accordance with Resolution **160 (WRC-15)** with options

**Method B1** – Revision of the regulatory provisions for HAPS in the FS with a primary status in bands already designated for HAPS

This may include, e.g. global or regional designation for HAPS, limitations regarding link directions, and inclusion of the technical conditions of operation of HAPS systems for the protection of other services. This could be achieved by new or revised footnotes to the Table of Frequency Allocations, and new or revised associated Resolutions.

**Method B2** – Add new designation(s) for HAPS in bands already allocated to the FS with a primary status

This may include, e.g. global or regional designation for HAPS, limitations regarding link directions, and inclusion of the technical conditions of operation of HAPS systems for the protection of other services. This could be achieved by new or revised footnotes to the Table of Frequency Allocations, and new or revised associated Resolutions.

**Method B3** – Add a primary allocation to the FS and a new designation for HAPS in the band 24.25-25.25 GHz (Region 2) not already allocated to the FS

This may include, primary allocation for FS in Region 2 and designation for HAPS in that Region, together with conditions e.g. limitations regarding link directions, and inclusion of the technical conditions of operation of HAPS systems for the protection of other services. This could be achieved by new or revised footnotes to the Table of Frequency Allocations, and new or revised associated Resolutions.

**Method C** – Suppress the existing HAPS designation, pursuant to *resolves* 3 of Resolution **160 (WRC-15)**

An overview of methods and relevant options currently considered in this CPM text under the agenda item is provided in the table below:

TABLE 1/1.14/4

Summary of methods to satisfy the agenda item and associated frequency bands

Section 1/1.14/	Bands	Methods and options		
		Method A	Method B	Method C
4.1/5.1	6 440- 6 520 MHz	√	B1	√
4.2/5.2	6 560- 6 640 MHz	√	Not proposed	√
4.3/5.3	21.4-22 GHz (R2 only)	√	B2	N/A
4.4/5.4	24.25-25.25 GHz (R2 only)	√	B3	N/A
4.5/5.5	25.25-27.5 GHz (R2 only)	√	B2	N/A
4.6/5.6	27.9-28.2 GHz	√	B1	√
4.7/5.7	31-31.3 GHz	√	B1	√
4.8/5.8	38-39.5 GHz	√	B2	N/A
4.9/5.9	47.2-47.5 GHz / 47.9-48.2 GHz	√	B1	√

#### **1/1.14/4.1 Frequency bands 6 440–6 520 MHz**

Methods A, B1 and C are applicable (see Methods 1A, 1B1 and 1C in Section 1/1.14/5.1).

##### **In case Method A is applied**

There would be no change to the HAPS designation in the 6 440-6 520 MHz band.

##### **In case Method B1 is applied**

**Option 1:** Designate the band 6 440-6 520 MHz worldwide for use by HAPS and limited to HAPS-to-ground direction via a new footnote RR No. **5.A114[-6400B1-O1]** together with a new Resolution [**A114-6400B1-O1**] (**WRC-19**) that will incorporate all necessary provisions to protect the existing services and taking into account RR No. **5.458**. To this effect the existing footnote RR No. **5.457** and existing Resolution **150 (WRC-12)** need to be amended accordingly.

**Option 2:** Designate the band 6 440-6 520 MHz worldwide for use by HAPS stations and limited to HAPS-to-ground direction, subject to the provisions of draft new Resolution [**A114-6400B1-O2**] (**WRC-19**), to protect existing primary services and taking into account RR No. **5.458**; including that HAPS shall not cause harmful interference to, nor claim protection from one, several or all existing primary services.

##### **In case Method C is applied**

The current designation in RR No. **5.457** and Resolution **150 (WRC-12)** would be suppressed, since the designation may not be technically feasible for HAPS on the condition that those affected countries agree, where applicable.

#### **1/1.14/4.2 Frequency band 6 560–6 640 MHz**

Methods A and C are applicable (see Methods 2A and 2C in Section 1/1.14/5.2 below).

##### **In case Method A is applied**

The band 6 560-6 640 MHz is not under consideration for HAPS; therefore, no modifications are required. The existing HAPS designation will remain unchanged, limited to the ground-to-HAPs direction, in accordance with Resolution **150 (WRC-12)**.

##### **In case Method C is applied**

The current designation to HAPS in the band 6 560- 6 640 MHz in RR No. **5.457** and Resolution **150 (WRC-12)** would be suppressed.

#### **1/1.14/4.3 Frequency band 21.4-22 GHz for Region 2 only**

Methods A and B2 are applicable (see Methods 3A and 3B2 in Section 1/1.14/5.3).

##### **In case Method A is applied**

There would be no change to the frequency band 21.4-22 GHz.

##### **In case Method B2 is applied**

**Option 1:** Designate in a new footnote RR No. **5.B114[-21B2-O1]** the band 21.4-22 GHz in Region 2 for use by HAPS stations in the HAPS-to-ground direction. Such use is proposed to be subject to the provisions of a new Resolution [**B114-21B2-O1**] (**WRC-19**) that will incorporate all necessary provisions to protect existing services.

**Option 2:** Designate in a new footnote RR No. **5.A114[-21B2-O2]** the band 21.4-22 GHz in Region 2 for use by HAPS stations, subject to the provisions of draft new Resolution

**[B114-21B2-O2] (WRC-19)**, containing necessary provisions to protect existing primary services; including that HAPS shall not cause harmful interference to, nor claim protection from one, several or all existing primary services.

#### **1/1.14/4.4 Frequency band 24.25-25.25 GHz for Region 2**

Method A and B3 are applicable (see Methods 4A and 4B3 in Section 1/1.14/5.4 below).

##### **In case Method A is applied**

There would be no change to the frequency band 24.25-25.25 GHz.

##### **In case Method B3 is applied**

**Option 1:** Allocate in Region 2 the band 24.25-25.25 GHz to the fixed service for the operation of HAPS systems. Designate the bands 24.25-25.25 GHz in Region 2 for use by HAPS in the HAPS-to-ground direction in a new footnote RR No. **5.C114[-24B3-O1]**. Such use is proposed to be subject to the provisions of a new Resolution **[C114-24B3-O1] (WRC-19)** that will incorporate all necessary provisions to protect existing services.

**Option 2:** Allocate in Region 2 the band 24.25-25.25 GHz to the fixed service for the operation of HAPS systems. Designate the bands 24.25-25.25 GHz in Region 2 for use by HAPS in a new footnote RR No. **5.C114[-24B3-O2]**. Such use is proposed to be subject to the provisions of a new Resolution **[C114-24B3-O2] (WRC-19)** that will incorporate all necessary provisions to protect existing services.

#### **1/1.14/4.5 Frequency band 25.25-27.5 GHz for Region 2**

Method A and B2 are applicable (see Methods 5A and 5B2 in Section 1/1.14/5.5 below).

##### **In case Method A is applied**

There would be no change to the frequency band 25.25-27.5 GHz.

##### **In case Method B2 is applied**

**Option 1:** Designate the bands 27-27.5 GHz in Region 2 for use by HAPS in the HAPS-to-ground direction in a new footnote RR No. **5.D114[-26B2-O1]**. Such use is proposed to be subject to the provisions of a new Resolution **[C114-24B3-O1] (WRC-19)** that will incorporate all necessary provisions to protect existing services.

**Option 2:** Designate the bands 25.25-27.5 GHz in Region 2 for use by HAPS in a new footnote RR No. **5.D114[-26B2-O2]**. Such use is proposed to be subject to the provisions of a new Resolution **[C114-24B3-O2] (WRC-19)** that will incorporate all necessary provisions to protect existing services and taking into account RR No. **5.536A**.

**Option 3:** Designate the band 25.25-27.5 GHz in Region 2 for use by HAPS stations, subject to the provisions of new Resolution **[D114-26B2-O3] (WRC-19)**, containing necessary provisions to protect existing services and taking into account RR No. **5.536A**. HAPS shall not cause harmful interference to, nor claim protection from one, several or all existing services.

#### **1/1.14/4.6 Frequency band 27.9-28.2 GHz**

Methods A, B1 and C are applicable (see Methods 6A, 6B1 and 6C in Section 1/1.14/5.6 below).

##### **In case Method A is applied**

The current designation would remain for fixed HAPS links as provided in RR No. **5.537A**.



### **In case Method B1 is applied**

**Option 1:** Designate the band 27.9-28.2 GHz worldwide for use by HAPS and limited to HAPS-to-ground direction through a new footnote RR No. **5.E114[-28B1-O1]**. A new Resolution **[E114-28+31B1-O1] (WRC-19)** will incorporate all necessary provisions to protect the existing services. Suppress RR No. **5.537A** and modify Resolution **145 (Rev.WRC-12)** accordingly.

**Option 2:** Designate the band 27.9-28.2 GHz worldwide for use by HAPS and limited to HAPS-to-ground direction through a new footnote RR No. **5.E114[-28B1-O2]**. Develop a new Resolution **[E114-28+31B1-O2] (WRC-19)** that will incorporate all necessary provisions to protect the existing services, maintaining that HAPS shall not cause harmful interference to, nor claim protection from one, several or all existing services. Suppress RR No. **5.537A** and Resolution **145 (Rev.WRC-12)** accordingly.

### **In case Method C is applied**

The current designation in RR No. **5.537A** and Resolution **145 (Rev.WRC-12)** would be suppressed.

### **1/1.14/4.7 Frequency band 31-31.3 GHz**

Methods A, B1 and C are applicable (see Methods 7A, 7B1 and 7C in Section 1/1.14/5.7 below).

### **In case Method A is applied**

There would be no change to the HAPS designation in the 31-31.3 GHz band. The current designation would remain for fixed HAPS links as provided in RR No. **5.543A**.

### **In case Method B1 is applied**

**Option 1a:** Designate worldwide the band 31–31.3 GHz for use by HAPS in the ground-to-HAPS direction through an new footnote RR No. **5.F114[-31B1-O1A]**. Such use is proposed to be subject to the provisions of a new Resolution **[E114-28+31B1-O1] (WRC-19)** and/or Resolution **145 (Rev.WRC-12)** that will be amended to incorporate all necessary provisions to protect the existing services.

**Option 1b:** Designate worldwide the band 31–31.3 GHz for use by HAPS in the HAPS-to-ground direction through an new footnote RR No. **5.F114[-31B1-O1B]**. Such use is proposed to be subject to the provisions of a new Resolution **[E114-28+31B1-O1] (WRC-19)** and/or Resolution **145 (Rev.WRC-12)** that will be amended to incorporate all necessary provisions to protect the existing services.

**Option 2:** Designate the band 31-31.3 GHz worldwide through a new footnote RR No. **5.F114[-31B1-O2]** for use by HAPS in the HAPS-to-ground direction. This designation will be subject to the provisions of draft new Resolution **[E114-28+31B1-O2] (WRC-19)** to incorporate all necessary provisions to protect existing primary services; maintaining that HAPS shall not cause harmful interference to, nor claim protection from one, several or all existing services.

### **In case Method C is applied**

The current designation in RR No. **5.543A** and Resolution **145 (Rev.WRC-12)** would be suppressed.

### **1/1.14/4.8 Frequency band 38-39.5 GHz**

Method A and B2 are applicable (see Methods 8A and 8B2 in Section 1/1.14/5.8 below).

### **In case Method A is applied**

There would be no change to the 38-39.5 GHz frequency band.

### **In case Method B2 is applied**

**Option 1a:** Designate the band 38-39.5 GHz through a new footnote RR No. **5.G114[-38B2-O1A]** for use by HAPS in the ground-to-HAPS direction on a worldwide basis. Such use is proposed to be subject to the provisions of a new Resolution [**G114-38B2-O1A+B**] (**WRC-19**) that will incorporate all necessary provisions to protect other services.

**Option 1b:** Designate the band 38-39.5 GHz through a new footnote RR No. **5.G114[-38B2-O1B]** for use by HAPS in the HAPS-to-ground direction on a worldwide basis. Such use is proposed to be subject to the provisions of a new Resolution [**G114-38B2-O1A+B**] (**WRC-19**) that will incorporate all necessary provisions to protect other services.

**Option 1c:** Designate the band 38-39.5 GHz through a new footnote RR No. **5.G114[-38B2-O1C]** for use by HAPS in both HAPS-to-ground and ground-to-HAPS directions. Such use is proposed to be subject to the provisions of a new Resolution [**G114-38B2-O1C**] (**WRC-19**) that will incorporate all necessary provisions to protect other services.

**Option 2:** Designate the band 38-39.5 GHz through a new footnote RR No **5.G114[-38B2-O2]** for use by HAPS stations in the ground-to-HAPS direction on a worldwide basis. This designation would be subject to the provisions of draft new Resolution [**G114-38B2-O2**] (**WRC-19**) containing necessary provisions to protect co-primary services. HAPS shall not cause harmful interference to, nor claim protection from one, several or all existing services.

### **1/1.14/4.9 Frequency band 47.2-47.5 GHz and 47.9-48.2 GHz**

Methods A, B1 and C are applicable (see Methods 9A, 9B1 and 9C in Section 1/1.14/5.9 below).

### **In case Method A is applied**

There would be no change to the HAPS designations in the 47.2-47.5 GHz and 47.9-48.2 GHz bands.

### **In case Method B1 is applied**

The use of the bands by HAPS is proposed to be subject to the provisions of Resolution **122 (WRC-07)** slightly amended to review the protection of existing services.

### **In case Method C is applied**

The current designation in RR No. **5.552A** would be suppressed together with Resolution **122 (WRC-07)**.

### **1/1.14/5 Regulatory and procedural considerations**

CPM19-2 is invited to carefully examine regulatory provisions contained in Section 5 to verify its consistency with:

- a) corresponding method(s) contained in section 4;
- b) results of studies in section 3;
- c) appropriateness of language and terms used taking into account past practices of previous WRC.

In the regulatory examples below, references to frequency bands in the fixed service being “designated” for use by high-altitude platform stations are intended to indicate that a particular

frequency band would be considered to be specifically identified in RR Article 5 for transmissions to or from high-altitude platform stations for purposes of RR No. 4.23.

For the purpose of Method A in the examples below “NOC” would be an affirmative proposal to WRC for a no change in the Radio Regulations. It is therefore expected that the difference between “NOC” and “NOC” be clearly described in the advance copy of the Director’s Report to the WRC which would be submitted to the CPM19-2.

In the example Resolutions contained below, some elements of compliance and administrative mechanisms regarding protection levels are not included in the examples and need to be developed for proposals to the CPM19-2 and WRC-19.

*NOTE: The following elements will need further examination to determine in which Resolution they should/may be included:*

- *The notifying administration of HAPS / the administration responsible for the operation of HAPS shall seek explicit agreement of any administration the territory of which is partially or wholly included in the operation of HAPS when serving the territory of that administration;*
- *An administration may, if it so decides, at any time during or after any stage inform the administration responsible for the operation of HAPS that its objection to being included in the service area of any assignments even if this assignment has been recorded in the MIFR;*
- *In order to satisfy mandatory conditions that HAPS not causing harmful interference to and/or not claiming protection from certain existing services (assignments/stations) the responsible administration for the operation of HAPS shall submit a firm commitment to the Bureau prior to the operation of HAPS assignment undertaking to take immediate actions to practically satisfy these conditions;*
- *In order to comply with certain technical level(s) which may not be verifiable or difficult to verify, the administration responsible for the operation of HAPS shall also submit a firm commitment to the Bureau undertaking the obligation that it comply and meet the corresponding technical levels.*

#### **1/1.14/5.1 Frequency band 6 440–6 520 MHz**

##### **1/1.14/5.1.1 For Method 1A**

**NOC**

## **ARTICLE 5**

### **Frequency allocations**

**NOC**

#### **RESOLUTION 150 (WRC-12)**

### **Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links for high-altitude platform stations in the fixed service**

**1/1.14/5.1.2 For Method 1B**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**5 570-6 700 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>5 925-6 700</b>	FIXED MOD 5.457 ADD 5.A114 FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B MOBILE 5.457C 5.149 5.440 5.458	

**1/1.14/5.1.2.1 For Method 1B1, Option 1**

**ADD**

**5.A114[-6400B1-O1]** The allocation to the fixed service in the band 6 440-6 520 MHz is designated for worldwide use by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the operation in the HAPS-to-ground direction and is subject to the provisions of Resolution [A114-6400B1-O1] (WRC-19). (WRC-19)

**MOD**

**5.457** In Australia, Burkina Faso, Cote d'Ivoire, Mali and Nigeria, the allocation to the fixed service in the band 6 560-6 640 MHz (ground-to-HAPS direction) may also be used by gateway links for high-altitude platform stations (HAPS) within the territory of these countries. Such use is limited to operation in HAPS gateway links and shall not cause harmful interference to, and shall not claim protection from, existing services, and shall be in compliance with Resolution **150 (Rev.WRC-19)**. Existing services shall not be constrained in future development by HAPS gateway links. The use of HAPS gateway links in these bands requires explicit agreement with other administrations whose territories are located within 1 000 kilometres from the border of an administration intending to use the HAPS gateway links. (WRC-19)

*Note: Under this option, if the band 6 440-6 520 MHz is modified, there would need to be consequential modifications to Resolution 150 (WRC-12) in implementation of this option under Method B1.*

### 1/1.14/5.1.2.2 For Method 1B1, Option 2

**ADD**

**5.A114[-6400B1-O2]** The allocation to the fixed service in the 6 440-6 520 MHz band is designated for worldwide use by administrations wishing to implement high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS subject to the provisions of Resolution [A114-6400B1-O2] (WRC-19). (WRC-19)

### 1/1.14/5.1.2.3 Example Resolution for Method 1B1 – Option 1

**ADD**

DRAFT NEW RESOLUTION [A114-6400B1-O1] (WRC-19)

#### **Use of the bands 6 440-6 520 MHz by high-altitude platform stations in the fixed service**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

Note: No text has been developed, it may be proposed in contributions to CPM19-2

*recognizing*

Note: No text has been developed, it may be proposed in contributions to CPM19-2

*resolves*

1 that for the purpose of protecting the fixed service systems in neighbouring administrations in the band 6 440-6 520 MHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, without the explicit agreement of the affected administration:

$$\begin{aligned} pfd_{mask}(El) &= -160 && \text{for } 0^\circ \leq El < 6^\circ \\ pfd_{mask}(El) &= 3.75 \times El - 182.5 && \text{for } 6^\circ \leq El < 10^\circ \\ pfd_{mask}(El) &= -152.5 + 25.5 \times \log_{10}(El - 8) && \text{for } 10^\circ \leq El < 56^\circ \\ pfd_{mask}(El) &= -109.63 && \text{for } 56^\circ \leq El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

To verify that the pfd produced by a HAPS platform does not exceed the above pfd mask, the following equation shall be used:

$$pfd(El) = e.i.r.p. \frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2(El)} \right)$$

where:

*e.i.r.p.*: is the maximum HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);

*d*: is the distance in metres between the HAPS and the ground (elevation angle dependent);

*pdf(El)*: is the power flux-density at the Earth's surface per HAPS platform station in dBW/m<sup>2</sup>/MHz;

2 that for the purpose of protecting the mobile service systems in neighbouring administrations in the band 6 440-6 520 MHz, the power flux-density limit at the surface of the Earth in neighbouring administrations per HAPS platform station shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, without the explicit agreement of the affected administration:

$$pdf_{max}(El) = (0.35 \times El - 120) \text{ for } El \leq 40^\circ$$

$$pdf_{max}(El) = -106 \text{ for } 40^\circ < El \leq 90^\circ$$

where *El* is the elevation angle in degrees (angles of arrival above the horizontal plane).

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pdf(El) = e.i.r.p.\frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2(El)} \right)$$

where:

*e.i.r.p.*: is the maximum HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);

*d*: is the distance in metres between the HAPS and the ground (elevation angle dependent);

*pdf(El)*: is the power flux-density at the Earth's surface per HAPS platform station in dBW/m<sup>2</sup>/MHz;

3 that for the purpose of protecting fixed-satellite service space station receivers in the band 6 440-6 520 MHz, the e.i.r.p. per HAPS platform transmitter shall be limited to -17.8 dBW/MHz for off-nadir angles higher than 95°;

4 that for the purpose of protecting EESS (passive) operations over oceans, the e.i.r.p. of HAPS platforms operating over the oceans or over the land at a distance lower than 29 km from a coast line (distance between the sub-HAPS point and the coast line) shall be limited to -34.9 dBW/200 MHz for off-nadir angle higher than 125°,

*instructs the Director of the Radiocommunication Bureau*

to take all necessary measures to implement this Resolution.

#### **1/1.14/5.1.2.4 Example Resolution for Method 1B1 – Option 2**

Note: the text of the draft new Resolution [A114-6400B1-O2] (WRC-19) for Method 1B1 – Option 2 has not been developed yet and may be proposed in contributions to CPM19-2.

1/1.14/5.1.3 For Method 1C

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

5 570-6 700 MHz

Allocation to services		
Region 1	Region 2	Region 3
5 925-6 700	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.149 5.440 5.458	5.457A 5.457B

SUP

5.457

SUP

### RESOLUTION 150 (WRC-12)

#### Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links for high-altitude platform stations in the fixed service

*Note: If one of the two bands in RR No. 5.457 and Resolution 150 (WRC-12) is suppressed and the other is maintained, there would need to be consequential modifications to both the footnote and the resolution in implementation of Method C.*

**1/1.14/5.2 Frequency band 6 560–6 640 MHz**

**1/1.14/5.2.1 For Method 2A**

**NOC**

**ARTICLE 5**

**Frequency allocations**

**NOC**

**RESOLUTION 150 (WRC-12)**

**Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links  
for high-altitude platform stations in the fixed service**

**1/1.14/5.2.2 For Method 2C**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations  
(See No. 2.1)**

**MOD**

**5 570-6 700 MHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>5 925-6 700</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B MOBILE 5.457C 5.149 5.440 5.458	

**SUP**

**5.457**



**SUP**

**RESOLUTION 150 (WRC-12)**

**Use of the bands 6 440-6 520 MHz and 6 560-6 640 MHz by gateway links  
for high-altitude platform stations in the fixed service**

*Note: If one of the two bands in No. 5.457 and Resolution 150 (WRC-12) is suppressed and the other is maintained, there would need to be consequential modifications to both the footnote and the resolution in implementation of Method C.*

**1/1.14/5.3 Frequency band 21.4-22 GHz for Region 2 only**

**1/1.14/5.3.1 For Method 3A**

**NOC**

**ARTICLE 5**

**Frequency allocations**

**1/1.14/5.3.2 For Method 3B2**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations  
(See No. 2.1)**

**MOD**

**18.4-22 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>21.4-22</b> FIXED MOBILE BROADCASTING-SATELLITE 5.208B 5.530A 5.530B 5.530D	<b>21.4-22</b> FIXED ADD 5.B114 MOBILE  5.530A	<b>21.4-22</b> FIXED MOBILE BROADCASTING-SATELLITE 5.208B 5.530A 5.530B 5.530D 5.531

### 1/1.14/5.3.2.1 For Method 3B2, Option 1

#### ADD

**5.B114[-21B2-O1]** The allocation to the fixed service in the band 21.4-22 GHz is designated for use in Region 2 by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction, and is subject to the provisions of Resolution **[B114-21B2-O1] (WRC-19)**. (WRC-19)

### 1/1.14/5.3.2.2 For Method 3B2, Option 2

#### ADD

**5.B114[-21B2-O2]** The allocation to the fixed service in the 21.4-22 GHz band is designated for use in Region 2 by administrations wishing to implement high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS. The use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[B114-21B2-O2] (WRC-19)**. (WRC-19)

### 1/1.14/5.3.2.3 Example Resolution for Method 3B2 – Option 1

#### ADD

## DRAFT NEW RESOLUTION [B114-21B2-O1] (WRC-19)

### Use of the bands 21.4-22 GHz by high-altitude platform stations in the fixed service for Region 2

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

Note: No text has been developed, it may be proposed in contributions to CPM19-2

*recognizing*

Note: No text has been developed, it may be proposed in contributions to CPM19-2

*resolves*

1 that for the purpose of protecting fixed service systems in neighbouring administrations in the band 21.4-22 GHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$pfd_{max}(El) = 0.7 \times El - 135 \text{ for } 0 \leq El < 10^\circ$$

$$pfd_{max}(El) = 2.4 \times El - 152 \text{ for } 10^\circ \leq El < 20^\circ$$

$$pfd_{max}(El) = 0.45 \times El - 113 \text{ for } 20^\circ \leq El < 60^\circ$$

$$pfd_{max}(El) = -86 \text{ for } 60^\circ \leq El \leq 90^\circ$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading up to a maximum of 20 dB.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = e.i.r.p. \frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{1}{4\pi d^2(El)} \right)$$

where:

$d$ : distance in metres between the HAPS and the ground (elevation angle dependent);

$e.i.r.p.$ : HAPS platform nominal e.i.r.p. spectral density in dBW/MHz at a specific elevation angle;

$pfd(El)$ : is the power flux-density at the Earth's surface per HAPS platform station in dBW/m<sup>2</sup>/MHz;

2 that in order to ensure the protection of EESS (passive), the e.i.r.p. per HAPS platform, in the bands 21.2-21.4 GHz and 22.21-22.5 GHz, shall not exceed:

$$e.i.r.p. = (-0.76El - 9.5) \text{ dBW}/100 \text{ MHz} \quad \text{for } -4.53^\circ \leq El < 35.5^\circ$$

$$e.i.r.p. = -36.5 \text{ dBW}/100 \text{ MHz} \quad \text{for } 35.5^\circ \leq El < 90^\circ$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane);

3 that in order to ensure the protection of the radio astronomy service, the unwanted emission pfd produced by HAPS platform downlink transmissions shall not exceed  $-176 \text{ dBW}/\text{m}^2/290 \text{ MHz}$  for continuum observations, and  $-192 \text{ dBW}/\text{m}^2/250 \text{ kHz}$  for spectral line observations in the band 22.21-22.5 GHz at an RAS station location at a height of 50 m. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model;

4 that *resolves* 3 above applies at any radio astronomy station that was in operation prior to 22 November 2019; and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS,

*instructs the Director of the Radiocommunication Bureau*

to take all necessary measures to implement this Resolution.

**1/1.14/5.3.2.4 Example Resolution for Method 3B2 – Option 2**

**ADD**

**DRAFT NEW RESOLUTION [B114-21B2-O2] (WRC-19)**

**Use of the bands 21.4-22 GHz by high-altitude platform stations in the fixed service for Region 2**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

*recognizing*

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

*resolves*

1 that in Region 2 the use of high-altitude platform stations (HAPS) within the fixed-service allocation within the 21.4-22 GHz band shall not cause harmful interference to, nor claim protection from, other stations of services operating in conformity with the Radio Regulations in accordance with the Table of Frequency Allocations of Article 5 (including passive operations in the bands 21.2-21.4 GHz and 22.21-22.5 GHz), and, further, that the development of these other services shall proceed without constraints by HAPS operating pursuant to this Resolution;

2 that for the purpose of protecting fixed service systems in neighbouring administrations in the band 21.4-22 GHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$\begin{aligned} pfd_{max}(El) &= 0.7 \times El - 135 \text{ for } 0 \leq El < 10^\circ \\ pfd_{max}(El) &= 2.4 \times El - 152 \text{ for } 10^\circ \leq El < 20^\circ \\ pfd_{max}(El) &= 0.45 \times El - 113 \text{ for } 20^\circ \leq El < 60^\circ \\ pfd_{max}(El) &= -86 \text{ for } 60^\circ \leq El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

This pfd mask already takes into account the impact of attenuation due to atmospheric gas. Automatic transmit power control may be used to increase the e.i.r.p. density in these frequency ranges to compensate for rain attenuation, to the extent that the power flux-density at the fixed service station does not exceed the value resulting from use by a HAPS station of an e.i.r.p. meeting the above limits in clear-sky conditions;

3 that in order to ensure the protection of EESS (passive) in the 21.2-21.4 GHz band, the total unwanted e.i.r.p. spectral density of each HAPS platform transmissions shall be limited to [-36.5] dB(W/100 MHz) for any off-nadir angle greater than [120] degrees;

4 that in order to ensure the protection of the EESS (passive) service, the total out-of-band e.i.r.p. spectral density of transmissions from HAPS ground stations, shall be limited to [-xx] dB(W/100 MHz) within the band 21.2-21.4 GHz;

5 that in order to ensure the protection of the radio astronomy service, the unwanted emission pfd produced by HAPS CPE and gateway uplink transmissions shall not exceed  $-146 \text{ dBW/m}^2/290 \text{ MHz}$  for continuum observations, and  $-162 \text{ dBW/m}^2/250 \text{ kHz}$  for spectral line observations in the band 22.21-22.5 GHz at an RAS station location at a height of 50 m, and that these pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model;

6 that in order to ensure the protection of the radio astronomy service, the unwanted emission pfd produced by HAPS platform downlink transmissions shall not exceed  $-176 \text{ dBW/m}^2/290 \text{ MHz}$  for continuum observations, and  $-192 \text{ dBW/m}^2/250 \text{ kHz}$  for spectral line observations in the band 22.21-22.5 GHz at an RAS station location at a height of 50 m, and that these pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model;

7 that *resolves* 5 and 6 above apply at any radio astronomy station that was in operation prior to 22 November 2019 and that has been notified to the Bureau in the band 22.21-22.5 GHz before 22 May 2020; and that radio astronomy stations notified after this date may seek an agreement with administrations that have notified HAPS;

8 that in order to ensure the protection of EESS (passive) services, the ground-to-HAPS level of unwanted equivalent isotropically radiated power (e.i.r.p.) in the frequency band 22.21-22.5 GHz shall be limited to  $[-32.6] \text{ dB(W/100 MHz)}$ ; and that the level of unwanted equivalent isotropically radiated power (e.i.r.p.) from a HAPS platform shall be limited to  $[-42.1 \text{ dB(W/100 MHz)}$ ] for off-nadir angle higher than  $[41]$  degrees;

9 those administrations in Region 2 which intend to implement systems using HAPS in the fixed service in these bands shall seek explicit agreement of concerned administrations with regard to their stations of services operating in accordance with the Table of Frequency Allocations of Article 5 to ensure that the conditions in *resolves* 2-8 are met,

*instructs the Director of the Radiocommunication Bureau*

to take all necessary measures to implement this Resolution.

#### **1/1.14/5.4 Frequency band 24.25-25.25 GHz for Region 2 only**

##### **1/1.14/5.4.1 For Method 4A**

**NOC**

## **ARTICLE 5**

### **Frequency allocations**

##### **1/1.14/5.4.2 For Method 4B3**

A new allocation to the fixed service in Region 2 is required as shown in the MOD table entry below:

ARTICLE 5

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**22-24.75 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>24.25-24.45</b> FIXED	<b>24.25-24.45</b> <u>FIXED</u> ADD 5.C114 RADIONAVIGATION	<b>24.25-24.45</b> RADIONAVIGATION FIXED MOBILE
<b>24.45-24.65</b> FIXED INTER-SATELLITE	<b>24.45-24.65</b> <u>FIXED</u> ADD 5.C114 INTER-SATELLITE RADIONAVIGATION  5.533	<b>24.45-24.65</b> FIXED INTER-SATELLITE MOBILE RADIONAVIGATION 5.533
<b>24.65-24.75</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE	<b>24.65-24.75</b> <u>FIXED</u> ADD 5.C114 INTER-SATELLITE RADIOLOCATION- SATELLITE (Earth-to-space)	<b>24.65-24.75</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE MOBILE 5.533

**MOD**

**24.75-29.9 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>24.75-25.25</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.532B	<b>24.75-25.25</b> <u>FIXED</u> ADD 5.C114 FIXED-SATELLITE (Earth-to-space) 5.535	<b>24.75-25.25</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.535 MOBILE

**1/1.14/5.4.2.1 Method 4B3, Option 1**

**ADD**

**5.C114[-24B3-O1]** The allocation to the fixed service in the band 24.25-25.25 GHz is designated for use in Region 2 by high-altitude platform stations (HAPS). Such use of the fixed-

service allocation by HAPS is limited to the HAPS-to-ground direction, and is subject to the provisions of Resolution [C114-24B3-O1] (WRC-19). (WRC-19)

#### 1/1.14/5.4.2.2 Method 4B3, Option 2

**ADD**

**5.C114[-24B3-O2]** The allocation to the fixed service in the band 24.25-25.25 GHz is designated for use in Region 2 by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution [C114-24B3-O2] (WRC-19). (WRC-19)

#### 1/1.14/5.4.2.3 Example Resolution for Method 4B3 – Option 1 and Method 5B2 – Option 1

**ADD**

### DRAFT NEW RESOLUTION [C114-24B3-O1] (WRC-19)

#### **Use of the bands 24.25-25.25 GHz and 27-27.5 GHz by high-altitude platform stations in the fixed service**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

Note: No text has been developed, it may be proposed in contributions to CPM19-2

*recognizing*

Note: No text has been developed, it may be proposed in contributions to CPM19-2

*resolves*

1 that for the purpose of protecting the fixed service systems in neighbouring administrations in the bands 27-27.5 GHz, the power flux-density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$\begin{aligned} pfd_{max}(El) &= 0.39 \times El - 132.12 \text{ for } 0 \leq El < 13^\circ \\ pfd_{max}(El) &= 2.715 \times El - 162.3 \text{ for } 13^\circ \leq El < 20^\circ \\ pfd_{max}(El) &= 0.45 \times El - 117 \text{ for } 20^\circ \leq El < 60^\circ \\ pfd_{max}(El) &= -90 \text{ for } 60^\circ \leq El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading up to a maximum of 20 dB;

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = e.i.r.p.(El) - 10 \cdot \log_{10}(4\pi d^2)$$

where:

- e.i.r.p.*: is the nominal HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);
- d*: is the distance in metres between the HAPS and the ground (elevation angle dependent);
- pfd(El)*: power flux-density at the Earth's surface per HAPS platform station in dBW/m<sup>2</sup>/MHz;

2 that for the purpose of protecting the mobile service systems in neighbouring administrations in the band 24.25-25.25 GHz and 27-27.5 GHz, the power flux-density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd masks in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$pfd_{max}(El) = 0.95 \times El - 114 \quad \text{for } 0 \leq El < 5.7^\circ$$

$$pfd_{max}(El) = 0.6 \times El - 112 \quad \text{for } 5.7 \leq El < 20^\circ$$

$$pfd_{max}(El) = -100 \quad \text{for } 20^\circ \leq El \leq 90^\circ$$

where *El* is the elevation angle in degrees (angle of arrival above the horizontal plane).

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = e.i.r.p.(El) - 10 \cdot \log_{10}(4\pi d^2)$$

where:

- d*: distance in metres between the HAPS and the ground (elevation angle dependent);
- e.i.r.p.*: HAPS platform nominal e.i.r.p. spectral density in dBW/MHz at a specific elevation angle;
- pfd(El)*: power flux-density at the Earth's surface per HAPS platform station in dBW/m<sup>2</sup>/MHz;

3 that for the purpose of protecting the inter-satellite service, the e.i.r.p. density per HAPS platform in the bands 27-27.5 GHz, shall not exceed -70.7 dBW/Hz for off-nadir angle higher than 85°;

4 that for the purpose of protecting the fixed-satellite service, the e.i.r.p. density per HAPS platform, in the bands 24.75-25.25 and 27-27.5 GHz, shall not exceed -10.8 dBW/MHz for off-nadir angle higher than 95°;

5 that for the purpose of protecting the satellite passive services the e.i.r.p. per HAPS platform, in the band 23.6-24.2 GHz, shall not exceed:

$$e.i.r.p. = (-0.7714 \cdot El - 16.5) \text{ dBW}/100 \text{ MHz} \quad \text{for } -4.53^\circ \leq El < 35^\circ$$

$$e.i.r.p. = -43.5 \text{ dBW}/100 \text{ MHz} \quad \text{for } 35^\circ \leq El < 90^\circ$$

where *El* is the elevation angle in degrees (angles of arrival above the horizontal plane);



6 that in order to ensure the protection of the radio astronomy service, the pfd produced by unwanted emissions from HAPS platform downlink transmissions shall not exceed  $-177 \text{ dBW/m}^2/400 \text{ MHz}$  for continuum observations and  $-191 \text{ dBW/m}^2/250 \text{ kHz}$  for spectral line observations in the band 23.6-24 GHz at an RAS station location at the height of 50 m; and that these pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model.

To verify the compliance the following formula shall be used:

$$pfd = e.i.r.p._{max\ clear\ sky}(Az, El) + Att_{618p=2\%} - 10 * \log_{10}(4\pi d^2)$$

where:

*e.i.r.p.\_{max clear sky}*: is the maximum e.i.r.p. towards the RAS station at which the HAPS platform station operates under clear-sky conditions in dBW/290 MHz for continuum observations and in dBW/250 kHz for spectral line observations in the band 23.6-24 GHz;

*Az*: is the azimuth in degrees from the HAPS platform toward the RAS station;

*El*: is the elevation angle in degrees at the HAPS platform towards the RAS station;

*Att<sub>618p=2%</sub>*: is the attenuation in dB from Recommendation ITU-R P.618 corresponding to  $p = 2\%$  of the time at the radio astronomy location;

*d*: is the separation distance in metres between the HAPS platform and the RAS station;

*pfd*: power flux-density at the Earth's surface per HAPS platform station in dBW/m<sup>2</sup>/290MHz for continuum observations and in dBW/m<sup>2</sup>/250 kHz for spectral line observations in the band 23.6-24 GHz;

7 that *resolves* 6 shall apply at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 23.6-24 GHz before 22 May 2020; and that radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS,

*instructs the Director of the Radiocommunication Bureau*

to take all necessary measures to implement this Resolution.

#### 1/1.14/5.4.2.4 Example Resolution for Method 4B3 – Option 2 and Method 5B2 – Option 2

ADD

### DRAFT NEW RESOLUTION [C114-24B3-O2]

## Use of the bands 24.25-27.5 GHz by fixed links for high-altitude platform stations in the fixed service in Region 2

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

*resolves*

1 that for the purpose of protecting the fixed service systems in neighbouring administrations in the bands 24.25-27.5 GHz, the power flux-density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$\begin{aligned} pfd_{max}(El) &= 0.39 \times El - 132.12 \text{ for } 0 \leq El < 13^\circ \\ pfd_{max}(El) &= 2.715 \times El - 162.3 \text{ for } 13^\circ \leq El < 20^\circ \\ pfd_{max}(El) &= 0.45 \times El - 117 \text{ for } 20^\circ \leq El < 60^\circ \\ pfd_{max}(El) &= -90 \text{ for } 60^\circ \leq El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

To compensate for additional propagation impairments in the main beam of the HAPS due to rain, the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading, but limited to a maximum of 20 dB.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = e.i.r.p.(El) - 10 \cdot \log_{10}(4\pi d^2)$$

where:

- $e.i.r.p.$ : is the nominal HAPS e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);
- $d$ : is the distance in metres between the HAPS and the ground (elevation angle dependent);
- $pfd(El)$ : power flux-density at the Earth's surface per HAPS platform station in dBW/m<sup>2</sup>/MHz;

2 that for the purpose of protecting the mobile service systems in neighbouring administrations in the band 24.25-25.25 GHz and 27-27.5 GHz, the power flux-density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd masks in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$\begin{aligned} pfd_{max}(El) &= 0.95 \times El - 114 \text{ for } 0 \leq El < 5.7^\circ \\ pfd_{max}(El) &= 0.6 \times El - 112 \text{ for } 5.7 \leq El < 20^\circ \\ pfd_{max}(El) &= -100 \text{ for } 20^\circ \leq El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angle of arrival above the horizontal plane).

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = e.i.r.p.(El) - 10 \cdot \log_{10}(4\pi d^2)$$

where:

- d*: distance in metres between the HAPS and the ground (elevation angle dependent);
- e.i.r.p.*: HAPS platform nominal e.i.r.p. spectral density in dBW/MHz at a specific elevation angle;
- pdf(El)*: power flux-density at the Earth's surface per HAPS platform station in dBW/m<sup>2</sup>/MHz;

3 that for the purpose of protecting the mobile service systems in neighbouring administrations in the band 24.25-27.5 GHz, the power flux-density limit per HAPS ground station at the surface of the Earth in neighbouring administrations shall not exceed the following pdf mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$pdf_{max}(El) = \begin{cases} 1.14 \times El - 111, & 0^\circ < El < 6.2^\circ \\ -103.9 & 6.2^\circ \leq El < 60^\circ \end{cases}$$

where *El* is the elevation angle in degrees (angle of arrival above the horizontal plane).

To verify that the pdf produced by HAPS ground station does not exceed the proposed pdf mask, the following equation was used:

$$pdf(El) = e.i.r.p. \frac{dBW}{MHz}(El) + 10 * \log_{10} \left( \frac{\lambda^2}{4\pi} \right) - P.452(d) - L_{pol} - B_{loss} - C_{loss}$$

where:

- e.i.r.p.*: is the nominal HAPS ground station e.i.r.p. density level in dBW/MHz (dependent to the elevation angle);
- d*: is the distance between the HAPS ground station and the border of the neighbouring administration (elevation angle dependent);
- L<sub>pol</sub>*: is the polarization discrimination in dB;
- C<sub>loss</sub>*: is the clutter loss (Recommendation ITU-R P.2108);
- P.452(*d*): is the propagation loss (Recommendation ITU-R P.452);
- B<sub>loss</sub>*: is the body loss (dB), only applicable to the user equipment (UE);

4 that for the purpose of protecting the inter-satellite service, the e.i.r.p. density per HAPS platform in the bands 27-27.5 GHz, shall not exceed -70.7 dBW/Hz for off-nadir angle higher than 85°;

5 that for the purpose of protecting the fixed-satellite service, the e.i.r.p. density per HAPS platform, in the bands 24.75-25.25 and 27-27.5 GHz, shall not exceed -10.8 dBW/MHz for off-nadir angle higher than 95°;

6 that for the purpose of protecting the Earth exploration-satellite passive services the e.i.r.p. per HAPS platform, in the band 23.6-24 GHz, shall not exceed:

$$e.i.r.p. = (-0.7714 \cdot El - 16.5) \text{ dBW}/100 \text{ MHz} \quad \text{for} \quad -4.53^\circ \leq El < 35^\circ$$

$$e.i.r.p. = -43.5 \frac{dBW}{100 \text{ MHz}} \quad \text{for} \quad 35^\circ \leq El < 90^\circ$$

where *El* is the elevation angle in degrees (angles of arrival above the horizontal plane);

7 that for the purpose of protecting the Earth exploration-satellite passive services the e.i.r.p. per HAPS ground stations, in the band 23.6-24 GHz, shall not exceed -36 dBW/200 MHz;

8 that in order to ensure the protection of fixed-satellite services from the HAPS ground station, [TBD];

9 that with respect to HAPS, the provisions of No. **5.536A** shall not apply;

10 that in order to ensure the protection of in-band SRS/EESS satellite services from the HAPS platform or from the HAPS ground station in the band 25.5-27 GHz, the pfd of a HAPS shall not exceed the threshold values below at the SRS/EESS earth stations. The EESS pfd threshold values shall be applied at earth stations which only support EESS operations. If the pfd threshold values below are exceeded, then HAPS shall coordinate in accordance with *resolves* 4, taking into account the parameters of the relevant systems.

### SRS

$$pfd, dB \left( \frac{W}{m^2 * MHz} \right) = \begin{cases} -138.8 + 25 * \log(5 - \varphi) & 0 \leq \varphi < 4.925 \\ -166.9 & 4.925 \leq \varphi < 5 \\ -183.9 & 5 \leq \varphi \leq 90 \end{cases}$$

Where ( $\varphi$ ) is the angle of arrival ( $\varphi$ ) of the interfering signal above the local horizontal plane at the SRS antenna.

Note: Consequential modifications of Appendix 5 should be considered.

### EESS non-GSO

$$pfd, dB \left( \frac{W}{m^2 * MHz} \right) = \begin{cases} -108.8 + (25 * \log(3 - \varphi)) & 0 \leq \varphi < 2.808 \\ -126.7 & 2.808 \leq \varphi < 3 \\ -143.4 & 3 \leq \varphi \leq 90 \end{cases}$$

Where ( $\varphi$ ) is the angle of arrival ( $\varphi$ ) of the interfering signal above the local horizontal plane at the EESS antenna.

### EESS GSO

$$pfd, dB \left( \frac{W}{m^2 * MHz} \right) = \begin{cases} -140.5 + 25 * \log(3 - \varphi) & 0 \leq \varphi < 2.808 \\ -158.4 & 2.808 \leq \varphi < 3 \\ -178.5 & 3 \leq \varphi \leq 90 \end{cases}$$

Where ( $\varphi$ ) is the angle of arrival ( $\varphi$ ) of the interfering signal above the local horizontal plane at the EESS antenna.

For the case of HAPS platforms to earth stations, the pfd values above applied to HAPS shall be met under clear-sky conditions 100% of the time. For the case of the HAPS ground station towards an SRS/EESS earth station path case, attenuation using the relevant ITU-R propagation Recommendations shall be applied using the following percentages: 1) SRS: .001%; 2) EESS non-GSO: .005%; 3) EESS GSO: 20%, and the HAPS and SRS/EESS antenna heights shall be used in this calculation;

11 that in order to ensure the protection of the radio astronomy service in the band 23.6-24 GHz from unwanted emissions of HAPS ground stations, the pfd of a HAPS ground station shall not exceed  $-147 \text{ dB(W/m}^2\text{/400 MHz)}$  for continuum observations and  $-161 \text{ dB(W/m}^2\text{/250 kHz)}$  for spectral line observations at an RAS station location at a height of 50 m. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model;

12 in order to ensure the protection of the radio astronomy service, the pfd produced by unwanted emissions from HAPS platform downlink transmissions shall not exceed

-177 dBW/m<sup>2</sup>/400 MHz for continuum observations and -191 dB W/m<sup>2</sup>/250 kHz for spectral line observations in the band 23.6-24 GHz at an RAS station location at the height of 50 m. These pfd values shall be verified considering a percentage of time of 2% in the relevant propagation model.

To verify the compliance the following formula shall be used:

$$pfd = e.i.r.p.\cdot p_{\max clear\ sky}(Az, El) + Att_{618p=2\%} - 10 * \log_{10}(4\pi d^2)$$

where:

*e.i.r.p.*<sub>max clear sky</sub>: is the maximum e.i.r.p. towards the RAS station at which the HAPS platform station operates under clear-sky conditions in dBW/290 MHz for continuum observations and in dBW/250 kHz for spectral line observations in the band 23.6-24 GHz;

*Az*: is the azimuth in degrees from the HAPS platform toward the RAS station;

*El*: is the elevation angle in degrees at the HAPS platform towards the RAS station;

*Att*<sub>618p=2%</sub>: is the attenuation in dB from Recommendation ITU-R P.618 corresponding to p=2% of the time at the radio astronomy location;

*d*: is the separation distance in metres between the HAPS platform and the RAS station;

*pfd*: power flux-density at the Earth's surface per HAPS platform station in dBW/m<sup>2</sup>/290 MHz for continuum observations and in dBW/m<sup>2</sup>/250 kHz for spectral line observations in the band 23.6-24 GHz;

13 that *resolves* 6 and 7 shall apply at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 23.6-24 GHz before 22 May 2020. Radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS,

*instructs the Director of the Radiocommunication Bureau*

to take all necessary measures to implement this Resolution.

## **1/1.14/5.5 Frequency band 25.25-27.5 GHz for Region 2 only**

### **1/1.14/5.5.1 For Method 5A**

**NOC**

## **ARTICLE 5**

### **Frequency allocations**

**1/1.14/5.5.2 For Method 5B2**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**24.75-29.9 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>25.25-25.5</b>	FIXED ADD 5.D114 INTER-SATELLITE 5.536 MOBILE Standard frequency and time signal-satellite (Earth-to-space)	
<b>25.5-27</b>	EARTH EXPLORATION-SATELLITE (space-to-Earth) 5.536B FIXED ADD 5.D114 INTER-SATELLITE 5.536 MOBILE SPACE RESEARCH (space-to-Earth) 5.536C Standard frequency and time signal-satellite (Earth-to-space) 5.536A	
<b>27-27.5</b> FIXED INTER-SATELLITE 5.536 MOBILE	<b>27-27.5</b> FIXED ADD 5.D114 FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE 5.536 5.537 MOBILE	

**1/1.14/5.5.2.1 For Method 5B2, Option 1**

**ADD**

**5.D114[-26B2-O1]** The allocation to the fixed service in the band 27-27.5 GHz is designated for use in Region 2 by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction, and is subject to the provisions of Resolution [C114-24B3-O1] (WRC-19). (WRC-19)

*Note: Should this Option 1 be selected, RR No. 5.D114 would be included only for the band 27-27.5 GHz in the MOD to RR Article 5 in section 1/1.14/5.5.2 above.*

**1/1.14/5.5.2.2 For Method 5B2, Option 2**

**ADD**

**5.D114[-26B2-O2]** The allocation to the fixed service in the band 25.25-27.5 GHz is designated for use in Region 2 by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[C114-24B3-O2] (WRC-19)**. (WRC-19)

**1/1.14/5.5.2.3 For Method 5B2, Option 3**

**ADD**

**5.D114[-26B2-O3]** The allocation to the fixed service in the 25.25-27.5 GHz band is designated for use in Region 2 by administrations wishing to implement high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS. The use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[D114-26B2-O3] (WRC-19)**. (WRC-19)

**1/1.14/5.5.2.4 Example Resolution for Method 5B2 – Option 1**

The example Resolution in Section 1/1.14/5.4.2.3 above includes the 27-27.5 GHz band for Method 4B2, Option 1.

**1/1.14/5.5.2.5 Example Resolution for Method 5B2 – Option 2**

The example Resolution in Section 1/1.14/5.4.2.4 above includes the 25.25-27.5 GHz band for Method 4B2, Option 2.

**1/1.14/5.5.2.6 Example Resolution for Method 5B2 – Option 3**

**ADD**

**DRAFT NEW RESOLUTION [D114-26B2-O3] (WRC-19)**

**Use of the bands 25.25-27.5 GHz by high-altitude platform stations in the fixed service in Region 2**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

Note: No text has been developed, it may be proposed in contributions to CPM19-2

*recognizing*

Note: No text has been developed, it may be proposed in contributions to CPM19-2

*resolves*

1 that, in Region 2 the use of high-altitude platform stations (HAPS) within the fixed-service allocations within the 25.25-27.5 GHz bands shall not cause harmful interference to, nor claim protection from, other stations of services operating in accordance with the Table of Frequency Allocations of Article 5, and, further, that the development of these other services shall proceed without constraints by HAPS operating pursuant to this Resolution. Such use of HAPS within the fixed-service allocations in the 25.25-27.5 GHz band may operate in the HAPS-to-ground (CPE only) or ground-to-HAPS direction;

2 that in order to ensure the protection of the fixed-satellite service in the band 27-27.5 GHz from the HAPS platform, the e.i.r.p. density per HAPS platform shall not exceed  $[-10.8]$  dBW/MHz for off-nadir angle higher than  $[85]^\circ$ ;

3 that in order to ensure the protection of the fixed-satellite service from the HAPS ground station, [TBD];

4 that in order to ensure the protection of in-band satellite services (i.e. EESS/SRS) from the HAPS platform towards an EESS/SRS earth station in the band 25.5-27 GHz, the pfd of a HAPS shall not exceed the following two sets of values:

$$pfd_{max}(El) = -103.3 - G_{EESS\ to\ HAPS}(El) \quad dBW/m^2/MHz \text{ for } 0 \leq El < 3^\circ$$

$$pfd_{max}(El) = -173.8 \quad dBW/m^2/MHz \text{ for } 3^\circ \leq El < 90^\circ$$

where  $G_{EESS/SRS\ to\ HAPS}(El)$  is the EESS antenna gain towards the HAPS platform following Appendix 8 antenna pattern for an off-axis equal to  $El$ .

$$pfd_{max}(El) = -106.8 - G_{SRS\ to\ HAPS}(El) \quad dBW/m^2/MHz \text{ for } 0 \leq El < 5^\circ$$

$$pfd_{max}(El) = -183.9 \quad dBW/m^2/MHz \text{ for } 5^\circ \leq El < 90^\circ$$

where  $G_{EESS/SRS\ to\ HAPS}(El)$  is the SRS antenna gain towards the HAPS platform following Recommendation ITU-R SA.509 antenna pattern for an off-axis equal to  $El$ ;

5 that in order to ensure the protection of EESS/SRS from the HAPS ground station in the band 25.5-27 GHz, the pfd level in the frequency band 25.5-27 GHz shall not exceed the value [TBD] dBW/m<sup>2</sup> with a reference bandwidth of 1 Hz at the input of the SRS earth station antenna for 0-deg interference arrival angle calculated using propagation loss for [0.0025%] exceedance probability;

6 that in order to ensure the protection of the inter-satellite service (ISS) in the 25.25-27.5 GHz band, HAPS systems shall conform to the provisions of Recommendation ITU-R F.1249-5, noting that the specific DRS GSO orbital locations to be protected are included in Recommendation ITU-R SA.1276-5;

7 that for the purpose of protecting fixed service systems in neighbouring administrations in the band 25.25-27.5 GHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement from the affected administration:

$$pfd_{max}(El) = 0.39 \times El - 132.12 \quad \text{for } 0 \leq El < 13^\circ$$

$$pfd_{max}(El) = 2.715 \times El - 162.3 \quad \text{for } 13^\circ \leq El < 20^\circ$$

$$pfd_{max}(El) = 0.45 \times El - 117 \quad \text{for } 20^\circ \leq El < 60^\circ$$

$$pfd_{max}(El) = -90 \quad \text{for } 60^\circ \leq El \leq 90^\circ$$



where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane). This pfd mask already takes into account the impact of attenuation due to atmospheric gases. Automatic transmit power control may be used to increase the e.i.r.p. density in these frequency ranges to compensate for rain attenuation, to the extent that the power flux-density at the fixed service station does not exceed the value resulting from use by a HAPS station of an e.i.r.p. meeting the above limits in clear-sky conditions;

8 that for the purpose of protecting mobile service systems in neighbouring administrations in the band 25.25-27.5 GHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask, under clear-sky conditions, without the explicit agreement from the affected administration:

(-114)	dBW/m <sup>2</sup> /MHz	( $0 \leq El \leq 4$ )
(-114 + 1.2 * ( $El - 4$ ))	dBW/m <sup>2</sup> /MHz	( $4 < El \leq 9$ )
(-108)	dBW/m <sup>2</sup> /MHz	( $9 < El \leq 90$ )

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane),

*instructs the Director of the Radiocommunication Bureau*

to take all necessary measures to implement this Resolution.

#### **1/1.14/5.6 Frequency band 27.9-28.2 GHz**

##### **1/1.14/5.6.1 For Method 6A**

**NOC**

### **ARTICLE 5**

#### **Frequency allocations**

**NOC**

#### **RESOLUTION 145 (REV.WRC-12)**

#### **Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high altitude platform stations in the fixed service**

**1/1.14/5.6.2 For Method 6B1**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**24.75-29.9 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>27.5-28.5</b>	FIXED ADD 5.E114 FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 MOBILE 5.538 5.540	

*Note: Under this method, if the band 27.9-28.2 GHz is modified, there would need to be consequential modifications to Resolution 145 (Rev.WRC-12) in implementation of Method B1.*

**1/1.14/5.6.2.1 For Method 6B1, Option 1**

**ADD**

**5.E114[-28B1-O1]** The allocation to the fixed service in the band 27.9-28.2 GHz is designated for worldwide use by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to operation in the HAPS-to-ground direction and is subject to the provisions of Resolution [E114-28+31B1-O1] (WRC-19). (WRC-19)

**SUP**

**5.537A**

**1/1.14/5.6.2.2 For Method 6B1, Option 2**

**ADD**

**5.E114[-28B1-O2]** The allocation to the fixed service in the 27.9-28.2 GHz band is designated for worldwide use by administrations wishing to implement high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS. The use of the fixed service allocation by HAPS is limited to operation in the HAPS-to-ground direction and is subject to the provisions of Resolution [E114-28+31B1-O2] (WRC-19). (WRC-19)

**SUP**

**5.537A**

**1/1.14/5.6.2.3 Example Resolution for Method 6B1 – Option 1 and Method 7B1 – Option 1**

**ADD**

**DRAFT NEW RESOLUTION [E114-28+31B1-O1] (WRC-19)**

**Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high-altitude platform stations in the fixed service**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

*recognizing*

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

*resolves*

1 that for the purpose of protecting the fixed wireless systems in neighbouring administrations in the band 27.9-28.2 GHz, the power flux-density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$\begin{aligned} pfd_{max}(El) &= (3 \times El - 140) \text{ for } El \leq 10^\circ \\ pfd_{max}(El) &= (0.57 \times El - 115.7) \text{ for } 10^\circ < El \leq 45^\circ \\ pfd_{max}(El) &= -90 \text{ for } 45^\circ < El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane).

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading up to a maximum of 20 dB.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(El) = e.i.r.p.(El) - 10 \cdot \log_{10}(4\pi d^2)$$

where:

- $d$ : is the distance in metres between the HAPS and the ground;
- $e.i.r.p.$ : HAPS platform nominal e.i.r.p. spectral density in dBW/MHz at a specific elevation angle;

$pdf(El)$ : power flux-density at the Earth's surface per HAPS platform station in dBW/m<sup>2</sup>/MHz;

2 that for the purpose of protecting the mobile service systems in neighbouring administrations in the band 27.9-28.2 GHz, the power flux-density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$\begin{aligned} pdf_{max}(El) &= (El - 120) \text{ for } El \leq 13^\circ \\ pdf_{max}(El) &= -107 \text{ for } 13^\circ < El \leq 65^\circ \\ pdf_{max}(El) &= 0.68 El - 151.2 \text{ for } 65^\circ < El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angle of arrival above the horizontal plane).

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pdf(El) = e.i.r.p.(El) - 10 \cdot \log_{10}(4\pi d^2)$$

where:

- $d$ : distance in metres between the HAPS and the ground (elevation angle dependent);
- $e.i.r.p.$ : HAPS platform nominal e.i.r.p. spectral density in dBW/MHz at a specific elevation angle;
- $pdf(El)$ : power flux-density at the Earth's surface per HAPS platform station in dB(W/m<sup>2</sup>/MHz);

3 that for the purpose of protecting the fixed-satellite service (Earth-to-space) in the 27.9-28.2 GHz, the maximum e.i.r.p. density per HAPS downlink shall be less than -9.7 dBW/MHz in any direction for off-nadir angle higher than 95°;

4 that for the purpose of protecting the fixed-service systems in neighbouring administrations in the band 31-31.3 GHz, the power flux-density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$\begin{aligned} pdf_{max}(El) &= (0.875 \times El - 143) \text{ for } El \leq 8^\circ \\ pdf_{max}(El) &= (2.58 \times El - 156.6) \text{ for } 8^\circ < El \leq 20^\circ \\ pdf_{max}(El) &= (0.375 \times El - 112.5) \text{ for } 20^\circ < El \leq 60^\circ \\ pdf_{max}(El) &= -90 \text{ for } 60^\circ < El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angle of arrival above the horizontal plane).

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading up to a maximum of 20 dB.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pdf(El) = e.i.r.p.(El) - 10 \cdot \log_{10}(4\pi d^2)$$

where:

- d*: distance in metres between the HAPS and the ground (elevation angle dependent);
- e.i.r.p.*: HAPS platform nominal e.i.r.p. spectral density in dBW/MHz at a specific elevation angle;
- pdf(El)*: power flux-density at the Earth's surface per HAPS platform station in dB(W/m<sup>2</sup>/MHz);

5 that in order to ensure the protection of EESS (passive), the level of unwanted power density into the HAPS ground station antenna in the band 31.3-31.8 GHz shall be limited to -83 dB(W/200 MHz) under clear-sky conditions and may be increased under rainy conditions to mitigate fading due to rain, provided that the effective impact on the passive satellite does not exceed the impact under clear-sky conditions;

6 that in order to ensure the protection of EESS (passive) services the e.i.r.p. per HAPS platform, in the band 31.3-31.8 GHz, shall not exceed:

$$\begin{aligned} e.i.r.p. &= (-El - 13.1) \text{ dBW/200 MHz} & \text{for } -4.53^\circ \leq El < 22^\circ \\ e.i.r.p. &= -35.1 \text{ dBW/200 MHz} & \text{for } 22^\circ \leq El < 90^\circ \end{aligned}$$

7 that in order to ensure the protection of the radio astronomy service, the pdf level produced by any HAPS ground station at the RAS stations listed, shall not exceed -141 dBW/m<sup>2</sup>/500 MHz in the band 31.3-31.8 GHz, unless a higher pdf is otherwise agreed between the corresponding administrations;

to verify the compliance with the proposed pdf mask the following equation shall be used:

$$pdf(El) = e.i.r.p.(El) + Att_{Rec P.452-16}(d) - 10 \log_{10} \left( \frac{\lambda^2}{4\pi} \right)$$

where:

- Att<sub>Rec P.452-16</sub>*: is the attenuation in dB based on Recommendation ITU-R P.452-16 propagation model with *p* = 2%;
- e.i.r.p.*: is the maximum HAPS e.i.r.p. density level in dBW/MHz/500 MHz (dependent to the elevation angle);
- d*: is the distance in metres between the HAPS and the ground (elevation angle dependent);
- pdf(El)*: power flux-density at the Earth's surface per HAPS platform station in dB(W/m<sup>2</sup>/500 MHz);

8 that in order to ensure the protection of the radio astronomy service the pdf produced by unwanted emissions from HAPS platform downlink transmissions shall not exceed -171 dBW/m<sup>2</sup>/500 MHz for continuum observations in the band 31.3-31.8 GHz at an RAS station location at a height of 50 m, where this pdf value shall be verified considering a percentage of time of 2% in the relevant propagation model;

to verify the compliance the following formula shall be used:

$$pdf(El) = e.i.r.p._{max \text{ clear sky}}(Az, El) + Att_{618 p=2\%} - 10 \log_{10}(4\pi d^2)$$

where:

- e.i.r.p.\_{max clear sky}*: is the maximum e.i.r.p. towards the RAS station at which the HAPS platform station operates under clear-sky conditions in dB(W/500 MHz);

- Az*: is the azimuth from the HAPS platform toward the RAS station;
- El*: is the elevation angle at the HAPS platform towards the RAS station;
- Att*<sub>618p=2%</sub>: is the attenuation from Recommendation ITU-R P.618 corresponding to  $p = 2\%$  of the time at the radio astronomy location;
- d*: is the separation distance in m between the HAPS platform and the RAS station;
- pf**d*(*El*): power flux-density at the Earth's surface per HAPS platform station in dB(W/m<sup>2</sup>/500 MHz);

9 that *resolves* 8 applies at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 31.3-31.8 GHz before 22 May 2020; and that radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS,

*instructs the Director of the Radiocommunication Bureau*

to take all necessary measures to implement this Resolution.

#### **1/1.14/5.6.2.4 Example Resolution for Method 6B1 – Option 2 and Method 7B1 – Option 2**

**ADD**

### **DRAFT NEW RESOLUTION [E114-28+31B1-O2] (WRC-19)**

#### **Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high-altitude platform stations in the fixed service**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

*recognizing*

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

*resolves*

1 that the use of high-altitude platform stations (HAPS) within the fixed-service allocations within the 27.9-28.2 GHz and 31-31.3 GHz bands shall not cause harmful interference to, nor claim protection from, other stations of services operating in accordance with the Table of Frequency Allocations of Article 5, and, further, that the development of these other services shall proceed without constraints by HAPS operating pursuant to this Resolution;

*Alternative 1 (Protection of mobile service):*

2 that for the purpose of protecting mobile service systems in neighbouring administrations in the band 27.9-28.2 GHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following

pdf mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$\begin{array}{ll} (-122.6) & (0 \leq El \leq 2) \\ (-122.6 + 1.5 * (El - 2)) & (2 < El \leq 13.6) \\ (-105.2) & (13.6 < El \leq 90) \end{array}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane);

or *Alternative 2 (Protection of mobile service)*:

2 that for the purpose of protecting mobile service systems in neighbouring administrations in the band 27.9-28.2 GHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following pdf mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$\begin{array}{ll} (-121.3 + 1.5 * El) & (0 < El \leq 5) \\ (-113.7) & (5 < El \leq 90) \end{array}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane);

or *Alternative 3 (Protection of mobile service)*:

2 that for the purpose of protecting the mobile service systems in the band 27.9-28.2 GHz, [92.6] km a protection distance between HAPS nadir and MS stations is required;

or *Alternative 4 (Protection of mobile service)*:

2 that for the purpose of protecting the mobile service systems in the band 27.9-28.2 GHz, for CPE beam of HAPS platform, the Tx e.i.r.p. spectral density shall be limited to [-30.2] dBW/MHz, and for GW beam of HAPS platform, the Tx e.i.r.p. spectral density shall be limited to [-20.9] dBW/MHz;

3 that for the purpose of protecting mobile service systems in neighbouring administrations in the band 31-31.3 GHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following pdf mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

[TBD]

where  $El$  is the elevation angle in degrees (angle of arrival above the horizontal plane);

4 that for the purpose of protecting the fixed-satellite service (Earth-to-space) in the band 27.9-28.2 GHz, the maximum e.i.r.p. density per HAPS downlink shall be less than -9.7 dBW/MHz in any direction for off-nadir angle higher than [85°];

5 that for the purpose of protecting fixed-service systems in neighbouring administrations in the band 27.9-28.2 GHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following pdf mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement from the affected administration:

$$\begin{array}{ll} pdf_{max}(El) = 2 \times El - 135 & \text{for } 0 \leq El < 10^\circ \\ pdf_{max}(El) = 0.66 \times El - 119.6 & \text{for } 10^\circ \leq El < 45^\circ \\ pdf_{max}(El) = -90 & \text{for } 45^\circ \leq El \leq 90^\circ \end{array}$$

where  $El$  is the elevation angle in degrees (angle of arrival above the horizontal plane). This pfd mask already takes into account the impact of attenuation due to atmospheric gases. Automatic transmit power control may be used to increase the e.i.r.p. density in these frequency ranges to compensate for rain attenuation, to the extent that the power flux-density at the fixed service station does not exceed the value resulting from use by a HAPS station of an e.i.r.p. meeting the above limits in clear-sky conditions;

6 that for the purpose of protecting fixed service systems in neighbouring administrations in the band 31-31.3 GHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$$\begin{aligned} pfd_{max}(El) &= 0.3 \times El - 140 && \text{for } 0 \leq El < 10^\circ \\ pfd_{max}(El) &= 3.1 \times El - 167 && \text{for } 10^\circ \leq El < 20^\circ \\ pfd_{max}(El) &= 0.375 \times El - 112.5 && \text{for } 20^\circ \leq El < 60^\circ \\ pfd_{max}(El) &= -90 && \text{for } 60^\circ \leq El \leq 90^\circ \end{aligned}$$

where  $El$  is the elevation angle in degrees (angle of arrival above the horizontal plane). This pfd mask already takes into account the impact of attenuation due to atmospheric gases. Automatic transmit power control may be used to increase the e.i.r.p. density in these frequency ranges to compensate for rain attenuation, to the extent that the power flux-density at the fixed service station does not exceed the value resulting from use by a HAPS station of an e.i.r.p. meeting the above limits in clear-sky conditions;

7 that in order to ensure the protection of the Earth exploration-satellite service (passive), the level of unwanted emission e.i.r.p. per HAPS platform transmitter operating in the 31-31.3 GHz band shall be limited into the 31.3-31.8 GHz band to:

$$\begin{aligned} [e.i.r.p._n = -El - 13.1 \text{ dBW/200 MHz} &&& \text{for } 4.53^\circ \leq El < 22^\circ \\ [e.i.r.p._n = -35.1 \text{ dBW/200 MHz} &&& \text{for } 22^\circ \leq El < 90^\circ] \end{aligned}$$

where  $El$  is the elevation angle in degrees (angles of arrival above the horizontal plane);

8 that in order to ensure the protection of the radio astronomy service the pfd produced by unwanted emissions from HAPS platform downlink transmissions shall not exceed  $-171$  dBW/m<sup>2</sup>/500 MHz for continuum observations in the band 31.3-31.8 GHz at an RAS station location at a height of 50 m; and that this pfd value shall be verified considering a percentage of time of 2% in the relevant propagation model;

9 that *resolves* 8 applies at any radio astronomy station that was in operation prior to 22 November 2019 and has been notified to the Bureau in the band 31.3-31.8 GHz before 22 May 2020; and that radio astronomy stations notified after this date may seek an agreement with administrations that have authorized HAPS;

10 that in order to ensure the protection of the Earth exploration-satellite service (passive), the unwanted emission power spectral density at the antenna input of the HAPS ground station operating in the 31-31.3 GHz band shall be limited to  $-83$  dB(W/200 MHz), under clear-sky conditions, in the frequency band 31.3-31.8 GHz,

*instructs the Director of the Radiocommunication Bureau*

to take all necessary measures to implement this Resolution.



**1/1.14/5.6.3 For Method 6C**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**24.75-29.9 GHz**

Allocation to services		
Region 1	Region 2	Region 3
27.5-28.5	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.538 5.540	5.484A 5.516B 5.539

**SUP**

**5.537A**

**SUP**

**RESOLUTION 145 (REV.WRC-12)**

**Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by  
high altitude platform stations in the fixed service**

*Note: If RR No. 5.537A is suppressed and RR No. 5.543A is retained, there would need to be consequential modifications to Resolution 145 (Rev.WRC-12) in implementation of Method 6C.*

**1/1.14/5.7 Frequency band 31-31.3 GHz**

**1/1.14/5.7.1 For Method 7A**

**NOC**

**ARTICLE 5**

**Frequency allocations**

**NOC**

**RESOLUTION 145 (REV.WRC-12)**

**Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by  
high altitude platform stations in the fixed service**

**1/1.14/5.7.2 For Method 7B1**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations  
(See No. 2.1)**

**MOD**

**29.9-34.2 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>31-31.3</b>	FIXED 5.338A ADD 5.F114 MOBILE Standard frequency and time signal-satellite (space-to-Earth) Space research 5.544 5.545 5.149	

*Note: Under this method, if the band 31-31.3 GHz is modified, there would need to be consequential modifications to Resolution 145 (Rev.WRC-12) in implementation of Method B1.*

**1/1.14/5.7.2.1 For Method 7B1, Option 1**

**1/1.14/5.7.2.1.1 For Method 7B1, Option 1A**

**ADD**

**5.F114[-31B1-O1A]** The allocation to the fixed service in the band 31-31.3 GHz is designated for worldwide use by high-altitude platform stations (HAPS) in the HAPS-to-ground direction. Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[E114-28+31B1-O1] (WRC-19)**. (WRC-19)

**SUP**

**5.543A**

**1/1.14/5.7.2.1.2 For Method 7B1, Option 1B**

**ADD**

**5.F114[-31B1-O1B]** The allocation to the fixed service in the band 31-31.3 GHz is designated for worldwide use by high-altitude platform stations (HAPS) in the ground-to-HAPS direction. Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution **[E114-28+31B1-O1] (WRC-19)**. (WRC-19)

**SUP**

**5.543A**

**1/1.14/5.7.2.2 For Method 7B1, Option 2**

**ADD**

**5.F114[-31B1-O2]** The allocation to the fixed service in the 31-31.3 GHz band is designated for worldwide use by administrations wishing to implement high-altitude platform stations (HAPS) in the HAPS-to-ground direction. Such use of the fixed-service allocation by HAPS shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS. Use of the band is subject to the provisions of Resolution **[E114-28+31B1-O2] (WRC-19)**. (WRC-19)

**SUP**

**5.543A**

**1/1.14/5.7.2.3 Example Resolution for Method 7B1 – Option 1**

The example Resolution in section 1/1.14/5.6.2.3 above includes the 31-31.3 GHz band for Method 6B1, Option 1.

**1/1.14/5.7.2.4 Example Resolution for Method 7B1 – Option 2**

The example Resolution in section 1/1.14/5.6.2.4 above includes the 31-31.3 GHz band for Method 6B1, Option 2.

1/1.14/5.7.3 For Method 7C

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

29.9-34.2 GHz

Allocation to services		
Region 1	Region 2	Region 3
31-31.3	FIXED 5.338A MOBILE Standard frequency and time signal-satellite (space-to-Earth) Space research 5.544 5.545 5.149	

SUP

5.543A

SUP

#### RESOLUTION 145 (REV.WRC-12)

#### Use of the bands 27.9-28.2 GHz and 31-31.3 GHz by high altitude platform stations in the fixed service

*Note: If No. 5.543A is suppressed and No. 5.537A is retained, there would need to be consequential modifications to Resolution 145 in implementation of Method C.*

**1/1.14/5.8 Frequency band 38-39.5 GHz**

**1/1.14/5.8.1 For Method 8A**

**NOC**

**ARTICLE 5**

**Frequency allocations**

**1/1.14/5.8.2 For Method 8B2**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**34.2-40 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>38-39.5</b>	FIXED ADD 5.G114 FIXED-SATELLITE (space-to-Earth) MOBILE Earth exploration-satellite (space-to-Earth) 5.547	

**1/1.14/5.8.2.1 For Method 8B2, Option 1**

**1/1.14/5.8.2.1.1 For Method 8B2, Option 1A**

**ADD**

**5.G114[-38B2-O1A]** The allocation to the fixed service in the band 38-39.5 GHz is designated for worldwide use by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the HAPS-to-ground direction, and is subject to the provisions of Resolution [G114-38B2-O1A+B] (WRC-19). (WRC-19)

**1/1.14/5.8.2.1.2 For Method 8B2, Option 1B**

**ADD**

**5.G114[-38B2-O1B]** The allocation to the fixed service in the band 38-39.5 GHz is designated for worldwide use by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is limited to the ground-to-HAPS direction, and is subject to the provisions of Resolution [G114-38B2-O1A+B] (WRC-19). (WRC-19)

**1/1.14/5.8.2.1.3 For Method 8B2, Option 1C**

**ADD**

**5.G114[-38B2-O1C]** The allocation to the fixed service in the band 38-39.5 GHz is designated for worldwide use by high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS is subject to the provisions of Resolution [G114-38B2-O1C] (WRC-19). (WRC-19)

**1/1.14/5.8.2.2 For Method 8B2, Option 2**

**ADD**

**5.G114[-38B2-O2]** The allocation to the fixed service in the 38-39.5 GHz band is designated for worldwide use by administrations wishing to implement high-altitude platform stations (HAPS). Such use of the fixed-service allocation by HAPS shall not cause harmful interference to, nor claim protection from, other types of fixed-service systems or other co-primary services. Furthermore, the development of these other services shall not be constrained by HAPS. The use of the fixed-service allocation by HAPS is limited to the ground-to-HAPS direction, and is subject to the provisions of Resolution [G114-38B2-O2] (WRC-19). (WRC-19)

**1/1.14/5.8.2.3 Example Resolution for Method 8B2 – Options 1A and 1B**

**ADD**

**DRAFT NEW RESOLUTION [G114-38B2-O1A+B] (WRC-19)**

**Use of the bands 38-39.5 GHz by high-altitude platform  
stations in the fixed service**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

Note: No text has been developed, it may be proposed in contributions to CPM19-2

*recognizing*

Note: No text has been developed, it may be proposed in contributions to CPM19-2

*resolves*

1 that for the purpose of protecting the fixed-service systems in neighbouring administrations in the band 38-39.5 GHz, the power flux-density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

-137	$\delta \leq 13^\circ$
$-137 + 3.125 (\delta - 13)$	$13^\circ < \delta \leq 25^\circ$
$-99.5 + 0.5 (\delta - 25)$	$25^\circ < \delta \leq 50^\circ$
-87	$50^\circ < \delta \leq 90^\circ$

where  $\delta$  is the elevation angle in degrees (angle of arrival above the horizontal plane).

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading up to a maximum of 20 dB.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(\delta) = e.i.r.p.(\delta) - 10\log_{10}(4\pi d^2)$$

where:

- d*: distance in metres between the HAPS and the ground (elevation angle dependent);
- e.i.r.p.*: HAPS platform nominal e.i.r.p. spectral density in dBW/MHz at a specific elevation angle;
- pfd*( $\delta$ ): power flux-density at the Earth's surface per HAPS platform station in dB(W/(m<sup>2</sup> · MHz));

2 that for the purpose of protecting the mobile service systems in neighbouring administrations in the band 38-39.5 GHz, the power flux-density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

-102	$\delta \leq 5^\circ$
$-102 + 0.25 (\delta - 5)$	$5^\circ < \delta \leq 25^\circ$
-97	$25^\circ < \delta \leq 90^\circ$

where  $\delta$  is the elevation angle in degrees (angle of arrival above the horizontal plane).

In order to compensate for additional propagation impairments in the main beam of the HAPS due to rain, any exceedance of the pfd mask shall be limited by a value equivalent to the level of rain fading.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(\delta) = e.i.r.p._{dBW/MHz}(\delta) - 10\log_{10}(4\pi d^2)$$

where:

- d*: distance in metres between the HAPS and the ground (elevation angle dependent);

*e.i.r.p.*: HAPS platform nominal e.i.r.p. spectral density in dBW/MHz at a specific elevation angle;

*pdf*( $\delta$ ): power flux-density at the Earth's surface per HAPS platform station in dB(W/(m<sup>2</sup> · MHz));

3 that for the purpose of protecting FSS GSO systems in the fixed-satellite service (space-to-Earth) in neighbouring administrations, coordination of a transmitting HAPS station is required when the power flux-density in dB(W/(m<sup>2</sup>/MHz)) over any point of an administration's border exceeds the following values:

$-169.9 + 1\,954\,\alpha^2$	for	$0 \leq \alpha < 0.136^\circ$
-133.9	for	$0.136^\circ \leq \alpha < 1^\circ$
$-133.9 + 25 \log \alpha$	for	$1^\circ \leq \alpha < 47.9^\circ$
-91.9	for	$47.9^\circ \leq \alpha \leq 180^\circ$

where  $\alpha$  is the minimum angle at the border between the line to the HAPS platform and the lines to the GSO arc in degrees.

To calculate the *pdf* produced by a HAPS platform, the following equation shall be used:

$$pdf_{I/N} = e.i.r.p. - 10\log_{10}(4\pi d^2) - Att_{gaz}$$

where:

*d*: distance between the HAPS and the GSO FSS earth station (m);

*Att<sub>gaz</sub>*: attenuation due to atmospheric gases on the HAPS to GSO FSS earth station path in dB;

*pdf<sub>I/N</sub>*: required *pdf* at the GSO FSS earth station location to meet the FSS protection criteria in dB(W/(m<sup>2</sup> · MHz));

*e.i.r.p.*: HAPS platform nominal e.i.r.p. spectral density in the direction of the GSO FSS earth station in dBW/MHz;

Note: In case this *pdf* is used as a hard limit, there may be a need that language and values may need to be revisited. See also paragraph c) in note at the beginning of section 5;

4 that for the purpose of protecting FSS non-GSO systems in the fixed-satellite service (space-to-Earth) in neighbouring administrations from co-channel interference, coordination of a transmitting HAPS station is required when the distance between the sub-HAPS point and any point of an administration's border is less than 100 km;

5 that in making assignments to HAPS platforms in the fixed service 38-39.5 GHz, administrations shall protect the space research service (space-to-Earth) in the band 37-38 GHz from harmful interference by unwanted emissions, taking into account the space research service (space-to-Earth) protection level of -217 dB(W/Hz) at the input of the SRS receiver with 0.001% exceedance due to atmospheric and precipitation effects as referred to in the relevant ITU-R Recommendations,

*instructs the Director of the Radiocommunication Bureau*

to take all necessary measures to implement this Resolution.



**1/1.14/5.8.2.4 Example Resolution for Method 8B2 – Option 1C**

**ADD**

**DRAFT NEW RESOLUTION [G114-38B2-O1C] (WRC-19)**

**Use of the bands 38-39.5 GHz by high-altitude platform stations in the fixed service**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

*recognizing*

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

*resolves*

1 that for the purpose of protecting the fixed-service systems in neighbouring administrations in the band 38-39.5 GHz, the power flux-density limit per HAPS platform station at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

-137	$\delta \leq 13^\circ$
$-137 + 3.125 (\delta - 13)$	$13^\circ < \delta \leq 25^\circ$
$-99.5 + 0.5 (\delta - 25)$	$25^\circ < \delta \leq 50^\circ$
-87	$50^\circ < \delta \leq 90^\circ$

where  $\delta$  is the elevation angle in degrees (angle of arrival above the horizontal plane).

In order to compensate additional propagation impairments in the main beam of the HAPS due to rain, the HAPS shall be operated so that the pfd mask can be increased in the corresponding beam by a value equivalent to the level of rain fading, but limited to a maximum of 20 dB.

To verify the compliance with the proposed pfd mask the following equation shall be used:

$$pfd(\delta) = e.i.r.p.(\delta) - 10 \log_{10}(4\pi d^2)$$

where:

- d*: distance in metres between the HAPS and the ground (elevation angle dependent);
- e.i.r.p.*: HAPS platform nominal e.i.r.p. spectral density in dBW/MHz at a specific elevation angle;
- pfd*( $\delta$ ): power flux-density at the Earth's surface per HAPS platform station in dB(W/(m<sup>2</sup> · MHz));

2 that in order to ensure the protection of mobile services, [65] km protection distance between HAPS nadir and MS stations is required;

3 that for the purpose of protecting FSS GSO systems in the fixed-satellite service (space-to-Earth), [60 km] protection distance between HAPS nadir and FSS earth stations is required;

4 that for the purpose of protecting FSS non-GSO systems in the fixed-satellite service (space-to-Earth), [60 km] protection distance between HAPS nadir and FSS earth stations is required;

5 that in making assignments to HAPS platforms in the fixed service 38-39.5 GHz, administrations shall protect the space research service (space-to-Earth) in the band 37-38 GHz from harmful interference by unwanted emissions, taking into account the space research service (space-to-Earth) protection level of  $-217$  dB(W/Hz) at the input of the SRS receiver with 0.001% exceedance due to atmospheric and precipitation effects as referred to in the relevant ITU-R Recommendations,

*instructs the Director of the Radiocommunication Bureau*

to take all necessary measures to implement this Resolution.

#### **1/1.14/5.8.2.5 Example Resolution for Method 8B2 – Option 2**

**ADD**

### **DRAFT NEW RESOLUTION [G114-38B2-O2] (WRC-19)**

#### **Use of the bands 38-39.5 GHz by high-altitude platform stations in the fixed service**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

*recognizing*

Note: No text has been developed, it may be proposed in contributions to CPM19-2.

*resolves*

1 that, the use of high-altitude platform stations (HAPS) within the fixed-service allocations within the 38-39.5 GHz bands shall not cause harmful interference to, nor claim protection from, other stations of services operating in accordance with the Table of Frequency Allocations of Article 5, and, further, that the development of these other services shall proceed without constraints by HAPS operating pursuant to this Resolution. Such use of HAPS within the fixed-service allocations in the 38-39.5 GHz band may operate in the HAPS-to-ground direction;

2 that systems using HAPS in the band 38-39.5 GHz, in accordance with *resolves* 1 above, shall not cause harmful interference to the fixed-satellite service and Earth exploration-satellite service (passive), having primary allocations in the band 38-39.5 GHz, taking into account the protection criteria given in the relevant ITU-R Recommendations [TBD];

3 that in making assignments to HAPS platforms in the fixed service in the bands 38-39.5 GHz, administrations shall protect the space research service (space-to-Earth) in the bands 37-

38 GHz from harmful interference by unwanted emissions, taking into account the space research service (space-to-Earth) protection level of  $-217$  dB(W/Hz) at the input terminals of the SRS receiver with 0.001% exceedance due to atmospheric and precipitation effects;

4 that for the purpose of protecting fixed-service systems in neighbouring administrations in the band 38-39.5 GHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$-137$	$\delta \leq 13^\circ$
$-137 + 3.125 (\delta - 13)$	$13^\circ < \delta \leq 25^\circ$
$-99.5 + 0.5 (\delta - 25)$	$25^\circ < \delta \leq 50^\circ$
$-87$	$50^\circ < \delta \leq 90^\circ$

where  $\delta$  is the elevation angle in degrees (angle of arrival above the horizontal plane). This pfd mask already takes into account the impact of attenuation due to atmospheric gases. Automatic transmit power control may be used to increase the e.i.r.p. density in these frequency ranges to compensate for rain attenuation, to the extent that the power flux-density at the fixed service station does not exceed the value resulting from use by a HAPS station of an e.i.r.p. meeting the above limits in clear-sky conditions;

5 that for the purpose of protecting mobile-service systems in neighbouring administrations in the band 38-39.5 GHz, the power flux-density level per HAPS platform station produced at the surface of the Earth in neighbouring administrations shall not exceed the following pfd mask in dBW/m<sup>2</sup>/MHz, under clear-sky conditions, without the explicit agreement of the affected administration:

$(-111.4)$	$(0 \leq El \leq 4)$
$(-111.4 + 1.2 * (El - 4))$	$(4 < El \leq 11.5)$
$(-102.4)$	$(11.5 < El \leq 90)$

where  $El$  is the elevation angle in degrees (angle of arrival above the horizontal plane),

*instructs the Director of the Radiocommunication Bureau*

to take all necessary measures to implement this Resolution.

## **1/1.14/5.9 Frequency band 47.2-47.5 GHz and 47.9-48.2 GHz**

### **1/1.14/5.9.1 For Method 9A**

**NOC**

## **ARTICLE 5**

### **Frequency allocations**

NOC

RESOLUTION 122 (REV.WRC-07)

**Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz by high altitude platform stations in the fixed service and by other services**

1/1.14/5.9.2 For Method 9B1

ARTICLE 5

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

MOD

40-47.5 GHz

Allocation to services		
Region 1	Region 2	Region 3
47.2-47.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE MOD 5.552A	

MOD

47.5-51.4 GHz

Allocation to services		
Region 1	Region 2	Region 3
47.9-48.2	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE MOD 5.552A	

1/1.14/5.9.2.1 Method 9B1

MOD

**5.552A** The allocation to the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz is designated for use by high altitude platform stations (HAPS). The use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz is subject to the provisions of Resolution **122 (Rev.WRC-19)**. (WRC-19)

**1/1.14/5.9.2.2 Example modification of Resolution 122 for Method 9B1**

**1/1.14/5.9.2.2.1 Example 1 for Method 9B1**

**MOD**

**RESOLUTION 122 (REV.WRC-19)**

**Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz by high altitude platform stations in the fixed service and by other services**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

...

*recognizing*

...

*resolves*

1 that to facilitate sharing with the FSS (Earth-to-space), the maximum transmit e.i.r.p. density of a ubiquitous HAPS ground terminal shall not exceed the following levels under clear-sky conditions:

6.4	dB(W/MHz)	for UAC	(30° < θ ≤ 90°)
22.57	dB(W/MHz)	for SAC	(15° < θ ≤ 30°)
28	dB(W/MHz)	for RAC	(5° < θ ≤ 15°)

where θ is the ground terminal elevation angle in degrees;

2 that the maximum transmit e.i.r.p. density levels specified in *resolves* 1 may be increased, using fading compensation techniques, by up to 5 dB during periods of rain;

*2bis* that the following measures shall be applied by HAPS platform stations to protect FSS (Earth-to-space):

[TBD];

3 that the ground terminal antenna patterns of HAPS operating in the bands 47.2-47.5 GHz and 47.9-48.2 GHz shall meet the following antenna beam patterns:

$$G(\varphi) = G_{max} - 2.5 \times 10^{-3} \left( \frac{D}{\lambda} \varphi \right)^2 \quad \text{for} \quad 0^\circ < \varphi < \varphi_m$$

$$G(\varphi) = 39 - 5 \log(D/\lambda) - 25 \log \varphi \quad \text{for} \quad \varphi_m \leq \varphi < 48^\circ$$

$$G(\varphi) = -3 - 5 \log(D/\lambda) \quad \text{for} \quad 48^\circ \leq \varphi \leq 180^\circ$$

where:

$G_{max}$ : maximum antenna gain (dBi)

$G(\varphi)$ : gain (dBi) relative to an isotropic antenna

$\varphi$ : off-axis angle (degrees)  
 $D$ : antenna diameter }  
 $\lambda$ : wavelength } expressed in the same units

$$\varphi_m = \frac{20 \lambda}{D} \sqrt{G_{max} - G_1} \quad \text{degrees}$$

$G_1$ : gain of the first side lobe  
 $= 2 + 15 \log (D/\lambda)$  (dBi);

4 that for the purpose of protecting fixed wireless systems in neighbouring administrations from co-channel interference, the pfd level produced at the Earth's surface per HAPS in dBW/m<sup>2</sup>/MHz in any part of the bands 47.2-47.5 GHz and 47.9-48.2 GHz shall not exceed the following power flux-density mask under clear-sky conditions unless explicit agreement of the affected administration is provided at the time of the notification of HAPS:

-141	dB(W/(m <sup>2</sup> · MHz))	for	0° ≤ δ < 3°
-141 + 2(δ - 3)	dB(W/( m <sup>2</sup> · MHz))	for	3° ≤ δ ≤ 13°
-121	dB(W/( m <sup>2</sup> · MHz))	for	13° < δ ≤ 90°

where δ is the angle of the arrival above the horizontal plane in degrees. Automatic transmit power control may be used to increase the e.i.r.p. density in these frequency ranges to compensate for rain attenuation, to the extent that the power flux-density at the fixed service station does not exceed the value resulting from use by a HAPS station of an e.i.r.p. meeting the above limits in clear-sky conditions;

5 that, to protect radio astronomy stations operating in the band 48.94-49.04 GHz from unwanted emissions of HAPS operating in the 47.2-47.5 GHz and 47.9-48.2 GHz bands, the separation distance between the radio astronomy station and the nadir of a HAPS platform shall exceed 50 km;

6 that administrations planning to implement a HAPS system in the 47.2-47.5 GHz and 47.9-48.2 GHz bands shall notify the frequency assignments by submitting all mandatory elements of Appendix 4 to the Bureau for the examination of compliance with respect to *resolves* 1, 2, 2bis, 3, 4 and 5 above with a view to their registration in the Master International Frequency Register;

7 that administrations shall notify the new data elements for the notices referred to in *instructs the Director of the Radiocommunication Bureau* 1 in order to enable the Bureau to perform the examinations;

8 that to protect mobile-service systems in the bands 47.2-47.5 GHz and 47.9-48.2 GHz in dBW/m<sup>2</sup>/MHz the pfd from HAPS shall not exceed:

(-109.8)	(0 ≤ El ≤ 4)
(-109.8 + 1.2 * (El - 4))	(4 < El ≤ 11.5)
(-100.8)	(11.5 < El ≤ 90);

where *El* is the elevation angle in degrees,

*invites administrations*

that intend to deploy HAPS systems in the fixed service in the bands 47.2-47.5 GHz and 47.9-48.2 GHz to consider specifying the use of the bands 47.2-47.35 GHz and 47.9-48.05 GHz for ubiquitous HAPS terminals,

*instructs the Director of the Radiocommunication Bureau*

...

#### **1/1.14/5.9.2.2.2 Example 2 for Method 9B1**

#### **MOD**

### **RESOLUTION 122 (REV.WRC-19)**

#### **Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz by high altitude platform stations in the fixed service and by other services**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

...

*recognizing*

...

*c)* that Recommendation ITU-R SF.1843 provides information on the feasibility of HAPS systems in the fixed service sharing with the FSS;

*d)* that ITU-R studies on HAPS operation in the bands 47.2-47.5 GHz and 47.9-48.2 GHz allocated to the fixed service have concluded that, in order to share with FSS (Earth-to-space), the maximum uplink transmit e.i.r.p. density of HAPS ground terminals in the bands should, in clear-sky conditions, be 6.4 dB(W/MHz) for Urban Area Coverage (UAC), 22.57 dB(W/MHz) for Suburban Area Coverage (SAC) and 28 dB(W/MHz) for Rural Area Coverage (RAC), and that these values can be increased by up to 20 dB during periods of rain;

...

*resolves*

...

2 that the maximum transmit e.i.r.p. density levels specified in *resolves* 1 may be increased, using fading compensation techniques, by up to 20 dB during periods of rain; ...

*invites administrations*

...

*instructs the Director of the Radiocommunication Bureau*

...

1/1.14/5.9.3 For Method 9C

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations (See No. 2.1)

**MOD**

**40-47.5 GHz**

Allocation to services		
Region 1	Region 2	Region 3
47.2-47.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE	

**MOD**

**47.5-51.4 GHz**

Allocation to services		
Region 1	Region 2	Region 3
47.9-48.2	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE	

**SUP**

**5.552A**

**SUP**

#### RESOLUTION 122 (REV.WRC-07)

**Use of the bands 47.2-47.5 GHz and 47.9-48.2 GHz by high altitude platform stations in the fixed service and by other services**



## Agenda item 1.15

**(WP 1A / WP 3J, WP 3K, WP 3M, WP 5A, WP 5C, WP 7C, WP 7D,  
(WP 4A), (WP 5D), (WP 6A))**

*1.15 to consider identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz, in accordance with Resolution 767 (WRC-15);*

**Resolution 767 (WRC-15)** – *Studies towards an identification for use by administrations for land-mobile and fixed services applications operating in the frequency range 275-450 GHz*

### **1/1.15/1 Executive summary**

This agenda item seeks to identify spectrum for land mobile service (LMS) and fixed service (FS) applications in the 275-450 GHz frequency range while maintaining protection of the existing Earth exploration-satellite service (EESS) (passive) and radio astronomy service (RAS) applications identified in RR No. **5.565**. A PDN Report ITU-R SM.[275-450GHz SHARING] has been developed. This Report contains the results of compatibility studies between LMS, FS applications and both EESS (passive), RAS in the 275-450 GHz band based on the technical information available on LMS and FS characteristics in Reports ITU-R [M.2417-0](#) and [F.2416-0](#), for the purpose of identifying spectrum that can be used by LMS/FS applications without the need for regulatory restrictions.

Compatibility studies between the RAS and LMS/FS applications concluded that atmospheric attenuation independent of free-space losses at 275-450 GHz is not sufficient to provide compatibility between FS and RAS operations in the absence of other considerations. Separation distances and/or avoidance angles between RAS stations and FS stations should be considered depending on the deployment environment of FS stations.

In order to maintain the protection of the passive services and satisfy the spectrum needs of the LMS/FS applications, five methods have been identified and are described in section 4 below.

### **1/1.15/2 Background**

RR No. **5.565** was revised in accordance with Resolution **950 (Rev.WRC-07)**, and the specific frequency bands were identified for measurements by passive services, such as the RAS, EESS (passive), and SRS (passive). The bands of interest to EESS/SRS (passive) from 275 to 3 000 GHz have been addressed in Report ITU-R [RS.2194-0](#) and the sharing studies between the RAS and active services in the frequency range 275-3 000 GHz have been conducted in Report ITU-R [RA.2189-0](#). In the specific identification of the frequencies in the range of 275-1 000 GHz, the passive services do not preclude use of this range by active services.

High data rate wireless communication systems above 100 Gbit/s have been discussed within international standardization organizations, and technology development in this area is growing. Several applications such as wireless links for data centres, close proximity wireless connections, intra-device communications and fronthaul/backhaul links which are expected to be operated in the band above 275 GHz are summarized in Report ITU-R [SM.2352-0](#). The LMS and FS applications have been studied by the relevant working parties based on Questions ITU-R 256/5 and 257/5, respectively. Reports ITU-R [F.2416-0](#) and ITU-R [M.2417-0](#) summarize the technical and operational parameters as well as the spectrum needs for each of the applications.

## **1/1.15/3 Summary and analysis of the results of ITU-R studies**

### **1/1.15/3.1 Technical and operational characteristics and spectrum needs**

#### **1/1.15/3.1.1 Land mobile service applications**

Report ITU-R [M.2417-0](#) provides the technical and operational characteristics and spectrum needs of LMS applications operating in the frequency band 275-450 GHz. The spectrum needs for the LMS applications identified to date, such as close proximity mobile system (CPMS) applications, intra-device applications, and wireless links for data centres, are 50 GHz of total spectrum bandwidth. One of the technical characteristics of LMS applications indicates that channel bandwidths of up to 103.68 GHz may be considered in the future. The LMS applications typically operate over short distances mostly indoors and/or with shielded conditions.

#### **1/1.15/3.1.2 Fixed service applications**

Report ITU-R [F.2416-0](#) provides the technical and operational characteristics and spectrum needs of FS applications operating in the frequency band 275-450 GHz. The Report states that a bandwidth of around 25 GHz may satisfy the initial typical deployment scenarios while a bandwidth of about 50 GHz will sufficiently support the evolution of IMT traffic of fronthaul and backhaul. The Report also indicates that the possible candidate frequency bands for fronthaul and backhaul applications are 275-325 GHz and 380-445 GHz, and that the frequency band 330-370 GHz may also be considered in the future, if and when parameters are available for that range.

#### **1/1.15/3.1.3 Passive service applications**

Several frequency bands in the 275-450 GHz range are identified for use by passive services for scientific investigation and environmental sensing and monitoring by both the EESS and the RAS, as provided in RR No. **5.565**. In this frequency range there are currently nine current or planned EESS (passive) sensors, which perform global measurements. Additionally there are thirteen distinct RAS sites using these frequencies throughout the world. Details on the EESS (passive) systems and RAS sites can be found in PDN Report ITU-R SM.[275-450GHz SHARING].

##### **1/1.15/3.1.3.1 Earth exploration-satellite service**

Systems in the EESS use sensitive instrumentation to detect naturally occurring electromagnetic energy absorbed and emitted by constituents of the Earth's atmosphere, land and sea. The scientific measurements made by EESS (passive) sensors provide for the measurement of atmospheric parameters (temperature, humidity, composition) that support weather forecasts, weather trend predictions, pollution alerts potentially affecting health, and provide Earth surface parameters (such as snow and ice cover), soil moisture levels (which are important to agriculture) and other important scientific investigations. In the 275-450 GHz frequency range, there are several different systems using various portions of this band for scientific measurements, and additional systems are planned. The PDN Report ITU-R RS.[275-450 GHz CHARS]<sup>2</sup> provides technical and operational characteristics of EESS (passive) systems in the frequency range 275-450 GHz.

##### **1/1.15/3.1.3.2 Radio astronomy service**

Radio astronomy systems operating in this spectrum range include several of the most advanced and sensitive, cryogenically-cooled radio receiving systems currently in existence. Many nations have contributed considerable time, resources, and expertise in the design and construction of these

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<sup>2</sup> [Annex 13](#) to [Document 7C/288](#).

facilities, which represent shared global resources for scientific investigation. Additionally, the frequency range in question is of importance for radio astronomy operations.

Radio astronomy systems in this spectrum range include single dish telescopes, interferometers, and balloon-borne platforms. Most RAS observatories are geographically located at high altitudes where water vapour presents far less attenuation in the bands listed in RR No. **5.565** than at sea level. The remoteness of these locations may facilitate sharing due to the propagation characteristics at these sites; however, in some cases the surrounding areas may also call for additional consideration as they result in less signal loss from potentially interfering transmitters.

New applications in the relevant bands should take into account transmitter power, geographic location of potentially impacted RAS sites, propagation at and around the sites in question, and protection criteria for RAS receivers specified in relevant ITU-R Recommendations.

The information about threshold levels of detrimental effects to radio astronomy systems are contained in Tables 9 and 10 of PDN Report ITU-R SM.[275-450GHz SHARING].

### **1/1.15/3.2 Sharing and compatibility studies in the frequency range 275-450 GHz**

The characteristics used for sharing and compatibility studies are based on the information on FS and MS parameters that were provided in ITU-R Reports as described above. These parameters were used in conjunction with characteristics of radio astronomy sites and EESS (passive) systems that are used in these bands, to assess whether the interference thresholds for RAS and EESS (passive) are exceeded for the fixed and mobile operational parameters and deployments given in the reports.

Studies done in PDN Report ITU-R SM.[275-450GHz SHARING] did not seek to develop regulatory provisions (such as power limits, shielding requirements and/or elevation angle restrictions, etc.) that could facilitate sharing with EESS and focused on identifying spectrum for LMS/FS applications, where such restrictions would not be necessary to protect the passive services.

#### **1/1.15/3.2.1 Sharing and compatibility studies for EESS (passive)**

Study 2 focused on an aggregate analysis performed for FS elevation angle distributions  $\pm 20$  and  $\pm 12$  degrees, and a static analysis of FS stations and EESS (passive) sensor for three different pointing scenarios across the 275-450 GHz frequency range. This study found compatibility in the frequency bands 275-286 GHz, 318-334 GHz, 350-356 GHz, 361-365 GHz, 369-392 GHz, 397-399 GHz, 409-411 GHz, 416-434 GHz and 439-450 GHz possible.

Study 3 contained in PDN Report ITU-R SM.[275-450GHz SHARING] concluded that the following bands in the 275-450 GHz frequency range can be identified for FS and LMS applications: 275-296 GHz, 306-313 GHz, 320-330 GHz and 356-450 GHz. Study 3 also noted that in the band 275-286 GHz, FS and LMS applications could be problematic for both conical and nadir scanning sensors; however, conical and nadir scanning sensors are not presently deployed in this band. If these types of sensors are to be deployed in this band in the future, further studies may be necessary to determine if there are sharing and compatibility issues.

Study 4 performed an analysis of the 275-325 GHz band and did not consider the entire 275-450 GHz range. This study concluded that the band 275-325 GHz can be made available to LMS applications, which include both indoor and outdoor use, in accordance with the deployment scenarios provided by Report ITU-R [M.2147-0](#). This result was based on the assumption that there would be a minimum building entry loss of 56 dB for indoor usage and 20 dB shielding loss for outdoor usage. Study 4 also concluded that the bands 275-286 GHz, 286-296 GHz, 306-313 GHz and 319-325 GHz are available for use of FS applications without any conditions.

Study 5 in PDN Report ITU-R SM.[275-450GHz SHARING] concluded that the following bands in the 275-450 GHz frequency range can be identified for FS and LMS applications: 275-296 GHz, 306-313 GHz, 320-330 GHz and 356-450 GHz. These results are based on the evaluation of interference into bands identified for EESS (passive) usage in RR No. **5.565**, if the actual bandwidth of the systems currently operating is taken into account instead of the entire identified bands, then the band 318-333 GHz can be considered instead of 320-330 GHz. Noting that this expanded range does not take into account future EESS (passive) use.

### **1/1.15/3.2.2          Sharing and compatibility studies for RAS**

Report ITU-R [RA.2189-0](#) indicates that, if an appropriate exclusion zone is used, the RAS can share with active service applications due to propagation conditions and power limitations of active services technologies. Recent compatibility studies, contained in PDN Report ITU-R SM.[275-450GHz SHARING], between the RAS and FS/LMS applications concluded that atmospheric attenuation alone, independent of free-space losses, at 275-450 GHz is not sufficient to provide compatibility between FS and RAS operations in the absence of other considerations. In the bands identified for RAS in RR No. **5.565** (275-323 GHz, 327-371 GHz, 388-424 GHz and 426-442 GHz), separation distances and or avoidance angles between RAS stations and FS stations should be considered depending on the deployment environment of FS stations.

### **1/1.15/4    Methods to satisfy the agenda item**

The following methods are considered to satisfy this agenda item and may be applied to the candidate frequency bands.

#### **1/1.15/4.1          Method A**

No change to the Radio Regulations.

#### **1/1.15/4.2          Method B**

Modifying the existing footnote RR No. **5.565** is proposed for FS/LMS applications in portions of the 275-450 GHz frequency range.

**Reasons:** Studies that evaluated the entire 275-450 GHz frequency range show sharing is feasible between FS/LMS applications and the EESS (passive)/RAS in the particular bands. For frequencies in the range 275-450 GHz not [identified/designated] for use under Method B, current studies have shown that sharing between FS/LMS applications and EESS (passive)/RAS applications is not feasible. Method B identifies frequency bands for use by LMS and FS applications that meet the spectrum needs summarized in ITU-R studies as contained in section 1/1.15/3 above.

#### **1/1.15/4.3          Method C**

This method suggests to modify RR No. **5.565** for use by FS/LMS applications in portions of the 275-450 GHz band, while considering the evolving guidance of ITU-R Recommendations and Reports.

**Reasons:** Studies that evaluated the entire 275-450 GHz range show that sharing is feasible between applications in the LMS/FS, and applications in the EESS (passive)/RAS in the particular frequency bands: 275-296 GHz, 306-313 GHz, 320-330 GHz and 356-450 GHz.

#### **1/1.15/4.4          Method D**

Adding a new footnote RR No. **5.A115/5.B115** is proposed for FS/LMS applications in portions of the 275-450 GHz band.

There are two different options in section 1/1.15/5 for Method D, which consider the identification of different frequency bands based on the results of the studies.

**Reasons:** Studies that evaluated the entire 275-450 GHz frequency range show sharing is feasible between FS/LMS applications and the EESS (passive)/RAS in the particular bands. For frequencies in the range 275-450 GHz not identified for use under Method D, current studies have shown that sharing between FS/LMS applications and EESS (passive)/RAS applications is not feasible. Method D identifies frequency bands for use by LMS and FS applications that meet the spectrum needs summarized in ITU-R studies as contained in section 1/1.15/3 above.

#### **1/1.15/4.5 Method E**

Adding a new footnote RR No. **5.C115** and modifying the existing footnote RR No. **5.565** are proposed for FS/LMS applications in portions of the 275-450 GHz band.

**Reasons:** Studies that evaluated the entire 275-450 GHz range show sharing is feasible between FS/LMS applications and the EESS (passive)/RAS in the particular bands. For frequencies in the range 275-450 GHz not identified for use under Method E, current studies have shown that sharing between FS/LMS applications and EESS (passive)/RAS applications is not feasible. Method E identifies frequency bands for use by LMS and FS applications that exceed spectrum needs summarized in ITU-R studies as contained in section 1/1.15/3 above. Method E provides guidance to administrations in which bands LMS and FS should operate.

#### **1/1.15/5 Regulatory and procedural considerations**

The regulatory and procedural considerations to satisfy the agenda item are considered below for each of the proposed methods defined in section 1/1.15/4.

#### **1/1.15/5.1 For Method B**

## **ARTICLE 5**

### **Frequency allocations**

#### **Section IV – Table of Frequency Allocations**

(See No. 2.1)

#### **MOD**

**248-3 000 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>275-3 000</b>	(Not allocated) MOD 5.565	

**MOD**

**5.565** The following frequency bands in the range 275-1 000 GHz are [identified/designated] for use by administrations for passive service applications:

- radio astronomy service: 275-323 GHz, 327-371 GHz, 388-424 GHz, 426-442 GHz, 453-510 GHz, 623-711 GHz, 795-909 GHz and 926-945 GHz;
- Earth exploration-satellite service (passive) and space research service (passive): 275-286 GHz, 296-306 GHz, 313-356 GHz, 361-365 GHz, 369-392 GHz, 397-399 GHz, 409-411 GHz, 416-434 GHz, 439-467 GHz, 477-502 GHz, 523-527 GHz, 538-581 GHz, 611-630 GHz, 634-654 GHz, 657-692 GHz, 713-718 GHz, 729-733 GHz, 750-754 GHz, 771-776 GHz, 823-846 GHz, 850-854 GHz, 857-862 GHz, 866-882 GHz, 905-928 GHz, 951-956 GHz, 968-973 GHz and 985-990 GHz.

Moreover, the following frequency bands within the range of 275-450 GHz are also [identified/designated] for use by administrations for implementing active service applications as mentioned below:

- land mobile service applications: 275-296 GHz, 306-313 GHz, 318-333 GHz and 356-450 GHz;
- fixed service applications: 275-296 GHz, 306-313 GHz, 318-333 GHz and 356-450 GHz.

The use of the range 275-1 000 GHz by the passive services does not preclude use of this range by active services. Administrations wishing to make frequencies in the 275-1 000 GHz range available for active service applications in particular for land mobile service and fixed service are urged to take all practicable steps to protect these passive services from harmful interference until the date when the Table of Frequency Allocations is established in the above-mentioned 275-1 000 GHz frequency range.

All frequencies in the range 1 000-3 000 GHz may be used by both active and passive services. (WRC-19)

**1/1.15/5.2 For Method C**

**MOD**

**248-3 000 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>275-3 000</b>	(Not allocated) MOD 5.565	

**MOD**

**5.565** The following frequency bands in the range 275-1 000 GHz are identified for use by administrations for active and passive service applications:

- radio astronomy service: 275-323 GHz, 327-371 GHz, 388-424 GHz, 426-442 GHz, 453-510 GHz, 623-711 GHz, 795-909 GHz and 926-945 GHz;
- Earth exploration-satellite service (passive) and space research service (passive): 275-286 GHz, 296-306 GHz, 313-356 GHz, 361-365 GHz, 369-392 GHz,

397-399 GHz, 409-411 GHz, 416-434 GHz, 439-467 GHz, 477-502 GHz, 523-527 GHz, 538-581 GHz, 611-630 GHz, 634-654 GHz, 657-692 GHz, 713-718 GHz, 729-733 GHz, 750-754 GHz, 771-776 GHz, 823-846 GHz, 850-854 GHz, 857-862 GHz, 866-882 GHz, 905-928 GHz, 951-956 GHz, 968-973 GHz and 985-990 GHz;

- fixed and land mobile service: 275-296 GHz, 306-313 GHz, 320-330 GHz and 356-450 GHz.

In the frequency bands 275-296 GHz, 306-313 GHz, 320-330 GHz and 356-450 GHz, no specific conditions are necessary by fixed and/or land mobile service applications to protect Earth exploration-satellite service (passive) applications.

In the frequency bands 275-323 GHz, 327-371 GHz, 388-424 GHz and 426-442 GHz, some specific conditions (e.g. minimum separation distances and/or avoidance angles) may be necessary to ensure protection of radio astronomy sites from fixed and/or land mobile service applications, on a case-by-case basis.

The use of the range 275-1 000 GHz by the passive services does not preclude use of this range by active services. Administrations wishing to make frequencies in the 275-1 000 GHz range available for active service applications are urged to take all practicable steps to protect these passive services from harmful interference until the date when the Table of Frequency Allocations is established in the above-mentioned 275-1 000 GHz frequency range. When applying this provision, administrations should take into account the latest relevant ITU-R Recommendations and may consider the latest relevant ITU-R Reports.

All frequencies in the range 1 000-3 000 GHz may be used by both active and passive services. (WRC-19)

### **1/1.15/5.3 For Method D**

#### **1/1.15/5.3.1 For Method D Option 1**

### **MOD**

#### **248-3 000 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>275-3 000</b>	(Not allocated) 5.565 ADD 5.A115	

### **ADD**

**5.A115** The following frequency bands are identified for use by administrations for land mobile and fixed service applications:

- 275-296 GHz, 306-313 GHz, 320-330 GHz and 356-450 GHz. (WRC-19)

### **NOC**

#### **5.565**

**Reasons:** Modifications to RR No. **5.565** are not necessary as the addition of fixed and land mobile services to the 275-450 GHz frequency range can be accomplished through the addition of a new footnote.

**1/1.15/5.3.2 For Method D Option 2**

**MOD**

248-3 000 GHz

Allocation to services		
Region 1	Region 2	Region 3
275-3 000	(Not allocated) 5.565 ADD 5.B115	

**ADD**

**5.B115** The following frequency bands are identified for use by administrations for the implementation of the following active service applications:

- land mobile service applications: 275-325 GHz;
- fixed service applications: 275-296 GHz, 306-313 GHz and 319-325 GHz.

Administrations wishing to make these above-mentioned frequency bands available for land mobile and/or fixed service applications are urged to take all practicable steps to protect passive services operating according to No. **5.565** until the date when the Table of Frequency Allocations is established in the 275-1 000 GHz frequency range.

In the frequency bands 275-325 GHz, some specific conditions (e.g. minimum separation distances and/or avoidance angles) may be necessary to ensure protection of radio astronomy sites from land mobile and/or fixed service applications, on a case-by-case basis. (WRC-19)

**NOC**

**5.565**

**Reasons:** Modifications to RR No. **5.565** are not necessary as the addition of fixed and land mobile services to the 275-325 GHz frequency range can be accomplished through the addition of a new footnote.

**1/1.15/5.4 For Method E**

**MOD**

248-3 000 GHz

Allocation to services		
Region 1	Region 2	Region 3
275-3 000	(Not allocated) MOD 5.565 ADD 5.C115	



## ADD

**5.C115** The following frequency bands are identified for use by administrations for the implementation of the following active service applications:

- land mobile service applications: 275-296 GHz, 306-313 GHz, 318-333 GHz and 356-450 GHz;
- fixed service applications: 275-296 GHz, 306-313 GHz, 318-333 GHz and 356-450 GHz.

Administrations wishing to make these above-mentioned frequency bands available for land mobile and/or fixed service applications are urged to take all practicable steps to protect passive services operating according to No. **5.565** until the date when the Table of Frequency Allocations is established in the 275-1 000 GHz frequency range. Frequency bands in the 275-450 GHz range not identified under this footnote were deemed incompatible with the existing Earth exploration-satellite service (passive) and radio astronomy service applications identified in No. **5.565**.

In the frequency bands 275-296 GHz, 306-313 GHz, 318-323 GHz, 327-333 GHz, 356-371 GHz, 388-424 GHz and 426-442 GHz, some specific conditions (e.g. minimum separation distances and/or avoidance angles) may be necessary to ensure protection of radio astronomy sites from land mobile and/or fixed service applications, on a case-by-case basis. (WRC-19)

## MOD

**5.565** The following frequency bands in the range 275-1 000 GHz are identified for use by administrations for passive service applications:

- radio astronomy service: 275-323 GHz, 327-371 GHz, 388-424 GHz, 426-442 GHz, 453-510 GHz, 623-711 GHz, 795-909 GHz and 926-945 GHz;
- Earth exploration-satellite service (passive) and space research service (passive): 275-286 GHz, 296-306 GHz, 313-356 GHz, 361-365 GHz, 369-392 GHz, 397-399 GHz, 409-411 GHz, 416-434 GHz, 439-467 GHz, 477-502 GHz, 523-527 GHz, 538-581 GHz, 611-630 GHz, 634-654 GHz, 657-692 GHz, 713-718 GHz, 729-733 GHz, 750-754 GHz, 771-776 GHz, 823-846 GHz, 850-854 GHz, 857-862 GHz, 866-882 GHz, 905-928 GHz, 951-956 GHz, 968-973 GHz and 985-990 GHz.

The use of the range 275-450 GHz by the passive services does not preclude use of this range by active services. The use of this frequency range by land mobile and fixed service applications shall be made in accordance with No. **5.C115**. Administrations wishing to make frequencies in the 275-450 GHz range available for applications under other active services than land mobile and fixed services are urged to take all practicable steps to protect the passive services from harmful interference until the date when the Table of Frequency Allocations is established in the above-mentioned 275-1 000 GHz frequency range.

The use of the range 450-1 000 GHz by the passive services does not preclude use of this range by active services. Administrations wishing to make frequencies in the 450-1 000 GHz range available for active service applications are urged to take all practicable steps to protect the passive services from harmful interference until the date when the Table of Frequency Allocations is established in the above-mentioned 275-1 000 GHz frequency range.

All frequencies in the range 1 000-3 000 GHz may be used by both active and passive services. (WRC-19)

**1/1.15/5.5 For all Methods A, B, C, D and E**

**SUP**

**RESOLUTION 767 (WRC-15)**

**Studies towards an identification for use by administrations for land-mobile and fixed services applications operating in the frequency range 275-450 GHz**

## CHAPTER 2

### **Broadband applications in the mobile service**

(Agenda items 1.13, 1.16, 9.1 (issues 9.1.1, 9.1.5, 9.1.8))

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## Agenda item 1.13

**(TG 5/1\* / WP 3J, WP 3K, WP 3M, WP 4A, WP 4B, WP 4C, WP 5A, WP 5B, WP 5C, WP 5D, WP 6A, WP 7B, WP 7C, WP 7D)**

*1.13 to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 238 (WRC-15);*

**Resolution 238 (WRC-15)** – *Studies on frequency-related matters for International Mobile Telecommunications identification including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency range between 24.25 and 86 GHz for the future development of International Mobile Telecommunications for 2020 and beyond*

Note 1: Section 4 of the draft CPM text reflects different options for methods to satisfy the agenda item in each of the frequency bands referred to in Resolution **238 (WRC-15)**. These options reflect views of the membership's contributions as well as those discussed at ITU-R. These options also cover a range of conditions and alternatives discussed, but are not reconciled due to the different divergent views expressed. The complexity of the issue, the divergent interests and time constraints did not permit to reduce them to a manageable number and size. These options and associated alternatives, to some cases, contain various ranges from “no condition” to “relatively severe condition”, which were not possible to be reconciled.

Note 2: Section 5 contains draft WRC Resolutions and regulatory provisions corresponding to each frequency band, which also mirror the options, alternatives and conditions as described above. Moreover, the preamble sections of these draft resolutions are compilations of input contributions, which seem considerably numerous and perhaps not really necessary to be included as compiled.

CPM19-2 is invited to carefully review these options, alternatives and conditions contained in Section 4, as well as the draft Resolutions, in particular their preambles, with a view to reconcile them to a workable and reasonable size.

### **2/1.13/1 Executive summary**

IMT-2020 supports several new applications. Resolution **238 (WRC-15)** invites ITU-R to carry out studies to determine the spectrum needs for IMT, as well as to conduct sharing and compatibility studies in the frequency range between 24.25 GHz and 86 GHz.

Under the text for agenda item 1.13 is considered the following:

- a description of the estimated spectrum needs for the terrestrial component of IMT in the frequency range between 24.25 GHz and 86 GHz;
- the sharing and compatibility studies carried out by ITU-R for each frequency band under study;
- the methods to satisfy agenda item 1.13;
- regulatory and procedural considerations for each frequency band under study.

It is to be noted that the methods to satisfy the agenda item are included in Section 2/1.13/4 and have been organized by frequency bands, as follows: Item A (24.25-27.5 GHz), Item B (31.8-33.4 GHz), Item C (37-40.5 GHz), Item D (40.5-42.5 GHz), Item E (42.5-43.5 GHz), Item F

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\* See the CPM19-1 Decision in Annex 9 to BR Administrative Circular [CA/226](#).

(45.5-47 GHz), Item G (47-47.2 GHz), Item H (47.2-50.2 GHz), Item I (50.4-52.6 GHz), Item J (66-71 GHz), Item K (71-76 GHz), and Item L (81-86 GHz).

It was decided to include for each of the frequency bands a no-change method to the Radio Regulations (RR). Some other methods are accompanied by a series of alternatives for allocation and/or identification for IMT as appropriate. Furthermore, conditions for protection measures of different services are also included, as appropriate. This is detailed in Section 2/1.13/4.

Finally, the regulatory and procedural considerations are available in Section 2/1.13/5.

## **2/1.13/2 Background**

IMT systems are now being evolved to provide diverse usage scenarios and applications such as enhanced mobile broadband (eMBB), massive machine-type communications (mMTC) and ultra-reliable and low-latency communications (URLLC) requiring larger contiguous blocks of spectrum than currently available as described in Recommendation ITU-R M.2083.

It is important to note that the properties of higher frequency bands, such as shorter wavelength, would better enable the use of advanced antenna systems, including multiple-input and multiple-output (MIMO) and beam-forming techniques in supporting eMBB.

Resolution **238 (WRC-15)** calls for studies to determine the spectrum needs for the terrestrial component of IMT in the frequency range between 24.25 GHz and 86 GHz, as well as sharing and compatibility studies, taking into account the protection of services to which the frequency band is allocated on a primary basis, for the frequency bands:

- 24.25-27.5 GHz<sup>3</sup>, 37-40.5 GHz, 42.5-43.5 GHz, 45.5-47 GHz, 47.2-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz and 81-86 GHz, which have allocations to the mobile service on a primary basis; and
- 31.8-33.4 GHz, 40.5-42.5 GHz and 47-47.2 GHz, which may require additional allocations to the mobile service on a primary basis.

## **2/1.13/3 Summary and analysis of the results of ITU-R studies**

### **2/1.13/3.1 Spectrum needs**

Studies for WRC-19 agenda item 1.13 estimated the spectrum needs for the terrestrial component of IMT in the frequency range between 24.25 GHz and 86 GHz, in accordance with Resolution **238 (WRC-15)** and [CA/226](#).

Terrestrial IMT-2020 systems will incorporate the use of new technologies that benefit from the physical characteristics of the frequencies in the frequency range from 24.25 to 86 GHz and the large bandwidths potentially available, which will provide higher data rates and lower latencies. A number of approaches were considered and the results obtained using the application-based and the technical performance-based approaches are summarized in Table 2/1.13/3-1. The estimated spectrum needs would be different based on the approaches used together with the assumptions thereof.

Furthermore, some administrations provided information on spectrum needs in their countries based on their national considerations, which is also summarized in Table 2/1.13/3-1.

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<sup>3</sup> When conducting studies in the frequency band 24.5-27.5 GHz, to take into account the need to ensure the protection of existing earth stations and the deployment of future receiving earth stations under the EESS (space-to-Earth) and SRS (space-to-Earth) allocation in the frequency band 25.5-27 GHz.

TABLE 2/1.13/3-1

**Spectrum needs for frequency ranges between 24.25 and 86 GHz (see Note)**

	Examples	Associated conditions for different examples	Spectrum needs in total (GHz) <sup>4</sup>	Spectrum needs (GHz) per range
Application-based approach	1	Overcrowded, dense urban and urban areas	18.7	3.3 (24.25-33.4 GHz range) 6.1 (37-52.6 GHz range) 9.3 (66-86 GHz range)
		Dense urban and urban areas	11.4	2.0 (24.25-33.4 GHz range) 3.7 (37-52.6 GHz range) 5.7 (66-86 GHz range)
	2	Highly crowded area	3.7	0.67 (24.25-33.4 GHz range) 1.2 (37-52.6 GHz range) 1.9 (66-86 GHz range)
		Crowded area	1.8	0.33 (24.25-33.4 GHz range) 0.61 (37-52.6 GHz range) 0.93 (66-86 GHz range)
Technical performance-based approach (Type 1 <sup>5</sup> )	1	User experienced data rate of 1 Gbit/s with $N$ simultaneously served users/devices at the cell-edge, e.g. indoor	3.33 ( $N=1$ ), 6.67 ( $N=2$ ), 13.33 ( $N=4$ )	Not available
		User experienced data rate of 100 Mbits/s with $N$ simultaneously served users/devices at the cell-edge, for wide area coverage	0.67 ( $N=1$ ), 1.32 ( $N=2$ ), 2.64 ( $N=4$ )	Not available
	2	eMBB dense urban	0.83-4.17	Not available
		eMBB indoor hot spot	3-15	Not available
	3	With a file transfer of 10 Mbits by a single user at cell-edge in 1 msec	33.33 GHz (one direction)	Not available
		With a file transfer of 1 Mbit by a single user at cell-edge in 1 msec	3.33 GHz (one direction)	
With a file transfer of 0.1 Mbits by a single user at cell-edge in 1 msec		333 MHz (one direction)		
Technical performance-	–	Dense urban micro	14.8-19.7	5.8-7.7 (24.25-43.5 GHz range)

<sup>4</sup> The spectrum needs estimates of the different approaches and examples should be considered separately.

<sup>5</sup> For Type 1, the spectrum needs are calculated taking into account a single technical performance requirement, i.e. user experienced data rate.

	Examples	Associated conditions for different examples	Spectrum needs in total (GHz) <sup>4</sup>	Spectrum needs (GHz) per range
based approach (Type 2 <sup>6</sup> )		Indoor hot spot		9-12 (24.25-43.5 GHz and 45.5-86 GHz range)
Information from some countries based on their national considerations	–	–	7-16	2-6 (24.25-43.5 GHz range) 5-10 (43.5-86 GHz range)

Note: The spectrum needs in the table above are for the frequency ranges between 24.25 GHz and 86 GHz as called for in *resolves to invite ITU-R 1 of Resolution 238 (WRC-15)*. The frequency bands studied and addressed in Sections 2/1.13/3, 2/1.13/4 and 2/1.13/5 are the specific frequency bands as called for in *resolves to invite ITU-R 2 of Resolution 238 (WRC-15)*.

In the above table, the application-based approach calculates the spectrum needs for IMT systems to support certain applications, which are characterized by various factors, such as connection density, application data rate, application usage pattern, deployment considerations, etc. Meanwhile, the technical performance-based approach calculates the spectrum needs to support certain technical performance requirements of IMT systems, such as peak data rate, user experienced data rate, area traffic capacity, etc.

As indicated in these approaches, for the spectrum needs of IMT-2020 in the range of 24.25 and 86 GHz, different channel propagation characteristics and available channel bandwidth should be taken into account. With a view to accommodate the wide range of usage and deployment scenarios for IMT-2020, it is important to consider a number of frequency bands within the ranges identified under Resolution 238 (WRC-15).

### 2/1.13/3.2 Sharing and compatibility studies

The following subsections present results for the sharing and compatibility studies for each frequency band. The characteristics and propagation models provided to Task Group (TG) 5/1 for use in the studies are referenced in Annex 1 to the TG 5/1 Chairman's Report (see Document [5-1/478](#)). No sharing and compatibility studies between IMT within the LMS and other systems of the MS were received in any of the bands, although characteristics were received for some of them.

#### 2/1.13/3.2.1 Frequency range 24.25-27.5 GHz

The frequency range 24.25-27.5 GHz, or parts thereof, is allocated to the EESS, FS, FSS, ISS, MS, RLSS, RNS and SRS. The frequency bands adjacent to this frequency range are allocated to the EESS (passive), RAS, RLS and SRS (passive). The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the EESS, EESS (passive), FS, FSS, ISS, RAS and SRS and are summarized in the subsections below. Characteristics were not received for the RLS, RLSS and RNS and therefore, studies were not carried out for these services. Studies are not needed for the SRS (passive), as this service is dealing with sensors around other planets and no interference issue is expected.

<sup>6</sup> For Type 2, the spectrum needs are calculated taking into account different technical performance requirements, i.e. user experienced data rate, peak data rate and area traffic capacity.



## **2/1.13/3.2.1.1 EESS/SRS and IMT**

### **2/1.13/3.2.1.1.1 EESS**

Some studies performed a non-site-specific aggregate analysis with Monte Carlo simulations. The simulations took time and deployment dependent parameters into account, and the probability distribution of IMT network aggregate interference was compared to the earth station protection criterion level. Some did the simulations in which time and deployment dependent parameters were mixed to illustrate a random deployment scenario and the average of the interference level from all the snapshots was compared to the protection criterion level at the specified time exceedance level. The separation distance was found to be in the range of 0.2-1.0 km in urban and suburban (including suburban open-space) scenarios.

Some studies performed a non-site-specific single-entry worst-case analysis, which evaluated the interference caused by a single base station (BS) in front of the earth station with Monte Carlo simulations. The separation distance was shown to be less than 0.8 km. Another study performed a single cluster worst-case analysis, where the interference from one cluster of 31 BSs and user equipment (UEs) in front of the earth station was analysed with Monte Carlo simulations. The separation distance was up to 1 km.

Two other single-entry studies used a deterministic analysis method. These studies led to a separation distance in the range 0.2-1.7 km. These studies assumed scenarios where the IMT BS antenna main beam pointed towards the EESS earth stations.

The results of non-site-specific studies considered flat terrain, as well as clutter loss according to Recommendation ITU-R P.2108, which addressed the urban and suburban environments.

Three studies addressed the separation distances that would be required around a number of specific EESS earth stations located in the USA, Europe and China, considering either one single BS whose antenna panel was oriented towards the victim earth station, or a cluster of up to 31 BSs with random antenna panel orientations. These studies led to the following separation distances for 8×8 antenna BSs:

- 3.9-6.0 km for EESS earth stations tracking non-geostationary-satellite orbit (non-GSO) satellites;
- 3.0-7.0 km for EESS earth stations tracking geostationary-satellite orbit (GSO) satellites.

These distances are only valid for the specific earth stations considered in these studies. The actual separation distances vary from one earth station to another and need to be determined on a case-by-case basis.

An additional aggregate study was performed for some of these specific earth stations using a full IMT network deployment in suburban and urban environments, showing that when the separation distance determined for the single-entry case was respected, then the EESS protection criterion was met.

All site-specific studies took into account the terrain elevation around the earth station as well as no clutter or local clutter values, which were lower than the clutter values considered in non-site-specific studies.

### **2/1.13/3.2.1.1.2 SRS**

Some studies performed a non-site-specific aggregate analysis with Monte Carlo simulations. The simulations took time and deployment dependent parameters into account, and the probability distribution of IMT network aggregate interference was compared to the earth station protection

criterion level. Some did simulations in which time and deployment dependent parameters were mixed to illustrate a random deployment scenario and the average of the interference level from all the snapshots was compared to the protection criterion level at the specified time exceedance level. The separation distance was found to be in the range of 0.8-2.0 km in urban, suburban (including suburban open-space) scenarios.

The results of non-site-specific studies considered flat terrain, as well as clutter loss according to Recommendation ITU-R P.2108, which addressed the urban and suburban environment.

Two studies addressed the separation distances that would be required around a number of specific SRS earth stations, considering either one single BS whose antenna panel was oriented towards the victim earth station, or a cluster of up to 31 BSs with random antenna panel orientations. The separation distance would be in the range of 23.8-92.0 km for SRS earth stations, based on the assumptions used in the studies. These distances are only valid for the specific earth stations considered in these studies. The actual separation distances vary from one earth station to another and need to be determined on a case-by-case basis.

All site-specific studies took into account the terrain elevation around the earth station, as well as no clutter or local clutter values, which were lower than the clutter values considered in non-site-specific studies.

## **2/1.13/3.2.1.2 Passive services in adjacent bands and IMT**

### **2/1.13/3.2.1.2.1 EESS (passive)**

Ten studies were performed in relation to compatibility between IMT-2020 in the 24.25-27.5 GHz band and the EESS (passive) in the band 23.6-24.0 GHz. The results in the tables below are expressed as:

- interference exceedance relative to the EESS (passive) protection criteria (−166 dB(W/200 MHz)) based on the IMT-2020 parameters provided; and
- corresponding unwanted emission levels to protect the EESS (passive).

While some of the studies were performed on all sensors in Recommendation ITU-R RS.1861 operating in the 23.6-24.0 GHz frequency band, the results below are based on the most restrictive Sensor F3. Results obtained for the other sensors are similar (F2 and F8) or less restrictive.

#### **Single element antenna pattern**

Some studies considered the IMT single element antenna pattern from Recommendation ITU-R M.2101:

Five studies led to the following results for Sensor F3 (applying the apportionment value of 3 dB of the EESS (passive) protection criteria):

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
A	22.5	−42	−46
B	24.5	−44	−48
I	21.9 to 24.4 (variation due to not normalized/normalized)	−42 to −44 (total UE and BS)	

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
L	18.5 to 25.2 (variation due to normalized/not normalized and percentage of distribution 50% to 99%)	-38.5 to -45	-42 to -49
M	17.7 to 23 dB, (variation due to normalized/not normalized and percentage of distribution 50% to 99%)	-38 to -43	-42 to -47

Three studies led to the following results for Sensor F3 (assuming no apportionment of the EESS (passive) protection criteria):

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
F	15.6 (considering a split of the interference of 90% for BS and 10% for UE)	-30	-40
H	16.4	-36	-40
J	19.4 to 20.4 (variation due to different percentile of unwanted emission level; 90 <sup>th</sup> to 99 <sup>th</sup> )	-35.4 to -36.4	-39.1 to -40.1

In addition, Studies A and B performed a sensitivity analysis considering a population-based redistribution of the IMT-2020 BSs (capped to a maximum of 10 BS/km<sup>2</sup>) and led to the following results for Sensor F3 (applying the apportionment value of 3 dB of the EESS (passive) protection criteria):

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
A	31	-51	-55
B	30.4	-50	-54

Moreover, Studies A and B considered a 2 dB “multi-operator interference factor” to cover the interference falling into the EESS (passive) band 23.6-24.0 GHz from multiple IMT-2020 operators’ channels using the entire 24.25-27.5 GHz frequency band for outdoor deployments and including the possible impact of outdoor UEs connected to indoor BS.

### Beamforming antenna model

Some studies performed a sensitivity analysis using a beamforming antenna model in the unwanted emission domain. In the absence of IMT-2020 antenna measurement data it was agreed in ITU-R that:

- the antenna pattern may remain beamformed to some extent in the adjacent frequency band;
- the Recommendation ITU-R M.2101 model applicable to beamforming gain may in that case underestimate the side-lobe levels (e.g. some simulations have shown that, for an 8×8 array simplified active antenna system (AAS) antenna design model with one slant dipole elements, the Recommendation ITU-R M.2101 model appears to be a reasonable match for the side lobes closest to the main beam, but side lobes further from the main beam would be underestimated by this model);
- the “variance” of the interference distribution is much wider compared to the use of a single element pattern and hence a conclusion on average interference would not be appropriate.

Five studies led to the following results for Sensor F3 (applying the apportionment value of 3 dB of the EESS (passive) protection criteria):

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
A and J	18 (these studies also considered a multi-operator interference factor)	-38	-42
I	21.1 to 22.6 (variation due to not normalized/normalized)	-41 to -42 for BS and UE (total)	
L	11 to 15.7 dB (variation due to normalized/not normalized and percentage of distribution 50% to 99%)	-31 to -36	-35 to -39
M	13.5 to 18 dB (variation due to normalized/not normalized and percentage of distribution 50% to 99%)	-33 to -39	-37 to -42

Five studies considered an IMT-2020 beamforming antenna pattern, assuming no apportionment, and led to the following results for Sensor F3:

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
C <sup>7</sup>	TBD	TBD	TBD

<sup>7</sup> An update will be provided to CPM19-2.

	(additional work is needed)		
F	9.2 dB (Considering a split of the interference of 90% for BS and 10% for UE)	-32	-33
G	9 to 14 dB (for an interference probability from 1% to 10%)	-29 to -34	-32 to -35
H	10.9 dB (Considering a split of the interference of 80% of BS and 20% of UE)	-30.9	-34.7
J	10.1 to 13.8 dB (variation due to with and without normalization at different percentiles of unwanted emission levels, 90% to 99%)	-30.1 to -33.8	-33.8 to -37.5

Two studies led to the following results on the permissible interference criteria levels over the measurement area as prescribed in Recommendation ITU-R RS.2017 for Sensor F3:

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
C <sup>8</sup>	TBD (additional work is needed)	TBD	TBD
G	9 to 14 dB (for an interference probability from 1% to 10%)	-29 to -34	-32 to -35

Study L considered an IMT unwanted emission distribution (mean value -30/-26.3 dB(W/200 MHz) per BS/UE, a standard deviation of 2 dB instead of the baseline fixed value for Sensor F3 (including apportionment) and led to the following results:

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
L	6.4 to 9.7	-26.4 to -29.7	-30.1 to -33.4

Study B also considered the possible impact of the second harmonic of the IMT-2020 stations operating in the 24.25-27.5 GHz frequency band falling in the 50.2-50.4 GHz and 52.6-54.25 GHz EESS (passive) frequency bands, in particular from IMT-2020 BSs.

<sup>8</sup> An update will be provided to CPM19-2.

### **2/1.13/3.2.1.2.2 RAS**

Four compatibility studies between the RAS in the frequency band 23.6-24 GHz and IMT systems in the frequency band 24.2.5-27.5 GHz were provided to ITU-R.

In the case of a single-entry analysis, one non-site specific study using a flat-Earth terrain profile derived a separation distance around a RAS station of 27 km for IMT user equipment and 48-52 km for IMT BSs for out-of-band IMT emission levels of  $-13$  dB(m/MHz) (i.e.  $-43$  dB(W/MHz)) and 5 km for user equipment and 17-18 km for BSs for  $-30$  dB(m/MHz) (i.e.  $-60$  dB(W/MHz)). Another study assumed out-of-band IMT emission levels of  $-65$  dB(W/MHz) for BSs and  $-61$  dB(W/MHz) for user equipment and derived a separation distance of up to 5 km for user equipment and up to 9 km for BSs. Another study using real terrain profiles derived separation distances for BSs and user equipment, which do not exceed 70 km for most of the radio telescopes considered.

Statistical results showed that if the combined aggregate interference of both BSs and user equipment were considered, separation distances were 17-22.5 km for a suburban environment and they ranged from 30 to 52 km for mixed or urban environments. This range was mainly due to the differences in assumed polarization loss (3 or 0 dB) and antenna gain normalization. Unless mentioned otherwise, the above separation distances were derived assuming a  $-13$  dB(m/MHz) i.e.  $-43$  dB(W/MHz) level of out-of-band emission levels for both IMT mobile and BSs. If the unwanted emission level is decreased (as has been proposed to protect the EESS (passive)), these separation distances also decrease, accordingly.

No detailed terrain profiles were used in most of these studies. Taking into account detailed terrain profiles around RAS stations would lead to different separation distances for RAS stations on a case-by-case basis. Given the expected dimensions of the coordination zones around RAS stations, the protection of RAS stations could be established on a national level.

### **2/1.13/3.2.1.3 FSS and IMT**

Sharing and compatibility studies between IMT and the FSS in the Earth-to-space direction have been provided to ITU-R for the frequency bands 24.65-25.25 GHz and 27-27.5 GHz.

#### **Aggregate interference from IMT stations into FSS space stations**

##### **Interference into FSS space stations – Baseline cases**

The FSS protection criteria (without apportionment) in this band are, for the long term,  $-10.5$  dB  $I/N$  (exceeded up to 20% or  $I/N$  average) and, for the short term,  $-6$  dB  $I/N$  exceeded 0.6% and 0 dB  $I/N$  exceeded 0.02% of time, location or probability, for example, for Monte Carlo simulations, the percentage of probability can be expressed in terms of a number of snapshots.

In the case of aggregate long-term interference from IMT stations into FSS space stations in a geostationary orbit, results showed that the calculated  $I/N$  ranged from  $-40.62$  dB to  $-19$  dB for the baseline case.

When considering short-term interference, seven of the studies provided results that showed maximum  $I/N$  values ranging from  $-28.3$  dB to  $-15.8$  dB for the baseline case, which satisfy the short-term protection criteria. The other studies do not address short-term interference.

The studies have been carried out with various methodologies, some statistical, some static/part statistical and some deterministic. The differences in the methodologies and assumptions that have been identified as influencing the results are the FSS boresight elevation angle of the satellite, the density of BSs, the normalization factor of the IMT antenna, the polarization discrimination and the use of clutter loss. The combination of these assumptions can cause a large variation in the results.

A comparison has been made between the studies in terms of long-term  $I/N$  results. In all the following cases, the most sensitive satellite carrier had an antenna gain of 46.6 dBi and a noise temperature of 400 K. The comparison below is based on this satellite carrier and on the cumulative distribution function (CDF) percentages listed above (i.e. 50%, 20% or  $I/N$  average, depending on the study).

Eight of the studies found long-term  $I/N$  values in the range  $-30.3$  dB to  $-24.3$  dB corresponding to FSS boresight elevation angles in the range of  $10^\circ$  to  $30^\circ$ . Some of the variation in results between these studies is due to the inclusion of an IMT antenna normalization factor, which may worsen the  $I/N$  by up to 2 dB. These studies all assumed 3 dB of polarization discrimination.

One study gave results close to other studies with a mean  $I/N$  up to  $-19.2$  dB for a  $10^\circ$  elevation and  $-27.7$  dB  $I/N$  for a  $45^\circ$  elevation with a normalization factor and with a 1.5 dB polarization discrimination.

Study N used census data to assess the IMT deployment density in built-up urban and suburban areas, rather than assuming a constant density, resulting in a mean  $I/N$  of  $-27$  dB for a  $10^\circ$  FSS boresight elevation, not taking into account polarization discrimination or clutter loss. Study E found an  $I/N$  mean of  $-32.8$  dB (with normalization factor), which may be explained by the higher FSS boresight elevation angle ( $48.2^\circ$ ). In this case the BS distribution, adjusted to match the distribution of large cities across different latitudes, makes it difficult to have a more precise comparison.

Different apportionment values for the FSS protection criteria, from 0 dB to 4.7 dB have been assumed in the various studies above.

### **Interference into FSS space stations – Non-baseline cases**

Several studies on the interference to FSS GSO satellites from IMT conducted a sensitivity analysis, i.e. up to 5 dB higher antenna element conducted power than that specified in the baseline or  $16 \times 16$  antenna array as provided for in the clarifications and guidance developed by the ITU-R on how to use the parameters provided in sharing and compatibility studies. These studies concluded that the interference would be increased up to 5 dB or up to 3 dB respectively.

Some studies evaluated the level of interference resulting from assumed deviations on the IMT characteristics other than those provided for in the clarifications and guidance developed by the ITU-R on how to use the parameters provided in sharing and compatibility studies. The additional assumptions included one or more of the following; denser IMT deployments, higher network loading, higher IMT BS conducted power or e.i.r.p., higher FSS boresight elevation angles or higher UE height.

- Study H showed that if a 5 dB higher antenna element conducted power is applied, together with  $16 \times 16$  antenna arrays the average  $I/N$  would be as high as  $-15$  dB.
- Study N showed that if uniform distribution of UE<sup>9</sup> in the BS service area is applied the average  $I/N$  would be as high as  $-12.9$  dB, not including clutter loss or polarization discrimination.
- Study M showed that if a 5 dB higher antenna element conducted power is applied, together with increase of network loading factor and  $16 \times 16$  antenna arrays, the  $I/N$  not exceeded more than 20% of the time would be  $-7.6$  dB.

Study P implemented a Monte Carlo simulation examining the average long-term interference from IMT stations to a non-GSO space station. The study found an  $I/N = -28.3$  dB for the nadir case

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<sup>9</sup> Noting that ITU-R recommended the use of a Rayleigh distribution of UE.

using baseline IMT parameters and ignoring clutter loss, polarization discrimination and atmospheric attenuation for low elevation angles. If the IMT parameters are varied from baseline, the  $I/N$  would be  $-21.7$  dB (for an increase of electronic up tilt of each IMT BS by 10 degrees) or  $-20.5$  dB (for an increase of IMT BS and UE deployment density of five times).

Note: Study P used non-GSO parameters not provided by the involved groups in ITU-R (non-GSO parameters based on filings to the ITU). The results of Study P were not verified by other studies.

### **Conclusions on aggregate interference from IMT stations into FSS space stations**

All studies show that sharing is feasible when using the baseline parameters.

Some administrations were of the view that, based on the results of studies using IMT characteristics other than those provided by the involved groups and in the clarifications and guidance developed by ITU-R on how to use the parameters provided in sharing and compatibility studies, mitigation techniques are required to address potential cases of interference and achieve compatibility between IMT stations and FSS space stations.

### **FSS earth station interference into IMT**

For the case of a FSS earth station interfering into IMT, the results of studies showed separation distances of less than 100 m up to about 10 km between the FSS earth station and IMT stations.

In the case of deployment of FSS earth stations at specified locations, when the required separation distance can be maintained between a location of a FSS earth station with known position and a deployment area of IMT stations, sharing between IMT and the FSS is feasible.

In case of deployment of small FSS earth stations at unspecified locations and IMT stations in the same geographical area, the separation distance between FSS and IMT stations cannot be ensured. Therefore, sharing may or may not be feasible and could be dealt with on a case-by-case basis.

#### **2/1.13/3.2.1.4 ISS and IMT**

Six sharing and compatibility studies were provided that assessed the aggregate interference from IMT-2020 stations into data relay satellite (DRS) systems, operating within an ISS allocation, in the 24.25-27.5 GHz frequency range.

The results of four studies showed a positive interference margin of 12.2 to 25 dB using the following assumptions: no apportionment, 3 dB polarization loss, three different DRS systems (Chinese Data Tracking and Relay System (CTDRS), European Data Relay System (EDRS) and Tracking and Data Relay Satellite (TDRS)), as well as different orbital locations and DRS beam pointing elevation angles. Two of these studies assessed aggregate interference levels within the visibility area of a DRS satellite (based on 99.9%  $I/N$  value or  $I/N$  value from a single snapshot or mean  $I/N$  value) and performed a sensitivity analysis on the antenna array (16×16 antenna array or 5 dB higher per antenna element power) and found an interference margin of 9.5 to 18.4 dB. One of these studies also considered a sensitivity analysis on a population redistribution, which found a margin of 8.2 to 10.2 dB for BS with 8×8 array and minimal elevation angle of 20 degrees towards the DRS satellite for IMT-2020 deployments.

A fifth study considered a statistical calculation based on BS antenna panel random positioning with antenna normalization and assuming an apportionment of 7 dB and a 1.5 dB polarization loss, and derived an interference margin of 10.2 dB for EDRS.

The results of a sixth study showed interference margins of  $-1.5$  and 0.7 dB for two different DRS systems (EDRS and TDRS) using the following assumptions: apportionment of 7 dB, 1.5 dB polarization loss, normalization of IMT-2020 antenna gain patterns and a DRS beam pointing elevation angle of 10 degrees. This study also contained a set of sensitivity analysis, e.g. a 16×16



antenna array and a 5 dB higher per antenna element power, which is similar to the other five studies. The study also considered IMT characteristics other than those provided by the involved ITU-R groups and in the clarifications and guidance developed by ITU-R on how to use the parameters in the studies as follows: A network loading factor of 50% resulted in a 3.5 dB increase in interference; the use of three sectors per BS resulted in a 4.1 dB increase; the application of all of the above-mentioned factors together resulted in an increase of interference up to 15.6 dB. Furthermore, 10% of outdoor users with a height from 10 m to 30 m resulted in an increase of interference by 3.5 and 8 dB for 8×8 and 16×16 antenna arrays, respectively. In order to compensate for the negative margins, this study proposed an e.i.r.p. mask as a mitigation technique to ensure the compatibility of IMT-2020 with ISS space stations.

### **2/1.13/3.2.1.5 FS and IMT**

Several sharing and compatibility studies between the FS and IMT in the frequency band 24.25-27.5 GHz were performed in ITU-R as detailed below.

The results of deterministic studies for the point-to-point FS, using the parameters and assumptions provided, found separation distances ranging from 2.6 km up to 70 km for co-channel cases, while immediately adjacent band cases range from 0.9 to 12 km. The larger separation distances (20 to 70 km) are only found in specific co-channel examples, with a limited probability of occurrence, in which BSs were placed directly in the main beam of high gain FS antennas.

Studies that applied a statistical approach (Monte Carlo simulation) using the parameters and assumptions as provided resulted in separation distances ranging from 1 km to 10 km. The separation distances depend on the scenarios analysed and the ways to account for clutter losses for co-frequency coexistence case.

The single-entry studies summarized above for both the deterministic approach (minimum coupling loss calculation) and the statistical approach (Monte Carlo simulation) showed that the separation distance primarily depends on the coexistence scenarios, frequency separation, relative positions of IMT-2020 BS and FS receiver antennas, and ways to account for clutter losses.

One study that used a statistical approach (Monte Carlo simulation) for multiple entry, using the provided parameters and assumptions, resulted in a separation distance of 4.2 km for the co-frequency coexistence case.

Point-to-multipoint studies investigated the effect of different parameters on a possible coexistence scenario between IMT-2020 and the FS in the 26 GHz band.

Studies that used a statistical approach (Monte Carlo simulation) using parameters and assumptions provided, found that for the co-channel case, the required separation distance ranged approximately from 0.5 up to 34 km. For the adjacent frequency case, the required separation distance ranged from 0 to less than 13 km, while the separation distance further reduced to less than 3 km with the use of a guardband. The separation distances mainly depended on the frequency separation, interference scenario and deployment environments.

The point-to-multipoint studies summarized above showed that coexistence between IMT-2020 and the fixed service is possible using frequency and/or spatial separation.

For both point-to-point and point-to-multipoint, coexistence between IMT-2020 and FS receivers can be achieved taking into account local specifics, frequency separation and deployment scenarios.

### **2/1.13/3.2.2 Frequency range 31.8-33.4 GHz**

The frequency range 31.8-33.4 GHz, or parts thereof, is allocated to the FS, ISS, RNS and SRS. The frequency bands adjacent to this frequency range are allocated to the EESS (passive), RAS and SRS

(passive). The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the RNS, SRS, EESS (passive) and RAS and are summarized in the subsections below. Characteristics were not received for the ISS and, therefore, studies were not carried out for the ISS. Studies are not needed for the SRS (passive), as this service is dealing with sensors around other planets and no interference issue is expected. Studies were not carried out for the FS.

#### **2/1.13/3.2.2.1 RNS and IMT**

Several studies have dealt with single-entry and aggregated interference from IMT into the RNS. All these studies have demonstrated difficulties for co-channel sharing.

In particular, for the case of compatibility of IMT-2020 and aircraft radars, the sharing studies (single-entry/aggregated, dynamic/static) have shown that IMT-2020 systems can cause interference to the airborne radars operating in the RNS:

- the percentages of time of exceedance of the protection criterion ( $I/N = -6$  dB) range from 20% up to 43% depending on the type of radar;
- separation distances of about 100 km are necessary to avoid interference exceeding the protection criterion, therefore coordination would be difficult to carry out for airborne radars.

Based on these results, it can be concluded that sharing between IMT-2020 systems and the RNS within 31.8-33.4 GHz is not feasible.

#### **2/1.13/3.2.2.2 SRS (deep space) (space-to-Earth) and IMT**

Sharing and compatibility studies between the SRS (deep space) (space-to-Earth) in the 31.8-32.3 GHz frequency band and IMT systems in the 31.8-33.4 GHz frequency band were conducted.

These studies have shown that the separation distances around several SRS earth station locations would be in the order of 24 to 83 km depending on the earth stations considered. These distances were calculated for a single BS and for multiple-entry aggregate interference with a power per antenna element of 10 dB (m/200 MHz), i.e.  $-20$  dB(W/200 MHz), and an  $8 \times 8$  elements antenna.

The study results indicate that the separation distances needed to protect these particular facilities are relatively small; consequently, the protection of these stations could be considered on a national or bilateral/multilateral level.

#### **2/1.13/3.2.2.3 EESS (passive) in adjacent band and IMT**

Three compatibility studies between the EESS (passive) sensors in the frequency band 31.3-31.8 GHz and IMT systems in the frequency band 31.8-33.4 GHz were provided to ITU-R. In this section, these studies are referred to as Studies 1 to 3. Among the sensors given in Recommendation ITU-R RS.1861, these studies showed that Sensor G3 is the most sensitive to aggregated interference from IMT systems.

When the IMT antenna pattern in the adjacent band is modelled by a single element, the levels of interference exceedance compared to the protection criterion of Sensor G3 were 23.7 dB in Study 1 and 16.1 dB in Study 3. The different exceedance levels were due to different assumptions employed in these studies, such as the apportionment of EESS (passive) protection criteria (Study 1: 3 dB, Study 3: 0 dB) and application of the normalization factor for the IMT single-element antenna pattern (BS: 4.8 dB, UE: 2.4 dB) (Study 1: applied, Study 3: not applied). Furthermore, Study 1 considered a 2 dB “multi-operator interference factor” to cover the interference falling into the EESS passive band 31.3-31.8 GHz from multiple IMT-2020 operators’ channels using the entire

31.8-33.4 GHz frequency band for outdoor deployments and including the possible impact of outdoor UEs connected to indoor BS.

As a sensitivity analysis for Sensor G3, Study 1 derived that, if the deployment density of IMT BSs in an urban area is increased using a population based redistribution, the exceedance level is increased to 28.4 dB. Study 1 also demonstrated that, when considering the new type of EESS (passive) sensor (MWI sensor), which presents different parameters than those described in Recommendation ITU-R RS.1861, the level of interference exceedance became 30.7 dB under the same conditions.

Studies 2 and 3 performed a sensitivity analysis using a beamforming antenna model in the unwanted emission domain. In the absence of IMT-2020 antenna measurement data, it was agreed in ITU-R that:

- the antenna pattern may remain beamformed to some extent in the adjacent frequency band;
- the Recommendation ITU-R M.2101 model applicable to beamforming gain may in that case underestimate the side-lobe levels (e.g. some simulations have shown that, for an 8×8 array simplified AAS antenna design model with one slant dipole elements, the Recommendation ITU-R M.2101 model appears to be a reasonable match for the side lobes closest to the main beam, but side lobes further from the main beam would be underestimated by this model);
- the “variance” of the interference distribution is much wider compared to the use of a single element pattern and hence a conclusion on average interference would not be appropriate.

Additional work is needed on Study 2<sup>10</sup>.

In Study 3, the exceedance level compared to the protection criterion of the Sensor G3 is calculated as 5.6 dB under the same conditions described above for the IMT single-element antenna pattern (based on no apportionment assumed).

Based on the levels of interference exceedance derived above for Sensor G3, the following unwanted emission limits in the 31.3-31.8 GHz frequency band are suggested in some studies:

- in Study 1: –50.3 dB(W/200 MHz) for BS and –48.4 dB(W/200 MHz) for UE.
- in Study 3: –26.7 dB(W/200 MHz) for BS and –24.1 dB(W/200 MHz) for UE.

#### **2/1.13/3.2.2.4 RAS in adjacent band and IMT**

A sharing and compatibility study between the RAS in the frequency band 31.3-31.8 GHz and IMT systems in the frequency band 31.8-33.4 GHz was conducted.

In the study, a –13 dB(m/MHz), i.e. –43 dB(W/MHz), level of unwanted emission was assumed for both IMT UEs and BSs. This study showed that for IMT UEs, the separation distances around RAS stations are 19 km for a single interferer scenario and 35 km for the aggregate interference scenario assuming a constant density of UEs around the RAS stations. For IMT BSs, the study showed that the separation distances are 48 km for a single interferer and 49 km for the aggregate interference scenario assuming a constant density of BSs around the RAS stations. If the combined aggregated emissions of both UEs and BSs are considered, the study derived a separation distance of 49 km.

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<sup>10</sup> An update will be provided to CPM19-2.

### **2/1.13/3.2.3 Frequency bands 37-40.5 GHz and 40.5-42.5 GHz**

The frequency range 37-42.5 GHz, or parts thereof, is allocated to the broadcasting service, BSS, EESS, FS, FSS, MS, MSS, RAS and SRS. The frequency bands adjacent to this frequency range are allocated to the EESS (passive) and SRS (passive). The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the EESS/SRS (passive) in 36-37 GHz, FSS, MSS, BSS, RAS and FS which are summarized in the subsections below. Characteristics were not received for the broadcasting service<sup>11</sup> or the EESS/SRS (40.0-40.5 GHz)<sup>12</sup> and, therefore, studies were not carried out for these services. Studies are not needed for the SRS (passive), as this service is dealing with sensors around other planets and no interference issue is expected.

#### **2/1.13/3.2.3.1 FSS/BSS/MSS (space-to-Earth) and IMT**

Several sharing and compatibility studies between IMT-2020 and FSS/BSS/MSS in the space-to-Earth direction were provided to ITU-R in the frequency bands 37.5-42.5 GHz, as well as in the frequency bands 47.5-47.9 GHz, 48.2-48.54 GHz and 49.44-50.2 GHz in Region 1. These studies employed statistical analyses using the same or similar parameter values and assessed aggregate interference from IMT-2020 stations into an earth station. With respect to the interference criteria of an earth station, different values were assumed according to the respective studies, together with different time percentages to model the long-term and short-term interference criteria. The results of these studies showed that, when a separation distance between 210 and 2 000 metres is kept between a location of a FSS earth station and a deployment area of IMT-2020 stations, the aggregate interference from IMT-2020 stations met the interference criteria assumed in the respective studies and sharing between IMT-2020 and the FSS in the space-to-Earth direction is feasible. One study conducted a sensitivity analysis of the IMT parameters and the results for the separation distance were consistent with the results given above.

In the case of deployment of FSS earth stations at specified locations, when the required separation distance can be maintained between a location of a FSS earth station with a known position and a deployment area of IMT stations, sharing between IMT and FSS is feasible.

In case of deployment of small FSS earth stations at unspecified locations and IMT stations in the same geographical area the separation distance between FSS and IMT stations cannot be ensured. Therefore, sharing may or may not be feasible and could be dealt with on a case-by-case basis.

#### **2/1.13/3.2.3.2 SRS and IMT**

Studies have shown that the separation distances around several SRS earth station locations would be in the order of 24 to 100 km depending on the earth stations considered and the surrounding terrain. Another study, considering space-very long baseline interferometry (VLBI) missions, clutter losses, and smooth Earth propagation predicted that the separation distance needed would be of the order of a few kilometres. The results depend on the earth station considered and the actual distance should be determined on a case-by-case basis.

The study results also indicated that the protection of these stations could be considered on a national or bilateral/multilateral level.

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<sup>11</sup> There are no entries in the MIFR for the broadcasting service in this band.

<sup>12</sup> EESS/SRS in the band is an active service operating in the Earth-to-space direction. No impact is expected from IMT.

### 2/1.13/3.2.3.3 EESS/SRS (passive) and IMT

Several compatibility studies between the EESS/SRS (passive) in the frequency band 36-37 GHz and IMT in the frequency band 37-43.5 GHz have been provided to ITU-R. These studies showed that Sensor H3 is the most sensitive to aggregated interference from IMT systems. According to the results of Studies A, B and C, assuming 317 IMT BSs within the instantaneous field of view (IFOV), when the unwanted emission level of IMT stations is  $-13$  dB(m/MHz), i.e.  $-43$  dB(W/MHz), the aggregate level interference exceedance for Sensor H3, were  $-4$  to  $17.4$  dB for UE and  $5$  to  $16.7$  dB for BS, corresponding to levels of unwanted emissions of  $-23$  to  $-37.6$  dB(W/100 MHz) for UE, and  $-28$  to  $-36.9$  dB(W/100 MHz) for BS depending on the assumptions used (in particular single element or beam forming antenna pattern). Studies A, B and C did not consider apportionment of the EESS (passive) protection criteria.

A new Study D was received that was not fully reviewed and the reason for the differences between the results of this study and the other studies could not be determined. This study considered the single element IMT antenna pattern, the 3 dB apportionment of the EESS (passive) protection criteria, as well as a 2 dB factor for multi-operator aggregation to account for the interference from other IMT-2020 operators' networks. On this basis, assuming 317 IMT BSs within the Sensor H3 IFOV, Study D showed that the levels of interference exceedance  $26.1$  dB, corresponding to levels of unwanted emissions for UE and BS of  $-46/-47$  dB(W/100 MHz), respectively. Considering that IMT-2020 is designed to provide hot spot coverage and not ubiquitous coverage it was questioned if these results would not be 'excluded' according to Recommendation ITU-R RS.2017, which allows for 0.1% in time or area of the  $10\,000\,000$  km<sup>2</sup> to exceed the interference criteria, this would allow for 66 pixels of Sensor H3 to exceed the  $-166$  dB(W/100 MHz) within this area or the corresponding time.

According to Resolution **752 (WRC-07)**, in order to facilitate sharing between active and passive services in the frequency band 36-37 GHz, stations in the MS brought into use after the date of entry into force of the Final Acts of WRC-07 shall comply with the sharing criterion that the maximum transmitter power at the antenna port is  $-10$  dBW.

In this case, the unwanted emission level of  $-13$  dB(m/MHz), i.e.  $-43$  dB(W/MHz), for an IMT station, which is equivalent to  $-13$  dBW in the frequency band 36-37 GHz, satisfies the conditions described in Resolution **752 (WRC-07)** ( $-10$  dBW). It should however be noted that the deployment of IMT-2020 is expected to be denser than the fixed and mobile systems considered in the development of Resolution **752 (WRC-07)**.

### 2/1.13/3.2.3.4 FS and IMT

One sharing and compatibility study between the FS and IMT in the frequency band 37.0-43.5 GHz was provided to ITU-R. The study assumed a scenario where an FS system points directly across an IMT deployment area in a dense urban environment. More specifically, the FS transmitter is located 1.1 km directly south of the centre of the IMT deployment area and the FS receiver is located 1.1 km directly north of the centre of the IMT deployment area. The FS station antennas are pointed toward each other.

The results of the study showed that, for 0.8% of the snapshots, the interference from IMT BSs into FS receivers exceeded the interference criterion of  $I/N = -10$  dB for the FS system.

Considering that only for a small percentage of snapshots the interference criterion is exceeded under the condition of a small separation distance described above, the study concluded that sharing between the FS and IMT is considered feasible when such a separation distance beyond 1.1 km is kept between a location of a FS station and a deployment area of IMT stations.

Additional studies may be needed to investigate other scenarios which are not considered in the above study.

### **2/1.13/3.2.3.5 RAS and IMT**

Two adjacent frequency band compatibility studies were conducted between the RAS in the frequency band 42.5-43.5 GHz and IMT systems in the frequency band 40.5-42.5 GHz. For one study a uniform density of user equipment and BSs was assumed around RAS stations while one study also considered a clustered deployment density.

In the adjacent frequency band compatibility studies, assuming a  $-13$  dB(m/MHz), i.e.  $-43$  dB(W/MHz), level of unwanted emissions for both IMT user equipment and BSs, separation distances of 38 km and 14 km were obtained between a RAS station and a BS and a user equipment, respectively. The separation distances assuming  $-30$  dB(m/MHz), i.e.  $-60$  dB(W/MHz), became 8 km and 2 km, respectively. In the aggregate interference scenario, if the combined aggregated emissions of both user equipment and BSs are considered, one study obtained separation distances of 5 km for a purely suburban environment. Results of the other studies ranged from 28 km (assuming polarization loss (3 dB) and not considering antenna gain normalization) to 48 km (clustered density, no polarization loss, normalized antenna gain) for mixed urban/suburban environments. Assuming a  $-30$  dB(m/MHz), i.e.  $-60$  dB(W/MHz), level of unwanted emissions for both IMT user equipment and BSs the combined separation distance became 18 km for a clustered deployment density.

No detailed terrain profiles were used in these studies. Considering detailed terrain profiles around RAS stations would lead to different separation distances for RAS stations on a case-by-case basis. Given the expected dimensions of the coordination zones around RAS stations, the protection of RAS stations could be established on a national level.

### **2/1.13/3.2.4 Frequency band 42.5-43.5GHz**

The frequency range 42.5-43.5 GHz is allocated to the FS, FSS, MS and RAS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies carried out for the FS, FSS (Earth-to-space) and RAS are summarized in the subsections below.

#### **2/1.13/3.2.4.1 FSS (Earth-to-space) and IMT**

Several sharing and compatibility studies were conducted between IMT-2020 and the FSS in the Earth-to-space direction in the frequency band 42.5-43.5 GHz. These studies used deterministic and statistical analyses.

#### **Aggregate interference from IMT-2020 into GSO FSS space stations**

In the case of aggregate interference from IMT stations into GSO FSS space stations, the results of studies, using parameters provided by the responsible groups of ITU-R, showed that the long-term interference  $I/N$  ranged from  $-43.46$  dB to  $-26.5$  dB. When compared with the  $-10.5$  dB  $I/N$  protection criterion, in all cases there is a positive margin between 33 dB to 16 dB without apportionment (30 dB to 13 dB with apportionment).

Some studies conducted sensitivity analyses using parameters, assumptions and the agreed course of action on how to vary these parameters developed by ITU-R on how to conduct sharing and compatibility studies, such as up to 5 dB higher antenna element conducted power than that specified in the baseline or  $16 \times 16$  antenna array. These studies found that the protection criteria were not exceeded with a positive margin.

Some studies conducted other sensitivity analyses using IMT parameters and assumptions, other than those considered by the ITU-R as well as differing from the agreed course of action on how to vary these parameters on how to conduct sharing and compatibility studies, using multiple deviations on the IMT characteristics (e.g. higher or lower IMT deployments, higher IMT BS e.i.r.p., higher IMT BS tilt angle, different antenna element output power and/or antenna array). These studies showed that the long-term interference  $I/N$  range was up to  $-16.4$  dB depending on different input data and assumptions and GSO FSS was considered to be protected with at least a  $5.9$  dB ( $2.9$  dB with apportionment) positive margin.

### **Aggregate interference from IMT-2020 into non-GSO FSS space stations**

In the case of aggregate interference from IMT stations into non-GSO FSS space stations, the results of fixed orbit position studies, based on parameters provided by the responsible groups of the ITU-R, showed that the long-term interference  $I/N$  values ranged from  $-35.9$  dB to  $-49.7$  dB for specific positions of the non-GSO satellite orbit. Two studies provided dynamic analyses of non-GSO systems which assess the parameters using Carrier #34 (with  $41.7$  dBi antenna gain) and Carrier #44 (with  $35$  dBi antenna gain). One study showed long-term  $I/N$  values ranging from  $-34.8$  dB to  $-38.2$  dB. In all cases there is a positive margin between  $24.3$  dB and  $27.7$  dB without apportionment.

Another study ran a dynamic simulation of a non-GSO network and found a long-term interference  $I/N$  of  $-21.3$  dB corresponding to a positive margin of  $10.8$  dB ( $7.8$  dB with apportionment). In addition, several other simulations under similar assumptions have resulted in an  $I/N$  below  $-30$  dB instead of  $-21.3$  dB.

Some studies conducted sensitivity analyses using IMT parameters and assumptions other than those considered by ITU-R as well as differing from the agreed course of action on how to vary these parameters on how to conduct sharing and compatibility studies, using multiple simultaneous deviations on the IMT characteristics (i.e. up to  $5$  dB higher antenna element conducted power than that specified in the baseline or  $16 \times 16$  antenna array and network loading factor up to  $50\%$ ). One study provided long-term  $I/N$  values from  $-11.5$  dB to  $-1.9$  dB depending on different input data and assumptions. In the worst case, the long-term protection criterion of  $-10.5$  dB will be exceeded by  $8.6$  dB ( $11.6$  dB with apportionment).

One study (Study H) evaluated a non-GSO system using a combination of parameters from different sources. The study found an  $I/N = -7.9$  dB, i.e. a negative margin of  $2.6$  dB ( $5.6$  dB with apportionment). In addition, several other simulations under similar assumptions resulted in an  $I/N$  below  $-25$  dB instead of  $-7.9$  dB, and well below the protection criteria.

Note: Study H used non-GSO parameters not provided by the ITU-R responsible group, but used parameters based on multiple systems filed in the ITU-R SRS database and similar antenna gain provided by the ITU-R responsible group (Carriers #28, #29, and #30).

Some administrations were of the view that, based on the results of studies using IMT parameters and assumptions other than those considered by ITU-R as well as the agreed course of action on how to vary these parameters, mitigation techniques are required to address potential cases of interference and achieve compatibility between IMT stations and FSS space stations.

### **Interference from FSS earth stations to IMT-2020**

For the case of an FSS earth station interfering into IMT, the results of studies showed separation distances between  $160$  metres to  $4\,000$  metres based on the assumptions used between the FSS earth station and the IMT stations.

In the case of deployment of FSS earth stations at specified locations, when the required separation distance can be maintained between a location of a FSS earth station with a known position and a deployment area of IMT stations, sharing between IMT and the FSS is feasible.

In case of deployment of small FSS earth stations at unspecified locations and IMT stations in the same geographical area the separation distance between the FSS and IMT stations cannot be ensured. Therefore, sharing may or may not be feasible and could be dealt with on a case-by-case basis.

#### **2/1.13/3.2.4.2 FS and IMT**

Note: See Section 2/1.13/3.2.3.4 above.

#### **2/1.13/3.2.4.3 RAS and IMT**

Two in-band sharing studies were conducted between the RAS and IMT in the frequency band 42.5-43.5 GHz. For one study a uniform density of user equipment and BSs was assumed around RAS stations, while another study also considered a clustered deployment density.

For the in-band sharing studies, in the single emitter case, separation distances from a RAS station were obtained to be 68 km and 42 km to a BS and a UE, respectively. If the combined aggregated emissions of both UE and BS were considered, separation distances ranging from 36 km (assuming polarization loss (3 dB) and using lower antenna height) to 57 km (clustered density, no polarization loss, normalized antenna gain and using higher antenna height) were derived for, respectively, purely suburban and mixed urban/suburban environments. These studies used the baseline assumptions as provided by the responsible groups.

No detailed terrain profiles were used in these studies. Considering detailed terrain profiles around RAS stations would lead to different separation distances for RAS stations on a case-by-case basis. Given the expected dimensions of the coordination zones around RAS stations, the protection of RAS stations could be established on a national level.

#### **2/1.13/3.2.5 Frequency range 45.5-47 GHz**

The frequency range 45.5-47 GHz, or parts thereof, is allocated to the MS, MSS, RNS and RNSS. The frequency bands adjacent to this frequency range are allocated to the ARS and ARSS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

No studies for this band were performed in ITU-R.

#### **2/1.13/3.2.6 Frequency range 47-47.2 GHz**

The frequency range 47-47.2 GHz, or parts thereof, is allocated to the ARS and ARSS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

No studies for this band were performed in ITU-R.

#### **2/1.13/3.2.7 Frequency range 47.2-50.2 GHz**

The frequency range 47.2-50.2 GHz, or parts thereof, is allocated to the FS, FSS and MS. The frequency bands adjacent to this frequency range are allocated to the EESS (passive) and SRS (passive). The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the EESS (passive) and FSS (Earth-to-space) and are summarized in the subsections below.



### **2/1.13/3.2.7.1 FSS (Earth-to-space) and IMT**

Several sharing and compatibility studies between IMT and the FSS in the Earth-to-space direction were conducted in the frequency band 47.2-50.2 GHz. These studies employed deterministic and statistical analyses.

In the case of aggregate interference from IMT stations into a GSO FSS space station, results of the studies using the assumptions provided by the responsible groups showed that the calculated  $I/N$  ranged from  $-37$  dB to  $-30$  dB. The difference relates to the used FSS boresight elevation angles and if IMT deployment is in the  $-3$  dB satellite footprint or the whole satellite visible Earth view. One study calculated probability distributions of IMT gain towards the space station and presumed the worst-case value for each IMT transmitter (elevation and azimuth) in the satellite beam and found an  $I/N$  of  $-19$  dB without clutter considerations.

For the non-GSO case, two deterministic studies using both a static scenario and single low elevation angle (i.e.  $10^\circ$ ) of the non-GSO satellite led to an  $I/N$  of  $-21.7$  dB and  $-35.6$  dB. Another study using a statistical analysis and the baseline parameters found an  $I/N$  of  $-37$  dB.

A sensitivity analysis was carried out using parameters, assumptions and the agreed course of action on how to vary these parameters developed by ITU-R on how to use the parameters provided in sharing and compatibility studies such as up to a 5 dB higher antenna element conducted power than that specified in the baseline or  $16 \times 16$  antenna array found that the protection criteria were met with a positive margin from 3.2 to 5.1 dB with a 3 dB apportionment. One study conducted a sensitivity analysis using IMT characteristics other than those considered by ITU-R, as well as differing from the agreed course of action on how to vary these parameters, i.e. a single-entry analysis with no clutter loss and with the IMT BS main beam directed towards the FSS satellite. This study found that under such circumstances there might be interference issues.

For both GSO and non-GSO systems, some administrations were of the view that, based on the results of studies using IMT characteristics other than those provided by the involved groups and in the clarifications and guidance developed by ITU-R on how to use the parameters provided in sharing and compatibility studies, mitigation techniques are required to address potential cases of interference and achieve compatibility between IMT stations and FSS space stations.

For the case of an FSS earth station interfering into IMT, the results concluded there is a need for a separation distance between 160 metres and 5 000 metres, based on the assumptions used between the FSS earth station and the IMT stations' deployed area.

In the case of deployment of FSS earth stations at specified locations, when the required separation distance can be maintained between a location of a FSS earth station with a known position and a deployment area of IMT stations, sharing between IMT and the FSS is feasible.

In the case of deployment of small FSS earth stations at unspecified locations and IMT stations in the same geographical area, the separation distance between the FSS and IMT stations cannot be ensured. Therefore, sharing may or may not be feasible and could be dealt with on a case-by-case basis.

### **2/1.13/3.2.7.2 FSS/BSS/MSS (space-to-Earth) and IMT**

See Section 2/1.13/3.2.3.1 above.

### **2/1.13/3.2.7.3 EESS (passive) and IMT**

Four studies were received in relation to compatibility between IMT-2020 in the 47.2-50.2 GHz frequency band and the EESS (passive) in the frequency band 50.2-50.4 GHz. The results in the tables below are expressed as:

- interference exceedance relative to the EESS (passive) protection criteria (−166 dB(W/200 MHz)) based on the IMT-2020 parameters provided; and
- corresponding unwanted emission levels to protect the EESS (passive).

Some studies considered the single antenna pattern from Recommendation ITU-R M.2101.

Studies B and C led to the following results for Sensor I1 (applying the apportionment value of 3 dB of the EESS (passive) protection criteria):

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
B	23.6	−41.4	−43.4
C	21.3 to 28.3	−39.4 to −46.4	−41.1 to −48.1

In addition, Study B considered a population-based redistribution of the IMT-2020 BSs (capped to a maximum of 10 BS/km<sup>2</sup>) and led to the following results for Sensor I1 was (applying the apportionment value of 3 dB of the EESS passive protection criteria):

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
B	29.5	−47.6	−49.3

Study B considered a 2 dB “multi-operator interference factor” to cover the interference falling into the EESS passive band 50.2-50.4 GHz from multiple IMT-2020 operators’ channels using the entire 47.2-50.2 GHz frequency band for outdoor deployments and including the possible impact of outdoor UEs connected to indoor BS.

Some studies performed a sensitivity analysis using a beamforming antenna model in the unwanted emission domain. In the absence of IMT-2020 antenna measurement data it was agreed in TG 5/1 that:

- the antenna pattern may remain beamformed to some extent in the adjacent frequency band;
- the Recommendation ITU-R M.2101 model applicable to beamforming gain may in that case underestimate the side-lobe levels (e.g. some simulations have shown that, for an 8×8 array simplified AAS antenna design model with one slant dipole elements, the Recommendation ITU-R M.2101 model appears to be a reasonable match for the side lobes closest to the main beam, but side lobes further from the main beam would be underestimated by this model);
- the “variance” of the interference distribution is much wider compared to the use of a single element pattern and hence a conclusion on average interference would not be appropriate.

Assuming no apportionment, Studies A and D considered an IMT-2020 beamforming antenna pattern and led to the following results for Sensor I1:

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
A <sup>13</sup>	TBD (additional work is needed)	TBD	TBD
D	8 to 12 (for BS) 5 to 11 (for UE)	-25 to -31	-31 to -35

Study D has a sensitivity analysis that connects the interference criteria's area allowance to the percentile used to determine the results, the effect of which is to simulate the impact over the entire two million square kilometres.

Study C considered apportionment and an IMT-2020 beamforming antenna pattern and led to the following results for Sensor I1:

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
C	9.2 to 15.6	-27.3 to -33.7	-29 to -35.4

Study C considered an IMT unwanted emission distribution (mean value -26/-24.4 dB(W/200 MHz) per BS/UE, standard deviation 2 dB) instead of the baseline fixed value for Sensor I1 (including apportionment) and led to the following results:

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
C	5 to 9.9	-23.1 to -28	-24.8 to -29.7

### 2/1.13/3.2.8 Frequency range 50.4-52.6 GHz

The frequency range 50.4-52.6 GHz, or parts thereof, is allocated to the FS, FSS and MS. The frequency bands adjacent to this frequency range are allocated to the EESS (passive) and SRS (passive). The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the EESS (passive) and FSS (Earth-to-space) and are summarized in the subsections below.

<sup>13</sup> An update will be provided to CPM19-2.

### **2/1.13/3.2.8.1 FSS (Earth-to-space) and IMT**

Several sharing and compatibility studies between IMT and the FSS in the Earth-to-space direction were conducted in the frequency band 50.4-52.6 GHz noting the FSS allocation is in the frequency band 50.4-51.4 GHz as well as issue 9.1.9<sup>14</sup>. These studies have employed deterministic and statistical analyses using the parameters provided by the responsible groups.

In the case of aggregate interference from IMT stations into a FSS space station, one study concluded that for the worst-case scenario, the mean  $I/N$ , is  $-34$  dB for GSO. Another study calculated a value of  $-30.4$  dB mean  $I/N$  for a GSO satellite and  $-21.7$  dB for a non-GSO satellite. One study calculated probability distributions of IMT gain towards the space station and presumed the worst-case value for each IMT transmitter (elevation and azimuth) in the satellite beam and found an  $I/N$  of  $-19$  dB without clutter considerations.

Sensitivity analyses were carried out using parameters' assumptions and the agreed course of action on how to vary these parameters developed by ITU-R on how to use the parameters provided in sharing and compatibility studies such as up to a 5 dB higher antenna element conducted power than that specified in the baseline or  $16 \times 16$  antenna array. These studies found that the protection criteria were not exceeded with a positive margin.

Some studies considered IMT characteristics that deviate even further (e.g. in terms of denser IMT deployments, higher IMT BS e.i.r.p., higher IMT BS elevation angle, different antenna element output power and/or antenna array), i.e. not in line with the agreed course of action on how to vary these parameters developed by ITU-R.

Some administrations were of the view that, based on the results of studies using IMT characteristics other than those provided by the involved groups and in the clarifications and guidance developed by ITU-R on how to use the parameters provided in sharing and compatibility studies, mitigation techniques are required to address potential cases of interference and achieve compatibility between IMT stations and FSS space stations.

For the case of an FSS earth station interfering into IMT, the results concluded there is a need for a separation distance from 160 metres to 5 km.

In the case of deployment of FSS earth stations at specified locations, when the required separation distance can be maintained between a location of a FSS earth station with a known position and a deployment area of IMT stations, sharing between IMT and the FSS is feasible.

In case of deployment of small FSS earth stations at unspecified locations and IMT stations in the same geographical area the separation distance between the FSS and IMT stations cannot be ensured. Therefore, sharing may or may not be feasible and could be dealt with on a case-by-case basis.

### **2/1.13/3.2.8.2 EESS (passive) and IMT**

Two compatibility studies between the EESS (passive) sensors in the frequency band 52.6-54.25 GHz and IMT systems in the frequency band 50.4-52.6 GHz (Studies A and B) were provided to ITU-R. Among the sensors given in Recommendation ITU-R RS.1861, these studies showed that Sensor J2 is the most sensitive to aggregated interference from IMT systems.

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<sup>14</sup> In accordance with Resolution **162 (WRC-15)**, agenda item 9.1, issue 9.1.9, invites ITU-R to conduct studies considering additional spectrum needs for development of the FSS and conduct sharing and compatibility studies with existing services to determine the suitability of new primary allocations to the FSS in the frequency band 51.4-52.4 GHz (Earth-to-space) limited to FSS feeder links for geostationary orbit use, and the possible associated regulatory actions.

Note that the results of Study A are preliminary. Additional work is needed on Study A<sup>15</sup>.

In Study B, under all deployment scenarios, negative margins up to 24.4 dB are calculated (assuming apportionment and multi-operator/channel factor). The impact of a population spatial distribution of BS is important, leading to a potential interference higher as compared to the ITU-R deployment Examples A and B, according to Annex 1 to the TG 5/1 Chairman's Report (see Document [5-1/478](#)), by about 6 dB (when capped to 10 BS/km<sup>2</sup>) and 9 dB (when uncapped). For the BS interference, the unwanted emission level is -45.3 dB(W/200 MHz). For the UE interference, the unwanted emission level needed is -44.3 dB(W/200 MHz).

### **2/1.13/3.2.9 Frequency range 66-71 GHz**

The frequency range 66-71 GHz, or parts thereof, is allocated to the ISS, MS, MSS, RNS and RNSS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the ISS and MSS (Earth-to-space) and are summarized in the subsections below. Characteristics were not received for the RNS and RNSS and therefore, studies were not carried out for these services. Studies were also not carried out for the MSS (space-to-Earth).

#### **2/1.13/3.2.9.1 ISS**

The study provided a single-entry worst-case analysis for both the BS and UE case for the interference scenario where the ISS DRS is at 1° elevation and at 80° elevation. These two cases emphasized two different situations; the situation where the atmospheric loss is minimized, and the situation where the antenna gain of the BS is maximized. The study showed an interference threshold margin towards the DRS in the range of 38 dB to 127 dB, assuming a protection criterion  $I_o/N_o$  of -10 dB.

Therefore, it can be assumed that coexistence between IMT-2020 and the ISS in the 66-71 GHz frequency band is feasible without additional technical or regulatory constraints on IMT.

#### **2/1.13/3.2.9.2 MSS (Earth-to-space)**

One study provided a single-entry analysis for a worst-case scenario to evaluate the interference level from IMT-2020 to a MSS receiving satellite, when IMT-2020 is deployed based on the characteristics provided by the involved ITU-R groups. This study considered the potential interference from the IMT-2020 BS and UE to the MSS receiving GSO satellite; where the range of elevation angles to the MSS satellite is from the horizon at 0° elevation to 90° elevation (zenith). In this study, the potential interference level was assessed as no protection criteria for MSS was available for this frequency band in ITU-R. This analysis showed that the interference level from IMT-2020 was from -347 dB(W/MHz) to -176 dB(W/MHz), considering the following assumptions: IMT-2020 BS antenna was pointing lower than 1.8° below the horizon and the IMT-2020 UE was pointing upwards directly to the satellite, the total output powers of BS and UE considered were 27 dB(m/200 MHz) (i.e. -3 dB(W/200 MHz) and 18 dB(m/200 MHz) (i.e. -12 dB(W/200 MHz), respectively (based on the characteristics provided by the involved ITU-R groups).

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<sup>15</sup> An update will be provided to CPM19-2.

### **2/1.13/3.2.10 Frequency range 71-76 GHz**

The frequency range 71-76 GHz, or parts thereof, is allocated to the broadcasting service, BSS, FS, FSS, MS and MSS. The frequency bands adjacent to this frequency range are allocated to the ARS, ARSS, RAS and RLS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the FS, RLS and FSS and are summarized in the subsections below. Characteristics were not received for the broadcasting service, ARS and ARSS and therefore, studies were not carried out for these services. Studies were also not carried out for the RAS, BSS and MSS (space-to-Earth).

#### **2/1.13/3.2.10.1 FS**

Statistical studies for a single-entry IMT BS case, for different antenna heights of FS receiver where the IMT BS is within the beam of the FS receiver, showed that a separation distance of 970 to 260 m for antenna heights of 10 to 40 m respectively, will ensure that the protection criteria for the FS receiver are met. Alternatively, a separation distance of 250 metres with an azimuth offset of antenna boresights between the IMT BS and FS receiver will also ensure that the protection criterion is met.

Statistical studies for the aggregated case showed that for different antenna heights of FS receiver (from 10 to 40 metres), a separation distance of 720 m from a FS receiver at 10 m will ensure that the protection criteria are met, in general, without separation distances for the aggregate case.

In summary, despite a strong interference potential when an IMT BS is located precisely in the FS receiver antenna boresight direction, the potential interference to FS receiver is limited and sharing would be feasible.

#### **2/1.13/3.2.10.2 RLS**

Two studies were received which dealt with the compatibility between IMT-2020 in the frequency bands 71-76 GHz and 81-86 GHz and automotive radar in the frequency band 76-77 GHz (i.e. Radar A of Category 1 from Recommendation ITU-R M.2057). Study A gave a range of IMT unwanted emission levels that were assumed to provide appropriate protection of the automotive radars, while Study B used various IMT-2020 unwanted emission levels to assess the probability of interference.

The IMT stations' spurious emission level assumed in both studies is a constant value over the operating band of automotive radars.

Study A assumed a 99% applicability of the protection criterion of  $I/N = -6$  dB and did not apply antenna normalization. The baseline and sensitivity analysis took into account different propagation models (Report ITU-R M.2412 and Recommendation ITU-R P.452); the sensitivity analysis considered the potential effects of the surrounding obstacles. The statistics used for deriving the IMT-2020 maximum unwanted emission limits included the interference cases to automotive radars in the range of 300 m from the BS, while the assumed BS cell radius was 100 m.

Study A showed that to protect automotive radars operating in the 76-77 GHz frequency band, IMT-2020 stations need to comply with the following maximum unwanted emission levels in the band 76-77 GHz:

For baseline analysis:

- For BS:  $-24.5$  dB(m/MHz) (equivalent to  $-31.5$  dB(W/200 MHz));
- For UE:  $-13$  dB(m/MHz) (equivalent to  $-20$  dB(W/200 MHz)).

For sensitivity analysis:

- For BS:  $-22.6$  dB(m/MHz) (equivalent to  $-29.6$  dB(W/200 MHz));
- For UE:  $-13$  dB(m/MHz) (equivalent to  $-20$  dB(W/200 MHz)).

The maximum additional isolation required for the IMT BS unwanted emissions in the frequency band 76-77 GHz for all studied cases is within the range 11.5 dB (baseline) to 9.6 dB (sensitivity analysis). No additional isolation is required for the IMT UE.

Study B found it was not possible to define the value of the unwanted emission limits of IMT-2020 appropriately, taking into account the information provided by the involved groups. Study B reflected that there was no model available for the roll-off of the IMT-2020 unwanted emissions in this out-of-band domain, no measurement of the IMT-2020 antenna pattern in adjacent bands and also concluded that there was no information about the foreseen deployment of IMT-2020 UEs with respect to vehicles for these bands. Notwithstanding that, the study concluded that an unwanted emission limit more stringent than  $-30$  dB(m/MHz) (i.e.  $-60$  dB(W/MHz)) (equivalent to more than 17 dB additional isolation) for both BS and UE is necessary to protect automotive radars in the RLS in the frequency band 76-77 GHz.

### **2/1.13/3.2.10.3 FSS**

A statistical aggregate interference study from the IMT BSs towards FSS earth stations was performed in the 71-76 GHz frequency band. The results showed that with the separation distance of 250 m around the FSS earth station, the aggregate interference level does not exceed the FSS long-term interference threshold, based on the assumptions and input parameters used in this study.

Therefore, according to the results of the study where a long-term interference threshold was applied, it can be assumed that coexistence between IMT-2020 and FSS in the 71-76 GHz band is feasible.

### **2/1.13/3.2.11 Frequency range 81-86 GHz**

The frequency range 81-86 GHz, or parts thereof, is allocated to the FS, FSS, MS, MSS and RAS. The frequency bands adjacent to this frequency range are allocated to the ARS, ARSS, EESS (passive), RAS, RLS and SRS (passive). The details of these allocations and those of the adjacent frequency bands can be found in RR Article 5.

Studies were carried out for the FS, FSS, RAS (in band and adjacent band), EESS (passive) and RLS and are summarized in the subsections below. Characteristics were not received for the ARS and ARSS and therefore, studies were not carried out for these services. Studies are not needed for the SRS (passive), as this service is dealing with sensors around other planets and no interference issue is expected. Studies were also not carried out for the MSS.

#### **2/1.13/3.2.11.1 EESS (passive)**

Three studies were received in relation to the compatibility between IMT-2020 in the 81-86 GHz frequency band and the EESS (passive) in the frequency band 86-92 GHz. The results in the tables below are expressed as:

- interference exceedance relative to the EESS (passive) protection criteria ( $-166$  dB(W/200 MHz)) based on the IMT-2020 parameters provided; and
- corresponding unwanted emission levels to protect the EESS (passive).

The results below are based on the most restrictive Sensor L3.

Studies A and C considered the IMT single element antenna pattern of Recommendation ITU-R M.2101 and led to the following results for Sensor L3:

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
A	23.6 dB (assuming normalization of antenna pattern, apportionment of the EESS protection criteria and multi-operator interference factors)	-43.5	-43.6
C	11.3	-31.2	-31.3

In addition, Study A performed a sensitivity analysis considering a population-based redistribution of the IMT-2020 BSs (capped to a maximum of 10 BS/km<sup>2</sup>) and led to the following results for Sensor L3 (assuming normalization of antenna pattern, apportionment of EESS protection criteria, and multi-operator interference factors):

Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
A	29.9	-49.8	-49.9

Some studies (Study B and C) performed a sensitivity analysis using a beamforming antenna model in the unwanted emission domain. In the absence of IMT-2020 antenna measurement data it was agreed in TG 5/1 that:

- the antenna pattern may remain beamformed to some extent in the adjacent frequency band;
- the Recommendation ITU-R M.2101 model applicable to beamforming gain may in that case underestimate the side-lobe levels (e.g. some simulations have shown that, for an 8 × 8 array simplified AAS antenna design model with one slant dipole elements, the Recommendation ITU-R M.2101 model appears to be a reasonable match for the side lobes closest to the main beam, but side lobes further from the main beam would be underestimated by this model);
- the “variance” of the interference distribution is much wider compared to the use of a single element pattern and hence a conclusion on the average interference would not be appropriate.

Studies B and C performed a sensitivity analysis using a beamforming antenna model in the unwanted emission domain (not considering normalization of antenna pattern, apportionment of EESS protection criteria nor multi-operator interference factors) and led to the following results for Sensor L3:



Study	Interference exceedance (dB)	Level of unwanted emissions to protect EESS (passive) (dB(W/200 MHz)) for:	
		UE	BS
B <sup>16</sup>	TBD (additional work is needed)	TBD	TBD
C	-1.3	-19.9	-20

### 2/1.13/3.2.11.2 FS

In-band sharing studies were conducted between the FS and IMT systems in the frequency band 81-86 GHz.

Statistical studies for a single-entry case for different antenna heights of the FS receiver (from 10 to 40 metres) showed that a protection distance of 250 to 950 metres will ensure that the protection criteria are met. Alternatively, with a protection distance of 250 metres with a proper deployment on azimuth offset of antenna boresight between IMT BS and the FS receiver (from  $\pm 10^\circ$  to  $0^\circ$ ), the protection criterion will also be met.

Statistical studies for the aggregate case showed that aggregate interference will decrease with the increase of the distance between the IMT network centre and the FS receiver for certain antenna heights. The protection distance from 0 m (IMT BS located below the FS receiver) to 710 m (for different antenna heights of the FS receiver from 40 to 10 metre) would be needed.

### 2/1.13/3.2.11.3 RAS (in-band)

Two sharing studies between the RAS and IMT in the frequency band 81-86 GHz were provided to ITU-R.

Statistical results showed that if the combined aggregate interference of both BSs and user equipment is considered, separation distances were 20.5 km for a suburban only environment and ranged from 35 to 49 km for mixed urban/suburban environments. This range was mainly due to the differences in assumed polarization loss (3 or 0 dB) and clutter loss probability (average or 2%).

It should be noted that no detailed terrain profiles were used in these studies. Taking into account detailed terrain profiles around RAS stations would lead to different separation distances for RAS stations on a case-by-case basis.

### 2/1.13/3.2.11.4 RAS (adjacent band)

Two compatibility studies between the RAS in the frequency range 76-94 GHz and IMT in the frequency band 81-86 GHz were provided to ITU-R.

For both studies a  $-13$  dB(m/MHz) (i.e.  $-43$  dB(W/MHz)) level of unwanted emissions was assumed for both IMT-2020 BSs and user equipment. Statistical results show that if the combined aggregated interference of both BSs and user equipment was considered, separation distances were 1.5 km for a suburban only environment and ranged from 6 to 29 km for mixed urban/suburban environments. This range was mainly due to differences in assumed polarization loss (3 or 0 dB) and antenna gain normalization.

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<sup>16</sup> An update will be provided to CPM19-2.

It should be noted that no detailed terrain profiles were used in these studies. Taking into account detailed terrain profiles around RAS stations would lead to different separation distances for RAS stations on a case-by-case basis.

### **2/1.13/3.2.11.5 RLS**

Two studies were received which dealt with the compatibility between IMT-2020 in the frequency bands 71-76 GHz and 81-86 GHz and automotive radar in the frequency band 77-81 GHz (i.e. Radar D of Category 2 from Recommendation ITU-R M.2057). Study A gave a range of IMT unwanted emission levels that were assumed to provide appropriate protection of the automotive radars, while Study B used various IMT-2020 unwanted emission levels to assess the probability of interference.

The IMT stations' spurious emission level assumed in both studies was a constant value over the operating frequency band of automotive radars.

Study A assumed a 99% applicability of the protection criterion of  $I/N = -6$  dB and did not apply antenna normalization.

Study A showed that to protect automotive radars operating in the 77-81 GHz frequency band, IMT-2020 stations need to comply with the maximum unwanted emission levels in the frequency band 77-81 GHz:

- For BS:  $-26.5$  dB(m/MHz) (equivalent to  $-33$  dB(W/200 MHz));
- For UE:  $-28$  dB(m/MHz) (equivalent to  $-35$  dB(W/200 MHz)).

The maximum additional isolation required for the IMT-2020 unwanted emissions in the frequency band 77-81 GHz for all studied cases were 13.5 dB for the BS and 15 dB for the UE.

Study B found it was not possible to define the value of the IMT-2020 unwanted emission limits appropriately taking into account information provided by the involved groups. Study B reflected that there was no model available for the roll-off of the IMT-2020 unwanted emissions in this out-of-band domain, no measurement of the IMT-2020 antenna pattern in adjacent bands and also concluded that there was no information about the foreseen deployment of IMT-2020 UEs with respect to vehicles for these bands. Notwithstanding that, the study concluded that an unwanted emission limit more stringent than  $-30$  dBm/MHz (i.e.  $-60$  dB(W/MHz) (equivalent to more than 17 dB additional isolation) for both BS and UE was necessary to protect automotive radars in the RLS in the frequency band 77-81 GHz.

### **2/1.13/3.2.11.6 FSS**

Aggregate interference simulations from IMT BSs towards a FSS space station were performed in the 81-86 GHz frequency band. The results showed that the FSS long-term interference threshold was not exceeded by IMT-2020 BS deployments. Also, aggregate interference simulations from FSS earth stations towards an IMT BS were performed in the 81-86 GHz frequency band. The results showed that, with the separation distance of 250 m around the IMT BS, the aggregate interference level did not exceed the IMT BS interference threshold, based on the assumptions and input parameters used in this study.

Note: Some groups developing the studies summarized above were held in parallel and there was no possibility for administrations with small delegations to attend all of these meetings. Since the results of these studies are contained in the draft CPM text, these administrations reserved their right that they may come back to these issues at CPM19-2.

## **2/1.13/4 Methods to satisfy the agenda item**

### **2/1.13/4.1 Item A: Frequency band 24.25-27.5 GHz**

#### **2/1.13/4.1.1 Method A1: NOC**

No change to the Radio Regulations.

#### **2/1.13/4.1.2 Method A2: Identification of the frequency band 24.25-27.5 GHz for IMT in accordance with the following two alternatives**

##### **Alternative 1**

Under this alternative, allocate the 24.25-25.25 GHz frequency band to the MS (except aeronautical mobile) on a primary basis in Regions 1 and 2 and identify the 24.25-27.5 GHz frequency band for the terrestrial component of IMT within the land mobile service in Regions 1, 2 and 3.

*Reasons: It is proposed to limit the identification of IMT by the LMS due to the fact that ITU-R did not undertake sharing and compatibility studies for aeronautical and maritime deployments of IMT-2020. Such an identification provides the same status for IMT in the RR (primary allocation) as it is provided for the existing IMT systems in other frequency bands. According to ITU-R deliverables in the frequency bands above 24 GHz IMT-2020 deployment on ships and airplanes is not expected. Based on the ITU-R studies, sharing conditions developed in the CPM Report for IMT applications in the LMS could not be applicable for IMT applications in the AMS and MMS, therefore the protection of incumbent services will not be ensured.*

##### **Alternative 2**

Under this alternative, allocate the 24.25-25.25 GHz frequency band to the MS (except aeronautical mobile) on a primary basis in Regions 1 and 2 and identify the 24.25-27.5 GHz frequency band for the terrestrial component of IMT in Regions 1, 2 and 3.

*Reasons: A restriction of IMT to the LMS allocation was not felt necessary for existing IMT frequency bands and is not necessary for new IMT frequency bands since the IMT characteristics, which included deployment, are already described in ITU-R Recommendations and Reports.*

*View 1: Alternative 2 allows for the operation of IMT-2020 stations within the maritime mobile service in the frequency band 24.25-27.5 GHz and the AMS in the frequency band 25.5-27.5 GHz, which contradicts with the IMT-2020 parameters provided by the responsible ITU-R group limited to LMS deployment. Sharing conditions developed in the CPM Report for IMT deployment in the LMS could not be applicable for IMT deployment in the AMS and MMS, therefore the protection of incumbent services will not be ensured.*

*View 2: For the frequency bands with existing MS allocations, as an application of the MS, IMT should not be limited to a lesser status than the rest of the MS as existing IMT identifications under the MS in the RR have never included this limitation. The AMS was not studied in the context of new MS allocations. Furthermore, any use of IMT aboard ships (i.e. in the MMS) would have low, negligible use (below that of suburban open area density); and therefore, would not result in any appreciable difference in aggregate interference to other services.*

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies. Administrations could consider applying the IMT Resolution and/or modifications to Resolution **750 (Rev.WRC-15)**, or neither, based on the conditions selected when identifying the frequency band for IMT.

**2/1.13/4.1.2.1 Condition A2a: Protection measures for the EESS (passive) in the 23.6-24 GHz frequency band**

**Option 1:**

Introduce in Table 1-1 of Resolution **750 (Rev.WRC-15)** limits on unwanted emissions in the frequency band 23.6-24 GHz from IMT BSs and IMT mobile stations within the 24.25-27.5 GHz frequency band (see Section 2/1.13/3.2.1) and add a cross-reference to Resolution **750 (Rev.WRC-15)** in the RR footnote that identifies the frequency band for IMT and revise RR No. **5.338A** accordingly.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force as it is based on an optional concept nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting an administration to adopt a provision to ensure the protection of services of other administrations, is merely wishful thinking as it does not have legal and procedural support, and in no way would address the protection of services of other administrations due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity or otherwise of that decision, if such decision is made unilaterally. In case that the interfering administration does not respond to the invitation then the protection of the victim service would be put at the mercy of the interfering service.*

*Reasons: The identification of the frequency band 24.25-27.5 GHz to IMT will require limits in Resolution **750 (Rev.WRC-15)** to ensure adjacent band compatibility with the EESS (passive) in the frequency band 23.6-24.0 GHz.*

**Option 2:**

To invite ITU-R to develop an ITU-R Recommendation to include limits on unwanted emissions in the frequency band 23.6-24 GHz from IMT BSs and IMT mobile stations within the 24.25-27.5 GHz frequency band, as appropriate.

*Views were expressed that the regulatory implementation in Options 2 and 3 does not provide protection to the EESS (passive) in the adjacent frequency band 23.6-24 GHz, within which all emissions are prohibited according to footnote RR No. **5.340**.*

**Option 3:**

No condition is necessary.

*Reasons: The emission limits defined in the IMT-2020 parameters are adequate to protect the existing passive services operating in the 23.6-24.0 GHz band, noting a 250 MHz guardband from the active service band 24.25-27.5 GHz. Therefore no further conditions are necessary.*

*Views were expressed that Option 3 contradicts the results of all sharing and compatibility studies presented in ITU-R and does not provide protection to the EESS (passive) in the adjacent frequency band 23.6-24 GHz.*

**2/1.13/4.1.2.2 Condition A2b: Protection measures for the EESS (passive) in the 50.2-50.4 GHz and 52.6-54.25 GHz frequency bands**

**Option 1:**

Introduce in Table 1-1 of Resolution **750 (Rev.WRC-15)** limits on unwanted emissions in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz from IMT BSs and IMT mobile stations in the frequency band 24.25-27.5 GHz or part thereof.

Add a cross-reference to Resolution **750 (Rev.WRC-15)** in the RR footnote that identifies the frequency band for IMT, and add the 24.25-27.5 GHz frequency band or part thereof to RR No. **5.338A**.

*Views were expressed that unwanted emissions limits for IMT in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz to protect the EESS (passive) derived from the results of the ITU-R compatibility studies (see Section 3) are more stringent than the generic ones from Recommendation ITU-R SM.329. Therefore, mandatory limits of unwanted emissions shall be included into Table 1-1 of Resolution 750 (Rev.WRC-15).*

### **Option 2:**

State in a *considering* of the WRC Resolution corresponding to the IMT identification of this frequency band that spurious emission limits of Recommendation ITU-R SM.329 Category B are sufficient to protect the EESS (passive) from the second harmonic of IMT BS emissions in the 26 GHz frequency band.

*Reasons: Studies have shown that Category B limits ( $-30$  dB(m/MHz), i.e.  $-60$  dB(W/MHz)) could be considered as sufficient to protect the EESS second harmonic. By stating it in the WRC Resolution would give the adequate rationale for ITU-R and standardization body to ensure that the applicable spurious limit would be compliant.*

*Views were expressed that this regulatory option is not based on any sharing and compatibility study. Category B limits in an ITU-R Recommendation do not apply worldwide and may not provide protection to the EESS (passive) in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz, which contradicts the objectives of Resolution 238 (WRC-15).*

*Views were expressed that conditions related to the second harmonic should be introduced as a requirement in the “resolves” part of the Resolution instead of in the “considering” part.*

### **Option 3:**

No condition is necessary.

*View 1: This option contradicts the sharing and compatibility study of ITU-R (see Section 2/1.13/3.2.1.2.1) showing that the more stringent limits to protect the EESS (passive) than the generic ones from Recommendation ITU-R SM.329 are required.*

*View 2: No ITU-R studies were performed on the second harmonic that conclusively showed that any additional protections were needed beyond those already specified in relevant ITU-R recommendations on IMT out-of-band emission limits.*

*View 3: Imposing limits on unwanted emissions at a separation of 22.7 GHz would create a far-reaching and problematic precedent that would impact all active services operating at one half of any of the frequency bands listed in footnote RR No. 5.340. The protection of the EESS (passive) in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz from emissions below 27.5 GHz is addressed by the existing generic spurious emission limits, as described in Recommendation ITU-R SM.329. Furthermore, footnote RR No. 5.340.1 provides that “The allocation to the Earth exploration-satellite service (passive) and the space research service (passive) in the band 50.2-50.4 GHz should not impose undue constraints on the use of the adjacent bands by the primary allocated services in those bands. (WRC-97).” Although not an immediately adjacent frequency band, imposition of technical rules 22.7 GHz away is inconsistent with the intent of RR No. 5.340.1.*

### **2/1.13/4.1.2.3 Condition A2c: Protection measures for earth stations in the SRS/EESS**

#### **Option 1:**

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- a) to invite ITU-R to develop an ITU-R Recommendation to assist administrations in protecting existing and future SRS/EESS earth stations operating in the frequency band 25.5-27 GHz;
- b) in addition, administrations should be invited to adopt provisions to protect other services from IMT networks and to ensure the possibility of deploying future SRS/EESS earth stations.

*Reasons: Studies have shown that the interference distance remains limited (i.e. a few km for the EESS and a few tens of km for the SRS), i.e. the issue will be mainly on a national level. For cross-border protection of earth stations, coordination procedures in RR Articles 9 and 11 would apply. The ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations. The reference to future SRS/EESS earth station responds to Resolution 238 (WRC-15), which emphasizes the need “to take into account the need to ensure the protection of existing earth stations and the deployment of future receiving earth stations under the EESS (space-to-Earth) and SRS (space-to-Earth) allocation in the frequency band 25.5-27 GHz”.*

*View 1: In relation to the compatibility between IMT-2020 and SRS/EESS earth stations, provisions RR Nos. 5.536A, 5.536B and 5.536C should either be revised or deleted.*

*View 2: The revision or deletion of RR Nos. 5.536A, 5.536B and 5.536C is outside of the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15).*

*View 3: The results of studies indicate coordination distances that pertain to national matters and thus RR Articles 9 and 11 should not apply.*

#### **Option 2:**

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- a) to invite ITU-R to develop an ITU-R Recommendation to assist administrations in protecting existing and future SRS/EESS earth stations operating in the frequency band 25.5-27 GHz and incorporate this Recommendation into the RR by reference;

*View 1: Such a recommendation has not been developed and could not be incorporated by reference at WRC-19. In addition, RR Articles 9 and 11 are already providing procedures for the protection of SRS/EESS earth stations.*

*View 2: The results of studies indicate coordination distances that pertain to national matters, and thus RR Articles 9 and 11 should not apply.*

#### **Option 3:**

Protection of other services (in-band and/or adjacent band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force as it is based on an optional concept nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting an administration to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking, as it does not have*

*legal and procedural support and in no way would address the protection of services of other administrations, due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity or otherwise of that decision if such a decision is made unilaterally. In case that the interfering administration does not respond to the invitation then the protection of the victim service would be put at the mercy of the interfering service.*

*View 1: RR Articles 9 and 11 already provide procedures for the protection of SRS/EESS earth stations. ITU-R Recommendations will help in effecting the coordination and also for national considerations.*

*View 2: The results of studies indicate coordination distances that pertain to national matters, and thus RR Articles 9 and 11 should not apply.*

**Option 4:**

No condition is necessary.

*View 1: No condition option does not ensure the protection of existing earth stations and the deployment of future receiving earth stations under the EESS (space-to-Earth) and SRS (space-to-Earth) allocation in the frequency band 25.5-27 GHz, which contradicts the objectives of Resolution 238 (WRC-15).*

*View 2: The results of studies indicate coordination distances that pertain to national matters, and thus no conditions are necessary to ensure the protection of earth stations of the SRS/EESS, and RR Articles 9 and 11 should not apply.*

**2/1.13/4.1.2.4 Condition A2d: Measures related to transmitting earth stations in the FSS (Earth-to-space) at known locations**

**Option 1:**

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- a) to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency band 24.25-27.5 GHz;
- b) in addition, administrations should be invited to adopt provisions to ensure the possibility of deploying future FSS earth stations.

*Reasons: Studies have shown that the interference distance remains limited (i.e. a few km), i.e. the issue will be mainly on a national level. For cross-border coordination, procedures in RR Articles 9 and 11 would apply. The ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations.*

*Different views were expressed on whether or not this option would ensure the coexistence between existing and future FSS earth stations and IMT.*

*Views were expressed that the results of studies indicate coordination distances that pertain to national matters, and thus RR Articles 9 and 11 should not apply.*

**Option 2:**

Reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- a) to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency band 24.25-27.5 GHz and incorporate this Recommendation into the RR by reference;

*View 1: Such a recommendation has not been developed and could not be incorporated by reference at WRC-19. In addition, RR Articles 9 and 11 already include procedures for the coexistence with FSS earth stations.*

*View 2: The results of studies indicate coordination distances that pertain to national matters and thus RR Articles 9 and 11 should not apply.*

### **Option 3:**

Protection of other services (in-band and/or adjacent band) by IMT should be contained in a WRC Resolution, cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force as it is based on an optional concept nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting an administration to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking as it does not have legal and procedural support, and in no way would address the protection of services of other administrations due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity or otherwise of that decision if such decision is made unilaterally. In case that the interfering administration does not respond to the invitation then the protection of the victim service would be put at the mercy of the interfering service.*

*View 1: RR Articles 9 and 11 already include procedures for the protection of SRS/EESS earth stations. ITU-R Recommendations will help in effecting the coordination and also for national considerations.*

*View 2: The results of studies indicate coordination distances that pertain to national matters and thus RR Articles 9 and 11 should not apply.*

### **Option 4:**

No condition is necessary.

*View 1: Option 4 does not ensure the evolving needs of the primary FSS, and may impose constraints on FSS earth station deployment, which contradicts the objectives of Resolution 238 (WRC-15).*

*View 2: Sharing and compatibility are feasible based on the FSS earth station characteristics, including current/future deployment, provided by the ITU-R involved group. In addition, since IMT is the victim of interference, no FSS earth station uplink protection conditions are needed as this is a matter for the national authority.*

## **2/1.13/4.1.2.5 Condition A2e: Protection measures for the ISS and FSS (Earth-to-space) receiving space stations**

### **Option 1:**

Introducing in the WRC Resolution corresponding to the IMT identification of this frequency band:

- A mandatory limit on the maximum total radiated power (TRP) of IMT BSs of [25/35/37/46/TBD] dB(m/200 MHz), i.e. [-5/5/7/16/TBD] dB(W/200 MHz).
- Requiring that the electrical tilt of IMT BS beams should normally not be higher than 0 degrees relative to the horizontal.
- Requiring that the mechanical tilt of IMT BSs be below the horizon.



*Views were expressed that the condition for electrical tilt is not implementable and could not be enforced by administrations due to the word “normally” used when defining limits of 0 degrees for electrical tilt. Studies also found that the interference impact on satellite receivers is significant even for a low number of outdoor IMT UEs at elevations above 0 degrees. Moreover, the antenna pattern of IMT BS in this option is not defined and in practice any antenna for the IMT BS could be used. When the antenna gain of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the ISS and FSS.*

*Views were expressed that studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevations above 0 degrees. Therefore, provisions are needed which are consistent with the assumptions.*

### **Option 2:**

Introducing in the WRC Resolution corresponding to the IMT identification of this frequency band:

- A mandatory limit on the maximum TRP of IMT BSs of [25/35/37/46/TBD] dB(m/200 MHz), i.e. [-5/5/7/16/TBD] dB(W/200 MHz).
- The elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal.
- Antenna pattern shall comply with Recommendation ITU-R M.2101.

### **Option 3:**

- Introducing in the Radio Regulations a mandatory limit on the maximum TRP of IMT BSs of [35/37] dB(m/200 MHz), i.e. [5/7] dB(W/200 MHz), to provide protection to the ISS and FSS (Earth-to-space) in the frequency band 24.25-27.5 GHz.
- Requiring that the combined tilt (electrical and mechanical) of IMT BSs should normally not be higher than 0 degrees.

*Views were expressed that the condition for electrical tilt is not implementable and could not be enforced by administrations due to the word “normally” used when defining limits of 0 degrees for electrical tilt. Studies also found that the interference impact on a satellite receiver is significant even for a low number of outdoor IMT UEs at elevations above 0 degrees. Moreover, the antenna pattern of the IMT BS in this option is not defined and in practice any antenna for an IMT BS could be used. When the antenna gain of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the ISS and FSS.*

*Views were expressed that studies assumed that most BSs are pointing to UEs on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, the limits in this option are overly restrictive and any provisions should be consistent with the assumptions.*

### **Option 4:**

- Requiring that when deploying outdoor BSs, it shall be ensured that each antenna is normally transmitting only with the main beam pointing below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the BS is only receiving.

*Reasons: Studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, provisions*

are needed, which are consistent with the assumptions. It is implementable and enforceable by including them in the licence conditions.

*View 1: The condition for main beam pointing is not implementable and could not be enforced by administrations due to the word “normally” used when defining main beam pointing limits. Moreover, the TRP value and antenna pattern of the IMT BS in this option is not defined and in practice any TRP and antenna pattern for the IMT BS could be used. When emissions of an IMT BS in skyward direction will be higher than assumed in the ITU-R studies (TRP 25 dB(m/200 MHz), i.e. –5 dB(W/200 MHz), and an antenna in line with Recommendation ITU-R M.2101), this option will not protect the ISS and FSS.*

*View 2: The majority of sharing and compatibility studies resulted in a high margin of protection to the FSS/ISS, thus there is no need for the implementation of TRP limits. The limitation on normally used up tilt provides sufficient certainty that the deployment of IMT systems will not change the coexistence conditions with the FSS/ISS over time. Furthermore, TRP limits are difficult to be enforced.*

#### **Option 5:**

- A mandatory limit on the maximum TRP of IMT BSs of [25/35/37/46/TBD] dBm/200 MHz, i.e. [–5/5/7/16/TBD] dB(W/200 MHz).
- Requiring that the mechanical tilt of IMT BSs shall be below [TBD degrees].
- Limits for the maximum density of BSs for outdoor urban hot spots and the maximum density of BSs for outdoor suburban hot spots within the territory of an administration.

*Views were expressed that restricting the density of BSs per km<sup>2</sup> would be difficult for administrations to implement. In addition, it is unclear which reference will be used for calculating the density. Moreover, the relevant area in terms of interference would depend on each satellite footprint, which could cover the territory of multiple administrations.*

*Views were expressed that a limitation on IMT-2020 BS density, as proposed in this option, is not implementable, because the number of outdoor urban hot spots is not limited and this does not ensure protection of newly filed satellite networks of the ISS and FSS. Moreover, the antenna pattern of the IMT BS in this option is not defined and in practice any antenna for the IMT BS could be used. When the antenna gain of the IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the ISS and FSS.*

#### **Option 6:**

- To introduce in the Radio Regulations an angular e.i.r.p. mask for the emissions of IMT BSs in the skyward direction as described in Section 2/1.13/5 (see Resolution [A113-IMT 26 GHz]).

*Reasons: The e.i.r.p. mask is based on a sharing and compatibility study and ensures protection of the ISS and FSS, while providing flexibility for IMT-2020 deployments (there are no separate limits for the mechanical downtilt and e-tilt angles, as well as fixed TRP values), and it is implementable since there are existing examples of the application of off-axis gain limits in the Radio Regulations and ITU-R Recommendations. Moreover the e.i.r.p. mask is fully in line with the IMT parameters provided by the ITU-R responsible group and does not introduce any additional restriction than the assumed parameters and assumptions developed by ITU-R.*

*Views were expressed that such an angular e.i.r.p. mask would be extremely complicated to implement with active antennas. The analysis that supports this mask is unclear and it is noted that all BSs would need to be pointing in the skyward direction towards the FSS space station, which is unlikely to be representative of IMT deployments. The interference potential depends mainly on the*

*number of simultaneous cases where there is emission in the skyward direction. The e.i.r.p. mask would be unduly restrictive.*

**Option 7:**

- Introducing in the Radio Regulations mandatory efd<sup>↑</sup> limits at the geostationary-satellite orbit by emissions from all the IMT BSs in the territory of an administration implementing IMT system(s) in the frequency band 24.25-27.5 GHz.

*Views were expressed that such an efd limit would be extremely complicated to implement. In addition, the methodology which is proposed, does not take into account that there will be a variety of BSs and terminals with evolving characteristics in the satellite footprint. Such a footprint may also cover the territory of several countries, which adds an additional difficulty to the implementation of this requirement.*

**Option 8:**

- A mandatory limit on the maximum TRP of IMT BSs of [25/35/37/46/TBD] dB(m/200 MHz), i.e. [-5/5/7/16/TBD] dB(W/200 MHz).

*Views were expressed that this regulatory option is not based on any sharing and compatibility study, since margins obtained in these studies were based on the assumption that the elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees and the impact of the IMT-2020 BS antenna main beam, pointing in the upper hemisphere, was not assessed, however it is possible in accordance with this option. This option does not ensure the protection of the ISS and FSS.*

*Other views were expressed that studies show that sharing is feasible based on typical deployment of IMT, therefore all those typical assumptions should not be reflected to mandatory limits as regulatory options.*

**Option 9:**

No condition is necessary.

*View 1: This option contradicts the results of sharing and compatibility studies, which were based on limitations of the IMT-2020 e.i.r.p. and the assumption that the elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees. The impact of the IMT-2020 BS antenna main beam, pointing in the upper hemisphere without any e.i.r.p. limit, was not assessed, however it is possible in accordance with this option. This option does not ensure the protection of the ISS and FSS.*

*View 2: These regulatory options are not necessary since studies show that sharing is feasible without any additional mandatory limits.*

**2/1.13/4.1.2.6 Condition A2f: Protection measures for the RAS**

**Option 1:**

Inviting ITU-R in the WRC Resolution corresponding to the IMT identification of this frequency band to update existing ITU-R Recommendations or develop new ITU-R Recommendations or Reports, as appropriate, to provide information on possible coordination and protection measures to assist the administrations in this matter.

**Option 2:**

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force as it is based on an optional concept nor by an ITU-R Resolution which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking as it does not have legal and procedural support, and in no way would address the protection of services of other administrations due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity or otherwise of that decision if such a decision is made unilaterally. In case that the interfering administration does not respond to the invitation, then the protection of the victim service would be put at the mercy of the interfering service.*

*Views were expressed that the results of studies indicate coordination distances that pertain to national matters.*

**Option 3:**

No condition is necessary.

**2/1.13/4.1.2.7 Condition A2g: Protection measures for multiple services**

In addition to the options and associated alternatives for protection measures of the different services as described above, additional options are suggested.

**Option 1:**

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. **9.21** in the corresponding footnote.

*View 1: There are no criteria for the BR to identify concerned administrations and the application of RR No. **9.21** would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

*View 2: Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.*

**Option 2:**

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

*Views were expressed that there are no criteria to identify concerned administrations nor a procedure to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

**Option 3:**

To invite ITU-R to regularly update characteristics of IMT deployments (including BS density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments. This would enable ITU-R to recommend corrective measures to address situations whereby the interference threshold of space stations would be at risk to be exceeded.

*Views were expressed that ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business, and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution **238 (WRC 15)**.*

*Views were expressed that further clarifications are required on the applicability of the implementation.*

**Option 4:**

No condition is necessary.

*View 1: Option 4 does not provide protection for incumbent services if Conditions A2a to A2f to protect specific services do not apply.*

*View 2: The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbents services, thus there is no need for the addition of some of the conditions indicated in Conditions A2a-A2f.*

**2/1.13/4.2 Item B: Frequency band 31.8-33.4 GHz**

**2/1.13/4.2.1 Method B1: NOC**

No change to the Radio Regulations due to sharing and compatibility study results between IMT systems and radionavigation systems showing their incompatibility.

**2/1.13/4.3 Item C: Frequency band 37-40.5 GHz**

**2/1.13/4.3.1 Method C1: NOC**

No change to the Radio Regulations.

**2/1.13/4.3.2 Method C2: Identification of the frequency band 37-40.5 GHz for IMT in accordance with the following two alternatives**

**Alternative 1**

Under this alternative, identify the 37-40.5 GHz frequency band for the terrestrial component of IMT within the land mobile service.

*Reasons: It is proposed to limit the identification of IMT by the LMS due to the fact that ITU-R did not undertake sharing and compatibility studies for aeronautical and maritime deployments of IMT-2020. Such an identification provides the same status for IMT in the RR (primary allocation) as it is provided for the existing IMT systems in other frequency band. According to ITU-R deliverables in the frequency bands above 24 GHz IMT-2020 deployment on ships and airplanes is not expected. Based on the ITU-R studies, sharing conditions developed in the CPM Report for IMT applications in the LMS could not be applicable for IMT applications in the AMS and MMS, therefore the protection of incumbent services will not be ensured.*

*Views were expressed that for the frequency bands with existing MS allocations, as an application of the MS, IMT should not be limited to a lesser status than the rest of the MS, as existing IMT identifications under the MS in the RR have never included this limitation. The AMS was not studied in the context of new MS allocations. Furthermore, any use of IMT aboard ships (i.e. in the MMS) would have low, negligible use (below that of suburban open area density); and therefore, would not result in any appreciable difference in aggregate interference to other services.*

**Alternative 2**

Under this alternative, identify the 37-40.5 GHz frequency band for the terrestrial component of IMT in Regions.

*Reasons: A restriction of IMT to LMS allocation was not felt necessary for existing IMT bands and is not necessary for new IMT bands since the IMT characteristics, which included deployment, are already described in ITU-R Recommendations and Reports.*

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies. Administrations could consider applying the IMT Resolution and/or modifications to Resolution **750 (Rev.WRC-15)**, or neither, based on the conditions selected when identifying the band for IMT.

#### **2/1.13/4.3.2.1 Condition C2a: Protection measures for the EESS (passive) in the 36-37 GHz frequency band**

##### **Option 1:**

Introduce in Table 1-1 of Resolution **750 (Rev.WRC-15)** limits on unwanted emissions in the frequency band 36-37 GHz from IMT BSs and IMT mobile stations within the 37-40.5 GHz frequency band and add a cross-reference to Resolution **750 (Rev.WRC-15)** in the RR footnote that identifies the frequency band for IMT and revise RR No. **5.338A** accordingly.

*Reasons: Based on results of the sharing and compatibility studies, the protection criterion for EESS passive sensors would be exceeded. Mandatory limits for unwanted emissions of IMT stations would be required to ensure the protection of the EESS (passive) in the frequency band 36-37 GHz, which are proposed to be inserted in Table 1-1 of Resolution 750 (Rev.WRC-15), containing similar conditions for the protection of the EESS (passive) in other frequency bands. The in-band output power limit (-10 dBW), established in Resolution 752 (WRC-07) for stations in the MS does not contain a reference bandwidth and was obtained for low-density terrestrial deployments, therefore is not applicable for IMT deployments.*

##### **Option 2:**

Introduce in Table 1-2 of Resolution **750 (Rev.WRC-15)** recommended levels on unwanted emissions in the frequency band 36-37 GHz from IMT BSs and IMT mobile stations within the 37-40.5 GHz frequency band and add a cross-reference to Resolution **750 (Rev.WRC-15)** in the RR footnote that identifies the frequency band for IMT and revise RR No. **5.338A** accordingly.

*Views were expressed that, based on results of the sharing and compatibility studies, the protection criterion for EESS passive sensors would be exceeded, therefore mandatory limits for unwanted emissions of IMT stations would be required to ensure the protection of the EESS (passive) in the frequency band 36-37 GHz. Introduction of recommended limits in Table 1-2 of Resolution 750 (Rev.WRC-15) would not ensure the protection of the EESS (passive) in the frequency band 36-37 GHz.*

##### **Option 3:**

Introduce limits on unwanted emissions in the frequency band 36-37 GHz from IMT BSs and IMT mobile stations within the 37-40.5 GHz frequency band in the WRC Resolution corresponding to the IMT identification of this frequency band.

*Reasons: Based on results of the sharing and compatibility studies, the protection criterion for EESS passive sensors would be exceeded, therefore mandatory limits for unwanted emissions of IMT stations would be required to ensure the protection of the EESS (passive) in the frequency band 36-37 GHz. Currently, Resolution 750 (Rev.WRC-15) contains only unwanted emission limits for the frequency bands allocated to the EESS (passive), subject to RR No. 5.340 (no active services in the frequency band), which is not the case for the 36-27 GHz frequency band, shared by the EESS (passive) with the FS and MS. In order to avoid possible discrepancies, it is proposed to introduce the above limits in a Resolution, corresponding to the IMT identification. The in-band*

*output power limit (–10 dBW), established in Resolution 752 (WRC-07) for stations in the MS was specified for low-density terrestrial deployments and is not applicable for IMT deployments.*

#### **Option 4:**

No condition is necessary.

*Reasons: Compatibility with EESS (passive) systems operating in the frequency band 36-37 GHz may require that IMT systems comply with some unwanted emission levels. However, the frequency band 36-37 GHz is also allocated on a primary basis to the MS and FS; and, coexistence conditions with the EESS (passive) are currently addressed in Resolution 752 (WRC-07). Thus, EESS (passive) observations in this frequency band already have to accept a certain level of interference. Therefore, it does not seem appropriate to include this frequency band in Resolution 750 (Rev.WRC-15).*

*Views were expressed that Option 4 (No condition) contradicts the results of the sharing and compatibility studies, showing that the protection criterion for EESS passive sensors would be exceeded. The in-band output power limit (–10 dBW), established in Resolution 752 (WRC-07) for stations in the MS was specified for low-density terrestrial deployments and is not applicable for IMT deployments, therefore the protection of the EESS (passive) in the adjacent frequency band 36-37 GHz would not be ensured.*

### **2/1.13/4.3.2.2 Condition C2b: Protection measures for the FSS (space-to-Earth)**

#### **Option 1:**

In a WRC Resolution:

- invite administrations to ensure the necessary balance in the frequency bands 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the MS and FSS, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. high-density applications in the fixed-satellite service (HDFSS)) and spectrum available for gateway earth stations;
- to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations from IMT deployments in neighbouring countries;
- in addition, administrations should be invited to apply this Recommendation when they decide to protect FSS earth stations from IMT networks and to ensure the possibility of deploying future gateway earth stations.

*Reasons: Studies have shown that the separation distance for interference-free operation of FSS earth stations is small (i.e. few km) and the issue will be mainly at a national level. For cross-border coordination, procedures in RR Articles 9 and 11 would apply. ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations.*

*Views were expressed that for cross-border protection of earth stations, coordination procedures in RR Articles 9 and 11 would apply. ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations.*

#### **Option 2:**

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation which does not have sufficient legal force as it is based on an optional concept nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking, as it does not have legal and procedural support and in no way would address the protection of services of other administrations due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity or otherwise of that decision, if such decision is made unilaterally. In case that the interfering administration does not respond to the invitation, then the protection of the victim service would be put at the mercy of the interfering service.*

*Views were expressed that protection of FSS earth stations is already covered by RR Articles 9 and 11 and does not need to be covered in other regulatory text. In addition, this option is ambiguous and does not provide any methodology for identifying affected administrations.*

### **Option 3:**

Revise RR No. **5.516B** to provide a common 2 GHz of spectrum to the FSS not shared with IMT (namely in the frequency range 37.5-39.5 GHz) throughout Region 1 that can be used for ubiquitous FSS earth stations (e.g. HDFSS).

*Views were expressed that this option should not be under Method C2 (IMT identification), but be in a separate Method C3 as it does not identify the frequency band for IMT, but for the HDFSS instead. CPM19-2 should consider moving this Option to a separate Method.*

*Views were expressed that the identification of new frequency ranges for the high-density fixed-satellite service (HDFSS) is not in the scope of Resolution 238 (WRC-15) and agenda item 1.13. It is not appropriate to allocate or identify new frequency ranges to other services and applications that are not within the scope of Resolution 238 (WRC-15) and agenda item 1.13. This is only for the allocation of frequency ranges to the MS and identification of IMT. Condition C2b, Option 3 should be deleted from the CPM Report.*

### **Option 4:**

For the 37.5-39.5 GHz frequency band: In a WRC Resolution:

- to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations from IMT deployments in neighbouring countries;
- in addition, administrations should be invited to apply this Recommendation when they decide to protect FSS earth stations from IMT networks and to ensure the possibility of deploying future gateway earth stations.

For the 39.5-40.5 GHz frequency band: In the footnote containing the IMT identification, administrations should take into account potential constraints to IMT in the frequency band, as appropriate, because of the potential deployment of high-density applications in the FSS in the frequency band 39.5-42 GHz as per RR No. **5.516B**.

In addition, administrations should be invited to ensure the necessary balance in the frequency bands 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the FSS, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. HDFSS) and spectrum available for gateway earth stations.



*Reasons: As recognized in the summary of studies, sharing between earth stations at unspecified locations (such as is the case for HDFSS) and IMT may or may not be possible on a case-by-case basis. As such, this option calls for administrations to take that into account and consider potential constraints to IMT, as appropriate, to ensure FSS/IMT compatibility.*

*Views were expressed that studies have shown that sharing is feasible between IMT and the FSS. Furthermore, RR No. 5.516B states that the identification of this frequency band for the HDFSS does not preclude the use of these frequency bands by other services and does not establish priority in the Radio Regulations among the users of these frequency bands. Therefore, a new footnote providing a higher status to the FSS would be in contravention of RR No. 5.516B and is not appropriate.*

#### **Option 5:**

In the footnote containing the IMT identification, administrations should take into account potential constraints to IMT in the frequency band, as appropriate, because of the potential deployment of high-density applications in the FSS in the frequency band 39.5-42 GHz as per RR No. 5.516B.

*Reasons: As recognized in the summary of studies, sharing between earth stations at unspecified locations (such as is the case for the HDFSS) and IMT may or may not be possible on a case-by-case basis. As such, this options calls for administrations to take that into account and consider potential constraints to IMT, as appropriate, to ensure FSS/IMT compatibility.*

*Views were expressed that studies have shown that sharing is feasible between IMT and the FSS. Furthermore, RR No. 5.516B states that the identification of this frequency band for the HDFSS does not preclude the use of these frequency bands by other services and does not establish priority in the Radio Regulations among the users of these frequency bands. Therefore, a new footnote providing a higher status to the FSS would be in contravention of RR No. 5.516B and is not appropriate.*

#### **Option 6:**

No condition is necessary.

*Reasons: Studies have shown that sharing is feasible between IMT and the FSS.*

### **2/1.13/4.3.2.3 Condition C2c: Protection measures for the SRS (space-to-Earth)**

#### **Option 1:**

Develop a WRC Resolution to:

- a) invite ITU-R to develop after WRC-19 an ITU-R Recommendation to assist administrations in ensuring protection of existing and future SRS earth stations operating in the frequency band 37-38 GHz taking into account the required protection criteria;
- b) invite administrations to adopt on a national level provisions to ensure the possibility of deploying future earth stations in the SRS (space-to-Earth).

*Reasons: Studies have shown that the separation distance for interference-free operation of SRS (space-to-Earth) earth stations is low and the issue will be mainly at a national level. For cross-border protection of earth stations, coordination procedures in RR Articles 9 and 11 would apply. ITU-R Recommendations would therefore help administrations during the coordination process and for national considerations.*

*Views were expressed that for the cross-border protection of earth stations, coordination procedures in RR Articles 9 and 11 would apply. ITU-R Recommendations would therefore help administrations during the coordination process and for national considerations.*

*Views were expressed that the protection of the services of other administrations within or adjacent to an IMT frequency band, is inconsistent with the very principle and purposes of the Radio Regulations due to the fact that the protection of incumbent services by IMT is not an action to be unilaterally decided by the IMT administration as there is no assurance that such a procedure unilaterally adopted by one administration would adequately protect the services of the other administration, which has not been involved in the development of such a procedure. This course of action is in full contradiction with the letter and spirit of the Radio Regulations, which make the protection of services by the concerned administration based on mutual agreement or based on clear-cut mandatory provisions in the Radio Regulations.*

### **Option 2:**

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force as it is based on an optional concept nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking, as it does not have legal and procedural support and in no way would address the protection of services of other administrations due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity, or otherwise, of that decision if such a decision is made unilaterally. In case that the interfering administration does not respond to the invitation then the protection of the victim service would be put at the mercy of the interfering service.*

*Views were expressed that RR Articles 9 and 11 already include procedures for the protection of SRS/EESS earth stations. ITU-R Recommendations will help in effecting the coordination and also for national considerations.*

### **Option 3:**

No condition is necessary.

*Reasons: Studies have shown that the separation distances are small and could be considered a national issue.*

*Views were expressed that no condition option contradicts results of sharing and compatibility studies and does not ensure the protection of existing earth stations and the deployment of future receiving earth stations under the SRS (space-to-Earth) allocation in the frequency band 37-38 GHz, which contradicts the objectives of Resolution 238 (WRC-15).*

## **2/1.13/4.3.2.4 Condition C2d: Measures for the SRS (Earth-to-space) and EESS (Earth-to-space)**

### **Option 1:**

To introduce RR provisions that IMT-2020 systems operating in the frequency band 37-40.5 GHz shall not claim protection from emissions of SRS (Earth-to-space) and EESS (Earth-to-space) earth stations operating in the frequency band 40-40.5 GHz to ensure future development of the SRS (Earth-to-space) and EESS (Earth-to-space).

**Option 2:**

No condition is necessary.

*Views were expressed that the MS has an existing co-primary allocation providing equal status to the SRS and EESS. Sharing with earth stations in the SRS (Earth-to-space) and EESS (Earth-to-space) are addressed by existing coordination processes in the RR.*

*Views were expressed that no condition option is not based on any sharing and compatibility study, and may constrain deployment of future earth stations under the SRS (Earth-to-space) and EESS (Earth-to-space) allocations in the frequency band 40-40.5 GHz, which contradicts the objectives of Resolution 238 (WRC-15).*

**2/1.13/4.3.2.5 Condition C2e: Protection measures for multiple services**

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

**Option 1:**

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. 9.21 in the corresponding footnote.

*Views were expressed that there are no criteria for BR to identify concerned administrations, and the application of RR No. 9.21 would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

*Other views were expressed given the small interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.*

**Option 2:**

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

*Views were expressed that there are no criteria to identify concerned administrations nor procedure to apply it. This would create an undue burden on administrations and on BR. It is not implementable and enforceable.*

**Option 3:**

No condition is necessary.

**2/1.13/4.4 Item D: Frequency band 40.5-42.5 GHz**

**2/1.13/4.4.1 Method D1: NOC**

No change to the Radio Regulations.

**2/1.13/4.4.2 Method D2: Identification of the frequency band 40.5-42.5 GHz for IMT in accordance with the following two alternatives**

**Alternative 1**

Under this alternative, upgrade the existing secondary allocation to the MS in the frequency band 40.5-42.5 GHz to a primary allocation in the Table of Frequency Allocations and identify the frequency band for the terrestrial component of IMT within the LMS.

*Reasons: It is proposed to limit the identification of IMT by LMS due to the fact that ITU-R did not undertake sharing and compatibility studies for aeronautical and maritime deployments of IMT-2020. Such an identification provides the same status for IMT in the RR (primary allocation) as it is provided for the existing IMT systems in other frequency bands. According to ITU-R deliverables in the frequency bands above 24 GHz, IMT-2020 deployment on ships and airplanes is not expected. Based on the ITU-R studies, sharing conditions developed in the CPM Report for IMT applications in the LMS could not be applicable for IMT applications in the AMS and MMS, therefore the protection of incumbent services will not be ensured.*

## **Alternative 2**

Under this alternative, upgrade the existing secondary allocation to the MS in the frequency band 40.5-42.5 GHz to a primary allocation in the Table of Frequency Allocations and identify the frequency band for the terrestrial component of IMT.

*Reasons: A restriction of IMT to the LMS allocation was not felt necessary for existing IMT frequency bands and is not necessary for new IMT frequency bands, since the IMT characteristics, which included deployment, are already described in ITU-R Recommendations and Reports.*

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies.

### **2/1.13/4.4.2.1 Condition D2a: Protection measures for the FSS (space-to-Earth)**

#### **Option 1:**

In a WRC Resolution:

- invite administrations to ensure the necessary balance in the frequency bands 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the MS and FSS, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. the HDFSS) and spectrum available for gateway earth stations;
- to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations from IMT deployments in neighbouring countries;
- in addition, administrations should be invited to apply this Recommendation when they decide to protect FSS earth stations from IMT networks and to ensure the possibility of deploying future gateway earth stations.

*Views were expressed that for cross-border protection of earth stations, coordination procedures in RR Articles 9 and 11 would apply. ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations.*

#### **Option 2:**

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution, cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force, as it is based on an optional concept, nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by*

*the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking as it does not have legal and procedural support and in no way would address the protection of services of other administrations, due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity, or otherwise, of that decision if such a decision is made unilaterally. In case that the interfering administration does not respond to the invitation, then the protection of the victim service would be put at the mercy of the interfering service.*

*Views were expressed that protection of FSS earth stations is already covered by RR Articles 9 and 11 and does not need to be covered in other regulatory text. In addition, this option is ambiguous and does not provide any methodology for identifying affected administrations.*

### **Option 3:**

In a WRC Resolution:

- to invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations from IMT deployments in neighbouring countries;
- in addition, administrations should be invited to apply this Recommendation when they decide to protect FSS earth stations from IMT networks and to ensure the possibility of deploying future gateway earth stations.

In the footnote containing the IMT identification, administrations should take into account potential constraints to IMT in the frequency band, as appropriate, because of the potential deployment of high-density applications in the FSS in the frequency band 39.5-42 GHz as per RR No. **5.516B**.

In addition, administrations should be invited to ensure the necessary balance in the frequency bands 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the FSS, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. the HDFSS) and spectrum available for gateway earth stations.

*Reasons: As recognized in the summary of studies, sharing between earth stations at unspecified locations (such as is the case of the HDFSS) and IMT may or may not be possible on a case-by-case basis. As such, this option calls for administrations to take that into account and consider potential constraints to IMT, as appropriate, to ensure FSS/IMT compatibility.*

*Views were expressed that this option should not be Method D2 (IMT identification), but be in a separate Method D3 as it does not identify the frequency band for IMT, but for the HDFSS instead. CPM19-2 should consider moving this option to a separate method.*

*Views were expressed that the identification of new frequency ranges for the high-density fixed-satellite service (HDFSS) is not in the scope of Resolution 238 (WRC-15) and agenda item 1.13. It is not appropriate to allocate or identify new frequency ranges to other services and applications that are not within the scope of Resolution 238 (WRC-15) and agenda item 1.13. This is only for the allocation of frequency ranges to the MS and identification of IMT-2020. Condition D2a, Option 3 should be deleted from the CPM Report.*

### **Option 4:**

In the footnote containing the IMT identification, administrations should take into account potential constraints to IMT in the frequency band, as appropriate, because of the potential deployment of high-density applications in the FSS in the frequency band 39.5-42 GHz as per RR No. **5.516B**.

*Reasons: As recognized in the summary of studies, sharing between earth stations at unspecified locations (such as is the case for the HDFSS) and IMT may or may not be possible on a case-by-case basis. As such, this options calls for administrations to take that into account and consider potential constraints to IMT, as appropriate, to ensure FSS/IMT compatibility.*

*Views were expressed that studies have shown that sharing is feasible between IMT and the FSS. Furthermore, RR No. 5.516B states that the identification of this frequency band for the HDFSS does not preclude the use of these frequency bands by other services and does not establish priority in the Radio Regulations among the users of these frequency bands. Therefore, a new footnote providing a higher status to the FSS would be in contravention of RR No. 5.516B and is not appropriate.*

**Option 5:**

No condition is necessary.

**2/1.13/4.4.2.2 Condition D2b: Protection measures for the RAS**

**Option 1:**

The RAS frequency band 42.5-43.5 GHz is covered by RR No. 5.149. Since the protection from interference caused by unwanted emissions into a frequency band used by the RAS is not always straightforward to implement, ITU-R should therefore be invited to update existing ITU-R Recommendations or develop new ITU-R Recommendations, as appropriate, to provide information on possible coordination and protection measures to assist administrations in this matter.

**Option 2:**

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force, as it is based on an optional concept, nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking, as it does not have legal and procedural support and in no way would address the protection of services of other administrations due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity, or otherwise, of that decision, if such decision is made unilaterally. In case that the interfering administration does not respond to the invitation then the protection of the victim service would be put at the mercy of the interfering service.*

*Views were expressed that the results of studies indicate coordination distances that pertain to national matters.*

**Option 3:**

No condition is necessary.

**2/1.13/4.4.2.3 Condition D2c: Protection measures for multiple services**

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

### **Option 1:**

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. 9.21 in the corresponding footnote.

*View 1: There are no criteria for BR to identify concerned administrations, and the application of RR No. 9.21 would create an undue burden on administrations and on BR. It is not implementable and enforceable.*

*View 2: Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.*

### **Option 2:**

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

*Views were expressed that there are no criteria to identify concerned administrations nor procedure to apply it. This would create an undue burden on administrations and on BR. It is not implementable and enforceable.*

### **Option 3:**

No condition is necessary.

*View 1: Option 4 does not provide protection for incumbent services if Conditions D2a-D2b to protect specific services do not apply.*

*View 2: The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbent services, thus there is no need for the addition of some of the conditions indicated in Conditions D2a-D2b.*

## **2/1.13/4.5 Item E: Frequency band 42.5-43.5 GHz**

### **2/1.13/4.5.1 Method E1: NOC**

No change to the Radio Regulations.

### **2/1.13/4.5.2 Method E2: Identification of the frequency band 42.5-43.5 GHz for IMT in accordance with the following two alternatives**

#### **Alternative 1**

Under this alternative, identify the frequency band for the terrestrial component of IMT within the land mobile service.

*Reasons: It is proposed to limit the identification of IMT by the LMS due to the fact that ITU-R did not undertake sharing and compatibility studies for aeronautical and maritime deployments of IMT-2020. Such an identification provides the same status for IMT in the RR (primary allocation) as it is provided for the existing IMT systems in other frequency band. According to ITU-R deliverables in the frequency bands above 24 GHz, IMT-2020 deployment on ships and airplanes is not expected. Based on the ITU-R studies, sharing conditions developed in the CPM Report for IMT applications in the LMS could not be applicable for IMT applications in the AMS and MMS, therefore the protection of incumbent services will not be ensured.*

*Views were expressed that for the frequency bands with existing MS allocations, as an application of the MS, IMT should not be limited to a lesser status than the rest of the MS, as existing IMT identifications under the MS in the RR have never included this limitation. The AMS was not studied*

*in the context of new MS allocations. Furthermore, any use of IMT aboard ships (i.e. in the MMS) would have low, negligible use (below that of suburban open area density), and therefore, would not result in any appreciable difference in aggregate interference to other services.*

## **Alternative 2**

Under this alternative, identify the frequency band for the terrestrial component of IMT.

*Reasons: A restriction of IMT to the LMS allocation was not felt necessary for existing IMT frequency bands and is not necessary for new IMT frequency bands, since the IMT characteristics, which included deployment, are already described in ITU-R Recommendations and Reports.*

*Views were expressed that Alternative 2 allows operation of the IMT-2020 stations within the MMS, which contradicts the IMT-2020 parameters provided by the responsible ITU-R group, limited to the LMS deployment. Sharing conditions developed in the CPM Report for IMT deployment in the LMS could not be applicable for IMT deployment in the AMS and MMS, therefore the protection of incumbent services will not be ensured.*

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies.

### **2/1.13/4.5.2.1 Condition E2a: Protection measures for the FSS (Earth-to-space)**

#### **Option 1:**

To introduce in the Radio Regulations provisions to limit:

- the maximum TRP of IMT BSs of [20.5/44/TBD] dB(m/200 MHz), i.e. [−9.5/14/TBD] dB(W/200 MHz);
- the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal;
- the antenna pattern shall comply with Recommendation ITU-R M.2101.

*Reasons: Conditions in Option 1 are based on sharing and compatibility study and ensures protection of the FSS service. Moreover, all studies use the antenna pattern of IMT BS in accordance with Recommendation ITU-R M.2101, in case of another antenna pattern it might be interference to the FSS receiving space station.*

*Views were expressed that studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, the limits in this option are overly restrictive and any provisions should be consistent with the assumptions and studies.*

#### **Option 2:**

- To introduce in the Radio Regulations an angular e.i.r.p. mask for the emissions of IMT BSs in the skyward direction, see Section 2/1.13/5 (Resolution [A113-IMT 40/50 GHz]).

*Reasons: The e.i.r.p. mask is based on sharing and compatibility studies and ensures the protection of the FSS, while providing flexibility for IMT-2020 deployments (there are no separate limits for mechanical downtilt and e-tilt angles, as well as fixed TRP values), and it is implementable, since there are existing examples of the application of off-axis gain limits in the Radio Regulations and ITU-R Recommendations.*



*Views were expressed that such an angular e.i.r.p. mask would be extremely complicated to implement with active antennas. The analysis that supports this mask is unclear and it is noted that all BSs would need to be pointing in the skyward direction towards the FSS space station, which is unlikely to be representative of IMT deployments. The interference potential depends mainly on the number of simultaneous cases where there is emission in the skyward direction. The e.i.r.p. mask would be unduly restrictive.*

### **Option 3:**

- Introducing in the Radio Regulations a mandatory limit on the maximum TRP of IMT BSs of [20.5/44/TBD] dB(m/200 MHz), i.e. [-9.5/14/TBD] dB(W/200 MHz) to provide protection to the FSS (Earth-to-space) in the frequency band 42.5-43.5 GHz.
- Requiring that the combined tilt (electrical and mechanical) of IMT BSs should normally not be higher than 0 degrees relative to the horizontal.

*Views were expressed that the condition for electrical tilt is not implementable and could not be enforced by administrations due to the word “normally” used when defining limits of 0 degrees for electrical tilt. Studies also found that the interference impact on satellite receivers is significant even for a low number of outdoor IMT UEs at elevations above 0 degrees. Moreover, the antenna pattern of an IMT BS in this option is not defined and in practice any antenna for an IMT BS could be used. When the antenna gain of an IMT BS in skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the FSS.*

*Views were expressed that studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, provisions are needed, which are consistent with the assumptions.*

*Views were expressed that studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, the limits in this option are overly restrictive and any provisions that are needed, should be consistent with the assumptions.*

### **Option 4:**

- Requiring that when deploying outdoor BSs, it shall be ensured that each antenna is normally transmitting only with the main beam pointing below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the BS is only receiving.

*Reasons: Studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, provisions are needed, which are consistent with the assumptions. It is implementable and enforceable by including them in the licence conditions.*

*Views were expressed that the condition for main beam pointing is not implementable and could not be enforced by administrations due to the word “normally” used when defining the main beam pointing limits. Moreover, the TRP value and antenna pattern of an IMT BS in this option is not defined and in practice any TRP and antenna pattern for an IMT BS could be used. When emissions of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (TRP 25 dB(m/200 MHz), i.e. -5 dB(W/200 MHz) and the antenna in line with Recommendation ITU-R M.2101), this option will not protect the FSS.*

### Option 5:

- Introducing in the Radio Regulations a mandatory limit on the maximum TRP of IMT BSs of [20.5/44/TBD] dB(m/200 MHz), i.e. [-9.5/14/TBD] dB(W/200 MHz) to provide long-term stability for the FSS (Earth-to-space) in the frequency band 42.5-43.5 GHz.
- Requiring that the mechanical tilt of IMT BSs shall be below [TBD degrees].
- Limits for the maximum density of BSs for outdoor urban hot spots and the maximum density of BSs for outdoor suburban hot spots within the territory of an administration.

*Views were expressed that restricting the density of BSs per km<sup>2</sup> would be difficult for administrations to implement. In addition, it is unclear which reference will be used for calculating the density. Moreover, the relevant area in terms of interference would depend on each satellite footprint, which could cover the territory of multiple administrations.*

*Views were expressed that a limitation for IMT-2020 BS density as proposed in this option, is not implementable, because the number of outdoor urban hot spots is not limited and this does not ensure the protection of satellite networks in the FSS. Moreover, the antenna pattern of an IMT BS in this option is not defined and in practice any antenna for an IMT BS could be used. When the antenna gain of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the FSS.*

### Option 6:

- Introducing in the Radio Regulations a mandatory limit on the maximum TRP of IMT BSs of [20.5/44/TBD] dB(m/200 MHz), i.e. [-9.5/14/TBD] dB(W/200 MHz) to provide a margin to future IMT characteristics beyond those studied to date and to provide long-term stability for the FSS (Earth-to-space) in the frequency band 42.5-43.5 GHz.
- Requiring that the main beam pointing of IMT BSs should avoid being higher than 0 degrees relative to the horizontal.
- Requiring that the mechanical tilt of IMT BSs shall be below the horizon.

*Views were expressed that the antenna pattern might be different than assumed in the ITU-R studies (Recommendation ITU-R M.2101). This option does not ensure the protection of the FSS.*

### Option 7:

No condition necessary.

*View 1: This option contradicts the results of sharing and compatibility studies, which were based on limitations of IMT-2020 e.i.r.p. and the assumption that elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees. The impact of the IMT-2020 BS antenna main beam, pointing in the upper hemisphere without any e.i.r.p. limit, was not assessed, however it is possible in accordance with this option. This option does not ensure the protection of the FSS.*

*View 2: These regulatory options are not necessary since studies show that sharing is feasible without any additional mandatory limits.*

## 2/1.13/4.5.2.2 Condition E2b: Protection measures for the RAS

### Option 1:

The RAS frequency band 42.5-43.5 GHz is covered by RR No. **5.149**. Coexistence with the IMT could be possible with proper mitigation and coordination measures despite the in-band sharing in this frequency band. ITU-R should therefore be invited to update existing ITU-R Recommendations or develop new ITU-R Recommendations, as appropriate, to provide information on possible coordination and protection measures for the RAS and assist administrations in this matter.

### **Option 2:**

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution, cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force, as it is based on an optional concept, nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking, as it does not have legal and procedural support and in no way would address the protection of services of other administrations due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity, or otherwise, of that decision, if such a decision is made unilaterally. In case that the interfering administration does not respond to the invitation, then the protection of the victim service would be put at the mercy of the interfering service.*

*Views were expressed that the results of studies indicate coordination distances that pertain to national matters.*

### **Option 3:**

No condition is necessary.

### **2/1.13/4.5.2.3 Condition E2c: Protection measures for multiple services**

In addition to the options and associated alternatives for the protection measures for the different services as described above, additional options are suggested.

#### **Option 1:**

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. 9.21 in the corresponding footnote.

*View 1: There are no criteria for the BR to identify concerned administrations, and the application of RR No. 9.21 would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

*View 2: Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.*

#### **Option 2:**

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

*Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

#### **Option 3:**

To invite ITU-R to regularly update characteristics of IMT deployments (including BS density) and to study/assess the impact on sharing and compatibility with other services resulting from these

deployments. This would enable ITU-R to recommend corrective measures to address situations whereby the interference threshold of space stations would be at risk to be exceeded.

*Views were expressed that ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business, and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC 15).*

*Views were expressed that further clarifications are required on the applicability of the implementation.*

#### **Option 4:**

No condition is necessary.

*View 1: Option 4 does not provide protection for incumbent services if Conditions E2a-E2b to protect specific services do not apply.*

*View 2: The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbent services, thus there is no need for the addition of some of the conditions indicated in Conditions E2a-E2b.*

#### **2/1.13/4.6 Item F: Frequency band 45.5-47 GHz**

##### **2/1.13/4.6.1 Method F1: NOC**

No change to the Radio Regulations.

##### **2/1.13/4.6.2 Method F2: Possible identification of the frequency band 45.5-47 GHz for IMT**

#### **Alternative 1**

Under this alternative, because no studies have been carried out, no identification of the frequency band for the terrestrial component of IMT would be made at WRC-19.

#### **Alternative 2**

Under this alternative, even though no studies have been carried out, identify the frequency band for the terrestrial component of IMT.

The method for identification of this frequency band for IMT was not discussed due to the absence of studies, while some Member States expressed interest to consider this frequency band for identification for IMT. This method must contain regulatory provisions and potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of ITU-R studies.

*Views were expressed that an IMT identification is not appropriate, since no studies were carried out.*

##### **2/1.13/4.6.2.1 Condition F2a: Protection measures for the MSS, RNS and RNSS**

[No studies available yet, therefore TBD]

##### **2/1.13/4.6.2.2 Condition F2b: Protection measures for multiple services**

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

### **Option 1:**

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. 9.21 in the corresponding footnote.

*View 1: There are no criteria for BR to identify concerned administrations and the application of RR No. 9.21 would create an undue burden on administrations and on BR. It is not implementable and enforceable.*

*View 2: Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.*

### **Option 2:**

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

*Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on BR. It is not implementable and enforceable.*

### **Option 3:**

No condition is necessary.

## **2/1.13/4.7 Item G: Frequency band 47-47.2 GHz**

### **2/1.13/4.7.1 Method G1: NOC**

No change to the Radio Regulations.

### **2/1.13/4.7.2 Method G2: Possible identification of the frequency band 47-47.2 GHz for IMT**

#### **Alternative 1**

Under this alternative, because no studies have been carried out, no identification of the frequency band for the terrestrial component of IMT would be made at WRC-19.

#### **Alternative 2**

Under this alternative, even though no studies have been carried out, identify the frequency band for the terrestrial component of IMT.

The method for the identification of this frequency band for IMT was not discussed due to the absence of studies, while some Member States expressed interest to consider this frequency band for the identification for IMT. This method must contain regulatory provisions and potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of ITU-R studies.

*Views were expressed that an IMT identification is not appropriate, since no studies were carried out.*

### **2/1.13/4.7.2.1 Condition G2a: Protection measures for the ARS and ARSS**

[No studies available yet, therefore TBD]

### **2/1.13/4.7.2.2 Condition G2b: Protection measures for multiple services**

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

#### **Option 1:**

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. **9.21** in the corresponding footnote.

*Views were expressed that there are no criteria for BR to identify concerned administrations, and the application of RR No. **9.21** would create an undue burden on administrations and on BR. It is not implementable and enforceable.*

#### **Option 2:**

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

*Views were expressed that there are no criteria to identify concerned administrations nor procedure to apply it. This would create an undue burden on administrations and on BR. It is not implementable and enforceable.*

#### **Option 3:**

No condition is necessary.

### **2/1.13/4.8 Item H: Frequency band 47.2-50.2 GHz**

#### **2/1.13/4.8.1 Method H1: NOC**

No change to the Radio Regulations.

#### **2/1.13/4.8.2 Method H2: Identification of the frequency band 47.2-50.2 GHz for IMT in accordance with the following two alternatives**

##### **Alternative 1**

Under this alternative, identify the 47.2-50.2 GHz frequency band for the terrestrial component of IMT within the LMS.

*Reasons: It is proposed to limit the identification of IMT by the LMS due to the fact that ITU-R did not undertake sharing and compatibility studies for aeronautical and maritime deployments of IMT-2020. Such an identification provides the same status for IMT in the RR (primary allocation) as it is provided for the existing IMT systems in other frequency bands. According to ITU-R deliverables in the frequency bands above 24 GHz IMT-2020, deployment on ships and airplanes is not expected. Based on the ITU-R studies, sharing conditions developed in the CPM Report for IMT applications in the LMS could not be applicable for IMT applications in the AMS and MMS, therefore the protection of incumbent services will not be ensured.*

*Views were expressed that for the frequency bands with existing MS allocations, as an application of the MS, IMT should not be limited to a lesser status than the rest of the MS as existing IMT identifications under the MS in the RR have never included this limitation. The AMS was not studied in the context of new MS allocations. Furthermore, any use of IMT aboard ships (i.e. in the MMS) would have low, negligible use (below that of suburban open area density), and therefore, would not result in any appreciable difference in the aggregate interference to other services.*

## Alternative 2

Under this alternative, identify the 47.2-50.2 GHz frequency band for the terrestrial component of IMT.

*Reasons: A restriction of IMT to the LMS allocation was not felt necessary for existing IMT frequency bands and is not necessary for new IMT frequency bands since the IMT characteristics, which included deployment, are already described in ITU-R Recommendations and Reports.*

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies. Administrations could consider applying the IMT Resolution and/or modifications to Resolution **750 (Rev.WRC-15)**, or neither, based on the conditions selected when identifying the frequency band for IMT.

### 2/1.13/4.8.2.1 Condition H2a: Protection measures for the EESS (passive)

#### Option 1:

Introduce in Table 1-1 of Resolution **750 (Rev.WRC-15)** limits on unwanted emissions in the frequency band 50.2-50.4 GHz from IMT BSs and IMT mobile stations within the 47.2-50.2 GHz frequency band (see Section 2/1.13/3.2.7) and add a cross-reference to Resolution **750 (Rev.WRC-15)** in the RR footnote that identifies the frequency band for IMT and revise RR No. **5.338A** accordingly.

#### Option 2:

Introduce in the Radio Regulations (Table 1-1 of Resolution **750 (Rev.WRC-15)**) mandatory limits on unwanted emissions in the frequency band 50.2-50.4 GHz from IMT stations (BS and UE) taking into account RR No. **5.340.1**.

#### Option 3:

No condition necessary.

*Views were expressed that Option 3 contradicts the results of the sharing and compatibility studies and does not provide protection of the EESS (passive) in adjacent frequency band 50.2-50.4 GHz, which contradicts the objectives of Resolution **238 (WRC-15)**.*

### 2/1.13/4.8.2.2 Condition H2b: Protection measures for the FSS (Earth-to-space)

#### Option 1:

To introduce in the Radio Regulations provisions to limit:

- the maximum TRP of IMT BSs of [26/44/TBD] dB(m/200 MHz), i.e. [-4/14/TBD] dB(W/200 MHz).
- the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal.
- The antenna pattern shall comply with Recommendation ITU-R M.2101.

*Views were expressed that studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, the limits in this option are overly restrictive and any provisions should be consistent with the assumptions and studies.*

### Option 2:

- To introduce in the Radio Regulations an angular e.i.r.p. mask for the emissions of IMT BSs in the skyward direction, see Section 2/1.13/5 (Resolution [A113-IMT 40/50 GHZ]).

### Option 3:

- Introducing in the Radio Regulations a mandatory limit on the maximum TRP of IMT BSs of [26/44/TBD] dB(m/200 MHz), i.e. [-4/14/TDB] dB(W/200 MHz) to provide protection of the FSS (Earth-to-space) in the frequency band 47.2-50.2 GHz.
- Requiring that the combined tilt (electrical and mechanical) of IMT BSs should normally not be higher than 0 degrees relative to the horizontal.

*Views were expressed that the condition for electrical tilt is not implementable and could not be enforced by administrations due to the word “normally” used when defining limits of 0 degrees for electrical tilt. Studies also found that the interference impact on satellite receivers is significant even for a low number of outdoor IMT UEs at elevations above 0 degrees. Moreover, the antenna pattern of an IMT BS in this option is not defined and in practice any antenna for an IMT BS could be used. When the antenna gain of an IMT BS in skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the FSS.*

### Option 4:

- Requiring that when deploying outdoor BSs, it shall be ensured that each antenna is normally transmitting only with the main beam pointing below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the BS is only receiving.

*Reasons: Studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, provisions are needed, which are consistent with the assumptions. It is implementable and enforceable by including them in the licence conditions.*

*Views were expressed that the condition for main beam pointing is not implementable and could not be enforced by administrations due to the word “normally” used when defining the main beam pointing limits. Moreover, the TRP value and antenna pattern of an IMT BS in this option is not defined and in practice any TRP and antenna pattern for an IMT BS could be used. When emissions of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (TRP 25 dB(m/200 MHz), i.e. -5 dB(W/200 MHz) and the antenna in line with Recommendation ITU-R M.2101), this option will not protect the FSS.*

### Option 5:

- Introducing in the Radio Regulations a mandatory limit on the maximum TRP of IMT BSs of [26/44/TBD] dB(m/200 MHz), i.e. [-4/14/TBD] dB(W/200 MHz) to provide long-term stability for the FSS (Earth-to-space) in the frequency band 47.2-50.2 GHz.
- Requiring that the mechanical tilt of IMT BSs shall be below [TBD degrees].
- Limits for the maximum density of BSs for outdoor urban hot spots and the maximum density of BSs for outdoor suburban hot spots within the territory of an administration.

*Views were expressed that restricting the density of BSs per km<sup>2</sup> would be difficult for administrations to implement. In addition, it is unclear which reference will be used for calculating the density. Moreover, the relevant area in terms of interference would depend on each satellite footprint, which could cover the territory of multiple administrations.*



*Views were expressed that the limitation of the IMT-2020 BS density, as proposed in this option, is not implementable, because the number of outdoor urban hot spots is not limited and this does not ensure the protection for satellite networks of the FSS. Moreover, the antenna pattern of an IMT BS in this option is not defined and in practice any antenna for an IMT BS could be used. When the antenna gain of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the FSS.*

#### **Option 6:**

- Introducing in the Radio Regulations a mandatory limit on the maximum TRP of IMT BSs of [26/44/TBD] dB(m/200 MHz), i.e. [−4/14/TBD] dB(W/200 MHz) to provide a margin to future IMT characteristics beyond those studied to date and to provide long-term stability to the FSS (Earth-to-space) in the frequency band 47.2-50.2 GHz.
- Requiring that the main beam pointing of IMT BSs should avoid being higher than 0 degrees relative to the horizontal.
- Requiring that the mechanical tilt of IMT BSs shall be below the horizon.

*Views were expressed that the antenna pattern might be different than assumed in the ITU-R studies (Recommendation ITU-R M.2101). This option does not ensure the protection of the FSS.*

#### **Option 7:**

In the footnote containing the IMT identification, administrations should take into account potential constraints to IMT in the frequency band, as appropriate, because of the potential deployment of high-density applications in the FSS in the 48.2-50.2 GHz band, as per RR No. **5.516B**.

In addition, administrations should be invited to ensure that the necessary balance in the frequency bands 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the FSS, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. the HDFSS) and spectrum available for gateway earth stations.

*Reasons: As recognized in the summary of studies, sharing between earth stations at unspecified locations (such as is the case for the HDFSS) and IMT may or may not be possible on a case-by-case basis. As such, this option calls for administrations to take that into account and consider potential constraints to IMT, as appropriate, to ensure FSS/IMT compatibility*

*Views were expressed that studies have shown that sharing is feasible between IMT and the FSS. Furthermore, RR No. **5.516B** states that the identification of this frequency band for the HDFSS does not preclude the use of these frequency bands by other services and does not establish priority in the Radio Regulations among the users of these frequency bands. Therefore, a new footnote providing a higher status to the FSS would be in contravention of RR No. **5.516B** and is not appropriate. The necessary frequency band balance between the FSS and IMT in these frequency bands is a national matter and a WRC Resolution invites to ensure a balanced condition would be inappropriate and should be removed.*

*Views were expressed that the use of the terms “should” and “potential constraints” are not appropriate for an RR footnote.*

#### **Option 8:**

No condition necessary.

*Views were expressed that this option contradicts the results of sharing and compatibility studies, which were based on limitations of IMT-2020 e.i.r.p. and the assumption that elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees. The impact of the IMT-2020 BS antenna*

*main beam, pointing in the upper hemisphere without any e.i.r.p. limit, was not assessed, however it is possible in accordance with this option. This option does not ensure the protection of the FSS.*

### **2/1.13/4.8.2.3 Condition H2c: Protection measures for the FSS (space-to-Earth)**

#### **Option 1:**

For the protection of the FSS in the frequency band 47.5-50.2 GHz, the following actions are required:

- ITU-R should be invited to develop ITU-R Recommendations to assist administrations in ensuring the protection of FSS earth stations in Region 1;
- Administrations should be invited to apply this Recommendation when they decide to protect FSS earth stations from IMT networks and to ensure the possibility of deploying future gateway earth stations in Region 1.

#### **Option 2:**

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force as it is based on an optional concept, nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking as it does not have legal and procedural support and in no way would address the protection of services of other administrations due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity, or otherwise, of that decision, if such a decision is made unilaterally. In case that the interfering administration does not respond to the invitation, then the protection of the victim service would be put at the mercy of the interfering service.*

#### **Option 3:**

No condition is necessary.

### **2/1.13/4.8.2.4 Condition H2d: Protection measures for multiple services**

In addition to the options and associated alternatives for protection measures of the different services as described above, additional options are suggested.

#### **Option 1:**

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. 9.21 in the corresponding footnote.

*View 1: There are no criteria for the BR to identify concerned administrations and the application of RR No. 9.21 would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

*View 2: Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.*

### **Option 2:**

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

*Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

### **Option 3:**

To invite ITU-R to regularly update characteristics of IMT deployments (including BS density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments. This would enable ITU-R to recommend corrective measures to address situations whereby the interference threshold of space stations would be at risk to be exceeded.

*Views were expressed that the ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC 15).*

*Views were expressed that further clarifications are required on the applicability of the implementation.*

### **Option 4:**

No condition is necessary.

*View 1: Option 4 does not provide protection for incumbent services if Conditions H2a-H2c to protect specific services do not apply.*

*View 2: The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbent services, thus there is no need for the addition of some of the conditions indicated in Conditions H2a-H2c.*

## **2/1.13/4.9 Item I: Frequency band 50.4-52.6 GHz**

### **2/1.13/4.9.1 Method I1: NOC**

No change to the Radio Regulations.

### **2/1.13/4.9.2 Method I2: Identification of the frequency band 50.4-52.6 GHz for IMT in accordance with the following two alternatives**

#### **Alternative 1**

Under this alternative, identify the 50.4-52.6 GHz frequency band for the terrestrial component of IMT within the LMS.

*Reasons: It is proposed to limit the identification of IMT by the LMS due to the fact that ITU-R did not undertake sharing and compatibility studies for aeronautical and maritime deployments of IMT-2020. Such an identification provides the same status for IMT in the RR (primary allocation) as it is provided for the existing IMT systems in other frequency bands. According to ITU-R deliverables in the frequency bands above 24 GHz IMT-2020, deployment on ships and airplanes is not expected. Based on the ITU-R studies, sharing conditions developed in the CPM Report for IMT applications in the LMS could not be applicable for IMT applications in the AMS and MMS, therefore the protection of incumbent services will not be ensured.*

*Views were expressed that for the frequency bands with existing MS allocations, as an application of the MS, IMT should not be limited to a lesser status than the rest of the MS as existing IMT identifications under the MS in the RR have never included this limitation. The AMS was not studied in the context of new MS allocations. Furthermore, any use of IMT aboard ships (i.e. in the MMS) would have low, negligible use (below that of suburban open area density), and therefore, would not result in any appreciable difference in the aggregate interference to other services.*

## **Alternative 2**

Under this alternative, identify the 50.4-52.6 GHz frequency band for the terrestrial component of IMT.

*Reasons: A restriction of IMT to the LMS allocation was not felt necessary for existing IMT frequency bands and is not necessary for new IMT frequency bands since the IMT characteristics, which included deployment, are already described in ITU-R Recommendations and Reports.*

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies. Administrations could consider applying the IMT Resolution and/or modifications to Resolution **750 (Rev.WRC-15)**, or neither, based on the conditions selected when identifying the band for IMT.

### **2/1.13/4.9.2.1 Condition I2a: Protection measures for the EESS (passive)**

#### **Option 1:**

Introduce in Table 1-1 of Resolution **750 (Rev.WRC-15)** limits on unwanted emissions in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz from IMT BSs and IMT mobile stations within the 50.4-52.6 GHz frequency band (see Section 2/1.13/3.2.8) and add a cross-reference to Resolution **750 (Rev.WRC-15)** in the RR footnote that identifies the frequency band for IMT and revise RR No. **5.338A** accordingly.

#### **Option 2:**

Introduce in the Radio Regulations (Table 1-1 of Resolution **750 (Rev.WRC-15)**) mandatory limits on unwanted emissions in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz from IMT stations (BS and UE) taking into account RR No. **5.340.1**.

#### **Option 3:**

No condition necessary.

*Views were expressed that Option 3 contradicts the results of the sharing and compatibility studies and does not provide protection of the EESS (passive) in adjacent frequency band 50.2-50.4 GHz, which contradicts the objectives of Resolution 238 (WRC-15).*

### **2/1.13/4.9.2.2 Condition I2b: Protection measures for the FSS (Earth-to-space)**

#### **Option 1:**

To introduce in the Radio Regulations provisions to limit:

- the maximum TRP of IMT BSs of [26/44/TBD] dB(m/200 MHz), i.e. [-4/14/TBD] dB(W/200 MHz);
- the elevation angle of the antenna main beam of IMT BSs not to be higher than 0 degrees relative to the horizontal;
- the antenna pattern shall comply with Recommendation ITU-R M.2101.

*Views were expressed that studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, the limits in this option are overly restrictive and any provisions should be consistent with the assumptions and studies.*

**Option 2:**

- To introduce in the Radio Regulations an angular e.i.r.p. mask for the emissions of IMT BSs in the skyward direction, see Section 2/1.13/5 (Resolution [A113-IMT 40/50 GHZ]).

**Option 3:**

- Introducing in the Radio Regulations a mandatory limit on the maximum TRP of IMT BSs of [26/44/TBD] dB(m/200 MHz), i.e. [−4/14/TBD] dB(W/200 MHz) to provide protection to the FSS (Earth-to-space) in the frequency band 50.4-52.6 GHz.
- Requiring that the combined tilt (electrical and mechanical) of IMT BSs should normally not be higher than 0 degrees relative to the horizontal.

*Views were expressed that the condition for electrical tilt is not implementable and could not be enforced by administrations due to the word “normally” used when defining limits of 0 degrees for electrical tilt. Studies also found that the interference impact on satellite receivers is significant even for a low number of outdoor IMT UEs at elevations above 0 degrees. Moreover, the antenna pattern of an IMT BS in this option is not defined and in practice any antenna for an IMT BS could be used. When the antenna gain of an IMT BS in skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the FSS.*

**Option 4:**

- Requiring that when deploying outdoor BSs, it shall be ensured that each antenna is normally transmitting only with the main beam pointing below the horizon and in addition the antenna shall have mechanical pointing below the horizon except when the BS is only receiving.

*Reasons: Studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevation angles above 0 degrees. Therefore, provisions are needed, which are consistent with the assumptions. It is implementable and enforceable by including them in the licence conditions.*

*Views were expressed that the condition for main beam pointing is not implementable and could not be enforced by administrations due to the word “normally” used when defining the main beam pointing limits. Moreover, the TRP value and antenna pattern of an IMT BS in this option is not defined and in practice any TRP and antenna pattern for an IMT BS could be used. When emissions of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (TRP 25 dB (m/200 MHz), i.e. −5 dB(W/200 MHz) and the antenna in line with Recommendation ITU-R M.2101), this option will not protect the FSS.*

**Option 5:**

- Introducing in the Radio Regulations a mandatory limit on the maximum TRP of IMT BSs of [26/44/TBD] dB(m/200 MHz), i.e. [−4/14/TBD] dB(W/200 MHz) to provide long-term stability to the FSS (Earth-to-space) in the frequency band 50.4-52.6 GHz.
- Requiring that the mechanical tilt of IMT BSs shall be below [TBD degrees].

- Limits for the maximum density of BSs for outdoor urban hot spots and the maximum density of BSs for outdoor suburban hot spots within the territory of an administration.

*Views were expressed that restricting the density of BSs per km<sup>2</sup> would be difficult for administrations to implement. In addition, it is unclear which reference will be used for calculating the density. Moreover, the relevant area in terms of interference would depend on each satellite footprint, which could cover the territory of multiple administrations.*

*Views were expressed that the limitation to the IMT-2020 BS density, as proposed in this option, is not implementable, because the number of outdoor urban hot spots is not limited and this does not ensure the protection of satellite networks of the FSS. Moreover, the antenna pattern of an IMT BS in this option is not defined and in practice any antenna for an IMT BS could be used. When the antenna gain of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the FSS.*

#### **Option 6:**

- Introducing in the Radio Regulations a mandatory limit on the maximum TRP of IMT BSs of [26/44/TBD] dB(m/200 MHz), i.e. [-4/14/TBD] dB(W/200 MHz) to provide a margin for future IMT characteristics beyond those studied to date, and to provide a long-term stability for the FSS (Earth-to-space) in the frequency band 50.4-52.6 GHz.
- Requiring that the main beam pointing of IMT BSs should avoid being higher than 0 degrees relative to the horizontal.
- Requiring that the mechanical tilt of IMT BSs shall be below the horizon.

*Views were expressed that the antenna pattern might be different than assumed in the ITU-R studies (Recommendation ITU-R M.2101). This option does not ensure the protection of the FSS.*

#### **Option 7:**

No condition necessary.

*Views were expressed that this option contradicts the results of sharing and compatibility studies, which were based on limitations of IMT-2020 e.i.r.p. and the assumption that elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees. The impact of the IMT-2020 BS antenna main beam, pointing in the upper-hemisphere without any e.i.r.p. limit, was not assessed, however it is possible in accordance with this option. This option does not ensure the protection of the FSS.*

### **2/1.13/4.9.2.3 Condition I2c: Protection measures for multiple services**

In addition to the options and associated alternatives for the protection measures of the different services as described above, additional options are suggested.

#### **Option 1:**

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. **9.21** in the corresponding footnote.

*View 1: There are no criteria for the BR to identify concerned administrations and the application of RR No. **9.21** would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

*View 2: Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.*

### **Option 2:**

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

*Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

### **Option 3:**

To invite ITU-R to update characteristics of IMT deployments regularly (including BS density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments. This would enable ITU-R to recommend corrective measures to address situations whereby the interference threshold of space stations would be at risk to be exceeded.

*Views were expressed that the ITU-R does not need to be invited to perform this work. ITU-R Reports and Recommendations can be updated as a matter of normal ITU-R business and on the basis of contributions from members. Recommending future corrective measures to address sharing is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC 15).*

*Views were expressed that further clarifications are required on the applicability of the implementation.*

### **Option 4:**

No condition is necessary.

*View 1: Option 4 does not provide protection for incumbent services if Conditions I2a-I2b to protect specific services do not apply.*

*View 2: The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbent services, thus there is no need for the addition of some of the conditions indicated in Conditions I2a-I2b.*

## **2/1.13/4.10 Item J: Frequency band 66-71 GHz**

### **2/1.13/4.10.1 Method J1: NOC**

No change to the Radio Regulations.

### **2/1.13/4.10.2 Method J2: Identification of the frequency band 66-71 GHz for IMT in accordance with the following two alternatives**

#### **Alternative 1**

Under this alternative, identify the 66-71 GHz frequency band for the terrestrial component of IMT within the land mobile service.

*Reasons: It is proposed to limit the identification of IMT by the LMS due to the fact that ITU-R did not undertake sharing and compatibility studies for aeronautical and maritime deployments of IMT-2020. Such an identification provides the same status for IMT in the RR (primary allocation) as it is provided for the existing IMT systems in other frequency band. According to ITU-R deliverables in the frequency bands above 24 GHz IMT-2020 deployment on ships and airplanes is not expected. Based on the ITU-R studies, sharing conditions developed in the CPM Report for IMT applications in the LMS could not be applicable for IMT applications in the AMS and MMS, therefore the protection of incumbent services will not be ensured.*

*Views were expressed that for the frequency bands with existing MS allocations, as an application of the MS, IMT should not be limited to a lesser status than the rest of the MS, as existing IMT identifications under the MS in the RR have never included this limitation. The AMS was not studied in the context of new MS allocations. Furthermore, any use of IMT aboard ships (i.e. in the MMS) would have low, negligible use (below that of suburban open area density), and therefore, would not result in any appreciable difference in aggregate interference to other services.*

## **Alternative 2**

Under this alternative, identify the 66-71 GHz frequency band for the terrestrial component of IMT.

*Reasons: A restriction of IMT to the LMS allocation was not felt necessary for existing IMT frequency bands and is not necessary for new IMT frequency bands, since the IMT characteristics, which included deployment, are already described in ITU-R Recommendations and Reports.*

For both alternatives, this method contains potential conditions for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies.

### **2/1.13/4.10.2.1 Condition J2a: Measures for coexistence with MGWS/WAS**

#### **Option 1:**

In order to take into account that the frequency band is intended to be used for IMT and multiple gigabit wireless systems (MGWS)/wireless access systems (WAS) technologies for similar deployments and that sharing protocols would ensure local compatibility, reflect in the WRC Resolution corresponding to the IMT identification of this frequency band:

- that administrations, when implementing or planning to implement IMT and MGWS/WAS in the frequency band 66-71 GHz, take into account the latest technical characteristics of IMT and MGWS/WAS, as provided in ITU-R Reports and Recommendations including, when available, sharing protocols as appropriate;

and

- to invite ITU-R to develop Recommendations and Reports that will assist administrations in ensuring that applications and services in the frequency band 66-71 GHz can utilize the frequency band efficiently including the development of appropriate sharing protocols between IMT and MGWS/WAS, where needed.

*Reasons: The frequency band 66-71 GHz is intended to be used for both IMT and MGWS/WAS technologies under similar deployment scenarios and, as a consequence, they may operate in the same locations. The development of appropriate sharing protocols within the ITU would assist administrations implementing both IMT and MGWS/WAS in ensuring local compatibility.*

*Views were expressed that no consensus was reached to include this option due to the fact that many terms above are unclear.*

*Views were expressed that the coexistence between IMT and WAS/MGWS must be clearly addressed to protect WAS/MGWS in the WRC Resolution. Furthermore these conditions must contain regulatory procedural measures, which are implementable.*

*Views were expressed that the course and sequence of action, scope of work, as well as use of terms used in the corresponding text such as “protocol” ....., the validity and the implementability of this method are totally ambiguous, confusing, unclear and incomplete. Moreover, suppression of any frequency band in the footnote RR No. 5.553 is outside the mandate of ITU-R. Consequently this method should therefore not be included in the CPM text.*



### **Option 2:**

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force as it is based on an optional concept, nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking, as it does not have legal and procedural support and in no way would address the protection of services of other administrations, due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity, or otherwise, of that decision, if such decision is made unilaterally. In case that the interfering administration does not respond to the invitation, then the protection of the victim service would be put at the mercy of the interfering service.*

### **Option 3:**

No condition is necessary.

### **2/1.13/4.10.2.2 Condition J2b: Removal of the 66-71 GHz frequency band from RR No. 5.553**

This condition does not address the protection of other services, but other modifications to the RR that would be required under this method.

### **Option 1:**

Revise RR No. 5.553 to remove the 66-71 GHz frequency band from that footnote.

*Reasons: Given the fact that the sharing studies show a large margin towards the MSS (Earth-to-space) and ISS operating in this frequency band, there is no need to maintain the frequency band 66-71 GHz in RR No. 5.553. Other services were not studied as described in Section 2/1.13/3.*

*Views were expressed that Condition J2b is invalid, because it entails regulatory modifications that are outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15). The proposed modification to RR No. 5.553 under this method removes interference protection from the SRS in the frequency band 66-71 GHz. Removing interference protection currently provided to the SRS is outside the scope of WRC-19 agenda item 1.13 and Resolution 238 (WRC-15). Moreover, the consequences of the proposed modification to RR No. 5.553 have not been fully investigated. Administrations are in early stages of deploying space networks in the frequency band 66-71 GHz (e.g., USASAT-NGSO-2). Condition J2b should be deleted from the CPM Report.*

*Views were expressed that this is not a condition that will protect existing services and this method should be deleted from the CPM text.*

*Views were expressed that the course and sequence of actions, scope of work, as well as the use of terms used in the corresponding text such as “protocol” ....., the validity and the implementability of this method are totally ambiguous, confusing, unclear and incomplete. Moreover, the suppression of any frequency band in the footnote RR No. 5.553 is outside of the mandate of the ITU-R. Consequently, this method should therefore not be included in the CPM text.*

### **Option 2:**

No condition is necessary.

### **2/1.13/4.10.2.3 Condition J2c: Protection measures for multiple services**

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

#### **Option 1:**

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. **9.21** in the corresponding footnote.

*Views were expressed that there are no criteria for the BR to identify concerned administrations, and the application of RR No. **9.21** would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

#### **Option 2:**

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

*Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

#### **Option 3:**

No condition is necessary.

*Views were expressed that conditions are required to address the coexistence between MGWS and IMT and that Option 3 should be deleted.*

*Views were expressed that taking into account the results of studies conducted for this frequency band, as well as the current and planned utilization of the frequency band by services to which the frequency band is currently allocated, the position to identify the frequency band without conditions is proposed.*

### **2/1.13/4.10.3 Method J3: To continue studies on the possibility of identification in the frequency band 66-71 GHz for IMT with a WRC Resolution**

In accordance with an associated WRC Resolution, to continue studies on the possibility of the identification for IMT in the frequency band 66-71 GHz for consideration at a future competent WRC. Modify RR No. **5.553** to indicate this Resolution for the frequency band 66-71 GHz in this footnote.

CPM19-2 is invited to consider the matter to take action as appropriate.

*Views were expressed that studies which have been carried out with MSS (E-s) and ISS have shown the compatibility. The absence of characteristics for RNSS and RNS showed the absence of planned deployment in this band. Therefore, putting forward the identification for IMT to WRC-23 would cause unnecessary delay in the identification and cause undue burden to WRC-23 preparations. In addition, a request for the IMT identification to be considered at a future competent WRC should be addressed under WRC-19 agenda item 10 and is out of the scope of WRC-19 agenda item 1.13.*

### **2/1.13/4.11 Item K: Frequency band 71-76 GHz**

#### **2/1.13/4.11.1 Method K1: NOC**

No change to the Radio Regulations.

**2/1.13/4.11.2 Method K2: Identification of the frequency band 71-76 GHz for IMT in accordance with the following two alternatives**

**Alternative 1**

Under this alternative, identify the 71-76 GHz frequency band for the terrestrial component of IMT within the LMS.

*Reasons: It is proposed to limit the identification of IMT by the LMS due to the fact that ITU-R did not undertake sharing and compatibility studies for aeronautical and maritime deployments of IMT-2020. Such an identification provides the same status for IMT in the RR (primary allocation) as it is provided for the existing IMT systems in other frequency bands. According to ITU-R deliverables in the frequency bands above 24 GHz IMT-2020, deployment on ships and airplanes is not expected. Based on the ITU-R studies, sharing conditions developed in the CPM Report for IMT applications in the LMS could not be applicable for IMT applications in the AMS and MMS, therefore the protection of incumbent services will not be ensured.*

*Views were expressed that for the frequency bands with existing MS allocations, as an application of the MS, IMT should not be limited to a lesser status than the rest of the MS as existing IMT identifications under the MS in the RR have never included this limitation. The AMS was not studied in the context of new MS allocations. Furthermore, any use of IMT aboard ships (i.e. in the MMS) would have low, negligible use (below that of suburban open area density), and therefore, would not result in any appreciable difference in the aggregate interference to other services.*

**Alternative 2**

Under this alternative, identify the 71-76 GHz frequency band for the terrestrial component of IMT.

*Reasons: A restriction of IMT to the LMS allocation was not felt necessary for existing IMT frequency bands and is not necessary for new IMT frequency bands, since the IMT characteristics, which included deployment, are already described in ITU-R Recommendations and Reports.*

For both alternatives, this method contains potential conditions as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies (see Section 2/1.13/3.2.10).

**2/1.13/4.11.2.1 Condition K2a: Protection measures for the RLS**

Introduce in the WRC Resolution corresponding to the IMT identification of this frequency band unwanted emission limits into 76-81 GHz from IMT BS and UE operating on frequency band 71-76 GHz.

**2/1.13/4.11.2.2 Condition K2b: Protection measures for the FSS (space-to-Earth)**

**Option 1:**

Invite ITU-R to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations.

*Views were expressed that for cross-border protection of earth stations, coordination procedures in RR Articles 9 and 11 would apply. The ITU-R Recommendation would therefore help administrations during the coordination process and for national considerations.*

### **Option 2:**

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution cross-referenced in the footnote in RR Article 5 in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force as it is based on an optional concept, nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking as it does not have legal and procedural support and in no way would address the protection of services of other administrations, due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity, or otherwise, of that decision, if such a decision is made unilaterally. In case that the interfering administration does not respond to the invitation then the protection of the victim service would be put at the mercy of the interfering service.*

*Views were expressed that protection of FSS earth stations is already covered by RR Articles 9 and 11 and does not need to be covered in other regulatory text. In addition, this option is ambiguous and does not provide any methodology for identifying affected administrations.*

### **Option 3:**

No condition is necessary.

#### **2/1.13/4.11.2.3 Condition K2c: Protection measures for multiple services**

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

#### **Option 1:**

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. 9.21 in the corresponding footnote.

*View 1: There are no criteria for the BR to identify concerned administrations, and the application of RR No. 9.21 would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

*View 2: Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.*

#### **Option 2:**

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

*Views were expressed that there are no criteria to identify concerned administrations nor procedure to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

#### **Option 3:**

No condition is necessary.

*View 1: Option 3 does not provide protection for incumbent services if Conditions K2a-K2b to protect specific services do not apply.*

*View 2: The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbent services, thus there is no need for the addition of some of the conditions indicated in Conditions K2a-K2b.*

**2/1.13/4.12 Item L: Frequency band 81-86 GHz**

**2/1.13/4.12.1 Method L1: NOC**

No change to the Radio Regulations.

**2/1.13/4.12.2 Method L2: Identification of the frequency band 81-86 GHz for IMT in accordance with the following two alternatives**

**Alternative 1**

Under this alternative, identify the 81-86 GHz frequency band for the terrestrial component of IMT within the LMS.

*Reasons: It is proposed to limit the identification of IMT by the LMS due to the fact that ITU-R did not undertake sharing and compatibility studies for aeronautical and maritime deployments of IMT-2020. Such an identification provides the same status for IMT in the RR (primary allocation) as it is provided for the existing IMT systems in other frequency band. According to ITU-R deliverables in the frequency bands above 24 GHz IMT-2020 deployment on ships and airplanes is not expected. Based on the ITU-R studies, sharing conditions developed in the CPM Report for IMT applications in the LMS could not be applicable for IMT applications in the AMS and MMS, therefore the protection of incumbent services will not be ensured.*

*Views were expressed that for the frequency bands with existing MS allocations, as an application of the MS, IMT should not be limited to a lesser status than the rest of the MS, as existing IMT identifications under the MS in the RR have never included this limitation. The AMS was not studied in the context of new MS allocations. Furthermore, any use of IMT aboard ships (i.e. in the MMS) would have low, negligible use (below that of suburban open area density), and therefore, would not result in any appreciable difference in aggregate interference to other services.*

**Alternative 2**

Under this alternative, identify the 81-86 GHz frequency band for the terrestrial component of IMT.

*Reasons: A restriction of IMT to LMS allocations was not felt necessary for existing IMT frequency bands and is not necessary for new IMT frequency bands, since the IMT characteristics, which included deployment, are already described in ITU-R Recommendations and Reports.*

For both alternatives, this method contains potential conditions, as the case may be, to protect services to which the frequency band and adjacent frequency bands are allocated, for consideration by administrations in preparing their proposals to WRC-19, taking into account the results of studies (see Section 2/1.13/3.2.11).

**2/1.13/4.12.2.1 Condition L2a: Protection measures for the EESS (passive)**

**Option 1:**

Introduce in Table 1-1 of Resolution **750 (Rev.WRC-15)** limits on unwanted emissions in the frequency band 86-92 GHz from IMT BSs and IMT mobile stations within the 81-86 GHz frequency band and add a cross-reference to Resolution **750 (Rev.WRC-15)** in the RR footnote that identifies the frequency band for IMT.

### **Option 2:**

No condition necessary.

*Views were expressed that Option 2 contradicts the results of all sharing and compatibility studies presented in ITU-R and does not provide protection to the EESS (passive) in the adjacent frequency band 86-92 GHz.*

#### **2/1.13/4.12.2.2 Condition L2b: Protection measures for the RLS**

Introduce in the WRC Resolution corresponding to the IMT identification of this frequency band unwanted emission limits into 76-81 GHz from IMT BS and UE operating on frequency band 81-86 GHz.

#### **2/1.13/4.12.2.3 Condition L2c: Protection measures for the RAS**

##### **Option 1:**

The RAS frequency band 81- 86 GHz is covered by RR No. **5.149**. Coexistence with the IMT could be possible with proper mitigation and coordination measures. ITU-R should be invited to update existing ITU-R Recommendations or develop new ITU-R Recommendations, as appropriate, to provide information on possible coordination and protection measures and assist the administrations in this matter.

##### **Option 2:**

Protection of other services (in-band and/or adjacent frequency band) by IMT should be contained in a WRC Resolution, cross-referenced in the footnote in RR Article **5** in which the frequency band is identified for IMT.

*Reasons: The protection of other services should merely be addressed by a Resolution and not by an ITU-R Recommendation, which does not have sufficient legal force, as it is based on an optional concept, nor by an ITU-R Resolution, which has merely some sort of technical and/or administrative application (see views as contained in the preliminary draft CPM text as adopted by the sixth meeting of Task Group 5/1). Moreover, inviting administrations to adopt a provision to ensure the protection of services of other administrations is merely wishful thinking, as it does not have legal and procedural support and in no way would address the protection of services of other administrations due to the fact that the action is just limited to be taken by the interfering administration without any agreement of the validity, or otherwise, of that decision, if such decision is made unilaterally. In case that the interfering administration does not respond to the invitation then the protection of the victim service would be put at the mercy of the interfering service.*

*Views were expressed that the results of studies indicate coordination distances that pertain to national matters.*

#### **2/1.13/4.12.2.4 Condition L2d: Protection measures for the FSS (Earth-to-space)**

##### **Option 1:**

- Introducing in the WRC Resolution corresponding to the IMT identification of this frequency band a mandatory limit on the maximum TRP of IMT BSs of [TBD] dB(W/200 MHz) to provide protection to the FSS (Earth-to-space) in the frequency band.
- Requiring that the combined tilt (electrical and mechanical) of IMT BSs should normally not be higher than 0 degrees.

*Views were expressed that the condition for electrical tilt is not implementable and could not be enforced by administrations due to the word “normally” used when defining limits of 0 degrees for electrical tilt. Studies also found that the interference impact on satellite receivers is significant even for a low number of outdoor IMT UEs at elevations above 0 degrees. Moreover, the antenna pattern of IMT BS in this option is not defined and in practice any antenna for the IMT BS could be used. When the antenna gain of an IMT BS in the skyward direction will be higher than assumed in the ITU-R studies (Recommendation ITU-R M.2101), this option will not protect the FSS.*

*Views were expressed that studies assumed that most BSs are pointing to terminals on the ground and some BSs could point higher than 0 degrees to serve some indoor UEs. Studies found that the impact remains low due to the low number of terminals at elevations above 0 degrees. Therefore, provisions are needed which are consistent with the assumptions.*

### **Option 2:**

- Introducing in the WRC Resolution corresponding to the IMT identification of this frequency band a mandatory angular e.i.r.p. mask for the emissions of IMT BSs in the skyward direction.

*Views were expressed that such an angular e.i.r.p. mask would be extremely complicated to implement with active antennas. The analysis that supports this mask is unclear and it is noted that all BSs would need to be pointing in the skyward direction towards the FSS space station, which is unlikely to be representative of IMT deployments. The interference potential depends mainly on the number of simultaneous cases where there is emission in the skyward direction. The e.i.r.p. mask would be unduly restrictive.*

### **Option 3:**

No condition is necessary.

*View 1: This option contradicts the results of sharing and compatibility studies, which were based on limitations of the IMT-2020 e.i.r.p. and the assumption that the elevation angle of the IMT-2020 BS antenna main beam is lower than 0 degrees. The impact of the IMT-2020 BS antenna main beam, pointing in the upper hemisphere without any e.i.r.p. limit, was not assessed, however it is possible in accordance with this option. This option does not ensure the protection of the FSS.*

*View 2: These regulatory options are not necessary since studies show that sharing is feasible without any additional mandatory limits.*

## **2/1.13/4.12.2.5 Condition L2e: Protection measures for multiple services**

In addition to the options and associated alternatives for protection measures for the different services as described above, additional options are suggested.

### **Option 1:**

Include as a prerequisite condition when identifying the frequency band for IMT to apply RR No. **9.21** in the corresponding footnote.

*View 1: There are no criteria for the BR to identify concerned administrations, and the application of RR No. **9.21** would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

*View 2: Given the short interference distances of IMT above 24 GHz over terrestrial paths, the number of cases subject to mandatory notification and coordination may be low and therefore unnecessary.*

**Option 2:**

Include as a prerequisite condition when identifying the frequency band for IMT to obtain agreement from the administrations concerned and reflect this in the corresponding footnote.

*Views were expressed that there are no criteria to identify concerned administrations nor procedures to apply it. This would create an undue burden on administrations and on the BR. It is not implementable and enforceable.*

**Option 3:**

No condition is necessary.

*View 1: Option 3 does not provide protection for incumbent services if Conditions L2a-L2d to protect specific services do not apply.*

*View 2: The majority of sharing and compatibility studies resulted in a significant margin of protection of incumbents services, thus there is no need for the addition of some of the conditions indicated in Conditions L2a-L2d.*

**2/1.13/5 Regulatory and procedural considerations**

In this section various alternatives and/or options are contained as footnotes to the Table of Frequency Allocations reflecting contributions from membership to ITU-R corresponding to options/alternatives contained in Section 2/1.13/4 of the draft CPM Report. CPM19-2 is invited to carefully examine the language used in these footnotes to ensure their accuracy and consistencies with past practices of WRCs.

**2/1.13/5.1 For Item A: Frequency band 24.25-27.5 GHz**

**2/1.13/5.1.1 For Method A1, see Section 2/1.13/5.14.1**

**2/1.13/5.1.2 For Method A2**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations  
(See No. 2.1)**

**MOD**

**22-24.75 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>24.25-24.45</b> FIXED MOBILE except aeronautical mobile ADD 5.A113 MOD 5.338A*	<b>24.25-24.45</b> MOBILE except aeronautical mobile ADD 5.A113 MOD 5.338A* RADIONAVIGATION	<b>24.25-24.45</b> FIXED MOBILE ADD 5.A113 MOD 5.338A* RADIONAVIGATION



<b>24.45-24.65</b> FIXED INTER-SATELLITE MOBILE except aeronautical mobile ADD 5.A113 MOD 5.338A*	<b>24.45-24.65</b> INTER-SATELLITE MOBILE except aeronautical mobile ADD 5.A113 MOD 5.338A* RADIONAVIGATION 5.533	<b>24.45-24.65</b> FIXED INTER-SATELLITE MOBILE ADD 5.A113 MOD 5.338A* RADIONAVIGATION 5.533
<b>24.65-24.75</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE MOBILE except aeronautical mobile ADD 5.A113 MOD 5.338A*	<b>24.65-24.75</b> INTER-SATELLITE MOBILE except aeronautical mobile ADD 5.A113 MOD 5.338A* RADIOLOCATION- SATELLITE (Earth-to-space)	<b>24.65-24.75</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE MOBILE ADD 5.A113 MOD 5.338A* 5.533

## MOD

### 24.75-29.9 GHz

Allocation to services		
Region 1	Region 2	Region 3
<b>24.75-25.25</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.532B MOBILE except aeronautical mobile ADD 5.A113 MOD 5.338A*	<b>24.75-25.25</b> FIXED-SATELLITE (Earth-to-space) 5.535 MOBILE except aeronautical mobile ADD 5.A113 MOD 5.338A*	<b>24.75-25.25</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.535 MOBILE ADD 5.A113 MOD 5.338A*
<b>25.25-25.5</b>	FIXED INTER-SATELLITE 5.536 MOBILE ADD 5.A113 MOD 5.338A* Standard frequency and time signal-satellite (Earth-to-space)	
<b>25.5-27</b>	EARTH EXPLORATION-SATELLITE (space-to Earth) MOD 5.536B ** FIXED INTER-SATELLITE 5.536 MOBILE ADD 5.A113 MOD 5.338A* SPACE RESEARCH (space-to-Earth) 5.536C Standard frequency and time signal-satellite (Earth-to-space) MOD 5.536A**	
<b>27-27.5</b> FIXED INTER-SATELLITE 5.536 MOBILE ADD 5.A113 MOD 5.338A*	<b>27-27.5</b> FIXED FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE 5.536 5.537 MOBILE ADD 5.A113 MOD 5.338A*	

Notes: \*MOD 5.338A is needed for Method A2, Alternatives 1 and 2, Condition A2a, Option 1, and for Alternative 1, Condition A2g, Options 1 and 2;

**\*\*MOD 5.536A and MOD 5.536B** are needed for Method A2, Alternatives 1 and 2, Condition A2c, Option 1

**For Method A2, Alternative 1, Condition A2a**

**ADD**

**5.A113a** The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolutions **[A113-IMT 26 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply.][Resolution **[A113-IMT 26 GHZ] (WRC-19)** applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

**For Method A2, Alternative 2, Condition A2a**

**ADD**

**5.A113b** The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolutions **[A113-IMT 26 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply.][Resolution **[A113-IMT 26 GHZ] (WRC-19)** applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.A113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.A113a or 5.A113b above could be selected. In addition, only one or none of the texts within square brackets should be kept based on the conditions selected when identifying the band for IMT.*

**For Method A2, Alternative 1, Condition A2g, Option 1**

**ADD**

**5.A113c** The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. **9.21**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[A113-IMT 26 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply. (WRC-19)

**For Method A2, Alternative 1, Condition A2g, Option 2**

**ADD**

**5.A113d** The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to

the land mobile service. Resolutions [A113-IMT 26 GHZ] (WRC-19) and 750 (Rev.WRC-19) apply. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.A113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.A113c or 5.A113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

**For Method A2, Alternatives 1 and 2, Condition A2a, Options 1, and for Alternative 1, Condition A2g, Options 1 and 2**

**MOD**

**5.338A** In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 24.25-[TBD] / [24.45 / 25.25 / 27.5] GHz, 30-31.3 GHz, 49.7-50.2 GHz, 50.4-50.9 GHz, 51.4-52.6 GHz, 81-86 GHz and 92-94 GHz, Resolution 750 (Rev.WRC-19) applies. (WRC-19)

**For Method A2, Alternatives 1 and 2, Condition A2c, Option 1**

**MOD**

**5.536A** Administrations operating earth stations in the Earth exploration-satellite service or the space research service shall not claim protection from stations (except IMT base stations and user terminals) in the fixed and mobile services operated by other administrations. In addition, earth stations in the Earth exploration-satellite service or in the space research service should be operated taking into account the most recent version of Recommendation ITU-R SA.1862. (WRC-19)

**MOD**

**5.536B** In Saudi Arabia, Austria, Bahrain, Belgium, Brazil, China, Korea (Rep. of), Denmark, Egypt, United Arab Emirates, Estonia, Finland, Hungary, India, Iran (Islamic Republic of), Ireland, Israel, Italy, Jordan, Kenya, Kuwait, Lebanon, Libya, Lithuania, Moldova, Norway, Oman, Uganda, Pakistan, the Philippines, Poland, Portugal, the Syrian Arab Republic, Dem. People's Rep. of Korea, Slovakia, the Czech Rep., Romania, the United Kingdom, Singapore, Sweden, Tanzania, Turkey, Viet Nam and Zimbabwe, earth stations operating in the Earth exploration-satellite service in the frequency band 25.5-27 GHz shall not claim protection from, or constrain the use and deployment of, stations (except IMT base stations and user terminals) of the fixed and mobile services. (WRC-19)

**2/1.13/5.2 For Item B: Frequency band 31.8-33.4 GHz, see Section 2/1.13/5.14.2**

**2/1.13/5.3 For Item C: Frequency band 37-40.5 GHz**

**2/1.13/5.3.1 For Method C1, see Section 2/1.13/5.14.3**

**2/1.13/5.3.2 For Method C2**

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations (See No. 2.1)

**MOD**

**34.2-40 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>37-37.5</b>	FIXED MOBILE except aeronautical mobile ADD 5.B113 MOD 5.338A* SPACE RESEARCH (space-to-Earth) 5.547	
<b>37.5-38</b>	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile ADD 5.B113 MOD 5.338A* SPACE RESEARCH (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547	
<b>38-39.5</b>	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE ADD 5.B113 MOD 5.338A* Earth exploration-satellite (space-to-Earth) 5.547	
<b>39.5-40</b>	FIXED FIXED-SATELLITE (space-to-Earth) MOD*** 5.516B MOBILE ADD 5.B113/5.C113** MOD 5.338A* MOBILE-SATELLITE (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547	

**MOD**

**40-47.5 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>40-40.5</b>	EARTH EXPLORATION-SATELLITE (Earth-to-space) FIXED FIXED-SATELLITE (space-to-Earth) MOD*** 5.516B MOBILE ADD 5.B113/5.C113** MOD 5.338A* MOBILE-SATELLITE (space-to-Earth) SPACE RESEARCH (Earth-to-space) Earth exploration-satellite (space-to-Earth)	

Notes: \*MOD **5.338A** is needed for Method C2, Alternatives 1 and 2, Condition C2a, Options 1, 2 and 3, and for Alternative 1, Condition C2e, Options 1 and 2;

\*\*ADD **5.C113** to be used instead of ADD **5.B113** for Method C2, Alternative 2, Condition C2b, Options 4 and 5

\*\*\*MOD in front of **5.516B** is needed for Method C2, Alternative 2, Condition C2b, Option 3

**For Method C2, Alternative 1, Condition C2a**

**ADD**

**5.B113a** The frequency band 37-40.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply.][Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

**For Method C2, Alternative 2, Condition C2a**

**ADD**

**5.B113b** The frequency band 37-40.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply.][Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.B113** included in the modification of RR Article 5 provided above, either of footnotes RR Nos. **5.B113a** or **5.B113b** above could be selected. In addition, only one or none of the texts within square brackets should be kept based on the conditions selected when identifying the band for IMT.*

**For Method C2, Alternative 1, Condition C2e, Option 1**

**ADD**

**5.B113c** The frequency band 37-40.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. **9.21**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply. (WRC-19)

**For Method C2, Alternative 1, Condition C2e, Option 2**

**ADD**

**5.B113d** The frequency band 37-40.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No.5.B113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.B113c or 5.B113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

**For Method C2, Alternatives 1 and 2, Condition C2a, Options 1, 2 and 3, and for Alternative 1, Condition C2e, Options 1 and 2**

**MOD**

**5.338A** In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 30-31.3 GHz, 37-40.5 GHz, 49.7-50.2 GHz, 50.4-50.9 GHz, 51.4-52.6 GHz, 81-86 GHz and 92-94 GHz, Resolution **750 (Rev.WRC-19)** applies. (WRC-19)

**For Method C2, Alternative 2, Condition C2b, Options 3**

See views in Section 2/1.13/4.3.2.2.

**MOD**

**5.516B** The following bands are identified for use by high-density applications in the fixed-satellite service:

- 17.3-17.7 GHz (space-to-Earth) in Region 1,
- 18.3-19.3 GHz (space-to-Earth) in Region 2,
- 19.7-20.2 GHz (space-to-Earth) in all Regions,
- 37.5-39.5 GHz (space-to-Earth) in Region 1,

39.5-40 GHz (space-to-Earth) in Region 1,  
40-40.5 GHz (space-to-Earth) in all Regions,  
40.5-42 GHz (space-to-Earth) in Region 2,  
47.5-47.9 GHz (space-to-Earth) in Region 1,  
48.2-48.54 GHz (space-to-Earth) in Region 1,  
49.44-50.2 GHz (space-to-Earth) in Region 1,  
and  
27.5-27.82 GHz (Earth-to-space) in Region 1,  
28.35-28.45 GHz (Earth-to-space) in Region 2,  
28.45-28.94 GHz (Earth-to-space) in all Regions,  
28.94-29.1 GHz (Earth-to-space) in Region 2 and 3,  
29.25-29.46 GHz (Earth-to-space) in Region 2,  
29.46-30 GHz (Earth-to-space) in all Regions,  
48.2-50.2 GHz (Earth-to-space) in Region 2.

This identification does not preclude the use of these bands by other fixed-satellite service applications or by other services to which these bands are allocated on a co-primary basis and does not establish priority in these Radio Regulations among users of the bands. Administrations should take this into account when considering regulatory provisions in relation to these bands. See Resolution **143 (WRC-03)**\*. (WRC-19)

#### **For Method C2, Alternative 2, Condition C2d, Option 4**

##### **ADD**

**5.B113e** The frequency band 37-39.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.B113 included in the modification of RR Article 5 provided above, footnote RR No. 5.B113e above could be selected.*

##### **ADD**

**5.C113** The frequency band 39.5-40.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Because of the potential deployment of high-density applications in the fixed-satellite service in the band 39.5-42 GHz (see No. **5.516B**), administrations should take into account potential constraints to IMT in this band, as appropriate. Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply. (WRC-19)

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\* *Note by the Secretariat:* This Resolution was revised by WRC-07.

*Note: Footnote RR No. 5.C113 provided above should be used instead of footnote RR No. 5.B113 for this frequency band for Method C2, Alternative 2, Condition C2b, Options 4 and 5.*

**For Method C2, Alternative 2, Condition C2b, Option 5**

**ADD**

**5.B113f** The frequency band 37-39.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Resolutions **[B113-IMT 40/50 GHZ]** (WRC-19) and **750 (Rev.WRC-19)** apply. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.B113 included in the modification of RR Article 5 provided above, footnote RR No. 5.B113f above could be selected.*

**For Method C2, Alternative 1, Condition C2b, Option 1**

**ADD**

**5.B113g** The frequency band 37-40.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. In the frequency band 40-40.5 GHz, IMT stations shall not claim protection from, nor constrain the use and development of, earth stations of the Earth exploration-satellite service and space research service. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[B113-IMT 40/50 GHZ]** (WRC-19) and **750 (Rev.WRC-19)** apply. (WRC-19)

*Note: The issue of not constraining the use and development of stations of other services has been discussed at previous WRCs and views were expressed that this is not implementable.*

*Note: When preparing the text for a proposed new footnote RR No. 5.B113 included in the modification of RR Article 5 provided above, footnote RR No. 5.B113g above could be selected.*

Another text for footnote RR No. **5.B113** is provided in Section 2/1.13/5.13.1 as footnote RR No. **5.B113h**.



**2/1.13/5.4 For Item D: Frequency band 40.5-42.5 GHz**

**2/1.13/5.4.1 For Method D1, see Section 2/1.13/5.14.4**

**2/1.13/5.4.2 For Method D2**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**

(See No. 2.1)

**MOD**

**40-47.5 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) MOBILE ADD 5.D113 BROADCASTING BROADCASTING-SATELLITE  5.547	<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.516B MOBILE ADD 5.D113 BROADCASTING BROADCASTING-SATELLITE Mobile-satellite (space-to-Earth)  5.547	<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) MOBILE ADD 5.D113 BROADCASTING BROADCASTING-SATELLITE  5.547
<b>41-42.5</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B MOBILE ADD 5.D113 BROADCASTING BROADCASTING-SATELLITE  5.547 5.551F 5.551H 5.551I	

**For Method D2, Alternative 1**

**ADD**

**5.D113a** The frequency band 40.5-42.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.] (WRC-19)

## **For Method D2, Alternative 2**

### **ADD**

**5.D113b** The frequency band 40.5-42.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.D113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.D113a or 5.D113b above could be selected. In addition, the text within square brackets should be kept or suppressed based on the conditions selected when identifying the band for IMT.*

## **For Method D2, Alternative 1, Condition D2c, Option 1**

### **ADD**

**5.D113c** The frequency band 40.5-42.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. 9.21. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

## **For Method D2, Alternative 1, Condition D2c, Option 2**

### **ADD**

**5.D113d** The frequency band 40.5-42.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.D113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.D113c or 5.D113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

## **For Method D2, Alternative 2, Condition D2a, Options 3 and 4**

### **ADD**

**5.D113e** The frequency band 40.5-42.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Because of the potential deployment of high-density applications in the fixed-satellite service in the band 39.5-42 GHz (see No. **5.516B**),

administrations should take into account potential constraints to IMT in this band, as appropriate. Resolution [B113-IMT 40/50 GHZ] (WRC-19) applies. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.D113 included in the modification of RR Article 5 provided above, footnote RR No. 5.D113e above could be selected.*

Another text for footnote RR No. 5.D113 is provided in Section 2/1.13/5.13.1 as footnote RR No. 5.B113h.

#### **2/1.13/5.5 For Item E: Frequency band 42.5-43.5 GHz**

**2/1.13/5.5.1 For Method E1, see Section 2/1.13/5.14.5**

**2/1.13/5.5.2 For Method E2**

## **ARTICLE 5**

### **Frequency allocations**

#### **Section IV – Table of Frequency Allocations**

(See No. 2.1)

#### **MOD**

40-47.5 GHz

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>42.5-43.5</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE except aeronautical mobile ADD 5.E113 RADIO ASTRONOMY 5.149 5.547	

#### **For Method E2, Alternative 1**

#### **ADD**

**5.E113a** The frequency band 42.5-43.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolution [B113-IMT 40/50 GHZ] (WRC-19) applies.] (WRC-19)

## **For Method E2, Alternative 2**

### **ADD**

**5.E113b** The frequency band 42.5-43.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.E113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.E113a or 5.E113b above could be selected. In addition, the text within square brackets should be kept or suppressed based on the conditions selected when identifying the band for IMT.*

## **For Method E2, Alternative 1, Condition E2c, Option 1**

### **ADD**

**5.E113c** The frequency band 42.5-43.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. 9.21. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

## **For Method E2, Alternative 1, Condition E2c, Option 2**

### **ADD**

**5.E113d** The frequency band 42.5-43.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.E113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.E113c or 5.E113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

Another text for footnote RR No. 5.E113 is provided in Section 2/1.13/5.13.1 as footnote RR No. 5.B113h.

**2/1.13/5.6 For Item F: Frequency band 45.5-47 GHz**

**2/1.13/5.6.1 For Method F1, see Section 2/1.13/5.14.6**

**2/1.13/5.6.2 For Method F2, Alternative 2**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**

(See No. 2.1)

**MOD**

**40-47.5 GHz**

Allocation to services		
Region 1	Region 2	Region 3
43.5-47	MOBILE 5.553 ADD 5.F113 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554	

**For Method F2, Alternative 2**

**ADD**

**5.F113a** The frequency band 45.5-47 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.F113 included in the modification of RR Article 5 provided above, footnote RR No. 5.F113a above could be selected. The text within square brackets should be kept or suppressed based on the conditions selected when identifying the frequency band for IMT.*

**For Method F2, Alternative 2, Condition F2b, Option 1**

**ADD**

**5.F113b** The frequency band 45.5-47 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. 9.21. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio

Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

**For Method F2, Alternative 2, Condition F2b, Option 2**

**ADD**

**5.F113c** The frequency band 45.5-47 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.F113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.F113b or 5.F113c above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

**2/1.13/5.7 For Item G: Frequency band 47-47.2 GHz**

**2/1.13/5.7.1 For Method G1, see Section 2/1.13/5.14.7**

**2/1.13/5.7.2 For Method G2, Alternative 2**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**40-47.5 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>47-47.2</b>	AMATEUR AMATEUR-SATELLITE MOBILE except aeronautical mobile ADD 5.G113	

## **For Method G2, Alternative 2**

### **ADD**

**5.G113a** The frequency band 47-47.2 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.G113 included in the modification of RR Article 5 provided above, footnote RR No. 5.G113a above could be selected. The text within square brackets should be kept or suppressed based on the conditions selected when identifying the frequency band for IMT.*

## **For Method G2, Alternative 2, Condition G2b, Option 1**

### **ADD**

**5.G113b** The frequency band 47-47.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. 9.21. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

## **For Method G2, Alternative 2, Condition G2b, Option 2**

### **ADD**

**5.G113c** The frequency band 47-47.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.G113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.G113b or 5.G113c above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

**2/1.13/5.8 For Item H: Frequency band 47.2-50.2 GHz**

**2/1.13/5.8.1 For Method H1, see Section 2/1.13/5.14.8**

**2/1.13/5.8.2 For Method H2**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**

(See No. 2.1)

**MOD**

**40-47.5 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>47.2-47.5</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE ADD 5.H113 5.552A	

**MOD**

**47.5-51.4 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>47.5-47.9</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 (space-to-Earth) 5.516B 5.554A MOBILE ADD 5.H113	<b>47.5-47.9</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE ADD 5.H113	
<b>47.9-48.2</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE ADD 5.H113 5.552A	
<b>48.2-48.54</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE ADD 5.H113	<b>48.2-50.2</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.516B *5.552 MOBILE ADD 5.H113	



<b>48.54-49.44</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE ADD 5.H113 5.149 5.340 5.555	
<b>49.44-50.2</b> FIXED FIXED-SATELLITE (Earth-to-space) *5.552 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE ADD 5.H113 MOD 5.338A*	5.149 MOD 5.338A* 5.340 5.555

Note: \*MOD 5.338A is needed for Method H2, Alternatives 1 and 2, Condition H2a, Options 1 and 2, and for Alternative 1, Condition H2d, Options 1 and 2.

**For Method H2, Alternative 1, Condition H2a**

**ADD**

**5.H113a** The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply.][Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

**For Method H2, Alternative 2, Condition H2a**

**ADD**

**5.H113b** The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolutions **[B113-IMT 40/50 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply.][Resolution **[B113-IMT 40/50 GHZ] (WRC-19)** applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.H113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.H113a or 5.H113b above could be selected. In addition, only one or none of the texts within square brackets should be kept based on the conditions selected when identifying the band for IMT.*

**For Method H2, Alternative 1, Condition H2d, Option 1**

**ADD**

**5.H113c** The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained

under No. **9.21**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions [**B113-IMT 40/50 GHZ**] (**WRC-19**) and **750 (Rev.WRC-19)** apply. (WRC-19)

#### **For Method H2, Alternative 1, Condition H2d, Option 2**

##### **ADD**

**5.H113d** The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions [**B113-IMT 40/50 GHZ**] (**WRC-19**) and **750 (Rev.WRC-19)** apply. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.H113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.H113c or 5.H113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

#### **For Method H2, Alternatives 1 and 2, Condition H2a, Options 1 and 2, and for Alternative 1, Condition H2d, Options 1 and 2**

##### **MOD**

**5.338A** In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 30-31.3 GHz, 49.7-50.2 GHz, 47.2-50.2 GHz, 50.4-50.9 GHz, 51.4-52.6 GHz, 81-86 GHz and 92-94 GHz, Resolution **750 (Rev.WRC-19)** applies. (WRC-19)

#### **For Method H2, Alternative 2, Condition H2b, Option 7**

##### **ADD**

**5.H113e** The frequency band 47.2-50.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Because of the potential deployment of high-density applications in the fixed-satellite service in the band 47.5-50.2 GHz (see No. **5.516B**), administrations should take into account potential constraints to IMT in this band, as appropriate. Resolutions [**B113-IMT 40/50 GHZ**] (**WRC-19**) and **750 (Rev.WRC-19)** apply. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.H113 included in the modification of RR Article 5 provided above, footnote RR No. 5.H113e above could be selected.*

**2/1.13/5.9 For Item I: Frequency band 50.4-52.6 GHz**

**2/1.13/5.9.1 For Method I1, see Section 2/1.13/5.14.9**

**2/1.13/5.9.2 For Method I2**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**

(See No. 2.1)

**MOD**

**47.5-51.4 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>50.4-51.4</b>	FIXED FIXED-SATELLITE (Earth-to-space) * MOBILE ADD 5.I113 Mobile-satellite (Earth-to-space) MOD 5.338A*	

**MOD**

**51.4-55.78 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>51.4-52.6</b>	FIXED * MOBILE ADD 5.I113 MOD 5.338A* 5.547 5.556	

Note: \*MOD 5.338A is needed for Method I2, Alternatives 1 and 2, Condition I2a, Options 1 and 2, and for Alternative 1, Condition I2c, Options 1 and 2.

**For Method I2, Alternative 1, Condition I2a**

**ADD**

**5.I113a** The frequency band 50.4-52.6 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolutions

**[B113-IMT 40/50 GHZ] (WRC-19) and 750 (Rev.WRC-19) apply.][Resolution [B113-IMT 40/50 GHZ] (WRC-19) applies.][Resolution 750 (Rev.WRC-19) applies.]** (WRC-19)

#### **For Method I2, Alternative 2, Condition I2a**

##### **ADD**

**5.II13b** The frequency band 50.4-52.6 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. **[Resolutions [B113-IMT 40/50 GHZ] (WRC-19) and 750 (Rev.WRC-19) apply.][Resolution [B113-IMT 40/50 GHZ] (WRC-19) applies.][Resolution 750 (Rev.WRC-19) applies.]** (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.II13 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.II13a or 5.II13b above could be selected. In addition, only one or none of the texts within square brackets should be kept based on the conditions selected when identifying the band for IMT.*

#### **For Method I2, Alternative 1, Condition I2c, Option 1**

##### **ADD**

**5.II13c** The frequency band 50.4-52.6 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. 9.21. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[B113-IMT 40/50 GHZ] (WRC-19) and 750 (Rev.WRC-19)** apply. (WRC-19)

#### **For Method I2, Alternative 1, Condition I2c, Option 2**

##### **ADD**

**5.II13d** The frequency band 50.4-52.6 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[B113-IMT 40/50 GHZ] (WRC-19) and 750 (Rev.WRC-19)** apply. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.II13 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.II13c or 5.II13d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

**For Method I2, Alternatives 1 and 2, Condition I2a, Options 1 and 2, and for Alternative 1, Condition I2c, Options 1 and 2**

**MOD**

**5.338A** In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 30-31.3 GHz, 49.7-50.2 GHz, 50.4-52.6 GHz, 81-86 GHz and 92-94 GHz, Resolution **750 (Rev.WRC-19)** applies. (WRC-19)

**2/1.13/5.10** For Item J: Frequency band 66-71 GHz

**2/1.13/5.10.1** For Method J1, see Section 2/1.13/5.14.10

**2/1.13/5.10.2** For Method J2

ARTICLE 5

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**66-81 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>66-71</b>	INTER-SATELLITE MOBILE MOD* 5.553 5.558 <u>ADD</u> 5.J113 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554	

Note: \*MOD **5.553** is needed for Method J2, Alternatives 1 and 2, Condition J2b, Option 1.

**For Method J2, Alternative 1**

**ADD**

**5.J113a** The frequency band 66-71 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolution **[C113-IMT 66/71 GHZ] (WRC-19)** applies.] (WRC-19)

## **For Method J2, Alternative 2**

### **ADD**

**5.J113b** The frequency band 66-71 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[C113-IMT 66/71 GHZ] (WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.J113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.J113a or 5.J113b above could be selected. In addition, the text within square brackets should be kept or suppressed based on the conditions selected when identifying the band for IMT.*

## **For Method J2, Alternative 1, Condition J2c, Option 1**

### **ADD**

**5.J113c** The frequency band 66-71 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. 9.21. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[C113-IMT 66/71 GHZ] (WRC-19)** applies. (WRC-19)

## **For Method J2, Alternative 1, Condition J2c, Option 2**

### **ADD**

**5.J113d** The frequency band 66-71 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[C113-IMT 66/71 GHZ] (WRC-19)** applies. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.J113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.J113c or 5.J113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

## **For Method J2, Alternatives 1 and 2, Condition J2b, Option 1**

### **MOD**

**5.553** In the band 43.5-47 GHz, stations in the land mobile service may be operated subject to not causing harmful interference to the space radiocommunication services to which this band is allocated (see No. 5.43). (WRC-19)

2/1.13/5.10.3 For Method J3

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations (See No. 2.1)

MOD

#### 66-81 GHz

Allocation to services		
Region 1	Region 2	Region 3
66-71	INTER-SATELLITE MOBILE MOD 5.553 5.558 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554	

MOD

**5.553** In the bands 43.5-47 GHz and 66-71 GHz, stations in the land mobile service may be operated subject to not causing harmful interference to the space radiocommunication services to which these bands are allocated (see No. **5.43**). See also Resolution **238 (Rev.WRC-19)**. (WRC-19)

- 2/1.13/5.11 For Item K: Frequency band 71-76 GHz**  
**2/1.13/5.11.1 For Method K1, see Section 2/1.13/5.14.11**  
**2/1.13/5.11.2 For Method K2**

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations

(See No. 2.1)

#### MOD

#### 66-81 GHz

Allocation to services		
Region 1	Region 2	Region 3
<b>71-74</b>	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE ADD 5.K113 MOBILE-SATELLITE (space-to-Earth)	
<b>74-76</b>	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE ADD 5.K113 BROADCASTING BROADCASTING-SATELLITE Space research (space-to-Earth) 5.561	

#### For Method K2, Alternative 1

#### ADD

**5.K113a** The frequency band 71-76 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolution **[E113-IMT 70/80 GHZ] (WRC-19)** applies.] (WRC-19)

#### For Method K2, Alternative 2

#### ADD

**5.K113b** The frequency band 71-76 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This



identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[E113-IMT 70/80 GHZ] (WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.K113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.K113a or 5.K113b above could be selected. In addition, the text within square brackets should be kept or suppressed based on the conditions selected when identifying the band for IMT.*

#### **For Method K2, Alternative 1, Condition K2c, Option 1**

##### **ADD**

**5.K113c** The frequency band 71-76 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. **9.21**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[E113-IMT 70/80 GHZ] (WRC-19)** applies. (WRC-19)

#### **For Method K2, Alternative 1, Condition K2c, Option 2**

##### **ADD**

**5.K113d** The frequency band 71-76 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolution **[E113-IMT 70/80 GHZ] (WRC-19)** applies. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. 5.K113 included in the modification of RR Article 5 provided above, either of footnotes RR Nos. 5.K113c or 5.K113d above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

- 2/1.13/5.12** For Item L: Frequency band 81-86 GHz
- 2/1.13/5.12.1** For Method L1, see Section 2/1.13/5.14.12
- 2/1.13/5.12.2** For Method L2

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations (See No. 2.1)

**MOD**

**81-86 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>81-84</b>	FIXED * FIXED-SATELLITE (Earth-to-space) MOBILE ADD 5.L113 MOBILE-SATELLITE (Earth-to-space) RADIO ASTRONOMY Space research (space-to-Earth) 5.149 5.561A 5.338A*	
<b>84-86</b>	FIXED * FIXED-SATELLITE (Earth-to-space) 5.561B MOBILE ADD 5.L113 RADIO ASTRONOMY 5.149 5.338A*	

Note: \* Moving **5.338A** is needed for Method L2, Alternatives 1 and 2, Condition L2a, Option 1, and for Alternative 1, Condition L2e, Options 1 and 2.

**For Method L2, Alternative 1, Condition L2a**

**ADD**

**5.L113a** The frequency band 81-86 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. [Resolutions **[E113-IMT 70/80 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply.][Resolution **[E113-IMT 70/80 GHZ] (WRC-19)** applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

**For Method L2, Alternative 2, Condition L2a**

**ADD**

**5.L113b** The frequency band 81-86 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolutions **[E113-IMT 70/80 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply.][Resolution **[E113-IMT 70/80 GHZ] (WRC-19)** applies.][Resolution **750 (Rev.WRC-19)** applies.] (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.L113** included in the modification of RR Article 5 provided above, either of footnotes RR Nos. **5.L113a** or **5.L113b** above*

*could be selected. In addition, only one or none of the texts within square brackets should be kept based on the conditions selected when identifying the band for IMT.*

**For Method L2, Alternative 1, Condition L2e, Option 1**

**ADD**

**5.L113c** The frequency band 81-86 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained under No. **9.21**. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[E113-IMT 70/80 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply. (WRC-19)

**For Method L2, Alternative 1, Condition L2e, Option 2**

**ADD**

**5.L113d** The frequency band 81-86 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) subject to agreement to be obtained from the concerned administrations. This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. The use of this frequency band by the mobile service for IMT is limited to the land mobile service. Resolutions **[E113-IMT 70/80 GHZ] (WRC-19)** and **750 (Rev.WRC-19)** apply. (WRC-19)

*Note: When preparing the text for a proposed new footnote RR No. **5.L113** included in the modification of RR Article 5 provided above, either of footnotes RR Nos. **5.L113c** or **5.L113d** above could be selected. An administration may also prefer to keep both options in its proposal as appropriate.*

**2/1.13/5.13**           **For some items**

**2/1.13/5.13.1**       **For Alternative 2 of Methods C2, D2, E2**

**ADD**

**5.B113h** The frequency band 37-43.5 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Because of the potential deployment of high-density applications in the fixed-satellite service in the bands 39.5-40 GHz in Region 1, 40-40.5 GHz in all Regions and 40.5-42 GHz in Region 2 (see No. **5.516B**), administrations should further take into account potential constraints to IMT in these bands, as appropriate. Resolution **[B113-IMT 40 GHZ] (WRC-19)** applies. (WRC-19)

*Note: The text of footnote RR No. **5.B113h** would be used for footnotes RR Nos. **5.B113**, **5.D113** and **5.E113** in Sections 2/1.13/5.3.2, 2/1.13/5.3.3 and 2/1.13/5.3.4, respectively.*

**2/1.13/5.13.2 For the relevant condition(s) and option(s) of Method A2**

*Note 1: For those administrations proposing a new IMT Resolution, multiple options are presented below for each condition, noting that the option of not applying that condition may also be considered.*

*Note 2: Views were expressed that regulatory examples should be of a mandatory nature without any subject or qualifier in the text.*

*Note 3: There is a clear contradiction between resolves 1a1 and invites administrations 1.*

*Note 4: The preamble to this Resolution is a compilation of input contributions and was not discussed. CPM 19-2 is invited to review the text below with a view to agreeing on a minimum number of provisions and to avoid duplications.*

*Note 5: Concerns were raised that the limits in recognizing l) should be in the resolves part of the resolution, not in a recognizing.*

**ADD**

**DRAFT NEW RESOLUTION [A113-IMT 26 GHZ] (WRC-19)**

**International Mobile Telecommunications  
in frequency band 24.25-27.5 GHz**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

*[a) that IMT encompasses IMT-2000, IMT-Advanced, and IMT-2020 collectively, as described in Resolution ITU-R 56;*

*b) that International Mobile Telecommunications (IMT), including IMT-2000, IMT-Advanced and IMT-2020, is the ITU vision of global mobile access;*

*c) that IMT systems provide telecommunication services on a worldwide scale regardless of location, network or terminal used;*

*or*

*c) that International Mobile Telecommunications (IMT) is intended to provide telecommunication services on a worldwide scale, regardless of location and type of network or terminal;*

*or*

*c) that International Mobile Telecommunications (IMT) is intended to provide telecommunication services on a worldwide scale, regardless of location and type of network or terminal;*

*d) that the evolution of IMT is being studied within ITU-R;*

*e) that the frequency bands 450-470 MHz, 694-960 MHz, 1 427-1 518 MHz, 1 710-1 885 MHz, 1 885-2 025 MHz, 2 110-2 200 MHz, 2 300-2 400 MHz, 2 500-2 690 MHz, 3 400-3 600 MHz, or parts thereof, are identified for use by administrations wishing to implement IMT;*

*f) that harmonized worldwide bands for IMT are desirable in order to achieve global roaming and the benefits of economies of scale;*

or

*f)* that harmonized worldwide bands and harmonized frequency arrangements for IMT are highly desirable in order to achieve global roaming and the benefits of economies of scale;

*g)* that timely availability of spectrum is important to support future applications;

or

*g)* that adequate and timely availability of spectrum and supporting regulatory provisions is essential to realize the objectives in Recommendation ITU-R M.2083;

*h)* that IMT systems are envisaged to provide increased peak data rates and capacity that may require a larger bandwidth;

*i)* that there is a need to continually take advantage of technological developments in order to increase the efficient use of spectrum and facilitate spectrum access;

*j)* that IMT-2020 systems should be able to provide enhanced mobile broadband, massive machine-type communications and low-latency communications;

or

*j)* that IMT systems are now being evolved to provide diverse usage scenarios and applications such as enhanced mobile broadband, massive machine-type communications and ultra-reliable and low-latency communications;

*k)* that ultra-low latency and very high bit-rate applications of IMT will require larger contiguous blocks of spectrum than those available in frequency bands that are currently identified for use by administrations wishing to implement IMT;

*l)* that the properties of higher frequency bands, such as shorter wavelength, would better enable the use of advanced antenna systems including MIMO and beam-forming techniques in supporting enhanced broadband;

or

*l)* that advanced antenna systems including beam-forming techniques will be used by IMT in frequency bands above 24 GHz;

*m)* that IMT systems have contributed to global economic and social development;

*n)* that ITU-R has studied, in preparation for WRC-19, sharing and compatibility with services allocated in the frequency band 24.25-27.5 GHz and its adjacent band, based on characteristics available at that time;

or

*n)* that ITU-R has studied, in preparation for WRC-19, sharing and compatibility with services allocated in bands identified for IMT above 24 GHz and in adjacent bands, based on the assumed characteristics of Recommendation ITU-R M.2101;

*o)* that WRC-19 identified the frequency band 24.25-27.5 GHz for IMT with certain regulatory conditions to address protection of services to which the band is allocated on a primary basis;

*p)* that any identification of frequency bands for IMT should take into account the use of the bands by other services and the evolving needs of these services;

or

- p)* that identification of frequency bands allocated to the mobile service on a co-primary basis for IMT may change the sharing situation regarding applications of services to which the frequency band is already allocated, and may require additional regulatory actions;
- q)* that low latency and high bit-rate applications of IMT-2020 will require large contiguous blocks of spectrum which is not available in frequency bands below 24 GHz;
- r)* that harmonization of frequency bands and conditions of use as well as frequency arrangements for IMT-2020 deployment facilitate global roaming and economies of scale;
- s)* that the results of ITU-R compatibility studies of IMT-2020 systems are probabilistic, and therefore the deployment parameters of IMT-2020 systems that affect compatibility with satellite receivers may vary during practical implementation and deployment of IMT-2020 networks;
- t)* that the identification of frequency bands for IMT-2020 requires technical and regulatory measures to ensure compatibility with and future development of incumbent services having an allocation in identified frequency bands;
- u)* that ITU-R has studied, in preparation for WRC-19, sharing and compatibility with services allocated in bands identified for IMT in the frequency band 24.25-27.5 GHz and in adjacent bands;
- v)* the need to protect existing services and to allow for their continued development when considering frequency bands for possible additional allocations to any service;
- w)* that identification of frequency bands allocated to the mobile service for IMT may change the sharing situation regarding applications of services to which the frequency band is already allocated, and may require additional regulatory actions;
- x)* the need to ensure the protection of existing earth stations and the deployment of future receiving earth stations under the EESS (space-to-Earth) and SRS (space-to-Earth) allocations in the frequency band 25.5-27 GHz;
- y)* that some frequency bands or portions of some frequency bands in which IMT may be implemented are already allocated to the fixed, mobile, space research, fixed-satellite, mobile-satellite and Earth exploration-satellite services on a co-primary basis and are already in use by incumbent services,]

*noting*

- [a)* Resolutions **223 (Rev.WRC-15)**, **224 (Rev.WRC-15)** and **225 (Rev.WRC-12)**, which also relate to IMT;
- b)* Recommendation ITU-R M.2083 provides IMT Vision – “Framework and overall objectives of the future development of IMT for 2020 and beyond”;
- or
- b)* Recommendation ITU-R M.2083, on the framework and objectives of the future development of IMT for 2020 and beyond;
- c)* that currently operating mobile communication systems may evolve to IMT in their existing frequency bands;
- d)* that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band by any application of the services to which it is allocated;

- e) that Resolution ITU-R 65 addresses the principles for the process of development of IMT for 2020 and beyond, and that Question ITU-R 77-7/5 considers the needs of developing countries in the development and implementation of IMT;
  - f) that Question ITU-R 229/5 seeks to address the further development of IMT;
  - g) that IMT encompasses IMT-2000, IMT-Advanced, and IMT-2020 collectively, as described in Resolution ITU-R 56-2;
  - h) that Report ITU-R M.2320 addresses future technology trends of terrestrial IMT systems;
  - i) Report ITU-R M.2376, on technical feasibility of IMT in the frequency bands above 6 GHz;
  - j) that Report ITU-R M.2370 analyses trends impacting future IMT traffic growth beyond the year 2020 and estimates global traffic demands for the period 2020 to 2030;
  - k) that there are ongoing studies within ITU-R on the propagation characteristics for mobile systems in higher frequency bands;
  - l) that the FSS allocation in the frequency band 24.65-25.25 GHz was made by WRC-12,]  
*recognizing*
- [a) that for some administrations the only way of implementing IMT would be spectrum re-farming;
  - b) that there is a lead time between the allocation of frequency bands by world radiocommunication conferences and the deployment of systems in those bands, and that timely availability of wide and contiguous blocks of spectrum is therefore important to support the development of IMT;
  - c) that identification of frequency bands for IMT should take into account the use of the bands by other services and the evolving needs of these services;
  - d) that there should be no additional regulatory or technical constraints imposed on services to which the frequency band is currently allocated on a primary basis;
  - e) that IMT technical and deployment characteristics may evolve in the future and the result of ITU-R compatibility and sharing studies between IMT-2020 and satellite receivers may not be valid;
  - f) that, due to the effect of aggregation of interference from IMT-2020 systems, the protection of satellite receivers is possible only if all administrations will follow the agreed technical characteristics and parameters of the deployment of IMT-2020 systems;
  - g) that ITU-R studies have shown that compatible operations of IMT and gateway-type receive satellite earth stations in the fixed-satellite service can be achieved through geographic separation between an IMT deployment and the receive earth station;
  - h) that the required geographic separation distance in *recognizing i)* will vary as a function of the earth station antenna diameter, elevation angle, surrounding terrain, and IMT network system design and can vary from a few hundred to a few thousand metres;
  - i) protection of satellite receivers in the fixed and mobile-satellite service can be achieved by controlling the emissions of IMT base stations [and user equipment] in the skyward direction;]

[For Condition A2a Option 1]

j) that Resolution **750 (Rev.WRC-19)** establishes limits on unwanted emissions in the frequency band 23.6-24 GHz from IMT base stations and IMT mobile stations within the [24.25-27.5 GHz] frequency band;

[For Condition A2b Option 1]

k) that Resolution **750 (Rev.WRC-19)** establishes limits on unwanted emissions in the frequency bands 50.2-50.4 GHz and 52.6-54.25 GHz from IMT base stations and IMT mobile stations within the frequency band [24.25-27.5 GHz];

[For Condition A2b Option 2]

l) that spurious emission limits of Recommendation ITU-R SM.329 Category B (-60 dB(W/MHz)) are sufficient to protect the EESS (passive) from the second harmonic of IMT base station emissions in the 24.25-27.5 GHz band,

*resolves*

[For Conditions A2c Option 3, A2d Option 3, A2e Options 1, 2, 3, 4, 5, 6, 7, 8, A2f Option 2, A2g Option 2]

1a in order to ensure the coexistence between IMT in the frequency band 24.25-27.5 GHz as identified by WRC-19 in Article 5 of the Radio Regulations and other services to which the frequency band is allocated including the protection of these other services, administrations shall apply the conditions as stated below;

[For Condition A2c Option 3]

1a1 the operation of IMT within the frequency band 24.25-27.5 GHz shall protect the existing and future SRS/EESS earth stations;

[For Condition A2d Option 3]

1a2 the operation of IMT within the frequency band 24.25-27.5 GHz shall protect the existing and future FSS earth stations;

[For Condition A2e Option 1A]

1a3.1 that the electrical tilt of IMT base-station beams shall normally not be higher than 0 degrees relative to the horizontal and the mechanical tilt of IMT base stations be below the horizon. In addition, IMT base stations shall comply with the TRP limits given in Table 1:

TABLE 1

**TRP\* limits for IMT base stations**

Frequency bands	dB(W/200 MHz)
24.25-27.5 GHz	[-5/5/7/16/TBD]

\* Total radiated power (TRP) is the sum of all power radiated by an antenna connected to a transmitter. This level applies for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing, carrier configurations).



*[For Condition A2e Option 1B]*

1a3.2 that the electrical tilt of IMT base-station beams shall not be higher than 0 degrees relative to the horizontal and the mechanical tilt of IMT base stations be below the horizon. In addition, IMT base stations shall comply with the TRP limits given in Table 1:

TABLE 1  
TRP\* limits for IMT base stations

Frequency bands	dB(W/200 MHz)
24.25-27.5 GHz	[-5/5/7/16/TBD]

\* Total radiated power (TRP) is the sum of all power radiated by an antenna connected to a transmitter. This level applies for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing, carrier configurations).

*[For Condition A2e, Option 2]*

1a4 that the elevation angle of the antenna main beam of IMT base stations shall not be higher than 0 degrees relative to the horizontal and the antenna pattern shall comply with Recommendation ITU-R M.2101. In addition, IMT base stations shall comply with the TRP limits given in Table 1:

TABLE 1  
TRP\* limits for IMT base stations

Frequency bands	dB(W/200 MHz)
24.25-27.5 GHz	[-5/5/7/16/TBD]

\* Possible example of definition of TRP: Total radiated power (TRP) is the sum of all power radiated by an antenna connected to a transmitter. This level applies for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing, carrier configurations).

*[For Condition A2e, Option 3A]*

1a5.1 that the combined tilt (electrical and mechanical) of IMT base stations should normally not be higher than 0 degrees relative to the horizontal. In addition, IMT base stations shall comply with the TRP limits given in Table 1:

TABLE 1  
TRP limits for IMT base stations

Frequency bands	dB(W/200 MHz)
24.25-27.5 GHz	[-5/5/7/16/TBD]

*[For Condition A2e, Option 3B]*

1a5.2 that the combined tilt (electrical and mechanical) of IMT base stations shall not be higher than 0 degrees relative to the horizontal. In addition, IMT base stations shall comply with the TRP limits given in Table 1:

TABLE 1

**TRP limits for IMT base stations**

Frequency bands	dB(W/200 MHz)
24.25-27.5 GHz	[-5/5/7/16/TBD]

[For Condition A2e, Option 4A]

1a6 that, when deploying outdoor base stations, it shall be ensured that each antenna normally transmits only with the main beam pointing below the horizon and the antenna shall have mechanical pointing below the horizon except when the base station is only receiving;

[For Condition A2e, Option 4B]

1a6 that, when deploying outdoor base stations, it shall be ensured that each antenna transmits only with the main beam pointing below the horizon and the antenna shall have mechanical pointing below the horizon except when the base station is only receiving;

[For Condition A2e, Option 5]

1a7 that the mechanical tilt of IMT base stations shall be below [TBD degrees], the maximum density of base stations for outdoor urban hot spots shall not exceed [TBD] and the maximum density of base stations for outdoor suburban hot spots shall not exceed [TBD] within the territory of an administration. In addition, IMT base stations shall comply with the TRP limits given in Table 1:

TABLE 1

**TRP\* limits for IMT base stations**

Frequency bands	dB(W/200 MHz)
24.25-27.5 GHz	[-5/5/7/16/TBD]

\* Total radiated power (TRP) is the sum of all power radiated by an antenna connected to a transmitter. This level applies for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing, carrier configurations).

[For Condition A2e, Option 6]

1a8 that, in order to protect satellite reception in the frequency band 24.25-27.5 GHz, IMT base stations shall comply with the following e.i.r.p. masks for the emissions:

Elevation angle	Maximum e.i.r.p. dB(W/200 MHz)
$5 \leq \Theta \leq 15$	$17 - 1.3(\Theta - 5)$
$15 < \Theta \leq 25$	4
$25 < \Theta \leq 55$	$4 - 0.43(\Theta - 25)$
$55 < \Theta \leq 90$	-8.9

[For Condition A2e, Option 7]

1a9 that, in order to protect satellite reception in the frequency band 24.25-27.5 GHz, administrations implementing IMT system(s) within their territory ensure that the equivalent power flux-density (see Annex),  $epfd_{\uparrow}$ , produced at any point in the geostationary-satellite orbit by emissions from all the IMT base stations in their territory in the frequency bands listed in Table X,

for all conditions and for all methods of modulation, shall not exceed the limits given in Table X for the specified percentages of time. These limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions (with appropriate losses and degradations, if applicable), into a reference antenna and in the reference bandwidth specified in Table X, for all pointing directions towards the Earth's surface visible from any given location in the geostationary-satellite orbit;

TABLE X

**Limits to the efd<sub>↑</sub> radiated by IMT base stations in the mobile service in certain frequency bands**

Frequency bands	epfd <sub>↑</sub> (dB(W/m <sup>2</sup> ))	Percentage of time, probability or location	Reference bandwidth (MHz)	Reference antenna beamwidth and reference radiation pattern (see Annex)
24.65-25.25 GHz	[TBD]	[TBD]	[TBD]	[0.8°] Recommendation ITU-R S.672-4, L <sub>s</sub> = [-25]
27.0-27.5 GHz	[TBD]	[TBD]	[TBD]	[0.8°] Recommendation ITU-R S.672-4, L <sub>s</sub> = [-25]

[For Condition A2e, Option 8]

1a10 that IMT stations shall comply with the TRP limits given in Table 1:

TABLE 1

**TRP\* limits for IMT base stations**

Frequency bands	dB(W/200 MHz)
24.25-27.5 GHz	[-5/5/7/16/TBD]

\* Total radiated power (TRP) is the sum of all power radiated by an antenna connected to a transmitter. This level applies for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing, carrier configurations).

[For Condition A2f, Option 2]

1a11 the operation of IMT within the frequency band 24.25-27.5 GHz shall protect the existing and future RAS stations in the frequency band 23.6-24 GHz;

[For Condition A2g, Option 2]

1a12 in the case that there is uncertainty on whether or not sharing between IMT and other services/systems is feasible, such case shall be treated on a case-by-case basis subject to the agreement to be obtained from the concerned administrations;

1b that administrations wishing to implement IMT consider the use of frequency band 24.25-27.5 GHz identified for IMT in No. **5.A113**, and the benefits of harmonized utilization of the spectrum for the terrestrial component of IMT taking into account the latest relevant ITU-R Recommendations,

Note: The order of appearance of *resolves* 1a and 1b above in this Resolution is yet to be decided. Furthermore, the place of *resolves* 1b is also yet to be decided (i.e. *resolves*, *resolves to invite administrations* or *invites administrations*). CPM 19-2 is invited to address the issue with a view to decide on the matter.

*invites administrations*

[For Condition A2c, Option 1]

1 to adopt provisions to protect other services from IMT networks and to ensure the possibility of deploying future SRS/EESS earth stations;

[For Condition A2d, Option 1]

2 to adopt provisions to ensure the possibility of deploying future FSS earth stations,  
Note: Concerns were expressed about *invites administrations* adopting provisions.

*invites ITU-R*

1 to develop harmonized frequency arrangements to facilitate IMT deployment in the frequency band 24.25-27.5 GHz, taking into account the results of sharing and compatibility studies;

[For Condition A2a, Option 2]

2 to develop a new ITU-R Recommendation, to include unwanted emission limits in the frequency band 23.6-24.0 GHz from IMT base stations within the 24.25-27.5 GHz frequency band, as appropriate;

[For Condition A2c, Option 1]

3 to develop an ITU-R Recommendation to assist administrations in protecting existing and future SRS/EESS earth stations operating in the frequency band 25.5-27 GHz;

[For Condition A2c, Option 2]

4 to develop an ITU-R Recommendation to assist administrations in protecting existing and future SRS/EESS earth stations operating in the frequency band 25.5-27 GHz, provided that this Recommendation is incorporated by reference into the Radio Regulations;

[For Condition A2d, Option 1]

5 to develop an ITU-R Recommendation to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency band 24.25-27.5 GHz;

[For Condition A2d, Option 2]

6 to develop an ITU-R Recommendation to assist administrations in ensuring the coexistence between existing and future FSS earth stations and IMT operating within the frequency band 24.25-27.5 GHz provided that this Recommendation is incorporated by reference into the Radio Regulations;

[For Condition A2e, Option 7]

7 to continue its studies and to develop ITU-R Recommendations and Reports, as appropriate, for a suitable methodology to calculate the  $epfd\uparrow$  level produced by all IMT base stations within the territory of an administration referred to in *resolves 1a9* above;

[For Condition A2f, Option 1]

8 to update existing ITU-R Recommendations or develop a new ITU-R Recommendation, as appropriate, to provide information and assistance to the administrations on possible coordination and protection measures for the radio astronomy service in the frequency band 23.6-24 GHz from the IMT deployment;

[For Condition A2g, Option 3]

9 to regularly update characteristics of IMT deployments (including base-station density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments;

Note: Views were expressed that further clarifications are required on the applicability of the implementation.

*instructs the Director of the Radiocommunication Bureau*

[For Condition A2e, Option 7]

to provide administrations with the software to calculate and validate the  $epfd$  level produced by all IMT base stations within the territory of the concerned administration in accordance with ITU-R Recommendations and Reports developed by *invites ITU-R 7* above and any technical means, training and manuals, along with any assistance requested by administrations to enable them to comply with *resolves 1a9* above.

Note: Further clarification with the BR is needed to assess if this instruction can be implemented and the associated costs. Views are expressed in Section 4.

## ANNEX TO RESOLUTION [A113-IMT 26 GHZ] (WRC-19)

The equivalent power flux-density is defined as the sum of the power flux-densities produced at a geostationary-satellite system receive station in the geostationary orbit by all the transmit IMT base stations within its territory, taking into account the off-axis discrimination of a reference receiving antenna assumed to be pointing in its nominal direction. The equivalent power flux-density is calculated using the following formula:

$$epfd = 10\log \left[ \sum_{i=1}^{N_a} 10^{\frac{P_i - A_{bs,i} - A_{g,i} - L_{clutter,i} - PD}{10}} \cdot \frac{G_t(\theta_i)}{4\pi d_i^2} \cdot \frac{G_r(\varphi_i)}{G_{r,max}} \right]$$

where:

- $N_a$ : number of simultaneously transmit IMT base stations within its territory, taking into account network loading factor (0.2) and a reference receiving antenna beam pattern assumed to be pointing in its nominal direction (i.e. number of all concerned IMT base stations  $\times$  networking loading factor (0.2))
- $i$ : index of the transmit IMT base station
- $P_i$ : RF power averaged by TDD activity factor (0.8), at the input of the antenna of the transmit IMT base station (dBW) in the reference bandwidth (i.e. maximum RF power – 0.97 (= 10log (0.8)) (dBW))
- $A_{bs,i}$ : the attenuation due to beam spreading (dB) over the interference path from the simulated IMT deployment location ( $n$ ) to the satellite detailed in Recommendation ITU-R P.619
- $A_{g,i}$ : the attenuation due to atmospheric gasses (dB) over the interference path from the simulated IMT deployment location ( $n$ ) to the satellite detailed in Recommendation ITU-R P.619
- $L_{clutter,i}$ : the average clutter loss in the interference path for location ( $n$ ) (dB), calculated using the entire cumulative distribution of clutter losses as detailed in Recommendation ITU-R P.2108

- PD*: the polarization discrimination (dB)
- $\theta_i$ : off-axis angle between the boresight of the transmit IMT base station and the direction of the geostationary-satellite system receive station
- $G_t(\theta_i)$ : transmit antenna gain (as a ratio) of the IMT base station in the direction of the geostationary-satellite system receive station
- $d_i$ : distance (m) between the transmit IMT base station and the geostationary-satellite system receive station
- $\varphi_i$ : off-axis angle between the boresight of the antenna of the geostationary-satellite system receive station and the direction of the  $i$ -th IMT base transmit station
- $G_r(\varphi_i)$ : receive antenna gain (as a ratio) of the geostationary-satellite system receive station in the direction of the  $i$ -th transmit IMT base station
- $G_{r,max}$ : maximum gain (as a ratio) of the antenna of the geostationary-satellite system receive station
- epfd*: computed equivalent power flux-density (dB(W/m<sup>2</sup>)) in the reference bandwidth.

\*\* For this table, reference patterns of Recommendation ITU-R S.672-4 shall be used only for the calculation of interference from IMT base stations in the mobile service into geostationary-satellite systems in the fixed-satellite service. In all cases of  $L_s$ , the parabolic main beam equation shall start at zero.

**2/1.13/5.13.3 For the relevant condition(s) and option(s) of Methods B2, C2, D2, E2, F2, G2, H2 and I2**

*Note 1: Due to time constraints, the text in this draft new Resolution has not been fully reviewed yet, in particular the elements related to the frequency bands above 47.2 GHz. CPM 19-2 is invited to carefully examine the text with a view to resolving any issues.*

*Note 2: For those administrations proposing a new IMT Resolution, multiple options are presented below for each condition, noting that the option of not applying that condition may also be considered.*

*Note 3: Views were expressed that regulatory examples should be of a mandatory nature without any subject or qualifier in the text.*

*Note 4: The preamble to this Resolution is a compilation of input contributions and was not discussed. CPM 19-2 is invited to review the text below with a view to agreeing a minimum number of provisions and to avoid duplications.*

**ADD**

**DRAFT NEW RESOLUTION [B113-IMT 40/50 GHz] (WRC-19)**

**International Mobile Telecommunications in frequency bands  
[37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz]**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*[considering*

- a) that International Mobile Telecommunications (IMT) is intended to provide telecommunication services on a worldwide scale, regardless of location and type of network or terminal;
- b) that IMT systems provide telecommunication services on a worldwide scale regardless of location, network or terminal used;
- c) that IMT systems have contributed to global economic and social development;
- d) that IMT encompasses IMT-2000, IMT-Advanced, and IMT-2020 collectively, as described in Resolution ITU-R 56;
- e) that International Mobile Telecommunications (IMT), including IMT-2000, IMT-Advanced and IMT-2020, is the ITU vision of global mobile access;
- f) that the evolution of IMT is being studied within ITU-R;
- g) that IMT systems are now being evolved to provide diverse usage scenarios and applications such as enhanced mobile broadband, massive machine-type communications and ultra-reliable and low-latency communications;
- h) that IMT-2020 systems should be able to provide enhanced mobile broadband, massive machine-type communications and low-latency communications;
- i) that low latency and high bit-rate applications of IMT-2020 will require large contiguous blocks of spectrum which is not available in frequency bands below 24 GHz;
- j) that ultra-low latency and very high bit-rate applications of IMT will require larger contiguous blocks of spectrum than those available in frequency bands that are currently identified for use by administrations wishing to implement IMT;
- k) that IMT systems are envisaged to provide increased peak data rates and capacity that may require a larger bandwidth;
- l) that there is a need to continually take advantage of technological developments in order to increase the efficient use of spectrum and facilitate spectrum access;
- m) that the properties of higher frequency bands, such as shorter wavelength, would better enable the use of advanced antenna systems including MIMO and beam-forming techniques in supporting enhanced broadband;
- n) that the frequency bands 450-470 MHz, 694-960 MHz, 1 427-1 518 MHz, 1 710-1 885 MHz, 1 885-2 025 MHz, 2 110-2 200 MHz, 2 300-2 400 MHz, 2 500-2 690 MHz, 3 400-3 600 MHz, or parts thereof, are identified for use by administrations wishing to implement IMT;
- o) that timely availability of spectrum is important to support future applications;
- p) that adequate and timely availability of spectrum and supporting regulatory provisions is essential to realize the objectives in Recommendation ITU-R M.2083;
- q) that harmonization of frequency bands and conditions of use as well as frequency arrangements for IMT-2020 deployment facilitate global roaming and economies of scale;
- r) that harmonized worldwide bands for IMT are desirable in order to achieve global roaming and the benefits of economies of scale;
- s) that harmonized worldwide bands and harmonized frequency arrangements for IMT are highly desirable in order to achieve global roaming and the benefits of economies of scale;

- t) that ITU-R has studied, in preparation for WRC-19, sharing and compatibility with services allocated in the frequency bands [37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz] and their adjacent bands;
- u) that the results of ITU-R compatibility studies of IMT-2020 systems are probabilistic, and therefore the deployment parameters of IMT-2020 systems that affect compatibility with satellite receivers may vary during practical implementation and deployment of IMT-2020 networks;
- v) that WRC-19 identified the frequency bands [37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz] for IMT with certain regulatory conditions to address protection of services to which the band is allocated on a primary basis;
- w) that any identification of frequency bands for IMT should take into account the use of the bands by other services and the evolving needs of these services;
- x) that identification of frequency bands allocated to the mobile service for IMT may change the sharing situation regarding applications of services to which the frequency band is already allocated, and may require additional regulatory actions;
- y) that the identification of frequency bands for IMT-2020 requires technical and regulatory measures to ensure compatibility with and future development of incumbent services having an allocation in identified frequency bands;
- z) the need to protect existing services and to allow for their continued development when considering frequency bands for possible additional allocations to any service,

*noting*

- a) Resolutions **223 (Rev.WRC-15)**, **224 (Rev.WRC-15)** and **225 (Rev.WRC-12)**, which also relate to IMT;
- b) that Resolution ITU-R 65 addresses the principles for the process of development of IMT for 2020 and beyond, and that Question ITU-R 77-7/5 considers the needs of developing countries in the development and implementation of IMT;
- c) that Question ITU-R 229/5 seeks to address the further development of IMT;
- d) that IMT encompasses IMT-2000, IMT-Advanced, and IMT-2020 collectively, as described in Resolution ITU-R 56-2;
- e) Recommendation ITU-R M.2083, on the framework and objectives of the future development of IMT for 2020 and beyond;
- f) that Recommendation ITU-R M.2083 provides IMT Vision – “Framework and overall objectives of the future development of IMT for 2020 and beyond”;
- g) that Report ITU-R M.2320 addresses future technology trends of terrestrial IMT systems;
- h) Report ITU-R M.2376, on technical feasibility of IMT in the frequency bands above 6 GHz;
- i) that Report ITU-R M.2370 analyses trends impacting future IMT traffic growth beyond the year 2020 and estimates global traffic demands for the period 2020 to 2030;
- j) that there are ongoing studies within ITU-R on the propagation characteristics for mobile systems in higher frequency bands;



- k) that currently operating mobile communication systems may evolve to IMT in their existing frequency bands;
- l) that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band by any application of the services to which it is allocated,
- recognizing*
- a) that there is a lead time between the allocation of frequency bands by world radiocommunication conferences and the deployment of systems in those bands, and that timely availability of wide and contiguous blocks of spectrum is therefore important to support the development of IMT;
- b) that the identification of frequency bands for IMT should take into account the use of the bands by other services and the evolving needs of these services;
- c) that identification of frequency bands for IMT should take into account the use of the bands by other services and the evolving needs of these services;
- d) that there should be no additional regulatory or technical constraints imposed on services to which the frequency band is currently allocated on a primary basis;
- e) that there should be no additional regulatory or technical constraints imposed on services to which the band is currently allocated on a primary basis;
- f) that IMT technical and deployment characteristics may evolve in the future and the result of ITU-R compatibility and sharing studies between IMT-2020 and satellite receivers may not be valid;
- g) that, due to the effect of aggregation of interference from IMT-2020 systems, the protection of satellite receivers is possible only if all administrations will follow the agreed technical characteristics and parameters of the deployment of IMT-2020 systems;
- h) that for some administrations the only way of implementing IMT would be spectrum re-farming;
- i) the identification of high-density applications in the fixed-satellite service in the space-to-Earth direction in the bands 39.5-40 GHz in Region 1, 40-40.5 GHz in all Regions and 40.5-42 GHz in Region 2 and in the Earth-to-space direction in the bands 47.5-47.9 GHz in Region 1, 48.2-48.54 GHz in Region 1, 49.44-50.2 GHz in Region 1 and 48.2-50.2 GHz in Region 2 (see No. **5.516B**);
- j) provision No. **5.516B**, which identifies the bands 39.5-40 GHz in Region 1, 40-40.5 GHz in all Regions and 40.5-42 GHz in Region 2 for use by high-density applications in the fixed-satellite service;
- k) the relevance of provisions Nos. **5.516B** and **5.547**, and Resolution **143 (WRC-07)**,]

*resolves*

[For Conditions C2a Option 3, C2b Option 2, C2c Option 2, C2e Option 2,  
D2a Option 2, D2b Option 2, D2c Option 2,  
E2a Options 1, 2, 3A, 3B, 4A, 4B, 5 and 6, E2b Option 2, E2c Option 2,  
F2b Option 2,  
G2b Option 2,  
H2b Options 1, 2, 3A, 3B, 4A, 4B, 5 and 6, H2c Option 2, H2d Option 2,  
I2b Options 1, 2, 3A, 3B, 4A, 4B, 5 and 6, I2c Option 2]

1a in order to ensure the coexistence between IMT in the frequency band[s] [37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz] as identified by WRC-19 in Article 5 of the Radio Regulations and other services to which the frequency band is allocated including the protection of these other services, administrations shall apply the conditions as stated below;

*[Condition C2a Options 1 and 2 are not applicable in this Resolution.]*

*[For Condition C2a Option 3]*

1a1 that unwanted emissions of IMT stations brought into use in the frequency bands and services listed in Table 1 below shall not exceed the corresponding limits in that table, subject to the specified conditions;

TABLE 1

EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from IMT-2020 stations in a specified bandwidth within the EESS (passive) band <sup>1</sup>
36-37 GHz	37-43.5 GHz	Mobile	[TBD*] dB(W/100 MHz) for BS and [TBD*] dB(W/100 MHz) for UE.

<sup>1</sup> The unwanted emission power level is to be understood/is understood to mean here as the level measured at the antenna port, unless specified in terms of total radiated power.

...

*Note \*: See Section 2/1.13/3.2.3.3*

*[For Condition C2b Option 2, D2a Option 2, H2c Option 2]*

1a2 the operation of IMT within the frequency bands 37-40.5 GHz, 40.5-42.5 GHz and 47.2-50.2 GHz shall protect the existing and future FSS earth stations;

*[For Condition C2c Option 2]*

1a3 the operation of IMT within the frequency band 37-40.5 GHz shall protect the existing and future SRS earth stations;

*[For Condition C2e Option 2, D2c Option 2, E2c Option 2, F2b Option 2, G2b Option 2, H2d Option 2, I2c Option 2]*

1a4 in the case that there is uncertainty on whether or not sharing between IMT and other services/systems is feasible, such case shall be treated on a case-by-case basis subject to the agreement to be obtained from the concerned administrations;

*[For Condition D2b Option 2, E2b Option 2]*

1a5 the operation of IMT within the frequency bands 40.5-42.5 GHz and 42.5-43.5 GHz shall protect the existing and future RAS stations in the frequency band 42.5-43.5 GHz;

*[For Condition E2a Option 1, H2b Option 1, I2b Option 1]*

1a6 that the elevation angle of the antenna main beam of IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz shall not be higher than 0 degrees relative to the horizontal, and the antenna pattern shall comply with Recommendation ITU-R M.2101. In addition, IMT base stations shall comply with the TRP limits given in Table 2:

TABLE 2

**TRP limits for IMT base stations**

Frequency bands	dB(W/200 MHz)
42.5-43.5 GHz	[-9.5/14/TBD]
47.2-50.2 GHz and 50.4-51.4 GHz	[-4/14/TBD]

[For Condition E2a Option 2, H2b Option 2, I2b Option 2]

1a7 that IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz shall comply with the e.i.r.p. masks for the emissions in Table 3:

TABLE 3

**e.i.r.p. masks for the emissions of IMT base stations**

Elevation angle	Maximum e.i.r.p. dB(W/200 MHz)
$5 \leq \Theta \leq 10$	$12.5 + N - 0.9 \cdot \Theta$
$10 < \Theta \leq 34$	$3.5 + N - 0.5(\Theta - 10)$
$34 < \Theta \leq 70$	$-8.5 + N - 0.35(\Theta - 34)$
$70 < \Theta \leq 90$	$-21.1 + N$

Note to Table 3: N = 0 for the frequency band 42.5-43.5 GHz and N = 5.6 for the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz.

[For Condition E2a Option 3A, H2b Option 3A, I2b Option 3A]

1a8 the combined tilt (electrical and mechanical) of IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz should normally not be higher than 0 degrees relative to the horizontal. In addition, IMT base stations shall comply with the TRP limits given in Table 4:

TABLE 4

**TRP limits for IMT base stations**

Frequency bands	dB(W/200 MHz)
42.5-43.5 GHz	[-9.5/14/TBD]
47.2-50.2 GHz and 50.4-51.4 GHz	[-4/14/TBD]

[For Condition E2a Option 3B, H2b Option 3B, I2b Option 3B]

1a9 the combined tilt (electrical and mechanical) of IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz shall not be higher than 0 degrees relative to the horizontal. In addition, IMT base stations shall comply with the TRP limits given in Table 5:

TABLE 5

**TRP limits for IMT base stations**

Frequency bands	dB(W/200 MHz)
42.5-43.5 GHz	[-9.5/14/TBD]
47.2-50.2 GHz and 50.4-51.4 GHz	[-4/14/TBD]

*[For Condition E2a Option 4A, H2b Option 4A, I2b Option 4A]*

1a10 that, when deploying outdoor IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz, it shall be ensured that each antenna normally transmits only with the main beam pointing below the horizon and the antenna shall have mechanical pointing below the horizon except when the base station is only receiving;

*[For Condition E2a Option 4B, H2b Option 4B, I2b Option 4B]*

1a11 that, when deploying outdoor IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz, it shall be ensured that each antenna transmits only with the main beam pointing below the horizon and the antenna shall have mechanical pointing below the horizon except when the base station is only receiving;

*[For Condition E2a Option 5, H2b Option 5, I2b Option 5]*

1a12 that the mechanical tilt of IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz shall be below [TBD] degrees, and a maximum density of [TBD] base stations per km<sup>2</sup> for outdoor urban hot spots and a maximum [TBD] of base stations per km<sup>2</sup> for outdoor suburban hot spots within the territory of an administration. In addition, IMT base stations shall comply with the TRP limits given in Table 6 to provide long-term stability for FSS (Earth-to-space) in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz:

TABLE 6  
TRP limits for IMT base stations

Frequency bands	dB(W/200 MHz)
42.5-43.5 GHz	[-9.5/14/TBD]
47.2-50.2 GHz and 50.4-51.4 GHz	[-4/14/TBD]

*[For Condition E2a Option 6, H2b Option 6, I2b Option 6]*

1a13 that the main beam pointing of IMT base stations in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz avoids being higher than 0 degrees relative to the horizontal. In addition, the mechanical tilt of IMT base stations shall be below the horizon, and IMT base stations shall comply with the TRP limits given in Table 7 to provide a margin to future IMT characteristics beyond those studied to date, and to provide long-term stability for FSS (Earth-to-space) in the frequency bands 42.5-43.5 GHz, 47.2-50.2 GHz and 50.2-50.6 GHz:

TABLE 7  
TRP\* limits for IMT base stations

Frequency bands	dB(W/200 MHz)
42.5-43.5 GHz	[-9.5/14/TBD]
47.2-50.2 GHz and 50.4-51.4 GHz	[-4/14/TBD]

\* Possible example of definition of TRP: Total radiated power (TRP) is the sum of all power radiated by an antenna connected to a transmitter. This level applies for all foreseen modes of operation (i.e. maximum in-band power, electrical pointing, carrier configurations).

1b that administrations wishing to implement IMT consider the use of frequency band[s] [37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz] identified for IMT in No[s]. **[5.B113, 5.C113,**

**5D.113]** and the benefits of harmonized utilization of the spectrum for the terrestrial component of IMT taking into account the latest relevant ITU-R Recommendation;

*Note 5: The order of appearance of resolves 1a and 1b above in this Resolution is yet to be decided. Furthermore, the place of resolves 1b is also yet to be decided (i.e. resolves or invites administrations). CPM 19-2 is invited to address the issue with a view to deciding the matter.*

*invites administrations*

*[For Condition C2b Option 1, C2b Option 4, D2a Option 1, D2a Option 3, H2b Option 7]*

*Example 1*

1 to ensure the necessary balance in the frequency band 37.5-42.5 GHz (downlink), 42.5-43.5 GHz (uplink), 47.2-50.2 GHz (uplink) and 50.4-51.4 GHz (uplink), allocated to the mobile service and fixed-satellite service, between spectrum available for IMT, spectrum available for ubiquitous earth stations (e.g. the HDFSS) and spectrum available for gateway earth stations;

*Example 2*

1 to ensure that, when considering, nationally or regionally, the spectrum to be used for IMT, due attention is paid to the need for spectrum for earth stations that could be deployed in a ubiquitous manner (i.e. small user earth stations) and for earth stations that could be coordinated (i.e. gateways) in both downlink (37.5-42.5 GHz) and uplink (42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz) directions, taking into account spectrum identified for the HDFSS as per No. **5.516B**;

*Example 3*

1 when considering the spectrum to be used for IMT, to take into account the need for spectrum for earth stations at unspecified points as well as those used for gateways, and further take into account spectrum identified for the HDFSS as per No. **5.516B**;

*[For Condition C2b Option 1, C2b Option 4, D2a Option 1, D2a Option 3, H2c Option 1]*

2 to adopt provisions to enable the deployment of future gateway FSS earth stations in portions of the frequency bands 37.5-40.5 GHz and 47.5-50.2 GHz (in Region 1);

*[For Condition C2c Option 1, C2d Option 1]*

3 to adopt provisions to enable the deployment of future earth stations in the SRS (space-to-Earth) in the frequency band 37-38 GHz and the SRS (Earth-to-space) and EESS (Earth-to-space) in the frequency band 40-40.5 GHz,

*invites ITU-R*

[1 to develop harmonized frequency arrangements to facilitate IMT deployment in the frequency bands [37-43.5 GHz, 45.5-50.2 GHz and 50.4-52.6 GHz] taking into account the results of sharing and compatibility studies;

2 to continue providing guidance to ensure that IMT can meet the telecommunication needs of the developing countries and rural areas in the context of the studies referred to above;]

*[For Condition C2b Option 1, C2b Option 4, D2a Option 1, D2a Option 3, H2c Option 1]*

3 to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations in the frequency bands 37.5-40.5 GHz, 40.5-42.5 GHz and 47.5-50.2 GHz (in Region 1) from IMT deployments in neighbouring countries;

*[For Condition C2c, Option 1]*

4 to develop an ITU-R Recommendation to assist administrations in protecting of existing and future SRS earth stations operating in the frequency band 37-38 GHz taking into account the required protection criteria;

*[For Condition D2b Option 1, E2b Option 1]*

5 to update existing ITU-R Recommendations or develop new ITU-R Recommendations, as appropriate, to provide information on possible coordination and protection measures for the RAS stations in the frequency band 42.5-43.5 GHz;

*[For Condition E2c Option 3, H2d Option 3, I2c Option 3]*

6 to regularly update characteristics of IMT deployments (including base station density) and to study/assess the impact on sharing and compatibility with other services resulting from these deployments.

*Note: Views were expressed that further clarifications are required on the applicability of the implementation.*

#### **2/1.13/5.13.4 For the relevant condition(s) and option(s) of Method J2**

*Note 1: Due to time constraints, the text in this draft new Resolution has not yet been fully reviewed. CPM 19-2 is invited to carefully examine the text with a view to resolving any issues.*

*Views were expressed that resolves 2 may be more appropriate to the "invites administrations" section. In addition, views were expressed that the word "protocol" needs clarification*

*Views were expressed that, depending on the decision on resolves 2, this text may not be needed*

*Views were expressed that invites 1, 2 and 3 were not appropriate for this Resolution*

**ADD**

### **DRAFT NEW RESOLUTION [C113-IMT 66/71 GHZ-J2] (WRC-19)**

#### **Use of the band 66-71 GHz for International Mobile Telecommunications (IMT) and non-IMT systems/Multiple Gigabit Wireless Systems (MGWS)/Wireless Access Systems (WAS)**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) [that International Mobile Telecommunications (IMT), including IMT-2000, IMT-Advanced and IMT-2020, is the ITU vision of global mobile access;
- b) that IMT systems provide telecommunication services on a worldwide scale regardless of location, network or terminal used;
- c) that the evolution of IMT is being studied within ITU-R;
- d) that the frequency bands 450-470 MHz, 470-698 MHz, 694/698-960 MHz, 1 427-1 518 MHz, 1 710-2 025 MHz, 2 110-2 200 MHz, 2 300-2 400 MHz, 2 500-2 690 MHz, 3 300-3 400 MHz, 3 400-3 600 MHz, 3 600-3 700 MHz, 4 800-4 990 MHz or parts thereof, are identified for use by administrations wishing to implement IMT;

- e) that harmonized worldwide bands and harmonized frequency arrangements for IMT and MGWS systems are highly desirable in order to achieve global roaming and the benefits of economies of scale;
- f) that timely availability of spectrum is important to support future applications;
- g) that IMT systems are envisaged to provide increased peak data rates and capacity that may require a larger bandwidth;][to be aligned with other Resolutions being drafted]
- h) that International Mobile Telecommunications (IMT) and Multiple Gigabit Wireless Systems (MGWS)/Wireless Access Systems (WAS) are intended to provide telecommunication services on a worldwide scale;
- i) that the lower adjacent band, 57-66 GHz, is used for MGWS/WAS,

*noting*

- [a) Resolutions **223 (Rev.WRC-15)**, **224 (Rev.WRC-15)** and **225 (Rev.WRC-12)**, which also relate to IMT;
- b) that Recommendation ITU-R M.2083 provides IMT Vision – “Framework and overall objectives of the future development of IMT for 2020 and beyond”;
- c) that currently operating mobile communication systems may evolve to IMT in their existing frequency bands;
- d) that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band by any application of the services to which it is allocated;] [to be aligned with other Resolutions being drafted]
- e) Recommendation ITU-R M.2003-2 on Multiple Gigabit Wireless Systems in frequencies around 60 GHz;
- f) Report ITU-R M.2227-2 on use of Multiple Gigabit Wireless Systems in frequencies around 60 GHz,

*resolves*

[1 to invite administrations planning to implement IMT to make available, based on user demand and other national considerations, the frequency band 66-71 GHz identified in No. **5.J113** for the terrestrial component of IMT; due consideration should be given to the benefits of harmonized utilization of the spectrum for the terrestrial component of IMT, taking into account the services to which the frequency band is currently allocated;] [to be aligned with other Resolutions being drafted]

2 that administrations when implementing or planning to implement IMT and MGWS/WAS in the frequency band 66-71 GHz take into account the latest technical characteristics of IMT and MGWS/WAS as provided in ITU-R Reports and Recommendations including, when available, coexistence protocols as appropriate (see *invites ITU-R 3*),

*invites administrations*

to take into account relevant ITU-R Recommendations and Reports, when implementing or planning to implement IMT and MGWS,

*invites ITU-R*

1 to develop harmonized frequency arrangements to facilitate IMT deployment in the frequency band 66-71 GHz;

- 2 to develop ITU-R Recommendations and Reports that will assist administrations in ensuring that applications and services in the band 66-71 GHz can utilize the band efficiently including the development of appropriate sharing protocols between IMT and MGWS/WAS where needed;
- 3 to develop ITU-R Recommendations and Reports, regularly updated, on IMT technical and operational, including deployment, characteristics;
- 4 to study the impact of evolved characteristics on sharing and compatibility with other services.

**2/1.13/5.13.5 For the relevant condition(s) and option(s) of Method J3**

*Note 1: Due to time constraints, the text in this draft revised Resolution has not yet been fully reviewed. CPM 19-2 is invited to carefully examine the text with a view to resolving any issues.*

*Note 2: Further clarification at CPM19-2 about the scope of the Resolution.*

**MOD**

**RESOLUTION 238 (WRC-19)**

**Studies on frequency-related matters for International Mobile Telecommunications identification in the frequency band 66-71 GHz for the future development of International Mobile Telecommunications for 2020 and beyond**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a)* that International Mobile Telecommunications (IMT) is intended to provide telecommunication services on a worldwide scale, regardless of location and type of network or terminal;
- b)* that ultra-low latency and very high bit rate applications of IMT will require larger contiguous blocks of spectrum than those available in frequency bands that are currently identified for use by administrations wishing to implement IMT;
- c)* that it may be suitable to examine higher frequency bands for these larger blocks of spectrum;
- d)* that the properties of higher frequency bands, such as shorter wavelength, would better enable the use of advanced antenna systems including MIMO and beam-forming techniques in supporting enhanced broadband;
- e)* that the frequency range 66-71 GHz, or parts thereof, is allocated to the ISS, MS, MSS, RNS and RNSS and, in accordance with No. **5.553**, stations in the band 66-71 GHz stations in the land mobile service may be operated subject to not causing harmful interference to the space radiocommunication systems to which this band are allocated;
- f)* that, in accordance with *resolves to invite ITU-R 2* of Resolution **238 (WRC-15)**, it was necessary to conduct and complete in time for WRC-19 the appropriate sharing and compatibility



studies, taking into account the protection of services to which the band 66-71 GHz is allocated on a primary basis;

g) that, during preparation for WRC-19, sharing and compatibility studies were carried out for the ISS and MSS (Earth-to-space). Studies were not carried out for RNS and RNSS and for MSS (space-to-Earth);

h) that the band 66-71 GHz is expected to be used for Mobile Broadband/Multiple Gigabit Wireless Systems (MGWS) including technologies that meet the IMT requirements and for those that do not;

i) that identification of frequency bands allocated to mobile service for IMT may change the sharing situation regarding applications of services to which the frequency band is already allocated, and may require additional regulatory actions;

j) the need to protect existing services and to allow for their continued development when considering frequency bands for possible additional allocations to any service,

*noting*

a) Resolutions **223 (Rev.WRC-15)**, **224 (Rev.WRC-15)**, **225 (Rev.WRC-12)**, [**A113-IMT 26GHz**] (**WRC-19**), which also relate to IMT;

b) Recommendation ITU-R M.2083, on the framework and objectives of the future development of IMT for 2020 and beyond;

c) that there are ongoing studies within ITU-R on the propagation characteristics for mobile systems in higher frequency bands;

d) the relevance of provisions in Nos. **5.553** and **5.558**, which may need to be taken into account in studies;

e) Recommendation ITU-R M.2003-2 on Multiple Gigabit Wireless Systems in frequencies around 60 GHz;

f) Report ITU-R M.2227-2 on use of Multiple Gigabit Wireless Systems in frequencies around 60 GHz,

*recognizing*

a) that no identification of frequency band 66-71 GHz for the terrestrial component of IMT was made at WRC-19 due to lack of studies in accordance with Resolution **238 (WRC-15)**, and therefore further studies between IMT and the inter-satellite service, mobile-satellite service, radionavigation service, radionavigation-satellite service and aeronautical mobile service in the frequency band 66-71 GHz still need to be addressed;

b) that identification of frequency bands for IMT should take into account the use of the bands by other services and the evolving needs of these services;

c) that there should be no additional regulatory or technical constraints imposed on services to which the band is currently allocated on a primary basis,

*resolves*

to invite [a future competent WRC/WRC-23] to consider the identification of the frequency band 66-71 GHz for the terrestrial component of IMT, based on the sharing and compatibility studies for protection of services to which this frequency band is allocated on a primary basis,

———invites ITU-R

- 1 to continue and complete in time for [a future competent WRC/WRC-23] the appropriate sharing and compatibility studies to protect services to which the frequency band 66-71 GHz is allocated on a primary basis;
- 2 to study the technical and regulatory conditions for the use of IMT in the frequency band 66-71 GHz in order to protect the aeronautical mobile service.

**2/1.13/5.13.6 For the relevant condition(s) and option(s) of Methods K2 and L2**

*Note 1: The text for this draft new Resolution was contributed to ITU-R and, due to time constraints, has not yet been discussed and reviewed. CPM 19-2 is invited to carefully examine the text with a view to resolving any issues.*

*Note 2: 71-76 GHz and 81-86 GHz frequency band specific items are expected to be added for CPM 19-2 for the considering, noting and recognizing sections.*

**ADD**

**DRAFT NEW RESOLUTION [E113-IMT 70/80 GHZ] (WRC-19)**

**International Mobile Telecommunications  
in frequency bands 71-76 and 81-86 GHz**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

*[Editor's note: generic items to be aligned with 26 GHz]*

*noting*

*[Editor's note: generic items to be aligned with 26 GHz]*

*recognizing*

*[Editor's note: generic items to be aligned with 26 GHz]*

*resolves*

1a in order to ensure the coexistence between IMT in the frequency bands 71-76 GHz and 81-86 GHz as identified by WRC-19 in Article 5 of the Radio Regulations and other services to which the frequency band is allocated including the protection of these other services, administrations shall apply the conditions as stated below;

*[For Condition K2a, L2b]*

1a1 that, in order to protect the radiolocation service in the frequency band 76-81 GHz, the unwanted emission limits into the 76-81 GHz band from IMT BSs and UEs operating in the 71-76 GHz and 81-86 GHz bands shall comply with the limits given in Table X1:

TABLE X1

**Limits of unwanted emissions into 76-81 GHz from IMT stations**

Station	76-77 GHz dB(W/200 MHz)	77-81 GHz dB(W/200 MHz)
BS	[TBD/-29.6/-31.5/< -37]	[TBD/-33/< -37]
UE	[TBD/-20/< -37]	[TBD/-35/< -37]

[For Condition K2b Option 2]

1a2 the operation of IMT within the frequency band 71-76 GHz shall protect the existing and future FSS earth stations;

[For Condition L2a Option 1 is not applicable in this Resolution]

[For Condition L2c Option 2]

1a3 the operation of IMT within the frequency band 81-86 GHz shall protect the existing and future RAS stations in the frequency bands 81-86 GHz and 76-94 GHz;

[For Condition L2d Option 1A]

1a4.1 that the combined tilt (electrical and mechanical) of IMT base stations should normally not be higher than 0 degrees relative to the horizontal. In addition, IMT base stations shall comply with the TRP limits given in Table X2:

TABLE X2

**TRP limits for IMT base stations**

Frequency bands	dB(W/200 MHz)
81-86 GHz	[TBD]

[For Condition L2d Option 1B]

1a4.2 that the combined tilt (electrical and mechanical) of IMT base stations shall not be higher than 0 degrees relative to the horizontal. In addition, IMT base stations shall comply with the TRP limits given in Table X3:

TABLE X3

**TRP limits for IMT base stations**

Frequency bands	dB(W/200 MHz)
81-86 GHz	[TBD]

[For Condition L2d Option 2]

1a5 that, in order to protect satellite reception in the frequency band 81-86 GHz, IMT base stations shall comply with the following e.i.r.p. masks for the emissions:

Elevation angle	Maximum e.i.r.p. dB(W/200 MHz)
$5 \leq \theta \leq 15$	TBD
$15 < \theta \leq 25$	TBD
$25 < \theta \leq 55$	TBD

55 < $\Theta$ ≤ 90	TBD
--------------------	-----

[For Condition K2c Option 2, L2e Option 2]

1a6 in the case that there is uncertainty on whether or not sharing between IMT and other services/systems is feasible, such case shall be treated on a case-by-case basis subject to the agreement to be obtained from the concerned administrations;

1b that administrations wishing to implement IMT consider the use of frequency bands 71-76 GHz and 81-86 GHz identified for IMT in Nos. **5.K113** and **5.L113**, and the benefits of harmonized utilization of the spectrum for the terrestrial component of IMT taking into account the latest relevant ITU-R Recommendation,

Note: The order of appearance of *resolves* 1a and 1b above in this Resolution is yet to be decided. Furthermore, the place of *resolves* 1b is also yet to be decided (i.e. *resolves* or *invites administrations*). CPM 19-2 is invited to address the issue with a view to deciding on the matter.

*invites ITU-R*

1 to develop harmonized frequency arrangements to facilitate IMT deployment in the frequency bands 71-76 and 81-86 GHz taking into account the results of sharing and compatibility studies;

[For Condition K2b Option 1]

2 to develop an ITU-R Recommendation to assist administrations in ensuring the protection of existing and future FSS earth stations in the frequency bands 71-76 GHz from IMT deployments in neighbouring countries;

[For Condition L2c Option 1]

3 to update existing ITU-R Recommendations or develop new ITU-R Recommendations, as appropriate, to provide information and assistance to the administrations on possible coordination and protection measures for the radio astronomy service in the frequency bands 81-86 GHz and 76-94 GHz from the IMT deployment.

**2/1.13/5.13.7 For the relevant condition(s) and option(s) of Methods A2, C2, H2, L2 and I2**

**MOD**

## RESOLUTION 750 (REV.WRC-19)

### **Compatibility between the Earth exploration-satellite service (passive) and relevant active services**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

...

*resolves*

1 that unwanted emissions of stations brought into use in the frequency bands and services listed in Table 1-1 below shall not exceed the corresponding limits in that table, subject to the specified conditions;

...

TABLE 1-1

EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band <sup>1</sup>
...	...	...	...
<i>Note: The row below applies only to Condition A2a Option 1</i>			
23.6-24 GHz	24.25-27.5 GHz or 24.25-25.25 GHz or 24.25-24.45 GHz or 24.25-TBD GHz	Mobile	TBD (see Section 2/1.13/3.2.1)
...	...	...	...
<i>Note: The row below applies only to Condition C2a Option 1</i>			
36-37 GHz	37-40.5 GHz	Mobile	TBD (see Section 2/1.13/3.2.1)
...	...	...	...
<i>Note: The row below applies only to Condition A2b Option 1</i>			
50.2-50.4 GHz	24.25-27.5 GHz or 24.25-25.25 GHz or 24.25-24.45 GHz or 24.25-TBD GHz	Mobile	TBD (see Section 2/1.13/3.2.1)
...	...	...	...
<i>Note: The row below applies only to Condition H2a Options 1 and 2</i>			
50.2-50.4 GHz	47.2-50.2 GHz	Mobile	TBD (see Section 2/1.13/3.2.1)
...	...	...	...
<i>Note: The row below applies only to Condition I2a Options 1 and 2</i>			
50.2-50.4 GHz	50.4-52.6 GHz	Mobile	TBD (see Section 2/1.13/3.2.1)
...	...	...	...
<i>Note: The row below applies only to Condition A2b Option 1</i>			

52.6-54.25 GHz	24.25-27.5 GHz or 24.25-25.25 GHz or 24.25-24.45 GHz or 24.25-TBD GHz	Mobile	TBD (see Section 2/1.13/3.2.1)
...	...	...	...
<i>Note: The row below applies only to Condition I2a Options 1 and 2</i>			
52.6-54.25 GHz	50.4-52.6 GHz	Mobile	TBD (see Section 2/1.13/3.2.1)
...	...	...	...
<i>Note: The row below applies only to Condition L2a Option 1</i>			
86-92 GHz	81-86 GHz	Mobile	TBD (see Section 2/1.13/3.2.1)
...	...	...	...

<sup>1</sup> The unwanted emission power level is to be understood as/is understood to mean the level measured at the antenna port, unless specified in terms of total radiated power.

...

TABLE 1-2

<b>EESS (passive) band</b>	<b>Active service band</b>	<b>Active service</b>	<b>Recommended maximum level of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band<sup>1</sup></b>
...	...	...	...
<i>Note: The row below applies only to Condition C2a Option 2</i>			
36-37 GHz	37-40.5 GHz	Mobile	TBD
...	...	...	...

*Notes to Table 1-2:*

<sup>1</sup> The unwanted emission power level is to be understood as/is understood to mean the level measured at the antenna port, unless specified in terms of total radiated power.

...

**2/1.13/5.14 For all items, for Methods A1, B1, C1, D1, E1, F1, G1, H1, I1, J1, K1 and L1 (NOC)**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations  
(See No. 2.1)**

<b>2/1.13/5.14.1</b>	<b>For Method A1 (NOC)</b>
<b>NOC</b>	<b>22-24.75 GHz</b>
<b>NOC</b>	<b>24.75-29.9 GHz</b>
<b>2/1.13/5.14.2</b>	<b>For Method B1 (NOC)</b>
<b>NOC</b>	<b>29.9-34.2 GHz</b>
<b>2/1.13/5.14.3</b>	<b>For Method C1 (NOC)</b>
<b>NOC</b>	<b>34.2-40 GHz</b>
<b>NOC</b>	<b>40-47.5 GHz</b>
<b>2/1.13/5.14.4</b>	<b>For Method D1 (NOC)</b>
<b>NOC</b>	<b>40-47.5 GHz</b>
<b>2/1.13/5.14.5</b>	<b>For Method E1 (NOC)</b>
<b>NOC</b>	<b>40-47.5 GHz</b>

**2/1.13/5.14.6 For Method F1 (NOC) and Method F2, Alternative 1**

**NOC**

**40-47.5 GHz**

**2/1.13/5.14.7 For Method G1 (NOC) and Method G2, Alternative 1**

**NOC**

**40-47.5 GHz**

**2/1.13/5.14.8 For Method H1 (NOC)**

**NOC**

**40-47.5 GHz**

**NOC**

**47.5-51.4 GHz**

**2/1.13/5.14.9 For Method I1 (NOC)**

**NOC**

**47.5-51.4 GHz**

**NOC**

**51.4-55.78 GHz**

**2/1.13/5.14.10 For Method J1 (NOC)**

**NOC**

**66-81 GHz**

**2/1.13/5.14.11 For Method K1 (NOC)**

**NOC**

**66-81 GHz**

**2/1.13/5.14.12 For Method L1 (NOC)**

**NOC**

**81-86 GHz**



**2/1.13/5.15 For all items, for all Methods, except Method J3 for which a modification of Resolution 238 (WRC-15) is proposed**

**SUP**

**RESOLUTION 238 (WRC-15)**

**Studies on frequency-related matters for International Mobile Telecommunications identification including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency range between 24.25 and 86 GHz for the future development of International Mobile Telecommunications for 2020 and beyond**

## Agenda item 1.16

(**WP 5A / WP 4A, WP 4C, WP 5B, WP 5C, WP 7C,**  
(**WP 1B), (WP 3J), (WP 3K), (WP 3M), (WP 5D)**)

*1.16 to consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution 239 (WRC-15);*

**Resolution 239 (WRC-15) – Studies concerning Wireless Access Systems including radio local area networks in the frequency bands between 5 150 MHz and 5 925 MHz**

### **2/1.16/1 Executive summary**

Section 2/1.16/2 provides background information about the development of wireless access systems (WAS)/radio local area networks (RLAN) usage and work at previous WRCs related to WAS/RLAN.

Section 2/1.16/3 describes:

- the results of ITU-R studies for the technical and operational requirements for RLANs taking into account that previous studies indicated the minimum spectrum requirement for RLANs using the 5 GHz frequency range in the year 2018 is estimated to be 880 MHz;
- the sharing and compatibility studies conducted by the ITU-R in accordance with Resolution 239 (WRC-15) for various frequency ranges;
- analyses of the results of studies for various frequency ranges;
- a list of frequency bands studied: 5 150-5 250 MHz, 5 250-5 350 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz, and 5 850-5 925 MHz.

Methods to satisfy the agenda item are included in section 2/1.16/4.

The frequency bands investigated under this agenda item, i.e. 5 150-5 250 MHz, 5 250-5 350 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz and 5 850-5 925 MHz, are denoted by the letters **A**, **B**, **C**, **D**, and **E**, respectively. When multiple methods are proposed for a particular frequency band, the methods are expressed by the associated letter and a numerical suffix (Method **A1**, Method **A2**, etc.); when only one method is proposed for a particular frequency band, the method is expressed by the associated letter (**B**, **C**, etc.).

For the 5 150-5 250 MHz frequency band, four methods (incl. NOC) are proposed (**A1**, **A2**, **A3** and **A4**); for the 5 250-5 350 MHz and for the 5 350-5 470 MHz frequency bands, only one method (NOC) is proposed (**B** and **C** respectively); for the 5 725-5 850 MHz frequency band, three methods (incl. NOC) are proposed (**D1**, **D2** and **D3**); for the 5 850-5 925 MHz frequency band only one method (NOC) is proposed (**E**).

Finally, the regulatory and procedural considerations can be found in section 2/1.16/5.

### **2/1.16/2 Background**

RLANs have proven to be a success in conjunction with other fixed and mobile networks at providing affordable and ubiquitous broadband wireless access to the Internet. Introduced by some administrations in the 2.4 GHz band and subsequently expanded into some of the 5 GHz frequency bands. RLANs, specifically Wi-Fi devices, now carry approximately half of all global Internet

Protocol (IP) traffic<sup>17</sup>. In fact, mobile carriers have increased their reliance on Wi-Fi offload, voice-over-Wi-Fi, and similar technologies<sup>18</sup>. As technology evolves to meet increasing performance demands and traffic on broadband WAS increases, the use of wider bandwidth channels in order to support high data rates creates a need for additional spectrum.

RR No. **5.446A** specifies that the use of the bands 5 150-5 350 MHz and 5 470-5 725 MHz by the stations in the mobile, except aeronautical mobile, service shall be in accordance with Resolution **229 (Rev.WRC-12)**.

Since WRC-03, the demand for mobile broadband applications especially for WAS/RLANs has been growing rapidly. Resolution **239 (WRC-15)** states “that the results of ITU-R studies indicate that the minimum spectrum need for WAS/RLAN in the 5 GHz frequency range in the year 2018 is estimated at 880 MHz; this figure includes 455-580 MHz already utilized by non-IMT mobile broadband applications operating within the 5 GHz range resulting in 300-425 MHz additional spectrum being required”.

One issue WRC-15 examined was the possibility of additional global allocations to the mobile service (MS) for terrestrial mobile broadband applications, including in the 5 GHz range, to facilitate contiguous spectrum for WAS/RLAN. This is to enable the use of wider channel bandwidths to support higher data throughput. The studies performed by ITU-R in preparation for WRC-15 indicated that if the WAS/RLAN mitigation measures were limited to the regulatory provisions of Resolution **229 (Rev.WRC-12)**, sharing between WAS/RLAN and the Earth exploration-satellite service (EESS) (active) systems in the frequency band 5 350 to 5 470 MHz may not be feasible, as well as being insufficient to ensure protection of certain radar types in this frequency band. For these cases, sharing may only be feasible if additional WAS/RLAN mitigation measures are implemented. However, no agreement was reached on the applicability of any additional WAS/RLAN mitigation techniques (see section 1/1.1/3.2.11 of the [Report of the CPM to WRC-15](#)).

No agreement was reached on the conclusions of the studies for the frequency band 5 725-5 850 MHz (see section 1/1.1/3.2.12 of the [Report of the CPM to WRC-15](#)). As such, WRC-15 concluded no change (NOC) for these frequency bands and established a WRC-19 agenda item to continue the work.

Resolution **239 (WRC-15)**, calls for ITU-R to:

- study WAS/RLAN technical characteristics and operational requirements in the 5 GHz frequency range;
- perform sharing and compatibility studies between WAS/RLAN applications and incumbent services in the frequency bands 5 150-5 350 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz and 5 850-5 925 MHz while ensuring the protection of incumbent services including their current and planned use;
- consider enabling outdoor WAS/RLAN operations in the frequency band 5 150-5 350 MHz;
- consider potential MS allocations to accommodate WAS/RLAN operations in the 5 350-5 470 MHz and 5 725-5 850 MHz frequency bands; and

---

<sup>17</sup> Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015-2020, pp. 24-25 (3 Feb. 2016), available at <http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.pdf>.

<sup>18</sup> Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015-2020, p. 25 (3 Feb. 2016).

- identify potential WAS/RLAN use in 5 850-5 925 MHz frequency band.

## **2/1.16/3 Summary and analysis of the results of ITU-R studies**

### **2/1.16/3.1 Technical and operational requirements for WAS/RLANs**

Further information on technical and operational requirements for WAS/RLANs considered in sharing and compatibility studies other than those referred in Resolution **229 (Rev.WRC-12)** can be found in the WDPDN Report ITU-R M.[RLAN REQ-PAR].

### **2/1.16/3.2 Sharing and compatibility studies**

#### **2/1.16/3.2.1 Frequency band 5 150-5 250 MHz**

The frequency band 5 150-5 250 MHz is allocated to various services as contained in the Radio Regulations (RR) Table of Frequency Allocations including associated footnotes thereto.

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>5 150-5 250</b>	FIXED-SATELLITE (Earth-to-space) 5.447A MOBILE except aeronautical mobile 5.446A 5.446B AERONAUTICAL RADIONAVIGATION 5.446 5.446C 5.447 5.447B 5.447C	

The studies described in the subsections below for the 5 150-5 250 MHz frequency band did not address the impact of out-of-band emissions.

#### **2/1.16/3.2.1.1 FSS for non-GSO MSS feeder uplinks and the MS/RLAN**

The studies described in this section assumed a WAS/RLAN e.i.r.p. distribution as contained in the WDPDN Report ITU-R M.[RLAN REQ-PAR].

One study showed that RLANs could protect the non-GSO mobile-satellite service (MSS) feeder links by operating up to 1 Watt conducted power and a power spectral density (PSD) of 17 dBm/MHz with an allowance for a 6 dBi antenna gain (i.e. a total 36 dBm e.i.r.p.), 2% of RLANs outdoors, using directional and omnidirectional antennas to minimize the likelihood of harmful interference to the operating MSS system. The study analysed RLAN aggregate interference into satellites in the system over a continuous six-day period. The time-variant CDMA channel capacity or radiofrequency power loss never exceeds 1%. Accordingly, the study found no impact to the satellite constellation capacity or satellite RF power and hence no harmful interference to the single MSS system using the 5 150-5 250 MHz frequency band for FSS feeder links.

Considering the results of this study RLANs could potentially operate outdoors and at higher powers in the 5 150-5 250 MHz frequency band. For outdoor Access Point (AP) antennas, 70% are assumed to employ antennas that are omnidirectional in the azimuth plane and facing with the main beam generally downward for the vertical plane; 16% employ a 6 dBi directional antenna with 50 degrees of down tilt; 6% a 12 dBi directional antenna with 30 degrees of down tilt; 8% employ directional point-to-point antennas. This study represents a typical deployment for the country in which this study was carried out, where outdoor deployments need to comply with emissions constrained in elevations higher than 30 degrees to be less than 125 mW e.i.r.p.

A separate comparison showed that higher power and outdoor operation of any RLAN described above, could potentially result in up to 30 dB more e.i.r.p. for RLAN emission elevation angles

≤30 degrees and up to 15 dB more e.i.r.p. for elevation angles >30 degrees, compared with that prescribed by Resolution **229 (Rev.WRC-12)**. It should also be noted that RLAN operations include a wide distribution of devices operating at a range of e.i.r.p. values.

Another sharing study is focused on evaluation of conditions that enable sharing and compatibility between RLAN and MSS. In this study, as mitigation measures, limitation of the number of outdoor access points and the maximum e.i.r.p. dependent on antenna elevation angles are considered. The conditions of the maximum e.i.r.p. are assumed to be the same as described in *resolves 4* in Resolution **229 (Rev.WRC-12)** for the 5 250-5 350 MHz frequency band. The results of the study show that if the number of outdoor RLANs is limited, the total interference level from RLANs is lower than the threshold for MSS feeder links. Since the 5 250-5 350 frequency band is adjacent to the 5 150-5 250 MHz frequency band, the conditions of these sub-bands are preferred to be equivalent.

Another study examined the impact to another non-GSO MSS system sharing the spectrum, which is the COMPASS-MSS system over Asia. The study shows that the COMPASS-MSS system feeder link would suffer interference from RLAN access points for more than 90% of the time if the RLAN devices are 5.3% outdoor used. This study assumed the RLAN density per inhabitants which uses the transmission density factors for RLANs in Europe proposed in WDPDN Report ITU-R M.[RLAN REQ-PAR].

Another study conducted when considering RLAN deployment over Europe, North Africa and part of Asia and the Middle East, concluded that RLAN outdoor relaxation (up to 5.3%) would cause harmful interference to the MSS feeder link. This study considered the 48 HIBLEO-X satellites and an e.i.r.p. of 1W and even 4W. The proposal for outdoor use with a limitation of e.i.r.p. to 125 mW for antenna elevation angles in excess of 30 degrees from the horizon by applying a constant discrimination, was also studied but did not solve the interference problem. This study also assessed low e.i.r.p. RLAN devices (up to 40 mW) restricted to in-vehicle usage. Simulations have shown that the same level of protection offered by the indoor usage is achieved for MSS when combining a low e.i.r.p. up to 40 mW and restricted to in-vehicle use. Low e.i.r.p. (up to 40 mW) associated with an in-vehicle usage restriction is an effective measure to mitigate the level of interference into the MSS feeder link.

No agreement was reached on the results of all these studies as outlined above.

#### **2/1.16/3.2.1.2 ARNS and MS/RLAN**

This frequency band is used for sense and avoid systems and the typical technical characteristics are given in Recommendation ITU-R M.2007 “*Characteristics of and protection criteria for radars operating in the aeronautical radionavigation service in the frequency band 5 150-5 250 MHz*”. These systems were characterized after the initial introduction of the WAS/RLANs under Resolution **229 (WRC-03)**. It should also be noted that the sharing studies carried out when the frequency band was allocated to mobile service on a primary basis for the implementation of WAS/RLAN assumed 1% accidental outdoor usage at 200 mW e.i.r.p.

In one deterministic, single-entry case example compatibility study, the results showed that the effective measures for reducing interference for airborne sense and avoid systems operation are to be developed to enable the usage of outdoor WAS/RLAN in the 5 150-5 250 MHz frequency band. One approach based on the worst-case results may be the reduction of e.i.r.p. values of WAS/RLAN transmitters approximately by 20 dB while increasing the receiver sensitivity can be considered as the effective method for reducing interference. Such method allows to compensate the absence of additional fading in the walls which provided sharing of WAS/RLAN systems with the aeronautical radionavigation service (ARNS) systems operating in the considered frequency band.

Without development of such measures for reducing the interference the decision of possible outdoor WAS/RLAN systems usage in the considered frequency band cannot be made.

Consideration of statistical analysis looking at multi-source interference could result in different protection distances. Further studies using an aggregate interference are needed for realistic results.

Another study is submitted that is focused on evaluation of conditions that enable sharing and compatibility. In this study, as mitigation measures, limitation of the number of outdoor RLANs, restriction of the location of outdoor RLANs and the maximum e.i.r.p. dependent on antenna elevation angles are considered. The conditions of maximum e.i.r.p. are assumed to be the same as described in *resolves 4* in Resolution **229 (Rev.WRC-12)** for the 5 250-5 350 MHz frequency band. Since the 5 250-5 350 frequency band is adjacent to the 5 150-5 250 MHz frequency band, the conditions of these sub-bands are preferred to be equivalent. The results of the study show that if the number of outdoor RLANs is limited, and the distance between RLANs and ARNS systems is larger than a specific protection distance, the total interference level from RLANs is lower than the threshold for ARNS systems with an adequate probability.

Another minimum coupling loss (MCL) coexistence study, showed that indeed an outdoor RLAN relaxation without any mitigation technique would cause harmful interference to the ARNS, but it was shown that the same level of protection offered by the indoor usage is achieved when combining a low e.i.r.p. of 40 mW and a restricted in-vehicle use for the outdoor case. Low e.i.r.p. (up to 40 mW) associated with an in-vehicle usage restriction is an effective measure to mitigate the level of interference into the ARNS.

### 2/1.16/3.2.1.3 Aeronautical mobile telemetry and MS/RLAN

Pursuant to RR No. **5.446C**, “in Region 1 (except in Algeria, Saudi Arabia, Bahrain, Egypt, United Arab Emirates, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Syrian Arab Republic, Sudan, South Sudan and Tunisia) and in Brazil, the band 5 150-5 250 MHz is also allocated to the aeronautical mobile service on a primary basis, limited to aeronautical telemetry transmissions from aircraft stations (see No. **1.83**), in accordance with Resolution **418 (Rev.WRC-12)\***. These stations shall not claim protection from other stations operating in accordance with Article 5. No. **5.43A** does not apply”.

One study indicated that MCL calculations showed that outdoor usage with the e.i.r.p. values recognized in Resolution **229 (Rev.WRC-12)** cannot ensure the coexistence of outdoor RLANs and the aeronautical mobile telemetry (AMT). However, this study showed that AMT systems can have the same level of protection established by Resolution **229 (Rev.WRC-12)**, when combining a low e.i.r.p. (up to 40 mW) with in-vehicle use.

### 2/1.16/3.2.2 Frequency band 5 250-5 350 MHz

The frequency band 5 250-5 350 MHz is allocated to various services as contained in the RR Table of Frequency Allocations including associated footnotes thereto.

Allocation to services		
Region 1	Region 2	Region 3
5 250-5 255	EARTH EXPLORATION-SATELLITE (active) MOBILE except aeronautical mobile 5.446A 5.447F RADIOLOCATION SPACE RESEARCH 5.447D 5.447E 5.448 5.448A	

<b>5 255-5 350</b>	EARTH EXPLORATION-SATELLITE (active) MOBILE except aeronautical mobile 5.446A 5.447F RADIOLOCATION SPACE RESEARCH (active) 5.447E 5.448 5.448A
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#### **2/1.16/3.2.2.1 EESS (active) and the MS/RLAN and radar systems and the MS/RLANs**

The current WAS/RLAN operating parameters are specified in Resolution **229 (Rev.WRC-12)**.

Since the adoption of Resolution **229** at WRC-03, millions of WAS/RLAN (e.g., Wi-Fi) devices have been deployed in the 5 250-5 350 MHz frequency band.

In preparation for WRC-19, studies in response to *invites ITU-R c*) of Resolution **239 (WRC-15)** have shown that changing the WAS/RLAN operating conditions in the 5 250-5 350 MHz frequency band as given in Resolution **229 (Rev.WRC-12)**, would not ensure protection of the radiodetermination service and EESS (active) sensors. Furthermore, it was confirmed that the current WAS/RLAN operating conditions in the 5 250-5 350 MHz frequency band are sufficient for the operating needs of WAS/RLAN users.

#### **2/1.16/3.2.3 Frequency band 5 350-5 470 MHz**

The frequency band 5 350-5 470 MHz, or parts thereof, is allocated to the EESS, RLS, ARNS, SRS and RNS. The details of these allocations can be found in RR Article **5**.

##### **2/1.16/3.2.3.1 EESS (active) and the MS/RLAN**

Previous ITU-R sharing studies show that sharing between RLAN and the EESS (active) systems in the 5 350-5 470 MHz frequency band would not be feasible unless additional RLAN mitigation measures are implemented. After further study of currently available mitigation measures, study results show that there are no feasible mitigation techniques to facilitate sharing between RLAN and EESS (active) in this band.

##### **2/1.16/3.2.3.2 Radar systems and the MS/RLANs**

The regulatory provisions in the 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz frequency bands contained in Resolution **229 (Rev.WRC-12)** are insufficient to ensure protection of certain radar types in the 5 350-5 470 MHz frequency band. After further study of currently available mitigation measures, study results show that there are no feasible mitigation techniques to facilitate sharing between RLAN and the different radar systems in the 5 350-5 470 MHz frequency band.

#### **2/1.16/3.2.4 Frequency band 5 725-5 850 MHz**

The frequency band 5 725-5 850 MHz is allocated to various services as contained in the RR Table of Frequency Allocations including associated footnotes thereto.

Allocation to services		
Region 1	Region 2	Region 3
<b>5 725-5 830</b> FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur 5.150 5.451 5.453 5.455	<b>5 725-5 830</b> RADIOLOCATION Amateur  5.150 5.453 5.455	
<b>5 830-5 850</b> FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.451 5.453 5.455	<b>5 830-5 850</b> RADIOLOCATION Amateur Amateur-satellite (space-to-Earth)  5.150 5.453 5.455	

The studies described in the subsections below for the 5 725-5 850 MHz frequency band did not address the impact of out-of-band emissions.

In this band a number of systems/applications operate in several countries in Region 1 including road transport and traffic telematics (RTTT), wireless industrial applications (WIA), broadband fixed wireless access (BFWA) and short-range devices (SRD) in addition to the designation of this band worldwide as industrial, scientific and medical (ISM) band. Some of these applications use WAS/RLAN technologies, operate at various power levels and use mitigation techniques (including dynamic frequency selection (DFS)) to enable sharing with the incumbent services operating in this band. Appropriate mitigation measures may be required to be applied to WAS/RLAN in these countries, in order to achieve coexistence between WAS/RLAN and these systems/applications, if WRC-19 decides to allocate the frequency band 5 725-5 850 MHz to the mobile service in Region 1, with the purpose to accommodate WAS/RLAN use. One administration has regulations allowing generic WAS/RLAN use in the frequency band 5 725-5 850 MHz that requires the same DFS implementation as BFWA and WIA to enable sharing with their incumbent services.

In Region 2, the 5 725-5 825 MHz frequency band is also used by WAS including RLANs. The fixed-satellite service (FSS) allocation in 5 725-5 850 MHz frequency band is in Region 1 only, therefore wireless WAS/RLAN and FSS sharing issues are not relevant in Regions 2 and 3.

In addition, RR No. **5.453** includes over 40 countries from Regions 1 and 3 which have allocated the 5 650-5 850 MHz frequency band to the fixed service (FS) and MS on a primary basis for which the provisions of Resolution **229 (Rev.WRC-12)** do not apply. Some of these countries operate WAS/RLANs technology under this footnote and one country in Region 3 operates ITS (intelligent transport systems) under the mobile allocation of this footnote.

#### **2/1.16/3.2.4.1 Radar systems and the MS/RLANs**

In one study of a single interferer to the ground-based radiolocation radars, the protection distances range from several tens of kilometres for outdoor WAS/RLAN and indoor WAS/RLAN as well. Consideration of multi-source interference result in additional increase of the required protection distance defined by the WAS/RLAN transmitter density and directivity characteristics of the considered radar. Thus based on this one study providing compatibility of WAS/RLAN with the radars operating in this frequency band will be difficult.



It should be noted that the current DFS techniques are not sufficient to protect the new frequency hopping radars modes operating in some countries in the 5 725-5 850 MHz frequency band. No new elements have been presented on any additional mitigation techniques that could be used to provide protection to these new frequency hopping radars operating modes.

#### **2/1.16/3.2.4.2 FSS (allocated only in Region 1) and MS/RLANs**

One study has been conducted with a variety of assumptions and interference environment. The initial conclusion was that sharing would be difficult without implementation of mitigation techniques.

Another study showed that by limiting the WAS/ RLANs to indoor only operations and a maximum e.i.r.p. of 200 mW sharing, including associated mitigation techniques, can be achieved between WAS/RLANs and the FSS operating in Region 1 only in the 5 725-5 850 MHz frequency band.

#### **2/1.16/3.2.5 Frequency band 5 850-5 925 MHz**

The frequency band 5 850-5 925 MHz is allocated to various services as contained in the RR Table of Frequency Allocations including associated footnotes thereto.

Allocation to services		
Region 1	Region 2	Region 3
<b>5 850-5 925</b> FIXED FIXED-SATELLITE (Earth-to-space) MOBILE  5.150	<b>5 850-5 925</b> FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Amateur Radiolocation  5.150	<b>5 850-5 925</b> FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Radiolocation  5.150

The mobile service is co-primary in the 5 850-5 925 MHz frequency band. Applications under the mobile service have already been implemented in various countries throughout the world. Therefore any sharing analysis carried out under this agenda should not prejudice usages of the mobile service while not imposing any additional constraints on other services to which the band is allocated.

Concerns were raised about different applications operating under the primary mobile service in this band. Some sharing studies carried out so far on a national or regional basis looking at WAS (RLAN) as an interferer into ITS showed the need for appropriate separation distances, in cases of co-channel operation. As a result, work by some administrations and regional groups on possible mitigation techniques was initiated to help improve the compatibility between individual RLAN devices and ITS applications. Based upon the results of these studies so far, conclusions could not be reached.

This band is also allocated to the FSS for uplink operations in all three ITU Regions supporting a variety of FSS applications including broadband service and studies should take account the protection of the current and planned FSS use.

## **2/1.16/4 Methods to satisfy the agenda item**

Regulatory procedures associated with some of the methods as described below are provided by the proponents of the methods in question, reflect the view of proponents, and were presented and discussed by ITU-R.

[Note: In case that reference is made to a specific country or regional situation in regard to the use of certain frequency bands under agenda item 1.16, since this may reflect the situation in that country thus it should not be generalized to give the impression that these conditions would be applicable to other countries or regions.]

[Note: Moreover, specific language is used in certain methods or its associated regulatory procedures which may not be consistent with past practices used by previous WRCs dealing with similar issues. CPM19-2 is invited to carefully consider these cases with a view to properly address them as needed.]

The frequency bands investigated under this agenda item, i.e. 5 150-5 250 MHz, 5 250-5 350 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz and 5 850-5 925 MHz, are denoted by the letters **A**, **B**, **C**, **D**, and **E**, respectively. The following convention has been used for method numbering.

- If multiple methods are proposed for a particular frequency band, the methods are expressed by the associated letter and a numerical suffix. For example, the four methods proposed for the 5 150-5 250 MHz frequency band are denoted by **Method A1**, **Method A2**, **Method A3** and **Method A4**.
- If only one method is proposed for a particular frequency band, the method is expressed by the associated letter. For instance, the only method proposed for the 5 250-5 350 MHz frequency band is denoted by **Method B**.

### **2/1.16/4.1 Frequency band A, 5 150-5 250 MHz**

#### **2/1.16/4.1.1 Method A1: No change to the RR**

No changes are proposed to the RR, with the exception of the suppression of Resolution **239 (WRC-15)**. The provisions of Resolution **229 (Rev.WRC-12)** applied to RLAN in this band should be retained to protect incumbents as supported by some ITU-R studies.

#### **2/1.16/4.1.2 Method A2: Revision to Resolution 229 (Rev.WRC-12) to enable outdoor RLAN operations including possible associated conditions for new e.i.r.p. limits**

Revisions to Resolution **229 (Rev.WRC-12)** are proposed in order to enable outdoor RLAN operations including possible associated conditions for new e.i.r.p. limits while addressing the protection of incumbent services.

#### **2/1.16/4.1.3 Method A3: Revision to Resolution 229 (Rev.WRC-12) to enable outdoor RLAN operations by applying the same conditions of use as defined for the 5 250-5 350 MHz frequency band in *resolves* 4 of Resolution 229 (Rev.WRC-12)**

Revisions to Resolution **229 (Rev.WRC-12)** are proposed to align the technical and regulatory conditions for the 5 150-5 250 MHz frequency band with those defined for the adjacent frequency band 5 250-5 350 MHz in *resolves* 4 of Resolution **229 (Rev.WRC-12)** to protect incumbent services.

**2/1.16/4.1.4 Method A4: Revisions to Resolution 229 (Rev.WRC-12) to enable in-vehicle use of RLAN operation with e.i.r.p. up to 40 mW**

Revisions to Resolution 229 (Rev.WRC-12) are proposed to enable RLAN in-vehicle use associated with e.i.r.p. levels up to 40 mW, to provide the same level of protection established by Resolution 229 (Rev.WRC-12) to incumbent services.

**2/1.16/4.2 Frequency band B, 5 250-5 350 MHz**

**2/1.16/4.2.1 Method B: No change to the RR**

Only one method is proposed, with no change to the RR, except suppression of Resolution 239 (WRC-15). The provisions of Resolution 229 (Rev.WRC-12) continue to be applied to RLAN in this band to protect incumbents.

**2/1.16/4.3 Frequency band C, 5 350-5 470 MHz**

**2/1.16/4.3.1 Method C: No change to the RR**

Only one method is proposed, with no change to the RR, except suppression of Resolution 239 (WRC-15).

**2/1.16/4.4 Frequency band D, 5 725-5 850 MHz**

**2/1.16/4.4.1 Method D1: No change to the RR**

No changes are proposed to the RR, with the exception of the suppression of Resolution 239 (WRC-15).

**2/1.16/4.4.2 Method D2: A new worldwide or Regional primary MS allocation**

Allocate the 5 725-5 850 MHz frequency band to the mobile service on a primary basis worldwide or in Region 1 to accommodate WAS/RLAN use restricted to indoor operation with e.i.r.p. limits up to 200 mW including associated mitigation techniques and together with the revision of Resolution 229 (Rev.WRC-12).

**2/1.16/4.4.3 Method D3: Accommodate WAS/RLAN in an existing or new footnote**

This method accommodates WAS/RLAN in an existing footnote having a mobile primary allocation or in a new footnote having a mobile primary allocation.

**2/1.16/4.5 Frequency band E, 5 850-5 925 MHz**

**2/1.16/4.5.1 Method E: No change to the RR**

Only one method is proposed, with no change to the RR, except suppression of Resolution 239 (WRC-15).

## 2/1.16/5 Regulatory and procedural considerations

2/1.16/5.1 Frequency band A, 5 150-5 250 MHz

2/1.16/5.1.1 For Method A1

### ARTICLE 5

#### Frequency allocations

##### Section IV – Table of Frequency Allocations

(See No. 2.1)

#### NOC

4 800-5 250 MHz

Allocation to services		
Region 1	Region 2	Region 3
5 150-5 250	FIXED-SATELLITE (Earth-to-space) 5.447A MOBILE except aeronautical mobile 5.446A 5.446B AERONAUTICAL RADIONAVIGATION 5.446 5.446C 5.447 5.447B 5.447C	

2/1.16/5.1.2 For Method A2

#### MOD

### RESOLUTION 229 (REV.WRC-19)

#### Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz by the mobile service for the implementation of wireless access systems including radio local area networks

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that WRC-03 allocated the bands 5 150-5 350 MHz and 5 470-5 725 MHz on a primary basis to the mobile service for the implementation of wireless access systems (WAS), including radio local area networks (RLANs);
- b) that WRC-03 decided to make an additional primary allocation for the Earth exploration-satellite service (EESS) (active) in the band 5 460-5 570 MHz and space research service (SRS) (active) in the band 5 350-5 570 MHz;
- c) that WRC-03 decided to upgrade the radiolocation service to a primary status in the 5 350-5 650 MHz band;

- d) that the band 5 150-5 250 MHz is allocated worldwide on a primary basis to the fixed-satellite service (FSS) (Earth-to-space), this allocation being limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service (No. **5.447A**);
- e) that the band 5 150-5 250 MHz is also allocated to the mobile service, on a primary basis, in some countries (No. **5.447**) subject to agreement obtained under No. **9.21**;
- f) that the band 5 250-5 460 MHz is allocated to the EESS (active) and the band 5 250-5 350 MHz to the SRS (active) on a primary basis;
- g) that the band 5 250-5 725 MHz is allocated on a primary basis to the radiodetermination service;
- h) that there is a need to protect the existing primary services in the 5 150-5 350 MHz and 5 470-5 725 MHz bands;
- i) that results of studies in ITU-R indicate that sharing in the band 5 150-5 250 MHz between WAS, including RLANs, and the FSS is feasible under specified conditions;
- j) that studies have shown that sharing between the radiodetermination and mobile services in the bands 5 250-5 350 MHz and 5 470-5 725 MHz is only possible with the application of mitigation techniques such as dynamic frequency selection;
- k) that there is a need to specify an appropriate e.i.r.p. limit and, where necessary, operational restrictions for WAS, including RLANs, in the mobile service in the bands 5 250-5 350 MHz and 5 470-5 570 MHz in order to protect systems in the EESS (active) and SRS (active);
- l) that the deployment density of WAS, including RLANs, will depend on a number of factors including intrasystem interference and the availability of other competing technologies and services;
- m) that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;
- n) that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;
- o) that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band,

*further considering*

- a) that the interference from a single WAS, including RLANs, complying with the operational restrictions under *resolves 2* will not on its own cause any unacceptable interference to FSS receivers on board satellites in the band 5 150-5 250 MHz;
- b) that such FSS satellite receivers may experience an unacceptable effect due to the aggregate interference from these WAS, including RLANs, especially in the case of a prolific growth in the number of these systems;
- c) that the aggregate effect on FSS satellite receivers will be due to the global deployment of WAS, including RLANs, and it may not be possible for administrations to determine the location of the source of the interference and the number of WAS, including RLANs, in operation simultaneously,

*noting*

- a) that, prior to WRC-03, a number of administrations have developed regulations to permit indoor and outdoor WAS, including RLANs, to operate in the various bands under consideration in this Resolution;
- b) that, in response to Resolution **229 (WRC-03)\***, ITU-R developed Report ITU-R M.2115, which provides testing procedures for implementation of dynamic frequency selection,

*recognizing*

- a) that in the band 5 600-5 650 MHz, ground-based meteorological radars are extensively deployed and support critical national weather services, according to footnote No. **5.452**;
- b) that the performance and interference criteria of spaceborne active sensors in the EESS (active) are given in Recommendation ITU-R RS.1166;
- c) that a mitigation technique to protect radiodetermination systems is given in Recommendation ITU-R M.1652;
- d) that Recommendation ITU-R RS.1632 identifies a suitable set of constraints for WAS, including RLANs, in order to protect the EESS (active) in the 5 250-5 350 MHz band;
- e) that Recommendation ITU-R M.1653 identifies the conditions for sharing between WAS, including RLANs, and the EESS (active) in the 5 470-5 570 MHz band;
- f) that the stations in the mobile service should also be designed to provide, on average, a near-uniform spread of the loading of the spectrum used by stations across the band or bands in use to improve sharing with satellite services;
- g) that WAS, including RLANs, provide effective broadband solutions, future demand has increased since the frequency range was first identified for this application;
- h) that there is a need for administrations to ensure that WAS, including RLANs, meet the required mitigation techniques, for example, through equipment or standards compliance procedures,

*resolves*

- 1 that the use of these bands by the mobile service is for the implementation of WAS, including RLANs, as described in the most recent version of Recommendation ITU-R M.1450;
- 2 that in the band 5 150-5 250 MHz, stations in the mobile service shall be restricted to a maximum conducted output of 1 W provided the maximum antenna gain does not exceed 6 dBi (i.e. a total maximum mean e.i.r.p. of 36 dBm)<sup>1</sup>, and, in addition, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band, and, for the outdoor operation of stations in the mobile service the maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon shall not exceed 125 mW (21 dBm), and finally, for WAS/RLAN transmitters operating in the 5 150-5 250 MHz band, all unwanted emissions outside of the 5 150-5 350 MHz band shall not exceed an e.i.r.p. of -27 dBm/MHz;

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\* *Note by the Secretariat:* This Resolution was revised by WRC-12.

<sup>1</sup> In the context of this Resolution, “mean e.i.r.p.” refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

3 that in the band 5 250-5 350 MHz, stations in the mobile service shall be limited to a maximum mean e.i.r.p. of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band. Administrations are requested to take appropriate measures that will result in the predominant number of stations in the mobile service being operated in an indoor environment. Furthermore, stations in the mobile service that are permitted to be used either indoors or outdoors may operate up to a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band, and, when operating above a mean e.i.r.p. of 200 mW, these stations shall comply with the following e.i.r.p. elevation angle mask where  $\theta$  is the angle above the local horizontal plane (of the Earth):

-13 dB(W/MHz)	for $0^\circ \leq \theta < 8^\circ$
-13 - 0.716( $\theta - 8$ ) dB(W/MHz)	for $8^\circ \leq \theta < 40^\circ$
-35.9 - 1.22( $\theta - 40$ ) dB(W/MHz)	for $40^\circ \leq \theta \leq 45^\circ$
-42 dB(W/MHz)	for $45^\circ < \theta$ ;

4 that administrations may exercise some flexibility in adopting other mitigation techniques, provided that they develop national regulations to meet their obligations to achieve an equivalent level of protection to the EESS (active) and the SRS (active) based on their system characteristics and interference criteria as stated in Recommendation ITU-R RS.1632;

5 that in the band 5 470-5 725 MHz, stations in the mobile service shall be restricted to a maximum transmitter power of 250 mW<sup>2</sup> with a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band;

6 that in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, systems in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

7 that, in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, the mitigation measures found in Annex 1 to Recommendation ITU-R M.1652-1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems,

*invites administrations*

to consider appropriate measures when allowing the operation of stations in the mobile service using the e.i.r.p. elevation angle mask referred in *resolves* 3 above, to ensure the equipment is operated in compliance with this mask,

*invites ITU-R*

1 to continue studies on mitigation techniques to provide protection of EESS from stations in the mobile service;

2 to continue studies on suitable test methods and procedures for the implementation of dynamic frequency selection, taking into account practical experience.

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<sup>2</sup> Administrations with existing regulations prior to WRC-03 may exercise some flexibility in determining transmitter power limits.

**2/1.16/5.1.3 For Method A3**

**MOD**

**RESOLUTION 229 (REV.WRC-19)**

**Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz  
by the mobile service for the implementation of wireless access systems  
including radio local area networks**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that WRC-03 allocated the bands 5 150-5 350 MHz and 5 470-5 725 MHz on a primary basis to the mobile service for the implementation of wireless access systems (WAS), including radio local area networks (RLANs);
- b) that WRC-03 decided to make an additional primary allocation for the Earth exploration-satellite service (EESS) (active) in the band 5 460-5 570 MHz and space research service (SRS) (active) in the band 5 350-5 570 MHz;
- c) that WRC-03 decided to upgrade the radiolocation service to a primary status in the 5 350-5 650 MHz band;
- d) that the band 5 150-5 250 MHz is allocated worldwide on a primary basis to the fixed-satellite service (FSS) (Earth-to-space), this allocation being limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service (No. **5.447A**);
- e) that the band 5 150-5 250 MHz is also allocated to the mobile service, on a primary basis, in some countries (No. **5.447**) subject to agreement obtained under No. **9.21**;
- f) that the band 5 250-5 460 MHz is allocated to the EESS (active) and the band 5 250-5 350 MHz to the SRS (active) on a primary basis;
- g) that the band 5 250-5 725 MHz is allocated on a primary basis to the radiodetermination service;
- h) that there is a need to protect the existing primary services in the 5 150-5 350 MHz and 5 470-5 725 MHz bands;
- i) that results of studies in ITU-R indicate that sharing in the band 5 150-5 250 MHz between WAS, including RLANs, and the FSS is feasible under specified conditions;
- j) that studies have shown that sharing between the radiodetermination and mobile services in the bands 5 250-5 350 MHz and 5 470-5 725 MHz is only possible with the application of mitigation techniques such as dynamic frequency selection;
- k) that there is a need to specify an appropriate e.i.r.p. limit and, where necessary, operational restrictions for WAS, including RLANs, in the mobile service in the bands 5 250-5 350 MHz and 5 470-5 570 MHz in order to protect systems in the EESS (active) and SRS (active);
- l) that the deployment density of WAS, including RLANs, will depend on a number of factors including intrasystem interference and the availability of other competing technologies and services;



- m) that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;
- n) that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;
- o) that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band,

*further considering*

- a) that the interference from a single WAS, including RLANs, complying with the operational restrictions under *resolves 2* will not on its own cause any unacceptable interference to FSS receivers on board satellites in the band 5 150-5 250 MHz;
- b) that such FSS satellite receivers may experience an unacceptable effect due to the aggregate interference from these WAS, including RLANs, especially in the case of a prolific growth in the number of these systems;
- c) that the aggregate effect on FSS satellite receivers will be due to the global deployment of WAS, including RLANs, and it may not be possible for administrations to determine the location of the source of the interference and the number of WAS, including RLANs, in operation simultaneously,

*noting*

- a) that, prior to WRC-03, a number of administrations have developed regulations to permit indoor and outdoor WAS, including RLANs, to operate in the various bands under consideration in this Resolution;
- b) that, in response to Resolution **229 (WRC-03)\***, ITU-R developed Report ITU-R M.2115, which provides testing procedures for implementation of dynamic frequency selection,

*recognizing*

- a) that in the band 5 600-5 650 MHz, ground-based meteorological radars are extensively deployed and support critical national weather services, according to footnote No. **5.452**;
- b) that the performance and interference criteria of spaceborne active sensors in the EESS (active) are given in Recommendation ITU-R RS.1166;
- c) that a mitigation technique to protect radiodetermination systems is given in Recommendation ITU-R M.1652;
- d) that Recommendation ITU-R RS.1632 identifies a suitable set of constraints for WAS, including RLANs, in order to protect the EESS (active) in the 5 250-5 350 MHz band;
- e) that Recommendation ITU-R M.1653 identifies the conditions for sharing between WAS, including RLANs, and the EESS (active) in the 5 470-5 570 MHz band;
- f) that the stations in the mobile service should also be designed to provide, on average, a near-uniform spread of the loading of the spectrum used by stations across the band or bands in use to improve sharing with satellite services;

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\* *Note by the Secretariat:* This Resolution was revised by WRC-12.

g) that WAS, including RLANs, provide effective broadband solutions, future demand has increased since the frequency range was first identified for this application;

h) that there is a need for administrations to ensure that WAS, including RLANs, meet the required mitigation techniques, for example, through equipment or standards compliance procedures,

*resolves*

1 that the use of these bands by the mobile service is for the implementation of WAS, including RLANs, as described in the most recent version of Recommendation ITU-R M.1450;

2 that in the bands 5 150-5 250 MHz and 5 250-5 350 MHz, stations in the mobile service shall be limited to a maximum mean e.i.r.p. of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band. Administrations are requested to take appropriate measures that will result in the predominant number of stations in the mobile service being operated in an indoor environment. Furthermore, stations in the mobile service that are permitted to be used either indoors or outdoors may operate up to a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band, and, when operating above a mean e.i.r.p. of 200 mW, these stations shall comply with the following e.i.r.p. elevation angle mask where  $\theta$  is the angle above the local horizontal plane (of the Earth):

-13 dB(W/MHz)	for $0^\circ \leq \theta < 8^\circ$
-13 - 0.716( $\theta - 8$ ) dB(W/MHz)	for $8^\circ \leq \theta < 40^\circ$
-35.9 - 1.22( $\theta - 40$ ) dB(W/MHz)	for $40^\circ \leq \theta \leq 45^\circ$
-42 dB(W/MHz)	for $45^\circ < \theta$ ;

3 that administrations may exercise some flexibility in adopting other mitigation techniques, provided that they develop national regulations to meet their obligations to achieve an equivalent level of protection to the EESS (active) and the SRS (active) based on their system characteristics and interference criteria as stated in Recommendation ITU-R RS.1632;

4 that in the band 5 470-5 725 MHz, stations in the mobile service shall be restricted to a maximum transmitter power of 250 mW<sup>1</sup> with a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band;

5 that in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, systems in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

6 that, in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, the mitigation measures found in Annex 1 to Recommendation ITU-R M.1652-1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems,

*invites administrations*

to consider appropriate measures when allowing the operation of stations in the mobile service using the e.i.r.p. elevation angle mask referred in *resolves 2* above, to ensure the equipment is operated in compliance with this mask,

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<sup>1</sup> Administrations with existing regulations prior to WRC-03 may exercise some flexibility in determining transmitter power limits.

*invites ITU-R*

- 1 to continue studies on mitigation techniques to provide protection of EESS from stations in the mobile service;
- 2 to continue studies on suitable test methods and procedures for the implementation of dynamic frequency selection, taking into account practical experience.

**2/1.16/5.1.4 For Method A4**

No change to the preamble (*considering, noting and recognizing* parts) of Resolution **229 (Rev.WRC-12)**.

**MOD**

**RESOLUTION 229 (REV.WRC-19)**

**Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz  
by the mobile service for the implementation of wireless access systems  
including radio local area networks**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

...

*resolves*

- 1 that the use of these bands by the mobile service is for the implementation of WAS, including RLANs, as described in the most recent version of Recommendation ITU-R M.1450;
- 2 that in the band 5 150-5 250 MHz, indoor stations in the mobile service shall operate with a maximum mean e.i.r.p.<sup>1</sup> of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band or equivalently 0.25 mW/25 kHz in any 25 kHz band, and, moreover, the in-vehicle use shall operate with a maximum e.i.r.p. of 40 mW;

...

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<sup>1</sup> In the context of this Resolution, “mean e.i.r.p.” refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

**2/1.16/5.2**      **Frequency band B, 5 250-5 350 MHz**

**2/1.16/5.2.1**    **For Method B**

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations (See No. 2.1)

**NOC**

**5 250-5 570 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>5 250-5 255</b>	EARTH EXPLORATION-SATELLITE (active) MOBILE except aeronautical mobile 5.446A 5.447F RADIOLOCATION SPACE RESEARCH 5.447D 5.447E 5.448 5.448A	
<b>5 255-5 350</b>	EARTH EXPLORATION-SATELLITE (active) MOBILE except aeronautical mobile 5.446A 5.447F RADIOLOCATION SPACE RESEARCH (active) 5.447E 5.448 5.448A	

**2/1.16/5.3            Frequency band C, 5 350-5 470 MHz**

**2/1.16/5.3.1        For Method C**

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations (See No. 2.1)

**NOC**

**5 250-5 570 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>5 350-5 460</b>	EARTH EXPLORATION-SATELLITE (active) 5.448B RADIOLOCATION 5.448D AERONAUTICAL RADIONAVIGATION 5.449 SPACE RESEARCH (active) 5.448C	
<b>5 460-5 470</b>	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION 5.448D RADIONAVIGATION 5.449 SPACE RESEARCH (active) 5.448B	

**2/1.16/5.4 Frequency band D, 5 725-5 850 MHz**

**2/1.16/5.4.1 For Method D1**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations  
(See No. 2.1)**

**NOC**

**5 570-6 700 MHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>5 725-5 830</b> FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur 5.150 5.451 5.453 5.455	<b>5 725-5 830</b> RADIOLOCATION Amateur 5.150 5.453 5.455	
<b>5 830-5 850</b> FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.451 5.453 5.455	<b>5 830-5 850</b> RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.453 5.455	

**2/1.16/5.4.2 For Method D2**

**MOD**

**5 570-6 700 MHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>5 725-5 830</b> FIXED-SATELLITE (Earth-to-space) MOBILE RADIOLOCATION Amateur 5.150 5.451 5.453 5.455	<b>5 725-5 830</b> MOBILE RADIOLOCATION Amateur 5.150 5.453 5.455	

<b>5 830-5 850</b> FIXED-SATELLITE (Earth-to-space) MOBILE RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.451 5.453 5.455	<b>5 830-5 850</b> MOBILE RADIOLOCATION Amateur Amateur-satellite (space-to-Earth)  5.150 5.453 5.455
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## MOD

### RESOLUTION 229 (REV.WRC-19)

#### **Use of the bands 5 150-5 250 MHz, 5 250-5 350 MHz, 5 470-5 725 MHz and 5 725-5 850 MHz by the mobile service for the implementation of wireless access systems including radio local area networks**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that WRC-03 allocated the bands 5 150-5 350 MHz and 5 470-5 725 MHz on a primary basis to the mobile service for the implementation of wireless access systems (WAS), including radio local area networks (RLANs);
- b) that WRC-03 decided to make an additional primary allocation for the Earth exploration-satellite service (EESS) (active) in the band 5 460-5 570 MHz and space research service (SRS) (active) in the band 5 350-5 570 MHz;
- c) that WRC-03 decided to upgrade the radiolocation service to a primary status in the 5 350-5 650 MHz band;
- d) that the band 5 150-5 250 MHz is allocated worldwide on a primary basis to the fixed-satellite service (FSS) (Earth-to-space), this allocation being limited to feeder links of non-geostationary-satellite systems in the mobile-satellite service (No. **5.447A**);
- e) that the band 5 150-5 250 MHz is also allocated to the mobile service, on a primary basis, in some countries (No. **5.447**) subject to agreement obtained under No. **9.21**;
- f) that the band 5 250-5 460 MHz is allocated to the EESS (active) and the band 5 250-5 350 MHz to the SRS (active) on a primary basis;
- g) that the band 5 250-5 850 MHz is allocated on a primary basis to the radiodetermination service;
- h) that the band 5 725-5 850 MHz is allocated in Region 1 only, on a primary basis to the fixed-satellite service (FSS) (Earth-to-space);
- i) that there is a need to protect the existing primary services in the 5 150-5 350 MHz and 5 470-5 850 MHz bands;
- j) that results of studies in ITU-R indicate that sharing in the bands 5 150-5 250 MHz and 5 725-5 850 MHz (Region 1 only) between WAS, including RLANs, and the FSS is feasible under specified conditions;

- k) that studies have shown that sharing between the radiodetermination and mobile services in the bands 5 250-5 350 MHz and 5 470-5 725 MHz is only possible with the application of mitigation techniques such as dynamic frequency selection;
- l) that there is a need to specify an appropriate e.i.r.p. limit and, where necessary, operational restrictions for WAS, including RLANs, in the mobile service in the bands 5 250-5 350 MHz and 5 470-5 570 MHz in order to protect systems in the EESS (active) and SRS (active);
- m) that the deployment density of WAS, including RLANs, will depend on a number of factors including intrasystem interference and the availability of other competing technologies and services;
- n) that the means to measure or calculate the aggregate pfd level at FSS satellite receivers specified in Recommendation ITU-R S.1426 are currently under study;
- o) that certain parameters contained in Recommendation ITU-R M.1454 related to the calculation of the number of RLANs tolerable by FSS satellite receivers operating in the band 5 150-5 250 MHz require further study;
- p) that an aggregate pfd level has been developed in Recommendation ITU-R S.1426 for the protection of FSS satellite receivers in the 5 150-5 250 MHz band,

*further considering*

- a) that the interference from a single WAS, including RLANs, complying with the operational restrictions under *resolves 2* will not on its own cause any unacceptable interference to FSS receivers on board satellites in the bands 5 150-5 250 MHz and 5 725-5 850 MHz (Region 1 only);
- b) that such FSS satellite receivers may experience an unacceptable effect due to the aggregate interference from these WAS, including RLANs, especially in the case of a prolific growth in the number of these systems;
- c) that the aggregate effect on FSS satellite receivers will be due to the global deployment of WAS, including RLANs, and it may not be possible for administrations to determine the location of the source of the interference and the number of WAS, including RLANs, in operation simultaneously,

*noting*

- a) that, prior to WRC-03, a number of administrations have developed regulations to permit indoor and outdoor WAS, including RLANs, to operate in the various bands under consideration in this Resolution;
- b) that, in response to Resolution **229 (WRC-03)\***, ITU-R developed Report ITU-R M.2115, which provides testing procedures for implementation of dynamic frequency selection,

*recognizing*

- a) that in the band 5 600-5 650 MHz, ground-based meteorological radars are extensively deployed and support critical national weather services, according to footnote No. **5.452**;

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\* *Note by the Secretariat:* This Resolution was revised by WRC-12.



- b) that the performance and interference criteria of spaceborne active sensors in the EESS (active) are given in Recommendation ITU-R RS.1166;
- c) that a mitigation technique to protect radiodetermination systems is given in Recommendation ITU-R M.1652;
- d) that Recommendation ITU-R RS.1632 identifies a suitable set of constraints for WAS, including RLANs, in order to protect the EESS (active) in the 5 250-5 350 MHz band;
- e) that Recommendation ITU-R M.1653 identifies the conditions for sharing between WAS, including RLANs, and the EESS (active) in the 5 470-5 570 MHz band;
- f) that the stations in the mobile service should also be designed to provide, on average, a near-uniform spread of the loading of the spectrum used by stations across the band or bands in use to improve sharing with satellite services;
- g) that WAS, including RLANs, provide effective broadband solutions, future demand has increased since the frequency range was first identified for this application;
- h) that there is a need for administrations to ensure that WAS, including RLANs, meet the required mitigation techniques, for example, through equipment or standards compliance procedures,

*resolves*

- 1 that the use of these bands by the mobile service is for the implementation of WAS, including RLANs, as described in the most recent version of Recommendation ITU-R M.1450;
- 2 that in the band 5 150-5 250 MHz, stations in the mobile service shall be restricted to indoor use with a maximum mean e.i.r.p.<sup>1</sup> of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band or equivalently 0.25 mW/25 kHz in any 25 kHz band;
- 3 that administrations may monitor whether the aggregate pfd levels given in Recommendation ITU-R S.1426<sup>2</sup> have been, or will be exceeded in the future, in order to enable a future competent conference to take appropriate action;
- 4 that in the band 5 250-5 350 MHz, stations in the mobile service shall be limited to a maximum mean e.i.r.p. of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band. Administrations are requested to take appropriate measures that will result in the predominant number of stations in the mobile service being operated in an indoor environment. Furthermore, stations in the mobile service that are permitted to be used either indoors or outdoors may operate up to a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band, and, when operating above a mean e.i.r.p. of 200 mW, these stations shall comply with the following e.i.r.p. elevation angle mask where  $\theta$  is the angle above the local horizontal plane (of the Earth):

-13 dB(W/MHz)	for $0^\circ \leq \theta < 8^\circ$
-13 - 0.716( $\theta - 8$ ) dB(W/MHz)	for $8^\circ \leq \theta < 40^\circ$
-35.9 - 1.22( $\theta - 40$ ) dB(W/MHz)	for $40^\circ \leq \theta \leq 45^\circ$

<sup>1</sup> In the context of this Resolution, “mean e.i.r.p.” refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

<sup>2</sup>  $-124 - 20 \log_{10} (h_{SAT}/1\ 414)$  dB(W/(m<sup>2</sup> · 1 MHz)), or equivalently,  $-140 - 20 \log_{10} (h_{SAT}/1\ 414)$  dB(W/(m<sup>2</sup> · 25 kHz)), at the FSS satellite orbit, where  $h_{SAT}$  is the altitude of the satellite (km).

–42 dB(W/MHz) for  $45^\circ < \theta$ ;

5 that administrations may exercise some flexibility in adopting other mitigation techniques, provided that they develop national regulations to meet their obligations to achieve an equivalent level of protection to the EESS (active) and the SRS (active) based on their system characteristics and interference criteria as stated in Recommendation ITU-R RS.1632;

6 that in the band 5 470-5 725 MHz, stations in the mobile service shall be restricted to a maximum transmitter power of 250 mW<sup>3</sup> with a maximum mean e.i.r.p. of 1 W and a maximum mean e.i.r.p. density of 50 mW/MHz in any 1 MHz band;

7(*Alt.A*) that in the band 5 725-5 850 MHz, stations in the mobile service shall be restricted to indoor<sup>4</sup> use with a maximum mean e.i.r.p.<sup>1</sup> of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band;

*OR*

7(*Alt.B*) that in Region 1 only in the band 5 725-5 850 MHz, stations in the mobile service shall be restricted to indoor<sup>4</sup> use with a maximum mean e.i.r.p.<sup>1</sup> of 200 mW and a maximum mean e.i.r.p. density of 10 mW/MHz in any 1 MHz band;

8 that in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, systems in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

9(*Alt.A*) that in the band 5 725-5 850 MHz, stations in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

*OR*

9(*Alt.B*) that in Region 1 only in the band 5 725-5 850 MHz, stations in the mobile service shall either employ transmitter power control to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or, if transmitter power control is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB;

10 that, in the bands 5 250-5 350 MHz and 5 470-5 725 MHz, the mitigation measures found in Annex 1 to Recommendation ITU-R M.1652-1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems;

11(*Alt.A*) that in the band 5 725-5 850 MHz, the mitigation measures found in Annex 1 to Recommendation ITU-R M.1652-1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems,

*OR*

11(*Alt.B*) that in Region 1 only in the band 5 725-5 850 MHz, the mitigation measures found in Annex 1 to Recommendation ITU-R M.1652-1 shall be implemented by systems in the mobile service to ensure compatible operation with radiodetermination systems,

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<sup>3</sup> Administrations with existing regulations prior to WRC-03 may exercise some flexibility in determining transmitter power limits.

<sup>4</sup> In this context “indoor only” should be considered as “no fixed outdoor usage” to allow for accidental outdoor usage by mobile terminals.

*invites administrations*

to consider appropriate measures when allowing the operation of stations in the mobile service using the e.i.r.p. elevation angle mask referred in *resolves* 4 above, to ensure the equipment is operated in compliance with this mask,

*invites ITU-R*

- 1 to continue studies on mitigation techniques to provide protection of EESS from stations in the mobile service;
- 2 to continue studies on suitable test methods and procedures for the implementation of dynamic frequency selection, taking into account practical experience.

[Note: It should be noted that footnote 3 of Resolution **229 (Rev.WRC-12)** (“Administrations with existing regulations prior to WRC-03 may exercise some flexibility in determining transmitter power limits”) may need to be revisited by WRC-19 in particular regarding its duration and scope of applications including reference to the countries or subregions that are benefiting from this grandfathering.]

#### **2/1.16/5.4.3 For Method D3**

Example of modified footnote:

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations

(See No. 2.1)

#### MOD

**5.453** *Additional allocation:* in Saudi Arabia, Bahrain, Bangladesh, Brunei Darussalam, Cameroon, China, Congo (Rep. of the), Korea (Rep. of), Côte d’Ivoire, Djibouti, Egypt, the United Arab Emirates, Gabon, Guinea, Equatorial Guinea, India, Indonesia, Iran (Islamic Republic of), Iraq, Israel, Japan, Jordan, Kenya, Kuwait, Lebanon, Libya, Madagascar, Malaysia, Niger, Nigeria, Oman, Uganda, Pakistan, the Philippines, Qatar, the Syrian Arab Republic, the Dem. People’s Rep. of Korea, Singapore, Sri Lanka, Swaziland, Tanzania, Chad, Thailand, Togo, Viet Nam, [*Country name*] and Yemen, the band 5 650-5 850 MHz is also allocated to the fixed and mobile services on a primary basis. In this case, the provisions of Resolution **229 (Rev.WRC-[12/19])** do not apply. (WRC-19)

[Note: The version of Resolution **229** to be referred to in RR No. **5.453** will depend on the decision of WRC-19 on the matter.]

Example of new footnote:

**ADD**

**5.A116** *Additional allocation:* in ....., [Country name], the band 5 725-5 850 MHz is also allocated to the mobile service on a primary basis. (WRC-19)

**2/1.16/5.5** For the frequency band 5 850-5 925 MHz

**2/1.16/5.5.1** For Method E

**NOC**

5 570-6 700 MHz

Allocation to services		
Region 1	Region 2	Region 3
<b>5 850-5 925</b> FIXED FIXED-SATELLITE (Earth-to-space) MOBILE  5.150	<b>5 850-5 925</b> FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Amateur Radiolocation  5.150	<b>5 850-5 925</b> FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Radiolocation  5.150

**2/1.16/5.6** For all frequency bands and all Methods

**SUP**

**RESOLUTION 239 (WRC-15)**

**Studies concerning Wireless Access Systems including radio local area networks in the frequency bands between 5 150 MHz and 5 925 MHz**

## Agenda item 9.1

9 *to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:*

9.1 *on the activities of the Radiocommunication Sector since WRC-15;*

NOTE: Nine issues have been identified by CPM19-1 under this agenda item.

### Agenda item 9.1(9.1.1)

#### **2/9.1.1 Resolution 212 (Rev.WRC-15)**

*Implementation of International Mobile Telecommunications in the frequency bands 1 885-2 025 MHz and 2 110-2 200 MHz*

**(WP 4C and WP 5D / -)**

#### **2/9.1.1/1 Executive summary**

Pursuant to Resolution **212 (Rev.WRC-15)**, the technical and operational studies for the implementation of International Mobile Telecommunications (IMT) in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz were conducted by the ITU-R. The studies considered the issue of coexistence and compatibility of terrestrial (composed of base station(s) (BS(s)) and user equipment (UE) and later on referred to as IMT BS(s) and IMT UE(s)) and satellite (composed of MSS space stations and mobile earth station(s) (MES(s)) and later on referred to as IMT space station(s) and IMT MES(s)) components of IMT in neighbouring countries/different concerned countries/adjacent geographical areas across different countries for four interference scenarios, and concluded as follows:

- For Scenario A1, in the 1 980-2 010 MHz frequency band, it was observed that the level of potential interference from IMT BS into IMT space stations is high, while the level of potential interference from IMT UE into IMT space stations is low. The studies have identified technical and operational measures to mitigate the potential interference from IMT BS and IMT UE. For IMT UEs, the measures can wholly eliminate the potential excess interference. For IMT BSs, there is no agreement on whether the measures can wholly eliminate the potential excess interference.
- For Scenario A2, in the frequency band 2 170-2 200 MHz, it was observed that potential interference from IMT BS into IMT MES may occur. The potential interference may be mitigated by one or more of: assessment of terrain and clutter effects and system characteristics, deployment environments, and separation distance. Given the varying characteristics of the border area across various countries, administrations can bilaterally determine the appropriate mitigation techniques on a case-by-case basis.
- For Scenario B1, in the frequency band 1 980-2 010 MHz, potential interference from IMT MESs to IMT BSs and IMT UEs, could be managed by bilateral/multilateral negotiation, in which actual technical/operational characteristics and mitigation measures for satellite and terrestrial components of IMT could be taken into account.
- For Scenario B2, in the frequency band 2 170-2 200 MHz, potential interference from the IMT space stations to IMT UEs, could be managed by bilateral/multilateral negotiation, in which actual technical/operational characteristics and mitigation measures for satellite and terrestrial components of IMT could be taken into account.

Details of studies are documented in the working document towards a PDN [Recommendation or Report] ITU-R M.[MSS&IMT-ADVANCED SHARING].

## 2/9.1.1/2 Background

The frequency bands 1 885-2 025 MHz and 2 110-2 200 MHz have been identified in the Radio Regulations (RR) for use by IMT. Within these broader frequency ranges, the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz are allocated to the FS, MS and MSS on a co-primary basis. The MSS allocation is in the Earth-to-space direction in the 1 980-2 010 MHz frequency band, and in the space-to-Earth direction in the 2 170-2 200 MHz frequency band. Both the satellite and terrestrial components of IMT have been deployed or are being considered for further deployment within the 1 980-2 010 MHz and 2 170-2 200 MHz frequency bands.

Resolution **212 (Rev.WRC-15)** invites “*ITU-R to study possible technical and operational measures to ensure coexistence and compatibility between the terrestrial component of IMT (in the mobile service) and the satellite component of IMT (in the mobile service and the mobile-satellite service) in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz where those frequency bands are shared by the mobile service and the mobile-satellite service in different countries, in particular for the deployment of independent satellite and terrestrial components of IMT and to facilitate development of both the satellite and terrestrial components of IMT*”.

In accordance with Resolution **212 (Rev.WRC-15)**, coexistence and compatibility between the terrestrial component of IMT (in the MS) and the satellite component of IMT (in the MS and the MSS) in neighbouring countries/different concerned countries/adjacent geographical areas across different countries were studied to facilitate the development of both the satellite and terrestrial components of IMT.

For the satellite component of IMT, the technical and operational characteristics used in the studies are based on the specifications from Recommendation ITU-R M.1850. It should be noted that some parameters used in the studies (e.g. bandwidth and satellite e.i.r.p.) are different from those currently in Recommendation ITU-R M.1850, as a consequence of technical development of the satellite component of IMT. The use of these parameters is still being studied in ITU-R. However, those differences do not affect the conclusions of the calculations in Scenarios A1 and A2.

The parameters for the terrestrial component of IMT used in the studies are based on Report ITU-R M.2292, and the methodology for modelling and simulating the terrestrial IMT network is given in Recommendation ITU-R M.2101. It should be noted that in addition to the values specified in Report ITU-R M.2292, one study employed different values for some of the parameters (noise figure, antenna gain and body loss), as a consequence of technical development of the terrestrial component of IMT, such as Machine Type Communication (MTC) as contained in Recommendation ITU-R M.2012. The use of these assumed IMT MTC UE parameters, which are still being studied in ITU-R, resulted in different conclusions from those results for IMT UEs related to the scenario of potential interference from IMT space stations into terrestrial receivers.

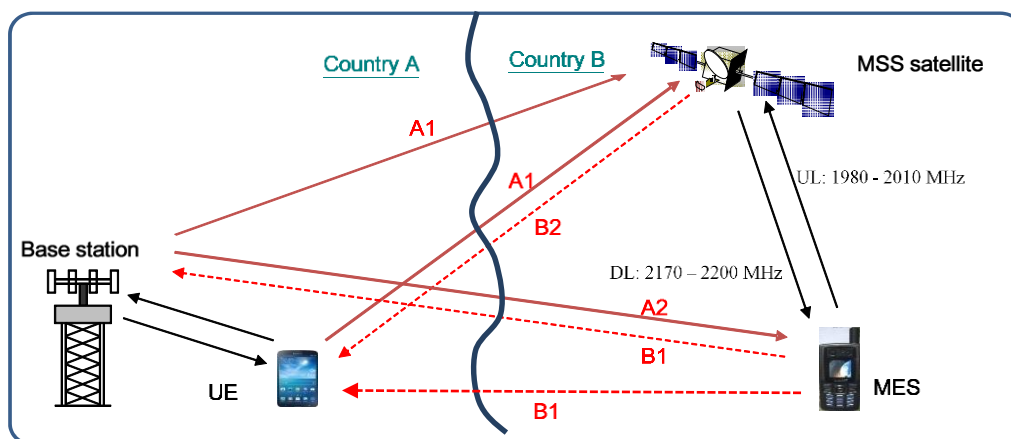
The protection criterion for IMT-Advanced is provided in Report ITU-R M.2292 as  $I/N = -6$  dB. Additional studies were performed with the protection criterion of  $I/N = -10$  dB in order to assess the impact of lower  $I/N$  values on the compatibility between the satellite and terrestrial components of IMT operating in neighbouring countries.

The recommended frequency arrangements for terrestrial IMT are contained in Recommendation ITU-R M.1036-5.

## 2/9.1.1/3 Summary and analysis of the results of ITU-R studies

Recommendations ITU-R M.1457, ITU-R M.2012, ITU-R M.1850 and ITU-R M.2047 are relevant to WRC-19 agenda item 9.1, issue 9.1.1.

Potential interference scenarios between the IMT space stations and MES and the IMT BS and UE are illustrated as follows:



The working document towards a PDN [Recommendation or Report] ITU-R M.[MSS&IMT-ADVANCED SHARING] documents the ITU-R studies conducted for the coexistence and the compatibility between the satellite component of IMT and the terrestrial component of IMT in neighbouring countries/different concerned countries/adjacent geographical areas across different countries in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz.

### 2/9.1.1/3.1 Summary of results of interference from IMT BSs and IMT UEs to IMT space stations (Scenario A1)

Studies of the uplink interference analysis into IMT space stations geostationary-satellite orbit (GSO), low-Earth orbit (LEO), medium-Earth orbit (MEO) and highly elliptical orbit (HEO) from IMT UE and IMT BS in the frequency bands 1 980-2 010 MHz were conducted and the results for all the different scenarios and cases are summarized below (a negative margin indicates interference exceeding the criterion).

Given the lack of protection criterion for compatibility studies between the terrestrial and satellite components of IMT, ITU-R considers that the most appropriate criteria to be used for studies is 6% ( $-12.2$  dB  $I/N$ ).

#### UE interference into GSO space station:

- The studies of aggregate interference from IMT UEs into a GSO satellite show a  $-2.8$  to  $27.1$  dB margin with respect to the  $I/N$  protection criterion of  $-12.2$  dB and a  $3.4$  to  $33.3$  dB margin with respect to the  $I/N$  protection criterion of  $-6$  dB.
- A study of aggregate interference from a MTC UE into a GSO satellite shows a  $-7.2$  to  $14.6$  dB margin with respect to the  $I/N$  protection criterion of  $-12.2$  dB and a  $-1.0$  to  $20.8$  dB margin with respect to the  $I/N$  protection criterion of  $-6$  dB. The parameters for the MTC UE used in the study are still under review and the results may have to be updated once the parameters are finalized.

- The studies of worst-case single-entry interference from a IMT UE into a GSO satellite show a  $-1.6$  to  $26.9$  dB margin with respect to the  $I/N$  protection criterion of  $-12.2$  dB and a  $4.6$  to  $33.1$  dB margin with respect to the  $I/N$  protection criterion of  $-6$  dB.
- A study of worst-case single-entry interference from a MTC UE into a GSO satellite shows a  $-2.7$  to  $5.3$  dB margin with respect to the  $I/N$  protection criterion of  $-12.2$  dB and a  $3.5$  to  $11.5$  dB margin with respect to the  $I/N$  protection criterion of  $-6$  dB. The parameters for the MTC UE used in the study are still under review and the results may have to be updated once the parameters are finalized.

#### **BS interference into GSO space station:**

- The studies of aggregate interference from IMT BSs into a GSO satellite show a  $-52.4$  to  $-19.5$  dB margin with respect to the  $I/N$  protection criterion of  $-12.2$  dB and a  $-46.2$  to  $-13.3$  dB margin with respect to the  $I/N$  protection criterion of  $-6$  dB. Another study shows a  $-44.7$  to  $-9.4$  dB margin with respect to the  $I/N$  protection criterion of  $-12.2$  dB and a  $-38.5$  to  $-3.2$  dB margin with respect to the  $I/N$  protection criterion of  $-6$  dB. These ranges and associated assumptions are under review within ITU-R.
- The studies of worst-case single-entry interference from IMT BSs into a GSO satellite show a  $-20.7$  to  $0.4$  dB margin with respect to the  $I/N$  protection criterion of  $-12.2$  dB and a  $-14.5$  to  $6.6$  dB margin with respect to the  $I/N$  protection criterion of  $-6$  dB.

#### **UE interference into MEO space station:**

- Using the methodology of static analysis, the studies of aggregate interference from IMT UEs into an MEO satellite show a  $5.5$  to  $22.7$  dB margin with respect to the  $I/N$  protection criterion of  $-12.2$  dB and a  $11.7$  to  $28.9$  dB margin with respect to the  $I/N$  protection criterion of  $-6$  dB. The parameters for the studies are still under review and the results may need to be updated once the parameters are finalized.
- Using the Monte Carlo methodology, a study of aggregate interference from IMT UEs into an MEO satellite shows a margin of  $-0.1$  dB with respect to the  $I/N$  protection criterion of  $-12.2$  dB, when the distance between the nearest IMT BS and the boresight of the satellite beam is  $500$  km. The assumptions and methodology used in this study are still under review.
- The studies of worst-case single-entry interference from a IMT UE into an MEO satellite show a  $2.6$  dB margin with respect to the  $I/N$  protection criterion of  $-12.2$  dB.

#### **BS interference into MEO space station:**

- Using the methodology of static analysis, the studies of aggregate interference from IMT BSs into an MEO satellite show a  $-37.9$  to  $-16.2$  dB margin with respect to the  $I/N$  protection criterion of  $-12.2$  dB and a  $-31.7$  to  $-10$  dB margin with respect to the  $I/N$  protection criterion of  $-6$  dB. The parameters for the studies are still under review and the results may need to be updated once the parameters are finalized.
- Using the Monte Carlo methodology, a study of aggregate interference from IMT BSs into an MEO satellite shows a margin of  $-41.8$  dB with respect to the  $I/N$  protection criterion of  $-12.2$  dB, when the distance between the nearest IMT BS and the boresight of the satellite beam is  $500$  km. The assumptions and methodology used in this study are still under review.
- The studies of worst-case single-entry interference from a IMT BS into a MEO satellite show a  $-1.1$  dB margin with respect to the  $I/N$  protection criterion of  $-12.2$  dB.



### **UE interference into HEO space station:**

- The studies of aggregate interference from IMT UEs into an HEO satellite show a 3.2 to 25.8 dB margin with respect to the *I/N* protection criterion of  $-12.2$  dB and a 9.4 to 32 dB margin with respect to the *I/N* protection criterion of  $-6$  dB.
- The studies of worst-case single-entry interference from a IMT UE into an HEO satellite show a 2.7 to 20.6 dB margin with respect to the *I/N* protection criterion of  $-12.2$  dB and a 8.9 to 26.8 dB margin with respect to the *I/N* protection criterion of  $-6$  dB.

### **BS interference into HEO space station:**

- The studies of aggregate interference from IMT BSs into an HEO satellite show a  $-44.4$  to  $-16.1$  dB margin with respect to the *I/N* protection criterion of  $-12.2$  dB and a  $-38.2$  to  $-9.9$  dB margin with respect to the *I/N* protection criterion of  $-6.0$  dB. The parameters for the studies are still under review and the results may need to be updated once the parameters are finalized.
- The studies of worst-case single-entry interference from a IMT BS into an HEO satellite show a  $-11.8$  to  $5.1$  dB margin with respect to the *I/N* protection criterion of  $-12.2$  dB and a  $-5.6$  to  $11.3$  dB margin with respect to the *I/N* protection criterion of  $-6$  dB.

### **UE interference into LEO space station:**

- The studies of aggregate interference from IMT UEs into a LEO satellite show a 0.2 to 15.0 dB margin with respect to the *I/N* protection criterion of  $-12.2$  dB and a 6.4 to 21.2 dB margin with respect to the *I/N* protection criterion of  $-6$  dB.
- The studies of worst-case single-entry interference from a IMT UE into a LEO satellite show a  $-5.1$  to  $19.4$  dB margin with respect to the *I/N* protection criterion of  $-12.2$  dB and a 1.1 to 25.6 dB margin with respect to the *I/N* protection criterion of  $-6$  dB.

### **BS interference into LEO space station:**

- The studies of aggregate interference from IMT BSs into a LEO satellite show a  $-39.5$  to  $-23.9$  dB margin with respect to the *I/N* protection criterion of  $-12.2$  dB and a  $-33.3$  to  $-17.7$  dB margin with respect to the *I/N* protection criterion of  $-6$  dB. The parameters for the studies are still under review and the results may need to be updated once the parameters are finalized.
- The studies of worst-case single-entry interference from a IMT BS into a LEO satellite show a  $-11.2$  to  $-2.7$  dB margin with respect to the *I/N* protection criterion of  $-12.2$  dB and a  $-5$  to  $3.5$  dB margin with respect to the *I/N* protection criterion of  $-6$  dB.

The studies showed that the margins are dependent on the location, the elevation angle of the IMT satellite component in relation to the terrestrial transmitters, the geographical area from where the aggregate interference is estimated and cell density of the terrestrial component of IMT in that geographic area.

The summary of these worst-case results shows that the level of interference from IMT BS into the IMT space stations is high, while the level of interference from IMT UE into the IMT space stations is low. The level of interference may be reduced as a result of mitigation techniques.

Several technical and operational measures were identified in the studies with the potential to mitigate the interference from IMT BSs into the IMT space stations.

With respect to the IMT BS, these measures include application of dynamic frequency resource blocks assignment through frequency and scheduler agility, use of antennas with improved

performance compared to Recommendation ITU-R F.1336, orientation of the IMT BS antenna to minimize transmissions in the direction of the GSO satellite and use of real deployment environments and propagation effects like clutter and terrain loss.

A study to illustrate the potential impact of some of these measures was performed. A commercially available IMT BS antenna was modelled, with all IMT BS antennas assumed to be deployed with nulls in the direction of the GSO satellite. Also, a modified terrestrial IMT activity factor of 20% was considered. With these measures, the studies showed a reduction of the potential exceedance by 24.7 dB, leading to a margin of  $-27.7$  dB for the worst-case scenario for the assumed IMT space station's protection criterion of  $I/N = -12.2$  dB and a margin of  $-21.5$  dB for the assumed  $I/N = -6$  dB. Due to time constraints, this study was not reviewed by ITU-R and questions have been raised about the applicability of the modelling criteria.

With respect to the satellite component of IMT, the following potential technical and operational mitigation measures have been identified: optimal orbital positions, narrower spot beams with sharper roll-off, satellite beam forming and nulling, use of satellite diversity, dynamic frequency management through frequency and scheduler agility, use of the ancillary terrestrial component (ATC)/complementary ground component (CGC) systems, actual antenna pattern of IMT space station's receiver antenna, and use of protection criteria based on actual system performance and available margins.

A study to illustrate the potential impact of steeper GSO IMT station's receiving antenna gain roll-off and targeted nulls through beam forming was performed. These result in reduction due to mitigation from IMT space station of 30.8 dB. Another study raised concerns regarding the ability of the IMT space station to implement these measures in practice, and to be able to reduce interference to the extent suggested. The above studies are still under review and the results need to be updated once they are mutually agreed by the concerned parties.

In this connection, these results are still under review within ITU-R, in particular the extent to which such mitigation techniques could address the interference issue, and the values contained in these studies as well as the appropriateness or otherwise of combination of both satellite and terrestrial mitigation measures may be considered are yet to be verified and agreed upon.

The summary of these results show that, following the application of mitigation techniques, the level of interference from IMT BS into IMT space stations can be reduced, while the level of interference from IMT UE into IMT space stations can be eliminated.

### **2/9.1.1/3.2 Summary of results of interference from IMT BSs to IMT MESs (Scenario A2)**

In the frequency band 2 170-2 200 MHz, interference analyses were carried out for IMT BS interference into a number of IMT MES with different antenna gain and receiver noise power to predict the interference into IMT MESs over a 100% land path with and without clutter effect, and a sea path. The Recommendation ITU-R P.452-16 propagation model was used to estimate the propagation loss and from this propagation loss the resulting separation distances were obtained for several IMT BSs with various e.i.r.p. levels to predict the interference into IMT MESs over various paths (land and sea). A static analysis was done for propagation losses not exceeded for time percentages of 1%, 10% and 50% over 100% land path with and without clutter effect and 100% sea path.

Given the lack of protection criterion for compatibility studies between the terrestrial and satellite components of IMT, WP 4C considers that the most appropriate criteria to be used for studies is 6% ( $-12.2$  dB  $I/N$ ). The results of the studies undertaken for a range of values are summarized below.

The minimum separation distance between a single IMT BS and IMT MES of the systems studied over a 100% land path using  $I/N$  protection criterion of  $-12.2$  dB varied in different studies:

- for  $p = 1\%$ , studies had results that varied from 230 to 338 km, 144.3 to 360 km, and 172.8 to 294 km;
- for  $p = 10\%$ , studies had results that varied from 48 to 123 km, 48 to 150 km, and 37.8 to 82.3 km;
- for  $p = 50\%$ , studies had results that varied from 35 to 51 km, 26.6 to 80 km, and 31.0 to 44.9 km.

The minimum separation distance between a single IMT BS and IMT MES of the systems studied over a 100% sea path using  $I/N$  protection criterion of  $-12.2$  dB varied in different studies:

- for  $p = 1\%$ , studies had results that varied from 360 to 550 km, 233.8 to 600 km, and 282.7 to 469 km;
- for  $p = 10\%$ , studies had results that varied from 118 to 232 km, 69.8 to 232 km, and 84.5 to 177.6 km;
- for  $p = 50\%$ , studies had results that varied from 35 to 51 km, 26.6 to 98 km, and 31.0 to 44.9 km.

It should be noted that the results provided are for the macro IMT BS deployment scenario. For the micro urban deployment scenarios using  $I/N$  protection criterion of  $-12.2$  dB, the separation distance varied between 35 km and 57 km, and 27.7 and 50.9 km for  $p = 10\%$  over 100% land and 100% sea paths.

The minimal separation distances between a single IMT BS and IMT MES over a 100% land path using  $I/N$  protection criterion of  $-6$  dB varied from 188 to 303 km for  $p = 1\%$ , 39 to 91 km for 10%, and 32 to 46 km for  $p = 50\%$ .

The minimal separation distances between a single IMT BS and IMT MES over a 100% sea path using  $I/N$  protection criterion of  $-6$  dB varied from 300 to 482 km for  $p = 1\%$ , 93 to 188 km for  $p = 10\%$ , and 32 to 46 km for  $p = 50\%$ .

The separation distance is dependent on the type of IMT MES, deployment environment of the IMT BSs, the time variability ( $p$ -value) and other parameters (e.g. latitude of transmitter and receiver, etc.) considered as part of the path configuration in Recommendation ITU-R P.452-16, and the gains of the transmit and receive antennas. Taking into account the actual propagation path profile with terrain and clutter losses (buildings and etc.) the separation distances between IMT MES and IMT BS will be significantly decreased.

Potential interference from IMT BSs into IMT MESs can be managed by the current cross-border coordination provisions in the RR. Since the actual technical/operational characteristics are expected to be exchanged, such bilateral coordination results can provide more flexibility than worst-case compatibility analysis. Furthermore, coordination may allow for the use of actual technical/operational characteristics such as more realistic parameters of radio stations and actual local propagation conditions, including actual terrain and clutter effects.

### **2/9.1.1/3.3 Summary of results of interference from IMT MESs to IMT BSs and IMT UEs (Scenario B1)**

In the frequency band 1 980-2 010 MHz, separation distances were calculated between a single IMT MES and IMT terrestrial receivers of various types. The separation distances required for the compatibility between the terrestrial and satellite components of IMT were observed to be dependent on the time variability ( $p$ -value) considered as part of the propagation model and the

characteristics of the IMT MESs, IMT BSs and IMT UEs. The table below specifies the separation distance determined as part of the studies:

Separation distance results (in km)						
Percentage of time setting in ITU-R P.452-16	IMT BS		IMT handheld UE		IMT MTC* UE	
	$I/N = -6$ dB	$I/N = -10$ dB	$I/N = -6$ dB	$I/N = -10$ dB	$I/N = -6$ dB	$I/N = -10$ dB
100% land path						
$p = 1\%$	255 to 348	280 to 373	128 to 192	155 to 219	196 to 257	223 to 281
$p = 10\%$	58 to 131	72 to 160	12 to 29	18 to 36	31 to 47	37 to 65
$p = 50\%$	38 to 54	40 to 69	$\leq 12$	10 to 15	13 to 19	15 to 22
100% sea path						
$p = 1\%$	402 to 586	446 to 631	220 to 308	257 to 349	315 to 412	356 to 455
$p = 10\%$	137 to 250	160 to 283	39 to 71	53 to 88	74 to 118	91 to 142
$p = 50\%$	37 to 54	40 to 69	$\leq 12$	10 to 15	13 to 19	15 to 22
*: Machine type communication.						

It is possible that the separation distances between IMT MES and IMT stations may be further reduced by considering actual propagation path terrain profiles and clutter losses (e.g. buildings, vegetation, etc.).

#### 2/9.1.1/3.4 Summary of results of interference from the IMT space stations to IMT UEs (Scenario B2)

In the frequency band 2 170-2 200 MHz, studies of downlink interference analysis into IMT UE from IMT space stations (GSO, LEO and HEO) were conducted and the summary of the results for all the different scenarios and cases are summarized below.

In the case of outdoor IMT UEs, the results show that, for some IMT space stations, the downlink interference to IMT UEs does not exceed the protection criterion of  $I/N = -6$  dB, while for other IMT space stations the interference to IMT UEs exceeds the protection criterion. A summary and analysis of the results of studies for the various IMT space stations are provided as follows:

- the interference from GSO system 1 exceeded the protection criterion by 8.9 dB;
- the interference from GSO system 2 exceeded the protection criterion by 0.9 dB;
- the interference from GSO system 3 and HEO system 4 does not exceed the protection criterion;
- the interference from LEO system 5 exceeded the protection criterion by 1 dB;
- in all cases of indoor IMT UEs, the results show high positive margin, i.e. no potential risk of downlink interference into indoor IMT UEs from all the IMT space stations.

See the working document towards a PDN [Recommendation or Report] ITU-R M.[MSS&IMT-ADVANCED SHARING] for details of systems 1, 2, 3, 4 and 5 above.

One study indicated that, in the case of outdoor IMT UEs assuming MTC, the interference from the IMT space stations exceeded the protection criterion by 3.0 to 22.9 dB, depending on the characteristics of IMT satellite component. This exceedance is due to different characteristics and parameters employed in the study for the IMT MTC UEs (0 dB body loss, 3 dBi antenna gain and

5 dB noise figure). Depending on the characteristics and parameters of the IMT satellite component, there is some risk of the indoor interference threshold being exceeded for MTC UEs.

It should be noted that if the protection criterion of  $I/N = -10$  dB is used, the exceedance of the protection criterion is increased by 4 dB relative to the results of the protection criterion of  $I/N = -6$  dB for all study scenarios.

The wide range of exceedance values across the studies performed indicate that the exceedance value is sensitive to the characteristics of the IMT satellite component and the IMT UEs which are expected to vary from deployment to deployment scenario.

The interference threshold used in the studies for IMT UE receivers translates to the following power flux-density (pfd) values for the assumed values of IMT UE antenna gain, body loss, receiver noise figure and protection criterion  $I/N$ :

Type of IMT UE receiver	$I/N = -6$ dB	$I/N = -10$ dB
IMT handheld UE (antenna gain = -3 dBi, body loss = 4 dB, receiver noise figure = 9 dB)	-105.8 dB(W/(m <sup>2</sup> · MHz))	-109.8 dB(W/(m <sup>2</sup> · MHz))
IMT MTC UE (antenna gain = 3 dBi, body loss = 0 dB, receiver noise figure = 5 dB)	-119.8 dB(W/(m <sup>2</sup> · MHz))	-123.8 dB(W/(m <sup>2</sup> · MHz))

Where interference would exceed the protection criterion for terrestrial IMT UEs, one mitigation would be for the IMT satellite component to modify its operation or design to reduce the downlink pfd in certain territories, where this can be achieved without significantly impacting on the MSS coverage to adjacent countries.

With respect to the satellite component of IMT, the following potential technical and operational mitigation measures have been identified which may be employed to mitigate the interference into terrestrial IMT UEs: narrower spot beams and steeper roll-off from the boresight of the antenna, antenna steering, beam forming, beam nulling, and dynamic frequency management.

## 2/9.1.1/4 Conclusions

Studies have been performed to evaluate the coexistence and compatibility of terrestrial and satellite components of IMT deployed in neighbouring countries/different concerned countries/adjacent geographical areas across different countries. The studies cover scenarios for IMT satellite component with different characteristics, and terrestrial IMT deployments in several different environments.

### 2/9.1.1/4.1 Interference from IMT BSs and IMT UEs to IMT space stations (Scenario A1)

In the frequency band 1 980-2 010 MHz, it was observed that the level of potential interference from IMT BS into IMT space stations is high, while the level of potential interference from IMT UE into IMT space stations is low.

Several technical and operational measures related to coexistence and compatibility between terrestrial and satellite IMT deployments for minimizing and mitigating the interference into the IMT space stations from terrestrial IMT stations have been identified in section 2/9.1.1/3.1 above and further detailed in the working document towards a PDN [Recommendation or Report] ITU-R M.[MSS&IMT-ADVANCED SHARING].

The studies of these technical and operational measures show that the potential interference from IMT UEs can be addressed through implementation of these mitigation measures by administrations to facilitate coexistence and compatibility between terrestrial and satellite deployments in their respective countries.

The studies of these technical and operational measures show that the potential interference from IMT BSs can be reduced. There are two views on this matter:

- some countries consider that, through implementation of mitigation measures, it is possible to partially reduce, but not wholly eliminate, potential excess interference. Additional measures should be considered to enable compatibility;
- some countries consider that, through implementation of mitigation measures, it is possible to wholly eliminate potential excess interference.

The implementation of mitigation measures may be considered on a case-by-case basis by administrations.

#### **2/9.1.1/4.2 Interference from IMT BSs to IMT MESs (Scenario A2)**

In the frequency band 2 170-2 200 MHz, it was observed that potential interference from IMT BSs into IMT MESs may occur.

The potential interference may be mitigated by one or more of: assessment of terrain and clutter effects and system characteristics, deployment environments, and separation distance.

Given the varying characteristics of the border area across various countries, administrations can bilaterally determine the appropriate mitigation techniques on a case-by-case basis.

#### **2/9.1.1/4.3 Interference from IMT MESs to IMT BSs and IMT UEs (Scenario B1)**

In the frequency band 1 980-2 010 MHz, the results of studies show that a separation distance is dependent on the type of IMT MES, IMT BS and IMT UE, and conditions of the propagation model including terrain and clutter effects.

The studies evaluating the interference between IMT terrestrial stations and IMT MES show that geographical separation at the border of two countries would be required. The geographical separation determined in the studies was observed to be larger for a sea-based border than a land-based border.

Potential interference from IMT MESs to IMT BSs and IMT UEs could be managed by bilateral/multilateral negotiation, in which actual technical/operational characteristics and mitigation measures for satellite and terrestrial components of IMT could be taken into account.

#### **2/9.1.1/4.4 Interference from IMT space stations to IMT UEs (Scenario B2)**

In the frequency band 2 170-2 200 MHz, the results of studies show that the downlink interference from IMT space stations to IMT UEs may exceed the protection criterion depending on the characteristics of IMT satellite component and those of IMT UEs.

Potential interference from IMT space stations to IMT UEs could be managed by bilateral/multilateral negotiation, in which actual technical/operational characteristics and mitigation measures for satellite and terrestrial components of IMT could be taken into account.

Several technical and operational measures related to coexistence and compatibility between terrestrial and satellite IMT deployments for minimizing and mitigating the interference into the IMT UEs from IMT space stations have been identified in section 2/9.1.1/3.4 above and further detailed in the working document towards a PDN [Recommendation or Report] ITU-R M.[MSS&IMT-ADVANCED SHARING].

NOTE: It is worth mentioning that with respect to the results of studies on WRC-19 agenda item 9.1, issue 9.1.1, the following views were expressed:

**View 1:**

- 1) It should be noted that the protection criterion for IMT-Advanced UE of  $I/N = -10$  dB is not in line with any ITU-R Recommendation/Report. The protection criteria of  $I/N = -10$  dB for the IMT-Advanced BS has been justified based on Report ITU-R M.2109 which applies for different frequency bands and different interference scenarios. Therefore, conclusions should be based only on the agreed criterion of  $-6$  dB  $I/N$  (Report ITU-R M.2292).
- 2) It should be noted that parameters for MTC of the terrestrial component of IMT are not in line with Report ITU-R M.2292 and should not be taken into account in a study results.
- 3) Regarding Scenario A1, potential interference in the frequency band 1 980-2 010 MHz from IMT terrestrial systems to the MSS satellite can be regulated by preventing use of this frequency band by IMT BS, or by establishing an e.i.r.p. limit, for example with the value 20 dBm/5 MHz on IMT station in the upper hemisphere. This e.i.r.p. limit could be addressed through modification of the *resolves* part of Resolution **212 (Rev.WRC-15)**.
- 4) Regarding Scenario A2, potential interference in the frequency band 2 170-2 200 MHz from IMT stations to MSS ESs can be regulated by the current provisions on border coordination given in RR Appendix 7.
- 5) Regarding Scenario B1, potential interference in the frequency band 1 980-2 010 MHz from MES to IMT BS can be addressed by the current provisions on border coordination given in the RR with necessary changes to Appendix 7 (Table 7a).
- 6) Regarding Scenario B2 potential interference in the frequency band 2 170-2 200 MHz from MSS satellites to IMT terrestrial systems can be addressed by establishing a coordination threshold pfd level. It is proposed to include the new pfd coordination threshold value of  $-105.8$  dB(W/m<sup>2</sup>) in 1 MHz in Table 5-2 of RR Appendix 5 in the frequency band 2 170-2 200 MHz for protection of terrestrial stations of IMT systems, together with creating a new Note 11 “The coordination thresholds in the frequency band 2 170-2 200 MHz (all Regions) apply to protect terrestrial stations of IMT systems”.
- 7) Also regarding Scenario B2, another view was expressed to use the existing pfd values available in the RR (Table 5-2 of Appendix 5) for other terrestrial services, noting that some ambiguity exists regarding its applicability for the protection of terrestrial component of IMT in Note 3 “The coordination thresholds in the band 2 160-2 170 MHz (Region 2) and 2 170-2 200 MHz (all Regions) to protect other terrestrial services do not apply to IMT systems, as the satellite and the terrestrial components are not intended to operate in the same area or on common frequencies within these bands.” Usage of the existing pfd threshold in the RR overprotects terrestrial IMT.

View 1 is based on Resolution ITU-R 2-7 *resolves 2*: “*that the scope of CPM shall be to prepare a consolidated report to be used in support of the work for World Radiocommunication Conferences, based on: the inclusion, to the extent possible, of reconciled differences in approaches as contained in the source material, or, in the case where the approaches cannot be reconciled, the inclusion of the differing views and their justification*”.

View 1 should be treated as part of the Conclusion in accordance to Document [5D/896](#) from the CPM Chairman with guidance regarding the “Conclusion” section of the draft CPM texts on the

nine issues under WRC-19 agenda item 9.1: “if different possible course of actions are suggested (i.e. no consensus on the issue), it may be sufficient to summarize them as different views in the “Conclusion” section without transforming these views into options or methods with associated regulatory examples, thus avoiding to transform a 9.1 issue into an agenda item”.

**View 2:**

Technical and operational measures studied and developed pursuant to Resolution **212 (Rev.WRC-15)** are sufficient to ensure coexistence and compatibility between the terrestrial and satellite components of IMT in adjacent geographic areas of neighbouring countries for all scenarios. Additional technical and operational capabilities made possible through availability of newer technologies could further facilitate compatibility between the two components of IMT. Therefore, there is no need for future regulatory studies or changes to the RR.

Because of the unique and varying system characteristics and deployment scenarios of the satellite and terrestrial components of IMT in neighbouring countries, bilateral discussions between affected administrations provide greater operational flexibility while ensuring coexistence between the two components deployed in neighbouring countries than regulatory actions on either service based on worst-case interference scenario.

Resolution **212 (Rev.WRC-15)**, the Resolution pertaining to WRC-19 agenda item 9.1, issue 9.1.1, is limited to the study of “possible technical and operational measures to ensure coexistence and compatibility between the terrestrial component of IMT (in the mobile service) and the satellite component of IMT (in the mobile service and the mobile-satellite service).” Possible technical and operational measures do not include any regulatory considerations, which are outside the scope of this issue.

Therefore, per *invites* in ITU-R Resolution **212 (Rev.WRC-15)**, only technical and operational measures were studied and no regulatory studies were performed related to WRC-19 agenda item 9.1, issue 9.1.1.

In addition to the protection criterion of  $I/N = -6$  dB, the IMT terrestrial studies have considered the use of the protection criterion of  $I/N = -10$  dB as there are some deployment scenarios that merit the consideration of the protection criterion of  $I/N = -10$  dB. Examples of such deployments include: 1) rural deployments optimized for wide area coverage, 2) emergency and disaster public safety deployments, and 3) machine type communications deployments in extended coverage areas operating under negative SNR conditions using the recent enhancements to IMT-Advanced in the Recommendation ITU-R M.2012-3. Moreover,  $I/N = -10$  dB and  $-20$  dB have also been specified for IMT-2000 systems in Report ITU-R M.2039, noting that both IMT-2000 and IMT-Advanced are OFDM based radio interfaces and that the receiver components in the IMT UEs in the 1 980-2 010 MHz frequency band used for the two technologies are the same and therefore must have the same protection requirements.

The scope of the WRC-19 agenda item 9.1, issue 9.1.1, is clear - to study the technical and operational measures for coexistence and compatibility of the satellite and terrestrial components of IMT. Many of the fundamental characteristics of satellite systems studied are not consistent with the satellite component of IMT specified in either Recommendation ITU-R M.1457 or Recommendation ITU-R M.2047 and conclusions may not be reflective of the satellite component of IMT.

Furthermore, non-GSO satellite systems for aggregate interference studies have been modelled with coverage enabled across all countries and is inconsistent with the scope specified in Resolution **212 (Rev.WRC-15)**. Additionally, there are several GSO



systems in operation today and therefore, factors related to satellite-satellite coordination between GSO and non-GSO satellite systems need to be used to determine the final parameters taking into account the constraints resulting from satellite-satellite coordination to be used in the aggregate studies between satellite and terrestrial systems. None of these have been performed and therefore the conclusions reached from the results of these studies cannot be considered representative of the non-GSO IMT satellite component.

CPM19-2 is invited to consider the matter with a view to address these views, as appropriate. It should be noted that there was no consensus on whether or not this NOTE should be associated with the Conclusions.

## Agenda item 9.1(9.1.5)

### **2/9.1.5 Resolution 764 (WRC-15)**

*Consideration of the technical and regulatory impacts of referencing Recommendations ITU-R M.1638-1 and ITU-R M.1849-1 in Nos. 5.447F and 5.450A of the Radio Regulations*

**(WP 5A / WP 5B, (WP 3M))**

#### **2/9.1.5/1 Executive summary**

Based on different studies regarding the technical and regulatory impacts of referencing Recommendations ITU-R M.1638-1 and ITU-R M.1849-1 in RR Nos. **5.447F** and **5.450A**, different approaches (as alternatives for addressing the issue) were suggested for regulatory examples.

Approach A updates the reference to Recommendation ITU-R M.1849-1 in RR No. **5.450A** and leaves all other references unchanged.

Approach B updates both footnotes by removing the references and replacing them with the sentence “No. **5.43A** does not apply”.

Approach C does not change the footnote texts at all.

#### **2/9.1.5/2 Background**

WRC-03 allocated the 5 150-5 350 MHz and 5 470-5 725 MHz frequency bands to the mobile service on a primary basis for the implementation of wireless access systems (WAS) including radio local area networks (RLANs) subject to Resolution **229 (Rev.WRC-12)**. WRC-03 also decided that the radiolocation service, the Earth exploration-satellite service (active) and the space research service (active) (RR No. **5.447F**) and the radiodetermination service (RR No. **5.450A**) shall not impose on the mobile service more stringent protection criteria, based on system characteristics and interference criteria, than those stated in Recommendations ITU-R M.1638-0 and ITU-R RS.1632-0, which were incorporated by reference.

During the WRC-15 study cycle, Recommendation ITU-R M.1638-0 was revised. In this revision process, several new radars with different system characteristics were included in Recommendation ITU-R M.1638-1, and the technical characteristics and protection criteria for ground-based meteorological radars were removed and are not included in Recommendation ITU-R M.1638-1 and were instead relocated to Recommendation ITU-R M.1849-1 and several new meteorological radars were added to Recommendation ITU-R M.1849-1 during this revision process (see also section 2/9.1.5/3.2).

Consistent with the provisions of Resolution **27 (Rev.WRC-12)**, for an ITU-R Recommendation (e.g. ITU-R M.1638), the reference in the Radio Regulations shall continue to apply to the earlier version incorporated by reference until such time as a competent WRC agrees to incorporate the new version. Given the potential impact on the widespread deployment of RLANs in the 5 250-5 350 MHz and 5 470-5 725 MHz frequency bands and the provisions of RR Nos. **5.447F** and **5.450A**, WRC-15 decided to study this matter under WRC-19 agenda item 9.1, issue 9.1.5.

If the references to the two Recommendations remain in the footnotes, the question of the revision of RR Nos. **5.447F** and **5.450A** would have to be re-addressed in the future (e.g. under agenda item 2) to consider the future updates of Recommendations ITU-R M.1638 and ITU-R M.1849, most probably with the same arguments as those currently developed under WRC-19 agenda item 9.1, issue 9.1.5.

Recommendation ITU-R M.1849-1 provides technical and operational aspects of ground-based meteorological radars. There were nine ground-based meteorological radars which were removed from Recommendation ITU-R M.1638-0. Eight of those radars in Recommendation ITU-R M.1849-0 were retained in Recommendation ITU-R M.1849-1. In addition, five other ground-based meteorological radars from Recommendation ITU-R M.1849-0 were retained and one additional new radar was added into Recommendation ITU-R M.1849-1, resulting in six radars that were not previously in Recommendation ITU-R M.1638-0 being included in Recommendation ITU-R M.1849-1. ITU-R also provided a summary of the radars operating in the frequency bands 5 250-5 350 MHz and 5 470-5 725 MHz as contained in Recommendations ITU-R M.1638-0, ITU-R M.1638-1, ITU-R M.1849-0 and ITU-R M.1849-1.

## **2/9.1.5/3 Summary and analysis of the results of ITU-R studies**

### **2/9.1.5/3.1 Summary of technical and operational studies**

#### **2/9.1.5/3.1.1 Approach A**

##### **With respect to Recommendation ITU-R M.1638:**

To address the situation described in section 2/9.1.5/2 above, an initial study showed that in case of reference replacement of Recommendation ITU-R M.1638-0 by the Recommendation ITU-R M.1638-1 in RR Nos. **5.447F** and **5.450A** the maximum permissible interference field strength in the frequency band 5 250-5 350 MHz is increased by 10 dB and by 7.2 dB in the frequency band 5 470-5 725 MHz. It should be noted that the protection requirements for meteorological radars are not included in Recommendation ITU-R M.1638-1.

Previous ITU-R studies (see section 1/1.1/3.2.11.2 of the [Report of the CPM to WRC-15](#)) showed that protecting certain new radar types contained in Recommendation ITU-R M.1638-1 would not be feasible. Therefore, the incorporation by reference to Recommendation ITU-R M.1638-0 should not be updated to Recommendation ITU-R M.1638-1 in RR Nos. **5.447F** and **5.450A** until further studies are completed.

##### **With respect to Recommendation ITU-R M.1849:**

An initial study addressing meteorological radars showed that:

- incorporation by reference of Recommendation ITU-R M.1849-1 in RR No. **5.447F** would result in imposing additional constraints on systems in the mobile service operating in the frequency band 5 250-5 350 MHz and would lead to changes of the conditions under which this frequency band is allocated to radio services. It is due to the fact that Recommendation ITU-R M.1638-0 does not include all meteorological radars that are incorporated in Recommendation ITU-R M.1849-1;
- incorporation by reference of Recommendation ITU-R M.1849-1 in RR No. **5.450A** would not result in imposing additional constraints on systems in the mobile service operating in the frequency band 5 470-5 725 MHz and would not impact the coexistence between radars and WAS/RLAN in the frequency band 5 470-5 725 MHz;
- the comparison of the technical characteristics of the meteorological radars given in Recommendation ITU-R M.1638-0 and Recommendation ITU-R M.1849-1, operating in the frequency band 5 470-5 725 MHz, showed that the technical characteristics of the meteorological radars leading to the most stringent interference protection requirements are covered in both Recommendations.

In addition, analysis of the relevant dynamic frequency selection (DFS) detection by WAS/RLAN comparing the meteorological radars described in Recommendations ITU-R M.1638-0 and ITU-R

M.1849-1 shows that adding a new reference to Recommendation ITU-R M.1849-1 to RR No. **5.450A** would not impose undue constraints on systems in the mobile service, in particular RLAN/WAS. The meteorological radars protection criteria was changed from –6 dB to –10 dB when transferring the meteorological radar technical and operational characteristics to Recommendation ITU-R M.1849-1 but these radars can be protected by the existing DFS mechanisms.

Therefore, a reference to Recommendation ITU-R M.1849-1 in RR No. **5.450A** would not impact the coexistence between radars WAS/RLAN in the frequency band 5 470-5 725 MHz.

#### **2/9.1.5/3.1.2 Approach B**

To address the situation described in section 2/9.1.5/2 above, an alternative approach is to delete the second sentence of the footnotes, where the Recommendations are referenced, and clarify that the provisions of RR No. **5.43A** do not apply in this case, such as presented in section 2/9.1.5/4.2 below.

This approach is a long-term solution that would avoid reopening the issue of technical and regulatory impacts of referencing new Recommendation versions in RR Nos. **5.447F** and **5.450A**. This should in particular be seen in the light of the fact that, in practice, the coexistence between WAS/RLAN and radars is not driven by those two footnotes but by Resolution **229 (Rev.WRC-12)** that defines the conditions for the mobile service to operate in these bands.

#### **2/9.1.5/3.1.3 Approach C**

Another alternative that was suggested is that no changes are to be done to the Radio Regulations in relation to the issue 9.1.5, except suppression of Resolution **764 (WRC-15)**, such as presented in section 2/9.1.5/4.3 below.

#### **2/9.1.5/3.2 List of relevant ITU-R Recommendations**

Recommendations ITU-R M.1638-0, ITU-R M.1638-1, ITU-R M.1849-0 and ITU-R M.1849-1.

#### **2/9.1.5/4 Conclusions**

Some approaches were suggested to address WRC-19 agenda item 9.1, issue 9.1.5 as outlined in the sub-sections 2/9.1.5/4.1, 2/9.1.5/4.2 and 2/9.1.5/4.3 below. In any case, Resolution **764 (WRC-15)** should be suppressed as shown in sub-section 2/9.1.5/4.4 below.

#### **2/9.1.5/4.1 Approach A**

Approach A updates the reference to Recommendation ITU-R M.1849-1 in RR No. **5.450A** and leaves all other references unchanged as shown in the regulatory example below:

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations

(See No. 2.1)

**NOC**

**5.447F**

**MOD**

**5.450A** In the frequency band 5 470-5 725 MHz, stations in the mobile service shall not claim protection from radiodetermination services. Radiodetermination services shall not impose on the mobile service more stringent protection criteria, based on system characteristics and interference criteria, than those stated in Recommendations ITU-R M.1638-0 and ITU-R M.1849-1. (WRC-19)

#### **2/9.1.5/4.2 Approach B**

To delete the second sentence of the footnotes, where the Recommendations are referenced, and introduce the sentence “No. **5.43A** does not apply” as shown in the regulatory example below:

**MOD**

**5.447F** In the frequency band 5 250-5 350 MHz, stations in the mobile service shall not claim protection from the radiolocation service, the Earth exploration-satellite service (active) and the space research service (active). No. **5.43A** does not apply. (WRC-19)

**MOD**

**5.450A** In the frequency band 5 470-5 725 MHz, stations in the mobile service shall not claim protection from radiodetermination services. No. **5.43A** does not apply. (WRC-19)

#### **2/9.1.5/4.3 Approach C**

No change to the Radio Regulations as shown in the regulatory example below:

**NOC**

**5.447F**

**NOC**

**5.450A**

**2/9.1.5/4.4 For all Approaches A, B and C**

**SUP**

**RESOLUTION 764 (WRC-15)**

**Consideration of the technical and regulatory impacts of referencing  
Recommendations ITU-R M.1638-1 and ITU-R M.1849-1  
in Nos. 5.447F and 5.450A of the Radio Regulations**

## Agenda item 9.1(9.1.8)

### **2/9.1.8 Issue 3) in the Annex to Resolution 958 (WRC-15)**

*Urgent studies required in preparation for the 2019 World Radiocommunication Conference*

3) *Studies on the technical and operational aspects of radio networks and systems, as well as spectrum needed, including possible harmonized use of spectrum to support the implementation of narrowband and broadband machine-type communication infrastructures, in order to develop Recommendations, Reports and/or Handbooks, as appropriate, and to take appropriate actions within the ITU Radiocommunication Sector (ITU-R) scope of work.*

**(WP 5D / WP 1B, WP 5A)**

#### **2/9.1.8/1 Executive summary**

Machine Type Communications (MTC), which are also known as Machine-to-Machine (M2M) communications or Internet of Things (IoT), describe communication between devices that do not require human intervention. An increasingly large number of MTC devices, with a range of performance and operational requirements, are expected to communicate due to further improvements of low-cost and low complexity device types requiring high reliability techniques, for instance in the field of traffic safety, traffic efficiency, smart grid, e-health, wireless industry automation, augmented reality, remote tactile control and tele-protection.

The results of ITU-R studies of the current and future spectrum use for narrowband and broadband MTC performed, as expressed in Resolution **958 (WRC-15)**, concluded that there is no need for any regulatory action in the Radio Regulations with regard to specific spectrum intended for use by those applications. Nonetheless, there are other mechanisms, which could facilitate the harmonized use of spectrum to support the implementation of narrowband and broadband MTC infrastructures, including ITU-R Recommendations or Reports.

#### **2/9.1.8/2 Background**

WRC-15 decided that urgent studies should be carried out “to support the implementation of narrowband and broadband machine-type communication infrastructures” under WRC-19 agenda item 9.1, issue 9.1.8, and that the Director of the Radiocommunication Bureau reports on these studies under agenda item 9.1 of WRC-19, based on the results of studies, as appropriate. This was decided taking into account the rapid growth expected for MTC and the advantages of wireless technologies instead of cabling, for instance: reduced complexity of installation, no damage to cables, increased machine deployment, mobility and flexibility.

There are ITU-R Resolutions such as Resolution ITU-R 54-2 “Studies to achieve harmonization for short-range devices” and Resolution ITU-R 66 “Studies related to wireless systems and applications for the development of the Internet of Things”. Furthermore, Resolution ITU-R 66 recognizes “that IoT is a concept encompassing various platforms, applications, and technologies that are, and will continue to be, implemented under a number of radiocommunication services”. In accordance with Resolution ITU-R 66, the ITU-R developed Report ITU-R SM.2423.

## **2/9.1.8/3 Summary and analysis of the results of ITU-R studies**

### **2/9.1.8/3.1 Summary and analysis of the results of ITU-R studies related to WRC-19 agenda item 9.1, issue 9.1.8**

PDN Report ITU-R M.[IMT.MTC] addresses the use of the terrestrial component of IMT for narrowband and broadband MTC and studies the technical and operational aspects of radio networks and systems, as well as spectrum needed, including possible harmonized use of spectrum to support the implementation of narrowband and broadband MTC infrastructures.

Existing spectrum already identified for IMT in the Radio Regulations and the frequency bands under study for IMT identification may also be utilized for narrowband and broadband MTC. Harmonized frequency arrangements for the terrestrial component of IMT are provided in Recommendation ITU-R M.1036.

The harmonized use of existing spectrum identified for IMT systems provides economies of scale to facilitate the deployment of narrowband and broadband IMT-based MTC ecosystems in a timely and cost effective manner. Such harmonized use of narrowband MTC ecosystems may include the use of the same IMT frequency arrangements within a certain region or number of administrations based on their needs. Example(s) for possible harmonized use of narrowband MTC, based on IMT frequency arrangements provided by Recommendation ITU-R M.1036, can be found in PDN Report ITU-R M.[IMT.MTC].

For non-IMT technologies, PDN Report ITU-R M.[NON\_IMT.MTC\_USAGE] studies the technical and operational aspects of MTC applications by non-IMT mobile systems, and presents information on MTC applications including wireless industrial automation. The Report considers the use of radio local area network (RLAN) technologies to support various applications, including MTC.

The harmonized use of existing spectrum used by RLAN systems at suitable power levels provides economies of scale to facilitate the deployment of non-IMT MTC ecosystems in a timely and cost effective manner. Example(s) of the use of possible harmonized spectrum for non-IMT MTC applications based on RLAN technologies in Recommendation ITU-R M.1450, can be found in PDN Report ITU-R M.[NON\_IMT.MTC\_USAGE].

### **2/9.1.8/3.2 List of other ITU-R Recommendations and Reports**

Recommendations ITU-R M.1450, ITU-R M.1457, ITU-R M.2002, ITU-R M.2012, ITU-R M.2083, ITU-R SM.1896 and ITU-R SM.2103. Reports ITU-R SM.2153 and ITU-R M.2224.

## **2/9.1.8/4 Conclusions**

ITU-R studies of the current and future spectrum use for narrowband and broadband MTC, performed as expressed in Resolution **958 (WRC-15)**, concluded that there is no need to take any regulatory action in the Radio Regulations with respect to specific spectrum for the use of those applications in the Radio Regulations. Nonetheless, there may be other ways to address the harmonized use of spectrum to support the implementation of narrowband and broadband MTC.

The study of technical and operational aspects including the potential harmonized spectrum usage to support the implementation of narrowband and broadband MTC infrastructures could be further accomplished through the course of the work in ITU-R Study Groups including the development of ITU-R Recommendations, Reports and/or Handbooks, as appropriate. Possible example(s) of the potential harmonized use of IMT-based MTC, based on IMT frequency arrangements provided by Recommendation ITU-R M.1036, can be found in PDN Report ITU-R M.[IMT.MTC] and for non-IMT technologies in PDN Report ITU-R M.[NON\_IMT.MTC\_USAGE].



## CHAPTER 3

### Satellite services

(Agenda items 1.4, 1.5, 1.6, 7, 9.1 (issues 9.1.2, 9.1.3, 9.1.9))

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## Agenda item 1.4 (WP 4A / (WP 3M))

*1.4 to consider the results of studies in accordance with Resolution 557 (WRC-15), and review, and revise if necessary, the limitations mentioned in Annex 7 to Appendix 30 (Rev.WRC-15), while ensuring the protection of, and without imposing additional constraints on, assignments in the Plan and the List and the future development of the broadcasting-satellite service within the Plan, and existing and planned fixed-satellite service networks;*

Resolution 557 (WRC-15) – Consideration of possible revision of Annex 7 to Appendix 30 of the Radio Regulations.

### 3/1.4/1 Executive summary

WRC-15 adopted Resolution 557 (WRC-15) to study possible revisions of the limitations mentioned in Annex 7 to Appendix 30 (Rev.WRC-15) of the Radio Regulations (RR).

It should be noted that the broadcasting-satellite service (BSS) not subject to RR Appendix 30 (12.5-12.7 GHz, in Region 3) is not the subject of consideration in accordance with Resolution 557 (WRC-15).

It should be emphasized that studies calling for revision of Annex 7 to RR Appendix 30 (Rev.WRC-15) under Resolution 557 (WRC-15) in no way was intended to have any impact whatsoever to the integrity of RR Appendix 30 for Regions 1 and 3.

The Annex 7 to RR Appendix 30 (Rev.WRC-15) contains several orbital position limitations for proposed modifications to the Region 2 Plan and for proposed new or modified assignments in the Regions 1 and 3 List applicable to specific parts of the frequency band 11.7-12.7 GHz.

There are no orbital position limitations in RR Appendix 30A. One can already apply for and use the entire feeder-link frequency band within the restricted portions of the Annex 7 to RR Appendix 30 (Rev.WRC-15) arc. As a result, it is not necessary to analyse the impact of removing limitations that do not exist.

Should WRC-19 decide to remove some or all the current limitations on the use of the orbital arc for Regions 1 and 3 BSS networks as contained in Annex 7 to RR Appendix 30 (Rev.WRC-15), priority on the use of these new orbital positions should be given to those countries in Regions 1 and 3 with Plan assignments with equivalent downlink protection margin values in the RR Appendix 30 equal or below -10 dB, and with neither frequency assignments included in the List nor for which complete RR Appendix 4 information has been received by the Bureau in accordance with the provisions of § 4.1.3 of RR Appendix 30 (Rev.WRC-15). See draft new Resolution [B14-PRIORITY] (WRC-19).

### 3/1.4/2 Background

In order to simplify the readiness of the limitations of Annex 7 to RR Appendix 30 (Rev.WRC-15), the following nomenclature was retained as shown in Table 3/1.4/2-1. The geographical presentation of Annex 7 to RR Appendix 30 (Rev.WRC-15) limitations A1 and A2 is shown in Figure 3/1.4/2-1.

TABLE 3/1.4/2-1

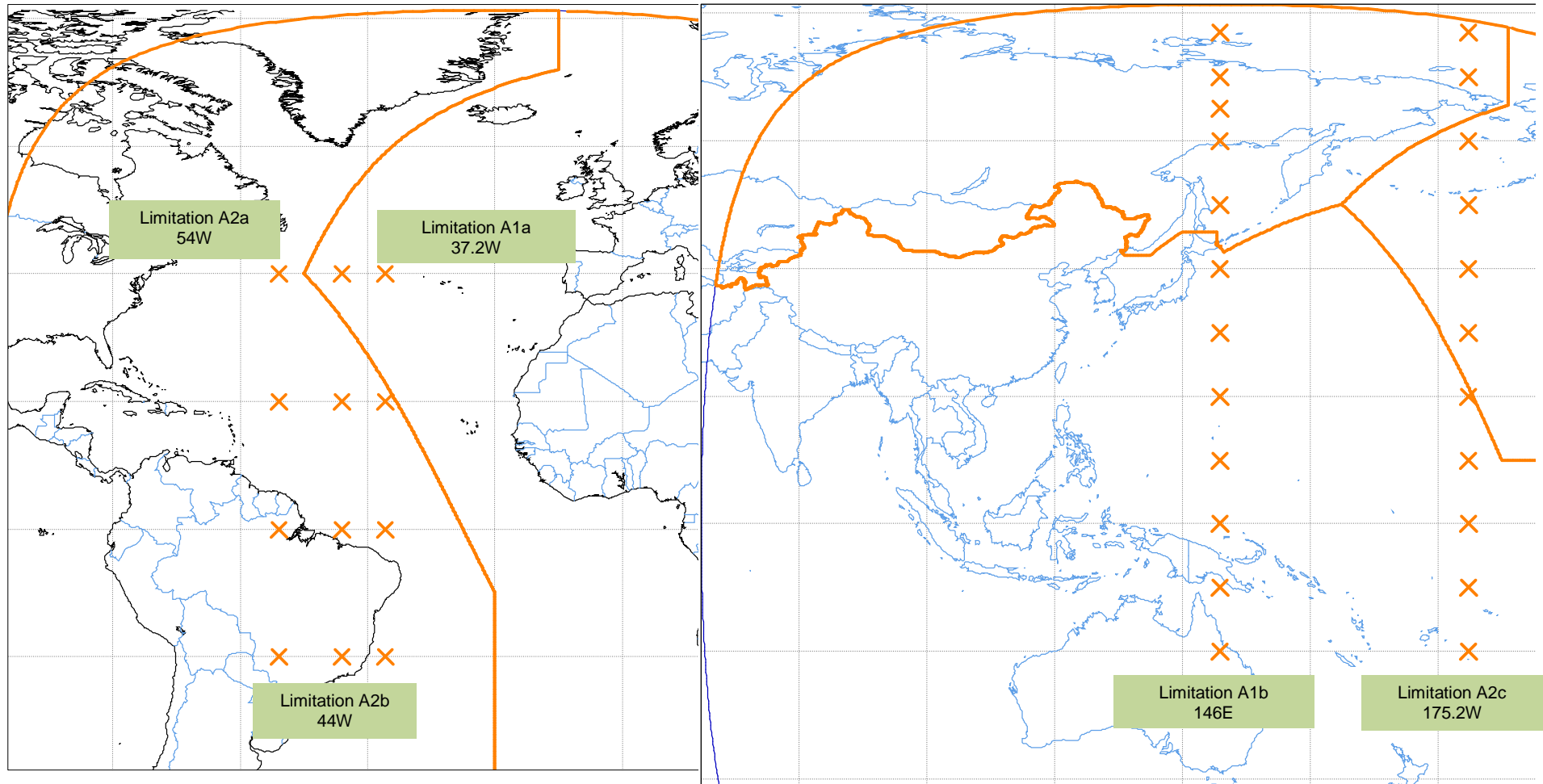
**Annex 7 to RR Appendix 30 (Rev.WRC-15) limitations**

<b>Annex 7 limitation</b>	<b>Region and service of interfering assignments</b>	<b>Region and service of impacted assignments</b>	<b>Frequency band</b>	<b>Limitation description</b>
A1a	Region 1 BSS	Region 2 FSS (Atlantic)	11.7-12.2 GHz	No assignments in the Region 1 List further west than 37.2° W
A1b		Region 2 FSS (Pacific)		No assignments in the Region 1 List further east than 146° E
		Region 3 BSS subject to RR Appendix 30		
A2a	Region 2 BSS	Region 1 FSS (Atlantic)	12.5-12.7 GHz	No modification in the Region 2 Plan further east than 54° W
A2b		Region 1 BSS subject to RR Appendix 30	12.2-12.5 GHz	No modification in the Region 2 Plan further east than 44° W
A2c		Region 3 FSS	12.2-12.7 GHz	No modification in the Region 2 Plan further west than 175.2° W
		Region 1 BSS subject to RR Appendix 30	12.2-12.5 GHz	
		Region 1 FSS (Pacific)	12.5-12.7 GHz	
A3a	Region 1 BSS	Region 2 FSS	11.7-12.2 GHz	No assignments in the Regions 1 and 3 List outside specific allowable portions of the orbital arc between 37.2° W and 10° E
A3b				Maximum e.i.r.p. of 56 dBW for assignments in the Regions 1 and 3 List at specific allowable portions of the orbital arc between 37.2° W and 10° E
A3c				Maximum power flux-density of -138 dB(W/(m <sup>2</sup> · 27 MHz)) at any point in Region 2 by assignments in the Regions 1 and 3 List located at 4° W and 9° E
B	Region 2 BSS	Region 2 BSS subject to RR Appendix 30	12.2-12.7 GHz	Required agreement of administrations having assignments to space stations in the same cluster when an administration may locate a satellite within this cluster

Geographical presentation of Annex 7 to RR Appendix 30 (Rev.WRC-15) limitations A1 and A2

Atlantic ocean region  
Limitations "A1a", "A2a", "A2b"

Pacific ocean region  
Limitations "A1b", "A2c"





Different regional allocations to the fixed-satellite service (FSS) and BSS in the 11.7-12.7 GHz frequency range are causing several interregional sharing situations between these services. BSS and FSS networks from different Regions may operate simultaneously and share orbit resource in their respective Regions. Annex 7 to RR Appendix 30 (Rev.WRC-15) contains several orbital position limitations for proposed new or modified assignments in the Regions 1 and 3 List (limitations A1a, A1b, A3a, A3b, A3c) and for proposed modifications to the Region 2 Plan (limitations A2a, A2b, A2c) applicable to specific parts of the frequency band 11.7-12.7 GHz.

The FSS in the same frequency band is not subject to orbital position limitations.

Revision/elimination of the Annex 7 to RR Appendix 30 orbital position limitations would ensure BSS an additional orbital resource.

### 3/1.4/3 Summary and analysis of the results of ITU-R studies

Detailed analysis of each study can be found in the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANEX7]. Moreover, it was shown that the deletion of each limitation is independent of the other and the deletion of multiple limitations has no cumulative effect.

#### 3/1.4/3.1 Review of the Radio Regulations and existing documentation

##### 3/1.4/3.1.1 Current allocations in the 11.7-12.7 GHz frequency band

The frequency band 11.7-12.7 GHz is allocated to different services as shown in Table 3/1.4/3.1.1-1.

TABLE 3/1.4/3.1.1-1

The current allocation to services in 11.7-12.7 GHz

Allocation to services		
Region 1	Region 2	Region 3
<b>11.7-12.5</b> FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492         5.487 5.487A	<b>11.7-12.1</b> FIXED 5.486 FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.488 Mobile except aeronautical mobile 5.485	<b>11.7-12.2</b> FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492         5.487 5.487A
	<b>12.1-12.2</b> FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.488 5.485 5.489	
		<b>12.2-12.7</b> FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 5.492

<p><b>12.5-12.75</b> FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B (Earth-to-space)</p> <p>5.494 5.495 5.496</p>	<p>5.487A 5.488 5.490</p> <p><b>12.7-12.75</b> FIXED FIXED-SATELLITE (Earth-to-space) MOBILE except aeronautical mobile</p>	<p><b>12.5-12.75</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B MOBILE except aeronautical mobile BROADCASTING- SATELLITE 5.493</p>
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### 3/1.4/3.1.2 Relevant provisions in the Radio Regulations

RR Appendix 30 RR has detailed provisions and associated coordination triggers both for modifications to the Region 2 Plan and/or Regions 1 and 3 List. In particular, the relevant provisions and associated technical criteria are:

- Article 4 of RR Appendix 30 → procedure for proposed modifications to the Region 2 Plan or Regions 1 and 3 List to coordinate with FSS or BSS subject to RR Appendix 30.
- Article 7 of RR Appendix 30 → procedure for BSS not subject to RR Appendix 30 or FSS networks to coordinate with BSS Plan or List assignments or previously filed modifications to the Region 2 Plan or Regions 1 and 3 List.
- Annex 1 to RR Appendix 30 (Sections 1, 3, 6) → criteria to determine if a proposed modification to the Region 2 Plan or proposed new or modified assignments in the Regions 1 and 3 List needs to coordinate with FSS or BSS subject to RR Appendix 30 networks or BSS networks in the frequency band 12.5-12.7 GHz in Region 3.
  - The criteria here are coordination threshold power flux-density (pfd) masks.
- Annex 4 to RR Appendix 30 → criteria to determine if FSS or BSS not subject to RR Appendix 30 (see text in “Executive summary” concerning BSS in the frequency band 12.5-12.7 GHz in Region 3 above) network needs to coordinate with the BSS Plan or List assignments or previously filed modifications to the Region 2 Plan or Regions 1 and 3 List.
  - The criteria here are coordination threshold pfd masks.
- Annex 6 to RR Appendix 30 → criteria for sharing between services including summary of the assumptions used to develop the pfd levels contained in Annexes 1 and 4 to RR Appendix 30.
- Annex 7 to RR Appendix 30 → orbital position limitations on proposed modifications to the Region 2 Plan or for proposed new or modified assignments in Regions 1 and 3 List, specifically applicable to Region 2 BSS in 12.2-12.7 GHz and to Region 1 BSS in 11.7-12.2 GHz. Annex 7 also contains associated e.i.r.p. limits for Region 1 BSS in the portion of the arc.

Annex 6 to RR Appendix 30 is particularly useful in understanding the derivation of the Annexes 1 and 4 to RR Appendix 30 coordination threshold pfd masks, with respect to the earth station characteristics considered and the allowable  $\Delta T/T$  value.

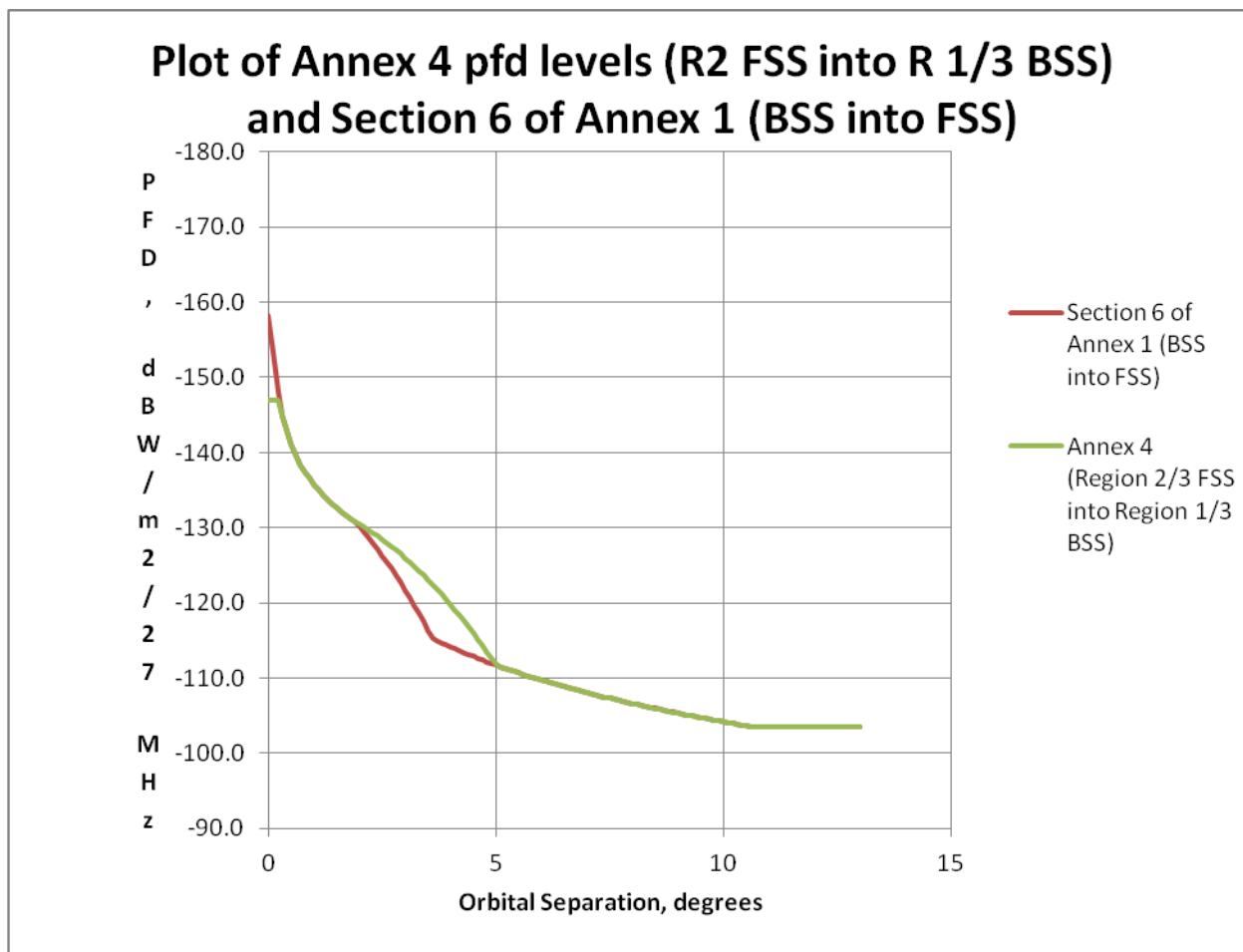
### 3/1.4/3.1.3 Some limitations and criteria applied to FSS and BSS subject to RR Appendix 30

In particular, it is interesting to consider the relationship between Annexes 1, 4, 6 and 7 to RR Appendix 30, and to assess the factors that may have driven adoption of those provisions as well as noting factors that may have changed since WRC-03.

Some comments on the relationship between Annexes 1, 4, 6 and 7 to RR Appendix **30** (see also Figure 3/1.4/3-1):

- Section 1 of Annex 1 to RR Appendix **30** includes a hard limit of  $-103.6 \text{ dBW/m}^2/27 \text{ MHz}$  for proposed new or modified assignments in the Regions 1 and 3 List. This is equivalent to roughly a peak e.i.r.p. of  $58.5 \text{ dBW}/27 \text{ MHz}$ .
- For minimum orbital separations equal to or more than  $10.57$  degrees the highest operating pfd level without triggering coordination of FSS in any Region vis-à-vis BSS under Annex 4 to RR Appendix **30** (or, for BSS vis-à-vis seeking agreement with FSS in Section 6 of Annex 1 to RR Appendix **30**) is also  $-103.6 \text{ dBW/m}^2/27 \text{ MHz}$ .
- For orbital separations less than  $0.23^\circ$  the highest operating pfd level without triggering coordination of FSS in any Region vis-à-vis BSS under Annex 4 to RR Appendix **30** is  $-147 \text{ dBW/m}^2/27 \text{ MHz}$  (see Figure 3/1.4/3-1).
- For orbital separations less than  $0.054^\circ$  the highest operating pfd level without triggering coordination of BSS in any Region vis-à-vis FSS under Section 6 of Annex 1 to RR Appendix **30** is  $-158.2 \text{ dBW/m}^2/27 \text{ MHz}$  ( $-186.5 \text{ dBW/m}^2/40 \text{ kHz}$ ) (see Figure 3/1.4/3-1).
- Section 3 of Annex 7 to RR Appendix **30** allows use of certain orbital positions by Regions 1 and 3 BSS List assignments in the shared with FSS part of the arc between Regions 1 and 2 in the Atlantic ocean side if the BSS peak e.i.r.p. level does not exceed  $56 \text{ dBW}/27 \text{ MHz}$ , which is several dB lower than that in Section 1/Annex 1 and Annex 4 to RR Appendix **30**.
- Different minimum and maximum earth station antenna sizes and associated noise temperature for FSS and BSS (see Annex 6 to RR Appendix **30**) led to different coordination threshold pfd masks for protecting each service.
  - For small orbital separations, larger earth station antennas lead to more stringent allowed pfd levels.
  - For large orbital separations, smaller earth station antennas lead to more stringent allowed pfd levels.

FIGURE 3/1.4/3-1

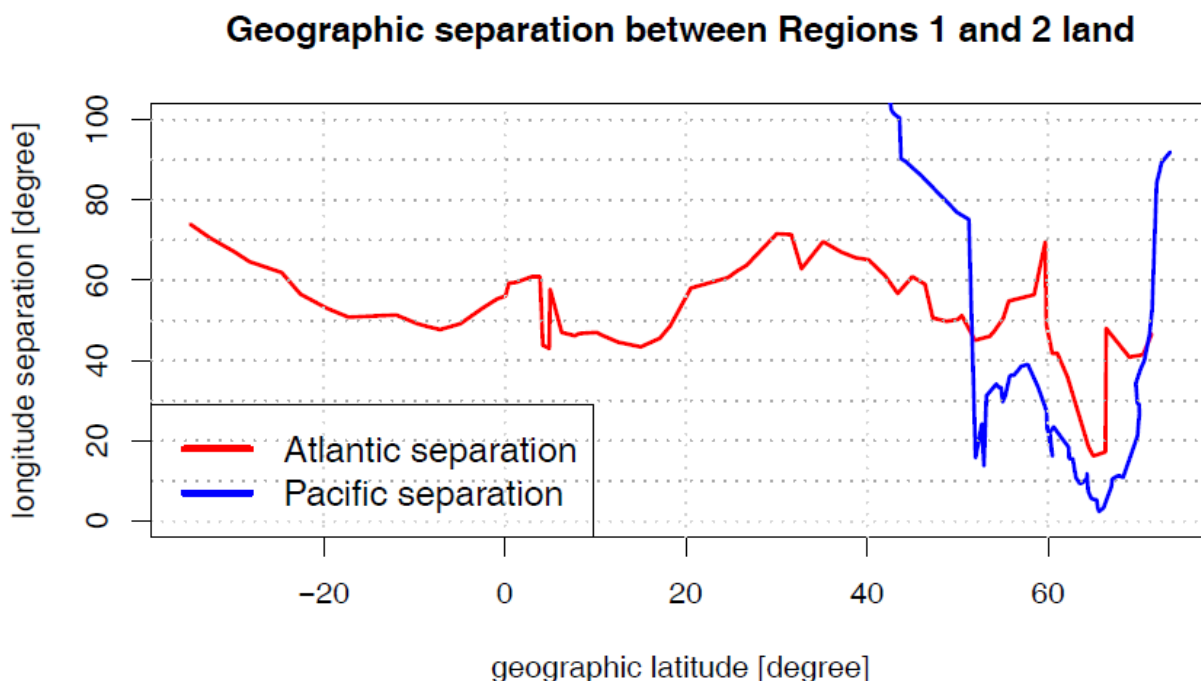


Other factors that are likely related to the development of the sharing criteria:

- Different expected operating e.i.r.p. levels for FSS and BSS.
  - Larger discrepancies could lead to more interference to FSS and larger orbital separations are needed to avoid triggering coordination.
- Difference in coverage areas and associated beam roll off between networks serving the different Regions.
  - Areas served by BSS and FSS in adjacent Regions are separated generally by large bodies of water with boundaries running north-south assuming that the service areas are limited to land.
  - Greater geographic discrimination facilitates sharing assuming that the service areas of FSS and BSS are not close to each other, which should at least be taken into account between Regions 1 and 2 especially in the Atlantic Ocean side.

Figure 3/1.4/3-2 illustrates the difference in the extent of the geographical separation between Regions 1 and 2 in the Atlantic and Pacific regions. Plotted curves represent the separation between the land territories of Regions 1 and 2, measured in degrees (longitude separation), as a function of the geographical latitude due to the presence of the Atlantic and Pacific Oceans, respectively.

FIGURE 3/1.4/3-2



It can be seen from the figure that the geographical separation in the Atlantic region is uniform, and it does not decrease below 40 degrees (except in the case of Iceland and Greenland and that is less than 2% of the total border length), whereas in the Pacific region the separation drops below 40 degrees (over about 50% of the border length) and even falls below 20 degrees in a certain range of latitudes (over about 25% of the border), reaching a minimum value of about 2 degrees. At such separations it is difficult to expect effective geographical discrimination in certain areas of the Pacific region.

In the following sections, the use since WRC-03 of the shared orbital arc resource is evaluated as more FSS and BSS networks have been brought into use and planned in the shared part of the orbital arc, between Regions 1 and 2 under the current Annex 7 to RR Appendix 30 (Rev.WRC-15) regime.

#### 3/1.4/3.1.4 Definition of the term “implemented” networks used in Resolution 557 (WRC-15)

*Recognizing b*) of Resolution 557 (WRC-15) refers to “BSS networks implemented in accordance with the current provisions of Annex 7 to Appendix 30”.

For the avoidance of doubt, the “implemented” networks referred to in this document are related to Regions 1 and 3 BSS networks in the orbital arc 37.2° W and 10° E:

- for which complete RR Appendix 4 information had been received by the Bureau under § 4.1.3 of RR Appendix 30 prior to 28 November 2015, and
- for which complete RR Appendix 4 information had been received by the Bureau under § 4.1.12 of RR Appendix 30 prior to 23 November 2019, and
- for which the complete due diligence information, in accordance with Annex 2 to Resolution 49 (Rev.WRC-15), had been received by the Bureau prior to 23 November 2019, and

- for which complete RR Appendix 4 information had been received by the Bureau under § 5.1.2 of RR Appendix 30 prior to 23 November 2019, and
- brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 23 November 2019.

### **3/1.4/3.2 Annex 7 limitation “A1a” (i.e. No assignments in the Region 1 List further west than 37.2° W in the frequency band 11.7-12.2 GHz)**

#### **3/1.4/3.2.1 Review of the limitation “A1a”**

Limitation “A1a” calls for “No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further west than 37.2° W”. This restriction in the orbital position was designed to protect FSS in Region 2 in the frequency band 11.7-12.2 GHz on the Atlantic Ocean side.

#### **3/1.4/3.2.2 Summary of studies**

Details of sharing studies are contained in § 6 and Appendix 1 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANEX7].

Due to the Atlantic Ocean, which provides geographical separation between the coverage areas in Region 1 and Region 2, the potential for interference between the FSS and the BSS in these Regions is significantly reduced. There may be enough geographic discrimination provided by the Atlantic Ocean to protect the FSS in Region 2 from BSS operating in 11.7-12.2 GHz in Region 1.

The sharing studies show that in all the cases the needed additional discrimination to complete coordination depends largely on the available orbital separation between the interfering and interfered-with network. In addition to that, usage of increased antenna sizes and improved antenna patterns represent factors that influence and could improve the sharing situation.

The sharing studies show that by assuming 20 dB due to geographic discrimination, representative BSS and FSS networks serving different Regions can co-exist without triggering coordination with orbital separations as small as 0.5 degrees (for FSS vs BSS) and 2 degrees (for BSS vs FSS), considering the carrier parameters and a coverage area within the –6 dB antenna gain contour. These small orbital separations further demonstrate that the restriction in the orbital position further west than 37.2° W could be suppressed to allow an RR Appendix 30 Region 1 List system at an orbital position further west than 37.2° W.

Another study shows that by applying 20 dB due to geographical discrimination, which could be feasible due to presence of the Atlantic Ocean between Regions 1 and 2, the coordination problems would be minimal for orbital separations as small as 1.6 degrees (for BSS vs FSS) and 1.3 degrees (for FSS vs BSS), depending on the combination of interfering peak e.i.r.p. and earth station receiving antenna diameter.

Furthermore, there are a large number of notified Region 2 FSS networks in the orbital arc above the Atlantic Ocean. It could be difficult for some new Region 1 BSS filings at orbital positions further west than 37.2° W and intended to operate in the area close to Region 2 to complete coordination. Therefore, it could be necessary to modify the service area and/or decrease the maximum e.i.r.p. over the area close to Region 2 in case of small orbital separations with respect to existing FSS networks in order to overcome all coordination problems with Region 2 FSS networks with earlier dates of receipt of the coordination request information.

In specific situations, with respect to FSS versus BSS networks with small orbital separations (i.e. future Region 2 FSS networks intending to operate in the service area close to the Region 1 border and with very close service areas of Region 2 FSS and future Region 1 BSS networks filed

further west than 37.2° W), deletion of limitation “A1a” could require that such Region 2 FSS networks modify their service area and/or decrease their maximum e.i.r.p. over the area close to Region 1. For such specific cases administrations concerned with such coordination problems would need to make additional efforts to overcome coordination problems to find a mutually acceptable solution.

Besides that, there are two possibilities to mitigate such problems in order to avoid the coordination process:

- a) to use the test points instead of the service area for identification of the need for coordination under Annex 4 to RR Appendix 30 of Region 2 FSS networks with future Region 1 BSS networks which occupy an orbital position further west than 37.2° W;
- b) carry out Annex 4 to RR Appendix 30 examination using part of the Region 1 BSS networks which occupy an orbital position further west than the 37.2° W service area on the land only.

However, for all other cases the relaxation of limitation “A1a” would lead to the situation where coordination is feasible, and in some cases not required, and would not require additional efforts by administrations in the coordination process for future Region 2 FSS networks.

Regarding assignments in the Regions 1 and 3 Plan, the studies demonstrate the protection of the Plan without any potential impact.

Regarding networks in the Regions 1 and 3 List located further east than 37.2° W for which the procedure of Article 4 of RR Appendix 30 has been completed or initiated, the studies demonstrate the protection of Article 4 networks without any potential impact.

Regarding networks in the Regions 1 and 3 List located further east than 37.2° W for which the procedure of Article 4 of RR Appendix 30 would be initiated after the possible deletion of this limitation, the studies demonstrate that in very few limited cases and for very specific conditions, a new Article 4 network located further east than 37.2° W and for which the procedure of Article 4 would be initiated after the possible deletion of this limitation could be impacted with the deletion of limitation “A1a” compared to the same situation without the deletion of such limitation. However the impact has been shown to be minimal.

### **3/1.4/3.2.3 Analysis of the results of the studies**

Limitation “A1a” which calls for “No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further west than 37.2° W” can be deleted, noting in some cases the necessity of additional efforts by administrations concerned in order to successfully resolve the cases of coordination between Region 1 BSS and Region 2 FSS networks submitted after WRC-19 at an orbital position further west than 37.2° W having small orbital separation.

### **3/1.4/3.3 Annex 7 limitation “A1b” (i.e. No assignments in the Region 1 List further east than 146° E in the frequency band 11.7-12.2 GHz)**

#### **3/1.4/3.3.1 Review of the limitation “A1b”**

Limitation “A1b” calls for “No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further east than 146° E”. This restriction in the orbital position was designed to protect FSS in Region 2 in the frequency band 11.7-12.2 GHz on the Pacific Ocean side and Region 3 BSS subject to RR Appendix 30.

### 3/1.4/3.3.2 Summary of studies

Details of sharing studies are contained in § 7 and Appendix 2 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANEX7].

There may be enough geographic discrimination provided by the Pacific Ocean to protect the FSS in Region 2 on the Pacific Ocean side and Region 3 BSS subject to RR Appendix 30 from BSS operating in 11.7-12.2 GHz in Region 1, except in the specific case of the Bering Strait area where there is no geographical discrimination.

The sharing studies show that in all the cases the needed additional discrimination to complete coordination depends largely on the available orbital separation between the interfering and interfered-with network. In addition to that, usage of increased antenna sizes and improved antenna patterns represent factors that influence and could improve the sharing situation.

The sharing studies show that by assuming 20 dB due to geographic discrimination, representative BSS and FSS networks serving different Regions can coexist with orbital separations as small as 0.5 degrees (for FSS vs BSS) and 2 degrees (for BSS vs FSS), depending on the carrier parameters and considering a coverage area within the -6 dB antenna gain contour. It is important to stress that this 20 dB due to geographic discrimination would not be achieved in the areas around the Bering Strait and pfd coordination limits could be exceeded except in cases where the aim points of satellite beams in question (Region 1 BSS and Region 2 FSS) are sufficiently separated<sup>19</sup>. Analysis of certain orbital separations further demonstrate that the restriction in the orbital position further east than 146° E could be suppressed to allow an RR Appendix 30 Region 1 List networks at an orbital position further east than 146° E. However, there could be some specific cases (e.g. same orbital location and very close service areas) that suggest additional efforts could be needed by concerned administrations to resolve such coordination cases.

If limitation "A1b" is suppressed and in case a future Region 1 BSS network is located further east than 146° E, certain future Region 2 FSS satellite networks serving Region 2 may not be allowed to produce high pfd levels in Region 1 areas without triggering coordination, where today they comply with Annex 4 to RR Appendix 30 pfd trigger levels for larger orbital separations as, in order not to trigger coordination, they have to comply with Annex 4 pfd trigger levels for smaller orbital separations than existing Region 2 FSS filings at the same orbital locations. Nevertheless, there are already many FSS networks situated very near to BSS networks.

As for new possible BSS networks, due to the significant number of current FSS networks filed further east than 146° E, it could be difficult for these new networks to complete coordination with Region 2 FSS networks with earlier dates of receipt of the coordination request information.

Therefore, it could be necessary to limit the service area and/or decrease the maximum e.i.r.p. over the area close to Region 2 in order to overcome all coordination problems with Region 2 FSS networks with earlier dates of receipt of the coordination request information. It has to also be stressed the current situation gives considerable overprotection to FSS networks.

In areas with limited geographical separation between Regions 1 and 2 (i.e. Chukotka and Alaska) where the Region 2 FSS and Region 1 BSS coverage areas are very close, future Region 2 FSS satellite networks filed could require additional efforts by administrations in the coordination process for the case of small orbital separations. However, for all other cases the relaxation of this limitation would not bring any additional constraints for future Region 2 FSS networks.

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<sup>19</sup> For instance, in case the Region 1 BSS pfd level produced in the Region 2 territory is limited by the value  $-158.2 \text{ dBW/m}^2/27 \text{ MHz}$  ( $-186.5 \text{ dB(W/(m}^2 \cdot 40 \text{ kHz))}$ ) (see Annex 4), the Region 2 FSS protection will be guaranteed even at orbital separations less than 0.054 degrees.



Another study shows that by applying 20 dB due to geographic discrimination, which could be feasible due to the presence of the Pacific Ocean between Regions 1 and 2 except areas around the Bering Strait, in this part of the orbital arc, the coordination problems would be minimal for orbital separations as small as 1.7 degrees (for BSS vs FSS), depending on the combination of interfering peak e.i.r.p. and earth station receiving antenna diameter.

It should be noted that this 20 dB due to geographic discrimination would not be achieved in the areas around the Bering Strait.

The sharing studies show that in the case of absence of geographic discrimination representative BSS and FSS networks serving different Regions can coexist with orbital separations of 3.5 degrees (for Region 2 FSS vs Region 1 BSS) and 5.8 degrees (for Region 2 BSS vs Region 1 FSS), depending on the carrier parameters (for the edge of coverage limited to the -6 dB antenna gain contour case), assuming that a protected part of the service area is over land.

Due to RR Appendix 30 Annexes 1 and 4 coordination threshold pfd masks, FSS networks in Region 2 and BSS networks in Region 1 in the frequency band 11.7-12.2 GHz could not in any case be forced to accept impermissible interference. The protection of FSS and BSS networks will be determined by the results of coordination.

Regarding assignments in the Regions 1 and 3 Plan, the studies demonstrate the protection of the Plan without any potential impact.

Regarding networks in the Regions 1 and 3 List located further west than 146° E for which the procedure of Article 4 of RR Appendix 30 has been completed or initiated, the studies demonstrate the protection of Article 4 networks without any potential impact.

Regarding networks in the Regions 1 and 3 List located further west than 146° E for which the procedure of Article 4 of RR Appendix 30 would be initiated after the possible deletion of this limitation, the studies demonstrate that in very few limited cases and for very specific conditions, a new Article 4 network located further west than 146° E for which the procedure of Article 4 would be initiated after the possible deletion of this limitation could be impacted with the deletion of limitation "A1b" compared to the same situation without deletion of such limitation. However the impact is assumed to be minimal.

### **3/1.4/3.3.3 Analysis of the results of the studies**

Limitation "A1b" which calls for "No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further east than 146° E" cannot be deleted due to the limited geographical separation between Regions 1 and 2 (i.e. Chukotka and Alaska).

### **3/1.4/3.4 Annex 7 limitation "A2a" (i.e. No modifications in the Region 2 Plan further east than 54° W in the frequency band 12.5-12.7 GHz)**

#### **3/1.4/3.4.1 Review of the limitation "A2a"**

Limitation "A2a" calls for "No broadcasting satellite serving an area in Region 2 and using a frequency in the band 12.5-12.7 GHz shall occupy a nominal orbital position further east than 54° W". This restriction in the orbital position was designed to protect FSS in Region 1 in the frequency band 12.5-12.7 GHz on the Atlantic Ocean side.

#### **3/1.4/3.4.2 Summary of studies**

Details of sharing studies are contained in § 8 and Appendix 3 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

Due to the Atlantic Ocean, which provides geographical separation between the coverage areas in Region 1 and Region 2, the potential for interference between the FSS and the BSS in these Regions is significantly reduced. There may be enough geographic discrimination provided by the Atlantic Ocean to protect the FSS in Region 1 from BSS operating in 12.5-12.7 GHz in Region 2.

The sharing studies show that in all the cases the needed additional discrimination to complete coordination depends largely on the applied orbital separation between the interfering and interfered-with network. In addition to that, usage of increased antenna sizes and improved antenna patterns represent factors that influence and could improve the sharing situation.

The sharing studies show that by assuming 20 dB due to geographic discrimination, representative BSS and FSS networks serving different Regions can coexist without triggering coordination with orbital separations as small as 0.5 degrees (for FSS vs BSS) and 1.9 degrees (for BSS vs FSS), depending on the carrier parameters and considering a coverage area limited to the -6 dB antenna gain contour. These small orbital separations further demonstrate that the restriction in the orbital position further east than 54° W could be suppressed to allow an RR Appendix 30 modifications to the Region 2 Plan at an orbital position further east than 54° W.

Another study shows that by applying 20 dB due to geographic discrimination, which could be feasible due to the presence of the Atlantic Ocean between Regions 1 and 2, the coordination problems would be minimal for orbital separations as small as 1.8 degrees (for BSS vs FSS) and 1.6 degrees (for FSS vs BSS), depending on the combination of interfering peak e.i.r.p. and earth station receiving antenna diameter.

Furthermore, there are a large number of notified Region 1 FSS networks in the orbital arc above the Atlantic Ocean. It could be difficult for some new Region 2 BSS filings at orbital positions further east than 54° W and intended to operate in the area close to Region 1 to complete coordination. Therefore, it could be necessary to modify the service area and/or decrease the maximum e.i.r.p. over the area close to Region 1 in case of small orbital separations with respect to existing FSS networks in order to overcome all coordination problems with Region 1 FSS networks with earlier dates of receipt of the coordination request information.

In specific situations with respect to FSS versus BSS networks with small orbital separations (i.e. future Region 1 FSS network intending to operate in the service area close to the Region 2 border and with very close service areas of future FSS and BSS networks filed further east than 54° W), deletion of limitation "A2a" could require that such Region 1 FSS networks modify their service area and/or decrease their maximum e.i.r.p. over the area close to Region 2. For such specific cases administrations concerned with such coordination problem would need to make additional efforts to overcome coordination problems to find a mutually acceptable solution.

Besides that, there are at least two possibilities to mitigate such problems in order to avoid the coordination process:

- a) to use the test points instead of the service area for identification of the need for coordination under Annex 4 to RR Appendix 30 of Region 1 FSS networks with future Region 2 BSS networks which occupy an orbital position further east than 54° W;
- b) carry out Annex 4 to RR Appendix 30 examination using part of the BSS networks which occupy an orbital position further east than 54° W service area on the land only.

However, for all other cases the relaxation of limitation "A2a" would lead to the situation where coordination is feasible, and in some cases not required, and would not require additional efforts by administrations in the coordination process for future Region 2 FSS networks.

Due to RR Appendix 30 Annexes 1 and 4 coordination threshold pfd masks, FSS networks in Region 2 and BSS networks in Region 1 in the frequency band 11.7-12.2 GHz could not in any case

be forced to accept impermissible interference. The protection of FSS and BSS networks will be determined by the results of coordination.

Regarding assignments in the Region 2 Plan, the studies demonstrate the protection of the Plan without any potential impact.

Regarding Region 2 networks located further west than 54° W for which the procedure of Article 4 of RR Appendix 30 has been completed or initiated, the studies demonstrate the protection of Article 4 networks without any potential impact.

### **3/1.4/3.4.3 Analysis of the results of the studies**

Limitation “A2a” which calls for “No broadcasting satellite serving an area in Region 2 and using a frequency in the band 12.5-12.7 GHz shall occupy a nominal orbital position further east than 54° W” can be deleted, noting the necessity of additional efforts by administrations concerned in order to successfully resolve the cases of coordination between Region 2 BSS and Region 1 FSS networks submitted after WRC-19 at an orbital position further east than 54° W having small orbital separation.

### **3/1.4/3.5 Annex 7 limitation “A2b” (i.e. No modifications in the Region 2 Plan further east than 44° W in the frequency band 12.2-12.5 GHz)**

#### **3/1.4/3.5.1 Review of the limitation “A2b”**

Limitation “A2b” calls for “No modification in the Region 2 Plan further east than 44° W in the band 12.2-12.5 GHz”. This restriction in the orbital position was designed to protect the Region 1 BSS subject to RR Appendix 30 in the frequency band 12.2-12.5 GHz from BSS operating in Region 2.

#### **3/1.4/3.5.2 Summary of studies**

Details of sharing studies are contained in § 9 and Appendix 4 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

Due to the Atlantic Ocean, which provides geographical separation between the coverage areas in Region 1 and Region 2, the potential for interference between the BSS in these Regions is significantly reduced. However there may be enough geographic discrimination provided by the Atlantic Ocean to protect the BSS in Region 1 from BSS operating in 12.2-12.5 GHz in Region 2.

The sharing studies show that in all the cases the needed additional discrimination to complete coordination depends largely on the available orbital separation between the interfering and victim network. In addition to that, usage of increased antenna sizes and improved antenna patterns represent factors that influence and could improve the sharing situation.

The sharing studies show that representative BSS networks serving different Regions can coexist without triggering coordination with orbital separations as small as 2 degrees (Region 2 BSS vs Region 1 BSS) and 2.1 degrees (Region 1 BSS versus Region 2 BSS), depending on the carrier parameters and geographic discrimination assumed and considering a coverage area limited to the –6 dB antenna gain contour. These small orbital separations further demonstrate that the restriction in the orbital position further east than 44° W could be suppressed to allow a RR Appendix 30 Region 2 Plan modification at an orbital position further east than 44° W.

Another study shows that by applying 20 dB due to geographic discrimination, which could be feasible due to the presence of the Atlantic Ocean between Regions 1 and 2, the coordination problems would be minimal for orbital separations as small as 2.2 degrees (for Region 2 BSS vs

Region 1 BSS) and 2.1 degrees (for Region 1 BSS versus Region 2 BSS), depending on the combination of interfering peak e.i.r.p. and earth station receiving antenna diameter.

Regarding assignments in the Region 2 Plan, the studies demonstrate the protection of the Plan without any potential impact.

Regarding Region 2 networks located further west than 44° W for which the procedure of Article 4 has been completed or initiated, the studies demonstrate the protection of Article 4 networks without any potential impact.

### **3/1.4/3.5.3 Analysis of the results of the studies**

Limitation “A2b” which calls for “No modification in the Region 2 Plan further east than 44° W in the band 12.2-12.5 GHz” can be deleted.

### **3/1.4/3.6 Annex 7 limitation “A2c” (i.e. No modifications in the Region 2 Plan further west than 175.2° W in the frequency band 12.2-12.7 GHz)**

#### **3/1.4/3.6.1 Review of the limitation “A2c”**

Limitation “A2c” calls for “No broadcasting satellite serving an area in Region 2 and using a frequency in the band 12.2-12.7 GHz shall occupy a nominal orbital position further west than 175.2° W”. This restriction in the orbital position was designed to protect FSS in Region 1 in the frequency band 12.5-12.7 GHz, BSS in Region 1 subject to RR Appendix 30 in the frequency band 12.2-12.5 GHz and FSS in Region 3 in the frequency band 12.2-12.7 GHz on the Pacific Ocean side.

#### **3/1.4/3.6.2 Summary of studies**

Details of sharing studies are contained in § 10 and Appendix 5 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

The sharing studies show that in all the cases the needed additional discrimination to complete coordination depends largely on the available orbital separation between the interfering and interfered-with network. In addition to that, usage of increased antenna sizes and improved antenna patterns represent factors that influence and could improve the sharing situation.

The sharing studies show that by assuming 20 dB due to geographic discrimination, representative BSS and FSS networks serving different Regions can coexist without triggering coordination with orbital separations as small as 0.5 degrees (for Region 1 FSS versus Region 2 BSS) and 1.9 degrees (for Region 2 BSS versus Region 1 FSS), depending on the carrier parameters and considering a coverage area limited to the –6 dB antenna gain contour. It is important to stress that this 20 dB due to geographic discrimination would not be achieved in the areas around the Bering Strait, therefore significant service area separation would not be achieved, so that orbital separation between networks would be the only source of discrimination.

The sharing study shows that in the case of absence of geographic discrimination representative BSS and FSS networks serving different Regions can coexist with orbital separations of 4.4 degrees (for Region 1 FSS versus Region 2 BSS) and 5.8 degrees (for Region 2 BSS versus Region 1 FSS), depending on the carrier parameters (for the edge of coverage limited to the –6 dB antenna gain contour case).

However, there could be some specific cases (e.g. same orbital location and very close service areas) that suggest additional efforts by concerned administrations to resolve such coordination cases.

Another study shows that by applying 20 dB due to geographic discrimination, which could be feasible due to presence of the Pacific Ocean between Regions 1 and 2 in this part of the orbital arc, the coordination problems would be minimal for orbital separations as small as 1.6 degrees (for Region 2 BSS versus Region 3 FSS) and 1.6 degrees (for Region 3 FSS versus Region 2 BSS), depending on the combination of interfering peak e.i.r.p. and earth station receiving antenna diameter. It should be noted that this 20 dB due to geographic discrimination would not be achieved in the areas around the Bering Strait and pfd coordination limits could be exceeded.

If limitation “A2c” is suppressed and in case a future Region 2 BSS network is located further west than 175.2° W, certain future Region 1 and 3 FSS satellite networks serving Regions 1 and 3 may not be allowed to create high pfd levels in Region 2 areas without triggering coordination, where today they comply with Annex 4 to RR Appendix 30 pfd trigger levels for larger orbital separations as, in order not to trigger coordination, they have to comply with Annex 4 pfd trigger levels for smaller orbital separations than existing Region 1 and 3 FSS filings at the same orbital locations. Nevertheless, there are already many FSS networks situated very near to BSS networks.

As for new possible BSS networks, due to the significant number of current FSS network filed further west than 175.2° W, it could be difficult for these new networks to complete coordination with Region 1 and 3 FSS networks with earlier dates of receipt of the coordination request information.

Therefore it could be necessary to limit the service area and/or decrease the maximum e.i.r.p. over the area close to Region 2 in order to overcome all coordination problems with Region 2 FSS networks with earlier dates of receipt of the coordination request information. It has to also be stressed the current situation gives considerable overprotection to FSS networks.

In areas with limited geographical separation between Regions 1 and 2 (i.e. Chukotka and Alaska) where the Region 1 FSS and Region 2 BSS coverage areas are very close, future Regions 1 and 3 FSS satellite networks filed could require additional efforts by administrations in the coordination process for the case of small orbital separations.

However, for all other cases the relaxation of limitation “A2c” would not bring any additional constraints for future Regions 1 and 3 FSS satellite networks.

If it were not for small geographical spacing between Regions 1 and 2 around the Bering Strait these small orbital separations could further demonstrate that the restriction in the orbital position “further west than 175.2° W” could be suppressed to allow RR Appendix 30 Region 2 networks at orbital positions further “west than 175.2° W”.

Due to RR Appendix 30 Annexes 1 and 4 coordination threshold pfd masks, BSS networks in Region 1 in the frequency band 12.2-12.5 GHz, FSS networks in Region 1 in the frequency band 12.5-12.7 GHz, and BSS networks in Region 2 in the frequency band 12.2-12.7 GHz could not be forced to accept impermissible interference. The protection of FSS and BSS networks will be determined by the results of coordination.

Regarding assignments in the Region 2 Plan, the studies demonstrate the protection of the Plan without any potential impact.

Regarding Region 2 networks located further east than 175.2° W for which the procedure of Article 4 of RR Appendix 30 has been completed or initiated, the studies demonstrate the protection of Article 4 networks without any potential impact.

### 3/1.4/3.6.3 Analysis of the results of the studies

Limitation “A2c” which calls for “No modification in the Region 2 Plan further west than 175.2° W in the band 12.2-12.7 GHz” cannot be deleted due to the limited geographical separation between Regions 1 and 2 (i.e. Chukotka and Alaska).

### 3/1.4/3.7 Annex 7 limitation “A3a” (i.e. No assignments in the Regions 1 and 3 List outside specific positions in the frequency band 11.7-12.2 GHz)

#### 3/1.4/3.7.1 Review of the limitation “A3a”

Section 3 of Annex 7 to RR Appendix 30 defines orbital position and e.i.r.p. limitations in the orbital arc 37.2° W-10° E, which were developed to preserve access to the geostationary-satellite orbit by the Region 2 FSS in the frequency band 11.7-12.2 GHz. The limitations state that the orbital position associated with any proposed new or modified assignment in the Regions 1 and 3 List of additional uses shall lie within one of the portions of the orbital arc listed in the table below.

TABLE 3/1.4/3.7.1-1  
Allowable portions of the orbital arc between 37.2° W and 10° E for assignments in the Regions 1 and 3 Plan and List

Allowable orbital position										
37.2° W to 36° W	33.5° W to 32.5° W	30° W to 29° W	26° W to 24° W	20° W to 18° W	14° W to 12° W	8° W to 6° W	4° W	2° W to 0° E	4° E to 6° E	9° E

Note - Table 3/1.4/3.7.1-1 is similar to Table 1 in Annex 7 to RR Appendix 30.

#### 3/1.4/3.7.2 Summary of studies

Details of sharing studies are contained in § 11 and Appendix 6 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

Study 1 shows that regarding intra-service sharing (i.e. Region 1 BSS vs Region 1 BSS), a noise increase by 0–7.85 dB in the worst case of the interference level (relative to the  $\Delta T/T$  obtained from two networks in adjacent allowable portions and only for two orbital positions - relative of ~6%) will be received by an earth station with antenna size 40 cm (that an incumbent is forced to accept in case WRC-19 would decide to remove the Annex 7 limitation A3a (Section A3 of Annex 7 to RR Appendix 30) if no additional specific measures would be considered. This result was obtained considering only two interfering satellites in compliance with Annex 1 pfd mask when they are placed in the worst positions in terms of causing interference, and it is recognized that the interference will be higher if more than two interfering satellites are to be considered. Therefore, there may be a risk that an existing satellite network implementing earth stations with antenna size 40 cm under the current regulatory regime defined by current orbit limitations in Annex 7 to RR Appendix 30, would not be able to continue its operation due to the possible additional level of interference that an incumbent might be forced to accept, unless no additional specific measures are considered. Such situation would be in contradiction to *recognizing b*) of Resolution 557 (WRC-15), stating: “that existing FSS networks operating in the frequency bands mentioned in *considering b*) and BSS networks implemented in accordance with the current provisions of Annex 7 to RR Appendix 30 shall continue to be protected”. Study 1 shows that the current protection

criteria in Annex 1 do not provide protection of antennas smaller than 60 cm for Region 1 and 3 BSS, in particular antenna size 40 cm.

At present there are six assignments in the orbital arc 37.2° W-10° E having antennas smaller than 60 cm in three different orbital locations: 33.5° W, 30° W, 5° E. According to this study noise increase in the worst case of the interference level for these orbital locations, and antenna 40 cm amount to 0.25/0.23 dB, 1.1/1.1 dB, 2.16/2.4 dB accordingly. But all mentioned assignments have antenna size 45 cm, except the one in 4.8° E having antennas of 40 cm, so noise increase will be smaller for antenna size 45 cm than mentioned.

Note - Values of noise increase are taken from Appendix 6, Section 1.1.1, of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7].

Study 2 calculates the pfd mask required to protect existing networks implementing earth stations with antenna size less than 0.60 m.

Studies 1 and 2 show the necessity to develop protection measures (see § 11.3.2 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7]) for implemented networks which are located in the allowable portions of the orbital arc 37.2° W-10° E with antenna sizes lower than 60 cm, from new possible network in previously forbidden arc portions, if the Annex 7 limitation “A3a” is suppressed.

Study 3 provides an assessment of the existing levels of protection of receiving stations with small antennas, in particular antenna size of 40 cm and examines to what extent the current regulatory framework allows to implement networks, using antennas smaller than 60 cm, while maintaining the same level of protection  $\Delta T/T=6\%$ , as defined by Annex 1 (Section 1) by determining the level of interference and  $\Delta T/T$  that may be currently caused by space stations (compliant with Annex 1 pfd mask) located in the adjacent allowable orbital arc positions (see §§ 11.2-11.4. and Section 3 of Appendix 6 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7]).

Additional studies show that forbidden arc portions protect networks with “small” antennas from allowed by Annex 1 interference at which  $\Delta T/T=6-41.27\%$ , but the same levels of interference can be caused by networks located in allowable arc portions (see §§ 11.2-11.4 and Section 3.7 of Appendix 6 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7]). Besides only part of forbidden arc portion provides protection to “small” antennas, that compensates lower selectivity ranges, so part of the forbidden arc portion can be eliminated from the point of view of preserving the protection of implemented<sup>20</sup> networks with “small” antennas from networks complying with Annex 1 pfd mask.

Thus, by itself, the presence of forbidden arc sections does not guarantee 6% interference level to earth stations with small antennas from networks complying with Annex 1 pfd mask.

Therefore, it cannot be claimed that forbidden arc portions always provide protection for a station with a “small” antenna, the presence of forbidden arc portions only reduces the probability of causing interference greater than 6% by networks in compliance with Annex 1 pfd mask.

However, in conclusion Study 3 determined that the network filed both in the allowable and forbidden portions of the orbital arc and being in compliance with Annex 1 pfd mask may cause interference to the earth station with 40 cm antenna resulting in  $\Delta T/T$  up to 41.27% and such levels of interference must be accepted.

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<sup>20</sup> See § 3/1.4/3.1.4.

Due to the nature of the Annex 1 pfd mask, only part of the forbidden arc portion provides protection from networks complying with this mask to networks with antenna sizes lower than 60 cm therefore part of the forbidden arc portion can be eliminated.

Study 4 shows possible implications to efficient protection of BSS satellite networks operating in this orbital arc with receiving earth station antennas of diameters smaller than 60 cm.

The current pfd protection masks that serve for the protection of Regions 1 and 3 planned BSS networks do not include the protection of receiving earth station antennas with diameters smaller than 60 cm. For example, between 2° and 5° of orbital separation the 45 cm receiving earth station antenna needs up to 7.2 dB bigger protection. Therefore, in the case of revision or complete suppression of this limitation, currently implemented<sup>2</sup> receiving earth station antennas with diameters smaller than 60 cm might not be sufficiently protected.

Study 5 shows that for antenna sizes greater than or equal to 60 cm, the deletion of the Annex 7 limitation “A3a” will not impact Regions 1 and 3 BSS networks located within the allowable portions of the orbital arc 37.2° W-10° E for which the procedure of Article 4 has been completed or initiated, given that the pfd mask for intra-service sharing in BSS in Regions 1 and 3 (i.e. Section 1 of Annex 1 of RR Appendix 30), was developed for these antenna sizes.

Study 6 shows that the level of EPM/pfd degradation caused by Regions 1 and 3 networks located within the allowable portions of the orbital arc in accordance to Table 1 of Annex 7 to RR Appendix 30, and for which the procedure of Article 4 of RR Appendix 30 would be initiated after the possible deletion of this limitation with respect to potential Region 1 BSS networks located within the forbidden arc according to Table 1 of Annex 7 to RR Appendix 30, is lower than the degradation caused to Region 1 BSS networks located within the allowable portions of the orbital arc in accordance to Table 1 of Annex 7 to RR Appendix 30.

### **3/1.4/3.7.3 Analysis of the results of the studies**

Limitation “A3a” which calls for “No modification in the Regions 1 and 3 List outside specific allowable portions of the orbital arc between 37.2° W and 10° E in the band 11.7-12.2 GHz” can be deleted, subject to additional measures ensuring the protection of, and without imposing additional constraints on, assignments in the Plan and in the List which are located in the allowable portion of the orbital arc 37.2° W-10° E and including those which have antenna sizes lower than 60 cm (see Section 11.3 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANEX7]).

### **3/1.4/3.8 Annex 7 limitation “A3b” (i.e. Maximum e.i.r.p. 56 dBW for assignments in the Regions 1 and 3 for specific positions in the frequency band 11.7-12.2 GHz)**

#### **3/1.4/3.8.1 Review of the limitation “A3b”**

Section 3 of Annex 7 to RR Appendix 30 defines orbital position and e.i.r.p. limitations in the orbital arc 37.2° W-10° E, which were developed to preserve access to the geostationary-satellite orbit by the Region 2 FSS in the frequency band 11.7-12.2 GHz.

This specific limitation (i.e. Annex 7 limitation “A3b”) states Region 1 BSS networks located within the allowable portion of the orbital arc 37.2° W-10° E but not coincident with any nominal orbital position in the Plan at the date of entry into force of the Final Acts of the 1977 Conference shall not transmit an e.i.r.p. greater than 56 dBW.

This constraint was historically developed as the Annex 7 to RR Appendix 30 limitation “A3a” to protect Region 2 FSS networks. As for operational constraints, it is not always feasible to locate the Region 1 BSS network at the exact orbital position; it was decided to give some flexibility on the restricted orbital arc allowable in the orbital arc 37.2° W-10° E but in the same time to not put to



many constraints into Region 2 FSS, it was decided to limit the power of these Region 1 BSS which are not located at the exact nominal orbital position.

Until the revision of Annex 7 to RR Appendix 30 by the WRC-2000, networks located within this arc but not coincident with any nominal orbital position in the 1977 Plan were obliged to reduce their e.i.r.p. by 8 dB compared to that appearing in the Regions 1 and 3 Plan. WRC-2000 reviewed this strong constraint and decided to keep this concept but with less reduction and finally agreed to this 56 dBW limit.

TABLE 3/1.4/3.8.1-1  
Portions of the orbital arc between 37.2° W and 10° E for assignments in the Regions 1 and 3 List with maximum e.i.r.p. of 56 dBW

Orbital position with maximum e.i.r.p. of 56 dBW limitation
] 36.8° W ; 36° W ]
] 33.5° W ; 32.5° W ]
] 30° W ; 29° W ]
[ 26° W ; 25.2° W [
] 24.8° W ; 24° W ]
[ 20° W ; 19.2° W [
] 18.8° W ; 18° W ]
[ 14° W ; 13.2° W [
] 12.8° W ; 12° W ]
[ 8° W ; 7.2° W [
] 6.8° W ; 6° W ]
[ 2° W ; 1.2° W [
] 0.8° W ; 0° E ]
[ 4° E ; 4.8° E [
] 5.2° E ; 6° E ]

### 3/1.4/3.8.2 Summary of studies

As this reduction of e.i.r.p. was to only protect Region 2 FSS in addition of Annex 7 to RR Appendix 30 limitation “A3a”, studies performed under Section 2 of Appendix 6 and Section 2 of Appendix 1 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7] are also applicable to this case.

### 3/1.4/3.8.3 Analysis of the results of the studies

As studies in Annex 6 of the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7] show the feasibility to suppress the Annex 7 limitation “A3a” without the necessity to impose e.i.r.p. limitation to Region 1 BSS networks depending on their specific orbital position, *de facto* the Annex 7 to RR Appendix 30 limitation “A3b” could also be suppressed.

### **3/1.4/3.9 Annex 7 limitation “A3c” (i.e. Maximum pfd of $-138 \text{ dB(W/m}^2 \cdot 27 \text{ MHz)}$ ) in Region 2 by assignments in the Regions 1 and 3 List at $4^\circ \text{ W}$ and $9^\circ \text{ E}$ in the frequency band 11.7-12.2 GHz)**

#### **3/1.4/3.9.1 Review of the limitation “A3c”**

Orbital positions  $4^\circ \text{ W}$  and  $9^\circ \text{ E}$  were initially not coincident with any nominal orbital position in the Plan at the date of entry into force of the Final Acts of the 1977 Conference but were added by WRC-2000 during the replanning process following specific requests made by two administrations. As a compromise solution, WRC-2000 agreed these two specific requests subject to some additional protection measure over Region 2 to specifically protect Region 2 FSS networks.

#### **3/1.4/3.9.2 Summary of studies**

As this specific pfd limit over Region 2 was to only protect Region 2 FSS for these two specific orbital positions, studies performed under Section 2 of Appendix 6 and Section 2 of Appendix 1 to the working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7] are also applicable to this case.

#### **3/1.4/3.9.3 Analysis of the results of the studies**

As studies in Appendix 6 of working document towards a preliminary draft new Report ITU-R BO.[AP30.ANNEX7] show the feasibility to suppress the Annex 7 to RR Appendix 30 limitation “A3a” without the necessity to impose additional pfd limits over Region 2 to Region 1 BSS networks depending on their specific orbital position, *de facto* the Annex 7 limitation “A3c” could also be suppressed.

### **3/1.4/3.10 Annex 7 limitation “B” (i.e. Region 2 cluster in the frequency band 12.2-12.7 GHz)**

#### **3/1.4/3.10.1 Review of the limitation “B”**

The Region 2 BSS Plan is based on the grouping of the space stations in nominal orbital positions of  $\pm 0.2^\circ$  from the centre of the cluster of satellites. Administrations may locate those satellites within a cluster at any orbital position within that cluster, provided they obtain the agreement of administrations having assignments to space stations in the same cluster.

It is proposed to keep limitation “B” unchanged and not suppress it.

### **3/1.4/4 Methods to satisfy the agenda item**

The methods to satisfy the agenda item are considered below for each Annex 7 to RR Appendix 30 limitation as defined in Table 3/1.4/2-1.

Any additional measures ensuring the protection of the implemented networks in the Regions 1 and 3 List shall cease to be in accordance with the period of operation of assignments in the List specified in § 4.1.24 of Article 4 RR Appendix 30 (Rev.WRC-15).

#### **3/1.4/4.1 Method A: no change**

This method proposes no change to Annex 7 to RR Appendix 30 and suppression of Resolution 557 (WRC-15).

#### **3/1.4/4.2 Method B: Deletion of some limitations of Annex 7 and addition of draft new Resolutions [A14-LIMITA3] (WRC-19), [B14-PRIORITY] (WRC-19)**

This method proposes to delete the following limitations of Annex 7 to RR Appendix 30:

- limitations “A1a”, “A2a”, “A2b”, “A3b”, and “A3c”;

- limitation “A3a” accompanied by draft new Resolution [A14-LIMITA3] (WRC-19) to guarantee the protection of frequency assignments with earth station receiving antenna size smaller than 60 cm (40 cm and 45 cm), in accordance with the criteria of RR Appendix 30 (Rev.WRC-15).

This method proposes to retain limitations “A1b”, “A2c” and “B”.

This method also proposes the application of draft new Resolution [B14-PRIORITY] (WRC-19) after the removal of the relevant limitations in Annex 7 to RR Appendix 30 (Rev.WRC-15), giving priority to national assignments in the Regions 1 and 3 Plan with equivalent downlink protection margin values equal or below –10 dB.

In addition, this method proposes suppression of Resolution 557 (WRC-15).

#### **3/1.4/4.3 Method C: Deletion of some limitations of Annex 7, addition of draft new Resolutions [A14-LIMITA3] (WRC-19), [B14-PRIORITY] (WRC-19) and application of draft new Resolution [C14-LIMITA1A2] (WRC-19) with revised criteria for protection of future BSS networks with respect to limitations “A1a” and “A2a”**

This method proposes to delete the following limitations of Annex 7 to RR Appendix 30:

- limitations “A1a” and “A2a” and the application of draft new Resolution [C14-LIMIT-A1A2] (WRC-19) with revised criteria for protection of future BSS networks;
- limitations “A2b”, “A3b”, “A3c”;
- limitations “A3a” accompanied by draft new Resolution [A14-LIMITA3] (WRC-19) to guarantee the protection of frequency assignments with earth station receiving antenna size smaller than 60 cm (40 cm and 45 cm), in accordance with the criteria of RR Appendix 30 (Rev.WRC-15).

This method proposes to retain limitations “A1b”, “A2c” and “B”.

This method also proposes the application of draft new Resolution [B14-PRIORITY] (WRC-19) after the removal of the relevant limitations in Annex 7 to RR Appendix 30 (Rev.WRC-15), giving priority to national assignments in the Regions 1 and 3 Plan with equivalent downlink protection margin values equal or below –10 dB.

In addition, this method proposes suppression of Resolution 557 (WRC-15).

#### **3/1.4/5 Regulatory and procedural considerations**

The regulatory and procedural considerations to satisfy the agenda item are considered below for each of the proposed methods defined in section 3/1.4/4.

It should be noted that all proposed methods implicitly assume suppression (SUP) of Resolution 557 (WRC-15).

**3/1.4/5.1 For Method A**

**APPENDIX 30 (REV.WRC-15)\***

**Provisions for all services and associated Plans and List<sup>1</sup> for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)**

**NOC**

**ANNEX 7 (REV.WRC-03)**

**Orbital position limitations**

**SUP**

**RESOLUTION 557 (WRC-15)**

**Consideration of possible revision of Annex 7 to Appendix 30 of the Radio Regulations**

**3/1.4/5.2 For Method B**

**APPENDIX 30 (REV.WRC-15)\***

**Provisions for all services and associated Plans and List<sup>1</sup> for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)**

**MOD**

**ANNEX 7 (REV.WRC-03)**

**Orbital position limitations<sup>ADD YY</sup>**

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<sup>YY</sup> See draft new Resolution [A14-LIMITA3] (WRC-19).

**MOD**

- 1) No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further east than 146° E.

**MOD**

- 2) No broadcasting satellite serving an area in Region 2 that involves an orbital position different from that contained in the Region 2 Plan shall occupy a nominal orbital position:

further west than 175.2° W in the band 12.2-12.7 GHz.

However, modifications necessary to resolve possible incompatibilities during the incorporation of the Regions 1 and 3 feeder-link Plan into the Radio Regulations shall be permitted.

**SUP**

- 3) The purpose of the following orbital position and e.i.r.p. limitations is to preserve access to the geostationary-satellite orbit by the Region 2 fixed-satellite service in the band 11.7-12.2 GHz. Within the orbital arc of the geostationary-satellite orbit between 37.2° W and 10° E, the orbital position associated with any proposed new or modified assignment in the Regions 1 and 3 List of additional uses shall lie within one of the portions of the orbital arc listed in Table 1. The e.i.r.p. of such assignments shall not exceed 56 dBW, except at the positions listed in Table 2.

**SUP**

TABLE 1

**Allowable portions of the orbital arc between 37.2° W and 10° E for new or modified assignments in the Regions 1 and 3 Plan and List**

<b>Orbital position</b>	37.2° W to 36° W	33.5° W to 32.5° W	30° W to 29° W	26° W to 24° W	20° W to 18° W	14° W to 12° W	8° W to 6° W	4° W <sup>1</sup>	2° W to 0°	4° E to 6° E	9° E <sup>1</sup>
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<sup>1</sup> Proposed new or modified assignments in the List which involve this orbital position shall not exceed the power flux-density limit  $-138 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  at any point in Region 2.

**SUP**

TABLE 2

**Nominal positions in the orbital arc between 37.2° W and 10° E at which the e.i.r.p. may exceed the limit of 56 dBW**

<b>Orbital position</b>	37° W $\pm 0.2^\circ$	33.5° W	30° W	25° W $\pm 0.2^\circ$	19° W $\pm 0.2^\circ$	13° W $\pm 0.2^\circ$	7° W $\pm 0.2^\circ$	4° W <sup>1</sup>	1° W $\pm 0.2^\circ$	5° E $\pm 0.2^\circ$	9° E <sup>1</sup>
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<sup>1</sup> Proposed new or modified assignments in the List which involve this orbital position shall not exceed the power flux-density limit  $-138 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  at any point in Region 2.

## NOC

B The Region 2 Plan is based on the grouping of the space stations in nominal orbital positions of  $\pm 0.2^\circ$  from the centre of the cluster of satellites. Administrations may locate those satellites within a cluster at any orbital position within that cluster, provided they obtain the agreement of administrations having assignments to space stations in the same cluster. (See § 4.13.1 of Annex 3 to Appendix **30A**.)

## ADD

### DRAFT NEW RESOLUTION [A14-LIMITA3] (WRC-19)

#### **Protection of implemented BSS networks in the orbital arc of the geostationary-satellite orbit between $37.2^\circ \text{ W}$ and $10^\circ \text{ E}$ in the frequency band 11.7-12.2 GHz**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that the provisions applying to the broadcasting-satellite service (BSS) in the frequency bands 11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3 are contained in Appendix **30**;
- b) that systems in the fixed-satellite service (FSS) and the broadcasting-satellite service share the frequency band 11.7-12.2 GHz;
- c) that WRC-19 suppressed the limitation in Section 3 Annex 7 to Appendix **30 (Rev.WRC-15)** which determined allowable portions of the orbital arc between  $37.2^\circ \text{ W}$  and  $10^\circ \text{ E}$  for new or modified assignments in the frequency band 11.7-12.2 GHz in the Regions 1 and 3 List;
- d) that Section 1 of Annex 1 to Appendix **30 (Rev.WRC-15)** provides criteria used for determination of coordination requirements for frequency assignments of Regions 1 and 3 Plan and List;
- e) that Section 1 of Annex 1 to Appendix **30 (Rev.WRC-15)** pfd mask values are based on the parameters adopted by WRC-2000 based on the minimum earth station receiving antenna size of 60 cm;
- f) that the use of this frequency band by the BSS is subject to the coordination procedure of Article 4 of Appendix **30 (Rev.WRC-19)**,

*noting*

- a) that the ITU Radiocommunication Sector (ITU-R) has carried out a significant amount of studies in preparation for conferences on BSS planning, and has developed a number of Reports and Recommendations;

- b) that within the orbital arc of the geostationary-satellite orbit between 37.2° W and 10° E before WRC-19 there were limitations on the use of some orbital positions for any proposed new or modified assignment in the Regions 1 and 3 List of additional uses in the frequency band 11.7-12.2 GHz;
- c) that some networks with an earth station receiving antenna size smaller than 60 cm were successfully implemented within the orbital arc mentioned in *noting b)*, in view of the protection due to the presence of limitations on the use of orbital positions in this orbital arc;
- d) that with the deletion of orbital position limitations, the protection of satellite assignments mentioned in *noting c)* shall be ensured;
- e) that the geostationary-satellite orbit between 37.2° W and 10° E is widely used by Region 1 BSS and Region 2 FSS networks;
- f) that equitable access to and efficient use of the 12 GHz frequency range should be encouraged,

*resolves*

1 that this Resolution is applicable only to implemented<sup>1</sup> networks with an earth station receiving antenna size smaller than 60 cm (40 cm and 45 cm) as outlined in Annex 1 of this Resolution;

2 that frequency assignments of the networks mentioned in *resolves 1* above are considered by the Bureau as being affected by a proposed new or modified assignment in the List filed to the GSO orbital positions mentioned in Annex 1 to this Resolution, only if the following conditions specified in Annex 1 of Appendix **30 (Rev.WRC-19)** are met:

- the minimum orbital spacing between the wanted and interfering space stations, under worst-case station-keeping conditions, is less than 9°;
- the reference equivalent downlink protection margin corresponding to at least one of the test points of that wanted assignment, including cumulative effect of any previous modification to the List or any previous agreement, falls more than 0.45 dB below 0 dB, or if already negative, more than 0.45 dB below that reference equivalent protection margin value;

3 that for cases, when a proposed new assignment in the List is filed within the geostationary orbital arc between 37.2° W and 10° E in orbital arc segments that differ from those

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<sup>1</sup> For the avoidance of doubt, the “implemented” networks referred to are related to Regions 1 and 3 BSS networks in the orbital arc 37.2° W and 10° E:

- for which complete Appendix **4** information had been received by the Bureau under § 4.1.3 of Appendix **30** prior to 28 November 2015, and
- for which complete Appendix **4** information had been received by the Bureau under § 4.1.12 of Appendix **30** prior to 23 November 2019, and
- for which the complete due diligence information, in accordance with Annex 2 to Resolution **49 (Rev.WRC-15)**, had been received by the Bureau prior to 23 November 2019, and
- for which complete Appendix **4** information had been received by the Bureau under § 5.1.2 of Appendix **30** prior to 23 November 2019, and
- brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 23 November 2019.

in Annex 1 to this Resolution, appropriate provisions of Annex 1 Appendix 30 (Rev.WRC-19) to determine the need for coordination, continue to be applied with respect to relevant frequency assignments of satellite networks mentioned in *resolves* 1.

## ANNEX 1 TO DRAFT NEW RESOLUTION [A14-LIMITA3] (WRC-19)

### Satellite networks and orbital arc segments for which this Resolution is applicable

Satellite networks for which this Resolution applies					Orbital arc segments where the conditions specified in <i>resolves</i> 2 of this Resolution apply
Orbital position	Earth station antenna size, cm	Satellite network	Date of receipt of part A submission	Notice Id Part II	
33.5° W	45	UKDIGISAT-4C	09.10.2014	TBD	36.0° W < $\theta$ ≤ 35.36° W; 31.64° W ≤ $\theta$ < 30.0° W; 29.0° W < $\theta$ ≤ 28.58° W;
30.0° W	45	HISPASAT-1	08.02.2000	99500256	34.92° W ≤ $\theta$ < 33.5° W; 32.5° W < $\theta$ ≤ 31.86° W; 28.14° W ≤ $\theta$ < 26.0° W;
		HISPASAT-37A	19.11.2014	117560019	
4.8° E	40	SIRIUS-N-BSS	17.11.2014	TBD	0 < $\theta$ ≤ 2.85° E; 6.75° E ≤ $\theta$ < 9.0° E; 9° E < $\theta$ ≤ 10° E;

Where  $\theta$  is the orbital position within the orbital segment defined in the table above.

*Note: Currently, the proposed table contains all possible satellite networks that could comply with the conditions specified in resolves 1. WRC-19 will update this table to reflect the satellite networks that in fact comply with these conditions.*

#### ADD

## DRAFT NEW RESOLUTION [B14-PRIORITY] (WRC-19)

### Additional temporary regulatory measures following deletion of part of Annex 7 to Appendix 30 by WRC-19

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that some national assignments especially those of developing countries in the Regions 1 and 3 Plan have equivalent downlink protection margin values in the Appendix 30 equal to or below -10 dB;
- b) that implementation of a national assignment in the Regions 1 and 3 Plan with an equivalent downlink protection margin equal or below -10 dB would be difficult;



c) that any modification of orbital position and other parameters of a national assignment in the Appendix 30 Plan would require a corresponding modification of the orbital position and other parameters in the Appendix 30A feeder-link Plan,

*recognizing*

a) that Article 44 of the ITU Constitution stipulates that: “*In using frequency bands for radio services, Member States shall bear in mind that radio frequencies and any associated orbits, including the geostationary-satellite orbit, are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulations, so that countries or groups of countries may have equitable access to those orbits and frequencies, taking account the special needs of the developing countries and the geographical situation of particular countries*”;

b) that Resolution 71 (Rev. Busan, 2014) of the Plenipotentiary Conference, ITU includes the ITU strategic plan for 2016-2019, which contains, as one of the strategic objectives of ITU-R: “*Meet, in a rational, equitable, efficient, economical and timely way, the ITU membership’s requirements for radio-frequency spectrum and satellite-orbit resources, while avoiding harmful interference*”,

*resolves*

1 that as of the “*date of entry into force of this Resolution*” and for a period of 90 (this period is only indicative) days, the special procedure outlined in the Attachment to this Resolution shall be applied in respect of submissions of Regions 1 and 3 administrations meeting the specified requirements in § 1 of the Attachment;

2 that as of the “*date of entry into force of this Resolution*” and for a period of 90 (this period depends on decision on *resolves* 1) days, submissions under § 4.1.3 of Appendices 30 and 30A in Regions 1 and 3 not meeting the specified requirements in § 1 of the Attachment to the Resolution at an orbital position of orbital arcs for which the Annex 7 to Appendix 30 (Rev.WRC-15) limitations were suppressed by WRC-19 shall be considered as received by the BR on the “*date of entry into force of this Resolution*” + 91 days,

*instructs the Director of the Radiocommunication Bureau*

to identify the administrations that meet the conditions of Section 1 of the Attachment to this Resolution and inform these administrations accordingly.

## ATTACHMENT TO DRAFT NEW RESOLUTION [B14-PRIORITY] (WRC-19)

### **Additional temporary regulatory measures following deletion of part of Annex 7 to Appendix 30 by WRC-19**

1 The special procedure described in this attachment can only be applied once by an administration with:

- a) no frequency assignments included in the List or for which complete Appendix 4 information has been received by the Bureau in accordance with the provision of § 4.1.3 of Appendix 30; and
- b) an assignment in the Regions 1 and 3 Plan of Appendix 30 when the equivalent downlink protection margin (EPM) value corresponding to a test point of its national assignment in the Regions 1 and 3 Plan is equal or below –10 dB for at least 50% of the

total number of EPM values of the assignment in the Regions 1 and 3 Plan in Appendix **30**.

2 Administrations seeking to apply this special procedure shall submit their request to the Bureau, with the information specified in § 4.1.3 of Appendices **30** and **30A**, in particular this information shall include:

- a) in the cover letter to the Bureau, the information that the administration requests the use of this special procedure together with the name of the Plan assignments for which condition defined in § 1 above is met;
- b) a service area is limited to the national territory as defined in the GIMS software application;
- c) a set of maximum 20 test points inside the national territory;
- d) a minimal ellipse determined by the set of test points submitted in c) above. An administration may request the Bureau to create such diagram;
- e) maximum ten channels for a Region 1 administration or 12 channels for a Region 3 administration with a bandwidth of 27 MHz;
- f) a corresponding submission for the Appendix **30A** feeder-link Plan in compliance with items b),c), d) and e) above.

3 Upon receipt of the complete information from an administration sent under § 3 above, the Bureau shall process the submissions in date order in accordance with Article 4 of Appendices **30** and **30A**.

4 The notifying administration shall request the subsequent WRCs to consider the inclusion in the Appendices **30** and **30A** Plans as a replacement of its national assignments appearing in the Plans, pursuant to paragraph 4.1.27 of Article 4 of Appendices **30** and **30A**.

**SUP**

## RESOLUTION 557 (WRC-15)

### **Consideration of possible revision of Annex 7 to Appendix 30 of the Radio Regulations**

**3/1.4/5.3 For Method C**

**APPENDIX 30 (REV.WRC-15)\***

**Provisions for all services and associated Plans and List<sup>1</sup> for  
the broadcasting-satellite service in the frequency bands  
11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1)  
and 12.2-12.7 GHz (in Region 2) (WRC-03)**

**MOD**

**ANNEX 7 (REV.WRC-03)**

**Orbital position limitations<sup>ADD YY, ADD ZZ</sup>**

**MOD**

- 1) No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further east than 146° E.

**MOD**

- 2) No broadcasting satellite serving an area in Region 2 that involves an orbital position different from that contained in the Region 2 Plan shall occupy a nominal orbital position:  
further west than 175.2° W in the band 12.2-12.7 GHz.  
However, modifications necessary to resolve possible incompatibilities during the incorporation of the Regions 1 and 3 feeder-link Plan into the Radio Regulations shall be permitted.

**SUP**

- 3) The purpose of the following orbital position and e.i.r.p. limitations is to preserve access to the geostationary-satellite orbit by the Region 2 fixed-satellite service in the band 11.7-12.2 GHz. Within the orbital arc of the geostationary-satellite orbit between 37.2° W and 10° E, the orbital position associated with any proposed new or modified assignment in the Regions 1 and 3 List of additional uses shall lie within one of the

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**YY** See draft new Resolution [A14-LIMITA3] (WRC-19).

**ZZ** Broadcasting satellites serving an area in Region 1 using a frequency in the band 11.7-12.2 GHz and occupying a nominal orbital position further west than 37.2° W and in Region 2 using a frequency in the band 12.5-12.7 GHz and occupying a nominal orbital position further east than 54° W shall be in accordance with draft new Resolution [C14-LIMITA1A2] (WRC-19).

portions of the orbital arc listed in Table 1. The e.i.r.p. of such assignments shall not exceed 56 dBW, except at the positions listed in Table 2.

**SUP**

TABLE 1

**Allowable portions of the orbital arc between 37.2° W and 10° E for new or modified assignments in the Regions 1 and 3 Plan and List**

<b>Orbital position</b>	37.2° W to 36° W	33.5° W to 32.5° W	30° W to 29° W	26° W to 24° W	20° W to 18° W	14° W to 12° W	8° W to 6° W	4° W <sup>1</sup>	2° W to 0°	4° E to 6° E	9° E <sup>1</sup>
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<sup>1</sup> Proposed new or modified assignments in the List which involve this orbital position shall not exceed the power flux-density limit  $-138 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  at any point in Region 2.

**SUP**

TABLE 2

**Nominal positions in the orbital arc between 37.2° W and 10° E at which the e.i.r.p. may exceed the limit of 56 dBW**

<b>Orbital position</b>	37° W $\pm 0.2^\circ$	33.5° W	30° W	25° W $\pm 0.2^\circ$	19° W $\pm 0.2^\circ$	13° W $\pm 0.2^\circ$	7° W $\pm 0.2^\circ$	4° W <sup>1</sup>	1° W $\pm 0.2^\circ$	5° E $\pm 0.2^\circ$	9° E <sup>1</sup>
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<sup>1</sup> Proposed new or modified assignments in the List which involve this orbital position shall not exceed the power flux-density limit  $-138 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  at any point in Region 2.

**NOC**

B The Region 2 Plan is based on the grouping of the space stations in nominal orbital positions of  $\pm 0.2^\circ$  from the centre of the cluster of satellites. Administrations may locate those satellites within a cluster at any orbital position within that cluster, provided they obtain the agreement of administrations having assignments to space stations in the same cluster. (See § 4.13.1 of Annex 3 to Appendix 30A.)

**ADD**

**DRAFT NEW RESOLUTION [A14-LIMITA3] (WRC-19)**

**Protection of implemented BSS networks in the orbital arc of the geostationary-satellite orbit between 37.2° W and 10° E in the frequency band 11.7-12.2 GHz**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that the provisions applying to the broadcasting-satellite service (BSS) in the frequency bands 11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3 are contained in Appendix 30;
- b) that systems in the fixed-satellite service (FSS) and the broadcasting-satellite service share the frequency band 11.7-12.2 GHz;
- c) that WRC-19 suppressed the limitation in Section 3 Annex 7 to Appendix 30 (**Rev.WRC-15**) which determined allowable portions of the orbital arc between 37.2° W and 10° E for new or modified assignments in the frequency band 11.7-12.2 GHz in the Regions 1 and 3 List;
- d) that Section 1 of Annex 1 to Appendix 30 (**Rev.WRC-15**) provides criteria used for determination of coordination requirements for frequency assignments of Regions 1 and 3 Plan and List;
- e) that Section 1 of Annex 1 to Appendix 30 (**Rev.WRC-15**) pfd mask values are based on the parameters adopted by WRC-2000 based on the minimum earth station receiving antenna size of 60 cm;
- f) that the use of this frequency band by the BSS is subject to the coordination procedure of Article 4 of Appendix 30 (**Rev.WRC-19**),

*noting*

- a) that the ITU Radiocommunication Sector (ITU-R) has carried out a significant amount of studies in preparation for conferences on BSS planning, and has developed a number of Reports and Recommendations;
- b) that within the orbital arc of the geostationary-satellite orbit between 37.2° W and 10° E before WRC-19 there were limitations on the use of some orbital positions for any proposed new or modified assignment in the Regions 1 and 3 List of additional uses in the frequency band 11.7-12.2 GHz;
- c) that some networks with earth station receiving antenna size smaller than 60 cm were successfully implemented within the orbital arc mentioned in *noting b*), in view of protection due to the presence of limitations on the use of orbital positions in this orbital arc;
- d) that with the deletion of orbital position limitations, the protection of satellite assignments mentioned in *noting c*) shall be ensured;
- e) that the geostationary-satellite orbit between 37.2° W and 10° E is widely used by Region 1 BSS and Region 2 FSS networks;
- f) that equitable access to and efficient use of the 12 GHz frequency range should be encouraged,

*resolves*

- 1 that this Resolution is applicable only to implemented<sup>1</sup> networks with earth station receiving antenna size smaller than 60 cm (40 cm and 45 cm) as outlined in Annex 1 of this Resolution;

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<sup>1</sup> For the avoidance of doubt, the “implemented” networks referred to are related to Regions 1 and 3 BSS networks in the orbital arc 37.2° W and 10° E:

2 that frequency assignments of the networks mentioned in *resolves 1* above are considered by the Bureau as being affected by a proposed new or modified assignment in the List filed to the GSO orbital positions mentioned in Annex 1 to this Resolution, only if the following conditions specified in Annex 1 of Appendix 30 (Rev.WRC-19) are met:

- the minimum orbital spacing between the wanted and interfering space stations, under worst-case station-keeping conditions, is less than 9°;
- the reference equivalent downlink protection margin corresponding to at least one of the test points of that wanted assignment, including cumulative effect of any previous modification to the List or any previous agreement, falls more than 0.45 dB below 0 dB, or if already negative, more than 0.45 dB below that reference equivalent protection margin value;

3 that for cases, when a proposed new assignment in the List is filed within the geostationary orbital arc between 37.2° W and 10° E in orbital arc segments that differ from those in Annex 1 to this Resolution, appropriate provisions of Annex 1 Appendix 30 (Rev.WRC-19) to determine the need for coordination, continue to be applied with respect to relevant frequency assignments of satellite networks mentioned in *resolves 1*.

## ANNEX 1 TO DRAFT NEW RESOLUTION [A14-LIMITA3] (WRC-19)

### Satellite networks and orbital arc segments for which this Resolution is applicable

Satellite networks for which this Resolution applies					Orbital arc segments where the conditions specified in <i>resolves 2</i> of this Resolution apply
Orbital position	Earth station antenna size, cm	Satellite network	Date of receipt of part A submission	Notice Id Part II	
33.5° W	45	UKDIGISAT-4C	09.10.2014	TBD	36.0° W < $\theta$ ≤ 35.36° W; 31.64° W ≤ $\theta$ < 30.0° W; 29.0° W < $\theta$ ≤ 28.58° W;
30.0° W	45	HISPASAT-1	08.02.2000	99500256	34.92° W ≤ $\theta$ < 33.5° W; 32.5° W < $\theta$ ≤ 31.86° W; 28.14° W ≤ $\theta$ < 26.0° W;
		HISPASAT-37A	19.11.2014	117560019	

- for which complete Appendix 4 information had been received by the Bureau under § 4.1.3 of Appendix 30 prior to 28 November 2015, and
- for which complete Appendix 4 information had been received by the Bureau under § 4.1.12 of Appendix 30 prior to 23 November 2019, and
- for which the complete due diligence information, in accordance with Annex 2 to Resolution 49 (Rev.WRC-15), had been received by the Bureau prior to 23 November 2019, and
- for which complete Appendix 4 information had been received by the Bureau under § 5.1.2 of Appendix 30 prior to 23 November 2019, and
- brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 23 November 2019.

4.8° E	40	SIRIUS-N-BSS	17.11.2014	TBD	$0 < \theta \leq 2.85^\circ \text{ E};$ $6.75^\circ \text{ E} \leq \theta < 9.0^\circ \text{ E};$ $9^\circ \text{ E} < \theta \leq 10^\circ \text{ E};$
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Where  $\theta$  is the orbital position within the orbital segment defined in the table above.

*Note - Currently, the proposed table contains all possible satellite networks that could comply with the conditions specified in resolves 1. WRC-19 will update this table to reflect the satellite networks that in fact comply with these conditions.*

## ADD

### DRAFT NEW RESOLUTION [B14-PRIORITY] (WRC-19)

#### **Additional temporary regulatory measures following deletion of part of Annex 7 to Appendix 30 by WRC-19**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that some national assignments especially those of developing countries in the Regions 1 and 3 Plan have equivalent downlink protection margin values in the RR Appendix 30 equal or below  $-10$  dB;
- b) that implementation of a national assignment in the Regions 1 and 3 Plan with an equivalent downlink protection margin equal or below  $-10$  dB would be difficult;
- c) that any modification of orbital position and other parameters of a national assignment in the Appendix 30 Plan would require a corresponding modification of the orbital position and other parameters in the Appendix 30A feeder-link Plan,

*recognizing*

- a) that Article 44 of the ITU Constitution stipulates that: “*In using frequency bands for radio services, Member States shall bear in mind that radio frequencies and any associated orbits, including the geostationary-satellite orbit, are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulations, so that countries or groups of countries may have equitable access to those orbits and frequencies, taking account the special needs of the developing countries and the geographical situation of particular countries*”;
- b) that Resolution 71 (Rev. Busan, 2014) of the Plenipotentiary Conference, ITU includes the ITU strategic plan for 2016-2019, which contains, as one of the strategic objectives of ITU-R: “*Meet, in a rational, equitable, efficient, economical and timely way, the ITU membership’s requirements for radio-frequency spectrum and satellite-orbit resources, while avoiding harmful interference*”,

*resolves*

- 1 that as of the “date of entry into force of this Resolution” and for a period of 90 (this period is only indicative) days, the special procedure outlined in the Attachment to this Resolution

shall be applied in respect of submissions of Regions 1 and 3 administrations meeting the specified requirements in § 1 of the Attachment;

2 that as of the “date of entry into force of this Resolution” and for a period of 90 (this period depends on decision on *resolves* 1) days, submissions under § 4.1.3 of Appendices **30** and **30A** in Regions 1 and 3 not meeting the specified requirements in § 1 of the Attachment to the Resolution at an orbital position of orbital arcs for which the Annex 7 to Appendix **30** (**Rev.WRC-15**) limitations were suppressed by WRC-19 shall be considered as received by BR on the “date of entry into force of this Resolution” + 91 days.

*instructs the Director of the Radiocommunication Bureau*

to identify the administrations that meet the conditions of Section 1 of the Attachment to this Resolution and inform these administrations accordingly.

## ATTACHMENT TO DRAFT NEW RESOLUTION [B14-PRIORITY] (WRC-19)

### **Additional temporary regulatory measures following deletion of part of Annex 7 to Appendix 30 by WRC-19**

1 The special procedure described in this attachment can only be applied once by an administration with:

- a) no frequency assignments included in the List or for which complete Appendix **4** information has been received by the Bureau in accordance with the provision of § 4.1.3 of Appendix **30**; and
- b) an assignment in the Regions 1 and 3 Plan of Appendix **30** when the equivalent downlink protection margin (EPM) value corresponding to a test point of its national assignment in the Regions 1 and 3 Plan is equal or below  $-10$  dB for at least 50% of the total number of EPM values of the assignment in the Regions 1 and 3 Plan in Appendix **30**.

2 Administrations seeking to apply this special procedure shall submit their request to the Bureau, with the information specified in § 4.1.3 of Appendices **30** and **30A**, in particular this information shall include:

- a) in the cover letter to the Bureau, the information that the administration requests the use of this special procedure together with the name of the Plan assignments for which condition defined in § 1 above is met;
- b) a service area is limited to the national territory as defined in the GIMS software application;
- c) a set of maximum 20 test points inside the national territory;
- d) a minimal ellipse determined by the set of test points submitted in c) above. An administration may request the Bureau to create such diagram;
- e) maximum ten channels for a Region 1 administration or 12 channels for a Region 3 administration with a bandwidth of 27 MHz;
- f) a corresponding submission for the Appendix **30A** feeder-link Plan in compliance with items b), c), d) and e) above.

3 Upon receipt of the complete information from an administration sent under § 3 above, the Bureau shall process the submissions in date order in accordance with Article 4 of Appendices **30** and **30A**.



4 The notifying administration shall request the subsequent WRCs to consider the inclusion in the Appendices **30** and **30A** Plans as a replacement of its national assignments appearing in the Plans, pursuant to paragraph 4.1.27 of Article 4 of Appendices **30** and **30A**.

**ADD**

DRAFT NEW RESOLUTION [C14-LIMITA1A2] (WRC-19)

**Need for coordination of Region 2 FSS networks in the frequency band 11.7-12.2 GHz with respect to the Region 1 BSS assignments located further west than 37.2° W and of Region 1 FSS networks in the frequency band 12.5-12.7 GHz with respect to the Region 2 BSS assignments located further east than 54° W**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that WRC-15 decided to conduct studies on, review, and identify possible revisions to, if necessary, the limitations mentioned in Annex 7 to Appendix **30 (Rev.WRC-15)**, while ensuring the protection of, and without imposing additional constraints on, assignments in the Plan and in the List and the future of broadcasting-satellite service (BSS) networks and existing fixed-satellite service (FSS) networks;
- b) that the provisions applying to the frequency assignments of BSS in the frequency bands 11.7-12.5 GHz in Region 1 and 12.2-12.7 GHz in Region 2 are contained in Appendix **30**;
- c) that the FSS has primary allocations in the frequency bands 12.5-12.75 GHz in Region 1 and 11.7-12.2 GHz in Region 2;
- d) that WRC-19 suppressed the limitation in Annex 7 to Appendix **30** that prevented broadcasting satellites serving an area in Region 1 and using frequency assignments in the frequency band 11.7-12.2 GHz at orbital positions further west than 37.2° W;
- e) that WRC-19 suppressed the limitation in Annex 7 to Appendix **30** that prevented broadcasting satellites serving an area in Region 2 and using frequency assignments in the frequency band 12.5-12.7 GHz at orbital positions further east than 54° W;
- f) that the result of those suppressions shall ensure the protection of, and cannot impose additional constraints on, assignments in the Plan and the List and the future development of the BSS within the Plan, and existing and future FSS networks,

*recognizing*

- a) that existing FSS networks operating in the frequency bands mentioned in *considering c)* and BSS frequency assignments in the Plan and List implemented in accordance with the provisions of Annex 7 to Appendix **30 (Rev.WRC-15)** prior to WRC-19 shall continue to be protected;
- b) that the frequency bands 11.7-12.5 GHz in Region 1 and 12.2-12.7 GHz in Region 2 are widely used by BSS networks, subject to the provisions of Annex 7 to Appendix **30 (Rev.WRC-15)** prior to WRC-19;

c) that the frequency bands 12.5-12.75 GHz in Region 1 and 11.7-12.2 GHz in Region 2 are widely used by FSS networks,

*resolves*

1 that, with respect to § 7.1 a), 7.2.1 b) and 7.2.1 c) of Article 7 of Appendix 30, for identification of the need for coordination of a transmitting space station in the fixed-satellite service (FSS) (space-to-Earth) of Region 2 with Region 1 BSS frequency assignments and using a frequency assignment in the frequency band 11.7-12.2 GHz with an orbital position further west than 37.2° W, the conditions contained in Annex 4 to Appendix 30 are replaced by the conditions in Annex 1 to this Resolution;

2 that, with respect to § 7.1 a), 7.2.1 b) and 7.2.1 c) of Article 7 of Appendix 30, for identification of the need for coordination of a transmitting space station in the fixed-satellite service (FSS) (space-to-Earth) of Region 1 with Region 2 BSS frequency assignments and using a frequency assignment in the frequency band 12.5-12.7 GHz with an orbital position further east than 54° W and not within its clusters in the Region 2 Plan of Appendix 30, the conditions contained in Annex 4 to Appendix 30 are replaced by the conditions in Annex 2 to this Resolution.

#### ANNEX 1 TO DRAFT NEW RESOLUTION [C14-LIMITA1A2] (WRC-19)

With respect to § 7.1 a), 7.2.1 b) and 7.2.1 c) of Article 7 of Appendix 30, coordination of a transmitting space station in the fixed-satellite service (FSS) (space-to-Earth) of Region 2 is required with a broadcasting satellite serving an area in Region 1 and using a frequency assignment in the frequency band 11.7-12.2 GHz with a nominal orbital position further west than 37.2° W when, under assumed free-space propagation conditions, the power flux-density at any test point of its service area of the overlapping frequency assignments in the BSS exceeds the following values:

-147	dB (W/(m <sup>2</sup> · 27 MHz))	for	0°	≤	θ < 0.23°
-135.7 + 17.74 log θ	dB (W/(m <sup>2</sup> · 27 MHz))	for	0.23°	≤	θ < 2.0°
-136.7 + 1.66 θ <sup>2</sup>	dB (W/(m <sup>2</sup> · 27 MHz))	for	2.0°	≤	θ < 3.59°
-129.2 + 25 log θ	dB (W/(m <sup>2</sup> · 27 MHz))	for	3.59°	≤	θ < 10.57°
-103.6	dB(W/(m <sup>2</sup> · 27 MHz))	for	10.57°	≤	θ

where θ is the minimum geocentric orbital separation in degrees between the wanted and interfering space stations, taking into account the respective east-west station-keeping accuracies.

#### ANNEX 2 TO DRAFT NEW RESOLUTION [C14-LIMITA1A2] (WRC-19)

With respect to § 7.1 a), 7.2.1 b) and 7.2.1 c) of Article 7 of Appendix 30, coordination of a transmitting space station in the fixed-satellite service (FSS) (space-to-Earth) of Region 1 is required with a broadcasting satellite serving an area in Region 2 and using a frequency assignment in the frequency band 12.5-12.7 GHz with a nominal orbital position further east than 54° W when, under assumed free-space propagation conditions, the power flux-density at any test point of its service area of the overlapping frequency assignments in the BSS exceeds the following values:

-147	dB (W/(m <sup>2</sup> · 27 MHz))	for	0°	≤	θ < 0.23°
-135.7 + 17.74 log θ	dB (W/(m <sup>2</sup> · 27 MHz))	for	0.23°	≤	θ < 1.8°

$-134.0 + 0.89 \theta^2$	dB (W/(m <sup>2</sup> · 27 MHz))	for	$1.8^\circ \leq$	$\theta < 5.0^\circ$
$-129.2 + 25 \log \theta$	dB (W/(m <sup>2</sup> · 27 MHz))	for	$5.0^\circ \leq$	$\theta < 10.57^\circ$
-103.6	dB (W/(m <sup>2</sup> · 27 MHz))	for	$10.57^\circ \leq$	$\theta$

where  $\theta$  is the minimum geocentric orbital separation in degrees between the wanted and interfering space stations, taking into account the respective east-west station-keeping accuracies.

**SUP**

## RESOLUTION 557 (WRC-15)

### **Consideration of possible revision of Annex 7 to Appendix 30 of the Radio Regulations**

## Agenda item 1.5

**(WP 4A / WP 4B, WP 4C, WP 5A, WP 5C, WP 7C, (WP 3M), (WP 5D), (WP 7B))**

*1.5 to consider the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service and take appropriate action, in accordance with Resolution 158 (WRC-15);*

**Resolution 158 (WRC-15)** – *Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service.*

### **3/1.5/1 Executive summary**

WRC-19 agenda item 1.5 considers the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion (ESIM) communicating with geostationary (GSO) space stations in the fixed-satellite service (FSS). This agenda item has studied three types of ESIM: aeronautical, maritime and land, depending on the type of vehicle on which they are installed.

Studies have been carried out on sharing and compatibility between ESIM and space as well as terrestrial services allocated in the frequency bands above. Not all studies have been concluded. The studies carried out so far have identified example provisions to protect such services or example guidelines to assist an administration wishing to deploy ESIM on the territory under its jurisdiction.

There are various responsibilities for the authorization and operation of ESIM and their interference management system. These responsibilities are described in Annex 3 to the draft new Resolution [A15] (WRC-19) in section 3/1.5/5 below. Due to time constraints, the contents of Annex 3 have not been discussed and agreed upon.

For this agenda item, two methods have been identified:

#### **Method A**

This method proposes no changes to the RR and suppression of Resolution 158 (WRC-15).

#### **Method B**

This method proposes to add a new footnote No. 5.A15 in RR Article 5 and a reference to a new WRC Resolution providing the conditions for the operation of ESIM and protection of the services to which the frequency bands are allocated, and consequential suppression of Resolution 158 (WRC-15).

### **3/1.5/2 Background**

ESIM are earth stations that communicate with GSO FSS space stations but operate on platforms in motion in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz. Currently there are three types of ESIM:

- ESIM on aircraft (aeronautical ESIM);
- ESIM on ships (maritime ESIM), and
- ESIM on land vehicles (land ESIM).

Any of the three types of ESIM can be used to provide broadband communications, including Internet connectivity.

Moreover, under Method B, for the operation of ESIM, the technical, operational and regulatory responsibilities of administrations and entities responsible for the operation, authorization and the interference management system of the various types of ESIM (on board aircraft, on board vessels and on board land vehicles) are defined and contained in Annex 3 to the draft new Resolution [A15] (WRC-19).

### **3/1.5/3 Summary and analysis of the results of ITU-R studies**

#### **3/1.5/3.1 Operation of ESIM in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz**

In accordance with Resolution 158 (WRC-15), ESIM need to protect the existing services to which the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands are allocated: the fixed service (FS), the mobile service (MS), the Earth exploration-satellite service (EESS), the meteorological-satellite service, the fixed-satellite service (FSS), including the non-GSO mobile-satellite service (MSS) feeder links operating in the FSS and the broadcasting-satellite service (BSS) feeder links.

The following sections provide details on how ESIM can protect the existing services to which the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands are allocated.

#### **3/1.5/3.2 Sharing studies with terrestrial services**

##### **3/1.5/3.2.1 Frequency band 17.7-19.7 GHz**

The ITU-R examined sharing conditions for ESIM with terrestrial services in the 17.7-19.7 GHz frequency band and concluded that there would be potential interference from transmitting stations of terrestrial services to ESIM receivers. The ESIM therefore should operate under the condition of not claiming protection from terrestrial services operating in accordance with RR.

##### **3/1.5/3.2.2 Frequency band 27.5-29.5 GHz**

The ITU-R examined sharing conditions between ESIM and terrestrial services in the 27.5-29.5 GHz frequency band and concluded that there would be potential interference to receiving stations of terrestrial services from ESIM transmitters. Therefore, aeronautical and maritime ESIM should operate under the specified technical, operational and regulatory conditions to avoid causing unacceptable interference to receiving stations of terrestrial services operating in accordance with RR.

Land ESIM need to operate under the condition of not causing interference to receiving stations of terrestrial services operating in accordance with RR.

Further information is provided in the relevant parts of Annex 2 and Annex 3 of the draft new Resolution [A15] (WRC-19).

#### **3/1.5/3.3 Sharing studies with space services**

##### **3/1.5/3.3.1 Sharing studies with the EESS (passive)**

The ITU-R examined sharing conditions for receiving ESIM with the EESS (passive) in the 18.6-18.8 GHz frequency band. This frequency band is used by EESS (passive) in remote sensing by Earth exploration. In this frequency band EESS (passive) and ESIM are both receiving. Therefore, no interference can be caused by ESIM into the EESS (passive).

### **3/1.5/3.3.2 Sharing studies with the meteorological-satellite service**

The ITU-R examined sharing conditions for receiving ESIM with the meteorological-satellite service in the 18 GHz range<sup>21</sup>. In this frequency band the meteorological-satellite earth station and ESIM are both receiving. Therefore, no interference can be caused by ESIM into the meteorological-satellite receiver station.

### **3/1.5/3.3.3 Sharing studies with the EESS (Earth-to-space)**

The ITU-R noted that the use of ESIM in the 27.5-29.5 GHz frequency band would not change the current interference environment with respect to the secondary EESS in the 28.5-29.5 GHz range, provided that ESIM operate within the envelope of GSO FSS networks.

### **3/1.5/3.3.4 Sharing studies with the FSS**

#### **3/1.5/3.3.4.1 GSO FSS networks**

With respect to GSO FSS satellite networks of other administrations, the ITU-R concluded that ESIM need to remain within the envelope of the satellite network with which these ESIM communicate. In order to implement this, the notifying administration of the GSO FSS network with which ESIM communicate needs to send to the Bureau the relevant RR Appendix 4 information related to the characteristics of the ESIM intended to communicate with the space station of that GSO FSS network. Upon receipt of this information, the Bureau needs to examine it and publish the results in a Special Section of the BR IFIC. If, following this examination, the Bureau concludes that ESIM are not within the envelope of the satellite network, it would return the information to the notifying administration with the reasons thereof.

#### **3/1.5/3.3.4.2 Non-GSO FSS systems**

##### **3/1.5/3.3.4.2.1 Frequency band 17.7-18.6 GHz (Resolution 158, recognizing further e))**

In this frequency band, since non-GSO FSS earth stations and ESIM are both receiving, no interference can be caused by ESIM into the non-GSO FSS receiving earth stations.

With respect to the interference into receiving ESIM, views were expressed that no protection could be claimed by ESIM from non-GSO FSS systems operating in the frequency band 17.8-18.6 GHz in accordance with RR provisions, including RR No. 22.5C. Further information with respect to the above is included in the draft new Resolution [A15] (WRC-19).

##### **3/1.5/3.3.4.2.2 Frequency band 18.8-19.3 GHz (Resolution 158, recognizing further f) and b))**

In this frequency band, non-GSO FSS earth stations and ESIM are both receiving, no interference can be caused by ESIM into the non-GSO FSS receiving earth stations.

Views were expressed that, since GSO FSS space stations communicating with ESIM would operate under technical and operational measures contained in the relevant coordination agreements in application of RR Nos. 9.12A and 9.13, ESIM would not require any additional protection.

##### **3/1.5/3.3.4.2.3 Frequency band 27.5-28.6 GHz (Resolution 158, recognizing further e) and b))**

In this frequency band, transmitting ESIM have the potential to interfere with non-GSO satellite receivers. Views were expressed that results of studies to date show that ESIM should comply with

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<sup>21</sup> See RR No. 5.519 for specific frequency ranges.

*resolves* 1.1.1 of the draft new Resolution [A15] (WRC-19) and the provisions contained in Annex 1 to the draft new Resolution [A15] (WRC-19) so that ESIM protect non-GSO satellite receivers in this frequency band.

#### **3/1.5/3.3.4.2.4 Frequency band 28.6-29.1 GHz (Resolution 158, recognizing further f) and b))**

In this frequency band RR Nos. **9.12A** and **9.13** apply.

Some views were expressed that the provisions of RR Nos. **9.12A** and **9.13** together with *resolves* 1.1.1 of the draft new Resolution [A15] (WRC-19) provide enough assurance that ESIM would not cause interference to non-GSO FSS space station receivers.

Some other views were expressed that transmitting ESIM have the potential to interfere with non-GSO satellite receivers and that ESIM should comply with *resolves* 1.1.1 of the draft new Resolution [A15] (WRC-19) and the provisions contained in Annex 1 to the draft new Resolution [A15] (WRC-19) so that ESIM protect non-GSO satellite receivers in this frequency band.

Studies are ongoing to determine whether ESIM should comply with any provisions so that ESIM avoid causing interference to non-GSO satellite receivers.

#### **3/1.5/3.3.4.3 Sharing with non-GSO MSS feeder links operating in the FSS**

##### **3/1.5/3.3.4.3.1 Frequency band 19.3-19.7 GHz (Resolution 158, recognizing further g))**

In this frequency band RR No. **9.11A** applies. However, non-GSO MSS feeder-link systems using the frequency band 19.3-19.7 GHz (space-to-Earth) are not subject to the provisions of RR No. **22.2**. Further, the use of this frequency band for other non-GSO FSS systems, or for the cases indicated in RR Nos. **5.523C** and **5.523E**, is not subject to the provisions of RR No. **9.11A**, but is subject to RR Articles **9** (except RR No. **9.11A**) and **11** procedures, and to the provisions of RR No. **22.2** (RR No. **5.523D**).

In this frequency band, ESIM and non-GSO MSS feeder-link earth stations are both receiving. The ITU-R concluded that no interference can be caused by the receiving ESIM into the non-GSO MSS feeder-link earth stations operating in the FSS.

##### **3/1.5/3.3.4.3.2 Frequency band 29.1-29.5 GHz (Resolution 158, recognizing further h) and j))**

In this frequency band RR No. **9.11A** applies. However, non-GSO MSS feeder-link systems using the frequency band 29.1-29.5 GHz (Earth-to-space) are not subject to the provisions of RR No. **22.2**, except as indicated in RR Nos. **5.523C** and **5.523E**, where such use is not subject to the provisions of RR No. **9.11A** and shall continue to be subject to RR Articles **9** (except RR No. **9.11A**) and **11** procedures, and to the provisions of RR No. **22.2** (RR No. **5.535A**).

In this frequency band, ESIM may interfere with non-GSO satellite receivers with which MSS feeder-link earth stations communicate. Studies are ongoing to determine whether any additional provisions are needed so that ESIM avoid causing interference to non-GSO space stations.

Some views were expressed that *resolves* 1.1.7 (Option 1), if retained, and Annex 1 of the draft new Resolution [A15] (WRC-19) provide for the protection of non-GSO MSS feeder links from ESIM communicating with GSO FSS networks.

Some other views were expressed that the provisions of RR No. **9.11A** together with *resolves* 1.1.1 of the draft new Resolution [A15] (WRC-19) provide enough assurance that ESIM would not cause interference to space station receivers of non-GSO MSS feeder links. This view is consistent with *resolves* 1.1.7 (Option 2), if retained, of the draft new Resolution [A15] (WRC-19).

#### **3/1.5/3.3.4.4 Sharing studies with BSS feeder links**

##### **3/1.5/3.3.4.4.1 Frequency bands 17.7-18.1 GHz (Resolution 158, recognizing further a)) and 18.1-18.4 GHz (Resolution 158, recognizing further c))**

In this frequency band, ESIM are receiving and BSS feeder-link earth stations are transmitting. The ITU-R concluded that ESIM should not claim protection from BSS feeder-link earth stations operating in accordance with the Radio Regulations and without affecting the future development of BSS feeder-link earth stations.

##### **3/1.5/3.3.4.4.2 Frequency band 27.5-29.5 GHz (Resolution 158, recognizing further i))**

In this frequency band, ESIM are transmitting and GSO FSS satellites with which BSS feeder-link earth stations communicate are receiving.

The ITU-R concluded that the same course of action contained in paragraph 3/1.5/3.3.4.1 (protection of other GSO FSS networks) should apply to avoid that ESIM interfere with GSO FSS satellite receivers with which BSS feeder-link earth stations communicate.

##### **3/1.5/3.3.4.5 Sharing studies between ESIM and non-GSO MSS feeder-link earth stations operating in the opposite direction in the frequency band 19.3-19.6 GHz**

In this frequency band, ESIM are receiving and non-GSO MSS feeder-link earth stations are transmitting and RR No. **5.523B** applies. The ITU-R concluded that ESIM should not claim protection from non-GSO MSS feeder-link earth stations operating in accordance with the Radio Regulations and without affecting the future development of non-GSO MSS feeder-link earth stations.

#### **3/1.5/4 Methods to satisfy the agenda item**

##### **3/1.5/4.1 Method A**

No changes to the RR and suppression of Resolution **158 (WRC-15)**.

##### **3/1.5/4.2 Method B**

Add a new footnote in RR Article **5** that refers to a new WRC Resolution with technical, operational and regulatory conditions for the operation of ESIM while ensuring protection of allocated services and consequential suppression of Resolution **158 (WRC-15)**.

#### **3/1.5/5 Regulatory and procedural considerations**

##### **3/1.5/5.1 For Method A**

NOC

## **ARTICLES**



**SUP**

**RESOLUTION 158 (WRC-15)**

**Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service**

**3/1.5/5.2 For Method B**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations  
(See No. 2.1)**

**MOD**

**15.4-18.4 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>17.7-18.1</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.484A ADD 5.A15 (Earth-to-space) 5.516 MOBILE	<b>17.7-17.8</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.517 ADD 5.A15 (Earth-to-space) 5.516 BROADCASTING-SATELLITE Mobile 5.515	<b>17.7-18.1</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.484A ADD 5.A15 (Earth-to-space) 5.516 MOBILE
	<b>17.8-18.1</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.484A ADD 5.A15 (Earth-to-space) 5.516 MOBILE 5.519	
<b>18.1-18.4</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.A15 (Earth-to-space) 5.520 MOBILE 5.519 5.521	

**MOD**

**18.4-22 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>18.4-18.6</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B ADD 5.A15 MOBILE	
<b>18.6-18.8</b> EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B ADD 5.A15 MOBILE except aeronautical mobile Space research (passive) 5.522A 5.522C	<b>18.6-18.8</b> EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.522B ADD 5.A15 MOBILE except aeronautical mobile SPACE RESEARCH (passive) 5.522A	<b>18.6-18.8</b> EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.522B ADD 5.A15 MOBILE except aeronautical mobile Space research (passive) 5.522A
<b>18.8-19.3</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.523A ADD 5.A15 MOBILE	
<b>19.3-19.7</b>	FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 5.523B 5.523C 5.523D 5.523E ADD 5.A15 MOBILE	

**MOD**

**24.75-29.9 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>27.5-28.5</b>	FIXED 5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 ADD 5.A15 MOBILE 5.538 5.540	
<b>28.5-29.1</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 ADD 5.A15 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	
<b>29.1-29.5</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.523C 5.523E 5.535A 5.539 5.541A ADD 5.A15 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	

**ADD**

**5.A15** The operation of earth stations in motion communicating with geostationary FSS space stations in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz shall be subject to draft new Resolution [A15] (WRC-19). (WRC-19)

**Reasons:** The objective of this footnote is to make draft new Resolution [A15] (WRC-19) mandatory.

**3/1.5/5.2.1 Example Resolution to address WRC-19 agenda item 1.5**

The following draft new Resolution [A15] (WRC-19) contains the regulatory, technical and operational conditions, based on ITU-R studies, to enable ESIM to communicate with GSO FSS space stations operating in the 27.5-29.5 GHz and 17.7-19.7 GHz frequency bands.

In several instances, alternatives are presented for specific items that remain under study within the ITU-R.

**ADD**

**DRAFT NEW RESOLUTION [A15] (WRC-19)**

**Use of the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz by earth stations in motion (ESIM) communicating with geostationary space stations in the fixed-satellite service**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that there is a need for global broadband mobile satellite communications, and that some of this need could be met by allowing earth stations in motion (ESIM) to communicate with space stations of GSO fixed-satellite service (FSS) operating in the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space);
- b) that appropriate regulatory and interference management mechanisms are necessary for the operation of ESIM;
- c) that the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) are also allocated to terrestrial and space services used by a variety of different systems and these existing services and their future development need to be protected from the operation of ESIM,

*recognizing*

- a) that the administration authorizing ESIM on the territory under its jurisdiction has the right to require that ESIM referred to above only use those assignments associated with FSS networks which have been successfully coordinated, notified, brought into use and recorded in the MIFR with a favourable finding under Article 11, including Nos. 11.31, 11.32 or 11.32A, where applicable;
- b) that for cases of incomplete coordination under No. 9.7 of the GSO FSS network with which ESIM communicate, the operation of ESIM in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz needs to be in accordance with the provisions of No. 11.42 with respect to any recorded frequency assignment which was the basis of the unfavourable finding under No. 11.38;

c) that any course of action taken under this Resolution has no impact on the original date of receipt of the frequency assignments of the GSO FSS satellite network with which ESIM communicate or on the coordination requirements of that satellite network,

*resolves*

1 that for any ESIM communicating with a GSO FSS space station in the frequency bands 17.7-19.7 GHz and 27.5-29.5 GHz, or portions thereof, the following conditions shall apply:

1.1 with respect to space services in the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands, ESIM shall comply with the following conditions:

1.1.1 with respect to satellite networks or systems of other administrations, ESIM shall remain within the envelope of the satellite network with which these ESIM communicate;

1.1.2 for the implementation of *resolves* 1.1.1 above, the notifying administration of the GSO FSS network with which ESIM communicate shall send to the Bureau under this Resolution the relevant Appendix 4 information related to the characteristics of the ESIM intended to communicate with the space station of that GSO FSS network;

### **Option 1**

1.1.3 upon receipt of the information provided in accordance with *resolves* 1.1.2 above, the Bureau shall examine it in relation to the requirements referred to in *resolves* 1.1.1 based on the information recorded in the MIFR and any other reliable information available to it and publish the results in a Special Section of the BR IFIC;

### **Option 2**

1.1.3 upon receipt of the information provided in accordance with *resolves* 1.1.2 above, the Bureau shall examine it in relation to the requirements referred to in *resolves* 1.1.1 based on the complete information submitted under No. 11.2 and complying with No. 11.28 and publish the results in a Special Section of the BR IFIC;

1.1.4 if, following the examination referred to in *resolves* 1.1.3 above, the Bureau concludes that ESIM are not within the envelope of the satellite network, the information shall be returned to the notifying administration;

1.1.5 the notifying administration responsible for the GSO FSS satellite network with which ESIM communicate shall, if requested, make available to the administration authorizing the operation of ESIM on the territory under its jurisdiction a commitment that their operation will be in conformity with the Radio Regulations and this Resolution;

Note - The most appropriate location of *resolves* 1.1.5 above should be given further consideration.

1.1.6 for the protection of non-GSO FSS systems operating in the frequency band 27.5-28.6/29.1 GHz, ESIM communicating with GSO FSS networks shall comply with the provisions contained in Annex 1 to this Resolution;

### **Option 1**

1.1.7 for the protection of non-GSO MSS feeder links operating in the frequency band 29.1-29.5 GHz, ESIM communicating with GSO FSS networks shall comply with the provisions contained in Annex 1 to this Resolution;

### **Option 2**

No 1.1.7 is needed.

1.1.8 that ESIM shall not claim protection from non-GSO FSS systems operating in the frequency band 17.8-18.6 GHz in accordance with the Radio Regulations, including No. **22.5C**;

1.1.9 that ESIM shall not claim protection from BSS feeder-link earth stations operating in the frequency band 17.7-18.4 GHz in accordance with the Radio Regulations and shall not affect their future development;

1.2 with respect to terrestrial services in the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands ESIM shall comply with the following conditions:

1.2.1 the receiving ESIM in the 17.7-19.7 GHz frequency band shall not claim protection from “any stations in the terrestrial services” / “any assignments to stations of terrestrial services” in this frequency band operating in accordance with the Radio Regulations and shall not affect the future development of these services;

1.2.2 the transmitting aeronautical and maritime ESIM in the 27.5-29.5 GHz frequency band shall not cause unacceptable interference to “any stations in the terrestrial services” / “any assignments to stations of terrestrial services” in this frequency band operating in accordance with the Radio Regulations and shall not affect the future development of these services and Annex 2 applies;

1.2.3 the transmitting land ESIM in the 27.5-29.5 GHz frequency band shall not cause interference to “any stations in the terrestrial services” / “any assignments to stations of terrestrial services” in this frequency band operating in accordance with the Radio Regulations and shall not affect the future development of these services and Annex 3 applies;

#### **Option 1**

1.2.4 for the implementation of *resolves* 1.2.2 and 1.2.3 above, the notifying administration responsible for the GSO FSS satellite network with which ESIM communicate shall submit to the Bureau together with the Appendix 4 data referred to in *resolves* 1.1.2 a commitment undertaking that in case of interference, upon receipt of a report of interference, take necessary action to immediately cease or reduce interference to an acceptable level;

#### **Option 2**

1.2.4 for the implementation of *resolves* 1.2.2 and 1.2.3 above, the notifying administration responsible for the GSO FSS satellite network with which ESIM communicate shall submit to the Bureau together with the Appendix 4 data referred to in *resolves* 1.1.2 a commitment to this effect;

#### **Option 1**

1.2.5 for the implementation of *resolves* 1.2.2 above, any transmitting aeronautical or maritime ESIM that conforms to the requirements in Annex 2 to this Resolution shall be deemed to have met its obligation to terrestrial stations;

#### **Option 2**

1.2.5 for the implementation of *resolves* 1.2.2 above, any transmitting maritime ESIM that conforms to the requirements in Annex 2 to this Resolution shall be deemed to have met its obligation to terrestrial stations;

#### **Option 3**

None of the options for 1.2.5 are needed.

2 that ESIM shall not be used or relied upon for safety-of-life applications;

3 for the implementation of this Resolution, administrations may consider relevant parts of Annex 3 when considering to authorize ESIM as well as in their bilateral or multilateral negotiations;

4 that, in addition to *resolves* 3, administrations authorizing land ESIM shall ensure that land ESIM operating in their territory do not cause unacceptable interference to terrestrial services of other countries operating in accordance with the Radio Regulations;

5 that the administration responsible for the GSO FSS satellite network with which the ESIM communicate shall ensure that:

5.1 ESIM employ techniques to track the associated GSO FSS satellite without inadvertently tracking adjacent GSO satellites;

5.2 the ESIM network operator put in place all necessary measures so that its ESIM are subject to permanent monitoring and control by a Network Control and Monitoring Centre (NCMC) or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility (see also Annex 3);

6 that the application of this Resolution does not provide regulatory status to ESIM different from that derived from the GSO FSS network with which they communicate taking into account the provisions referred to in this Resolution,

*instructs the Director of the Radiocommunication Bureau*

1 to take any necessary actions for the implementation of this Resolution;

2 to take any necessary actions to facilitate the implementation of this Resolution by administrations, including assisting in resolving any potential interference issues;

3 to report to WRC-23 any difficulties or inconsistencies encountered in the implementation of this Resolution,

*invites administrations*

to collaborate, to the maximum extent practicable, for the implementation of this Resolution, in particular for resolving any potential interference,

*instructs the Secretary-General*

to bring this Resolution to the attention of the Secretary-General of the International Maritime Organization (IMO) and of the Secretary General of the International Civil Aviation Organization (ICAO).

## ANNEX 1 TO DRAFT NEW RESOLUTION [A15] (WRC-19)

### Option 1

#### **Provisions for ESIM to protect non-GSO FSS systems in the frequency band 27.5-28.6 or 29.1 GHz and non-GSO MSS feeder links in frequency band 29.1-29.5 GHz**

## Option 2

### Course of action by ESIM to comply with this Resolution vis-à-vis non-GSO FSS systems in the frequency band 27.5-28.6 or 29.1 GHz and non-GSO MSS feeder links in frequency band 29.1-29.5 GHz

## Option 3

### Compliance of ESIM operation with relevant parts of draft new Resolution [A15] (WRC-19)

Note - The title of this Annex should reflect its content.

1 In order to protect those non-GSO FSS referred to in *resolves* 1.1.6 of this Resolution, ESIM shall comply with the following provisions:

#### Option 1

a) for any direction in the region outside  $3^\circ$  of the GSO, in the frequency band 27.5-28.6/29.1 GHz, the levels contained in Recommendation ITU-R S.524-9 may be exceeded by no more than 3 dB;

#### Option 2

a) the level of equivalent isotropically radiated power (e.i.r.p.) density emitted by an ESIM in a geostationary-satellite network in the 27.5-28.6/29.1 GHz frequency band shall not exceed the following values for any off-axis angle  $\varphi$  which is  $3^\circ$  or more off the main-lobe axis of an ESIM antenna and outside  $3^\circ$  of the GSO:

<i>Off-axis angle</i>	<i>Maximum e.i.r.p. density</i>
$3^\circ \leq \varphi \leq 7^\circ$	$28 - 25 \log \varphi$ dB(W/40 kHz)
$7^\circ < \varphi \leq 9.2^\circ$	7 dB(W/40 kHz)
$9.2^\circ < \varphi \leq 48^\circ$	$31 - 25 \log \varphi$ dB(W/40 kHz)
$48^\circ < \varphi \leq 180^\circ$	-1 dB(W/40 kHz)

#### Option 1

b) for any ESIM that does not meet the condition a)/Option 2 above, outside of  $3^\circ$  of the GSO, the maximum ESIM on-axis e.i.r.p. shall not exceed 55 dBW for emission bandwidths up to and including 100 MHz. For emission bandwidths larger than 100 MHz, the maximum ESIM on-axis e.i.r.p. may be increased proportionately;

#### Option 2

b) for any ESIM that does not meet the condition a)/Option 2 above, outside of  $3^\circ$  of the GSO, the maximum ESIM on-axis e.i.r.p. shall not exceed 55 dBW for emission bandwidths of 100 MHz. For emission bandwidths smaller or larger than 100 MHz, the maximum ESIM on-axis e.i.r.p. may be decreased or increased proportionately, as appropriate.

### **Option 1**

2 In order to protect those non-GSO MSS feeder-links referred to in *resolves* 1.1.7 of this Resolution, ESIM shall comply with the following:

Note: Yet to be developed.

### **Option 2**

Consistent with *resolves* 1.1.7 Option 2, no item 2 is needed.

## **ANNEX 2 TO DRAFT NEW RESOLUTION [A15] (WRC-19)**

### **PART 1**

#### **Provisions for maritime ESIM to protect terrestrial services operating in the frequency band 27.5-29.5 GHz for the implementation of *resolves* 1.2.2**

### **PART 2**

#### **Option 1:**

#### **Provisions for aeronautical ESIM to protect terrestrial services operating in the frequency band 27.5-29.5 GHz for the implementation of *resolves* 1.2.2**

#### **Option 2:**

#### **Guidelines for assisting administrations to facilitate the authorization of aeronautical ESIM operating in the 27.5-29.5 GHz for the implementation of *resolves* 1.2.2**

#### **Option 1**

The administration that authorizes the use of aeronautical or maritime ESIM in these frequency bands shall ensure that such stations follow the provisions of this Annex and thus do not present any potential to cause unacceptable interference to the services of concerned administrations.

#### **Option 2**

The paragraph above is not needed due to the fact that this paragraph contains regulatory text which is outside the scope of this Annex technical criteria/parameters/conditions by which *resolves* 1.2.2 should be implemented.

#### **Option 3**

This Annex contains technical and operational criteria/parameters/conditions that maritime and aeronautical ESIM need to comply with.

### **PART 1**

Note: Due to lack of time, Part 1 of this Annex has not been discussed in detail and needs to be given further consideration.



Transmitting maritime ESIM operating in the frequency band 27.5-29.5 GHz shall comply with the following conditions:

1 the notifying administration of the GSO FSS satellite network with which a maritime ESIM communicates shall ensure compliance of the maritime ESIM terminal with the provision of items 1.1 and 1.2 below:

or

1 maritime ESIM shall comply with the provision of items 1.1 and 1.2 below:

or

1 the administration that authorizes the maritime ESIM shall ensure that such stations do not cause unacceptable interference to the terrestrial services of concerned administrations with the provision of items 1.1 and 1.2 below:

1.1 the minimum distances from the low-water mark as officially recognized by the coastal State beyond which maritime ESIM can operate without the prior agreement of any administration is [60-70/80/120] km in the 27.5-29.5 GHz frequency band. Any transmissions from maritime ESIM within the minimum distance shall be subject to the prior agreement of the concerned coastal State;

1.2 the maximum maritime ESIM e.i.r.p. spectral density towards the territory of any coastal State will be limited to [12.98/24.44] dBW in reference bandwidth of [1/14] MHz. Transmissions from maritime ESIM with higher e.i.r.p. spectral density levels towards the territory of any coastal state shall be subject to the prior agreement of the concerned coastal State.

## PART 2

“Transmitting aeronautical ESIM operating in the frequency band 27.5-29.5 GHz shall comply with the following conditions” / “Administrations authorizing aeronautical ESIM transmitting in the frequency band 27.5-29.5 GHz may consider the following guidelines for their operation”:

1 aeronautical ESIM communicating with GSO FSS networks shall comply with the provisions of items 1.1 and 1.2 below:

1.1 unless otherwise agreed by the administration concerned, the maximum pfd produced at any point of the surface of the Earth on the territory under the jurisdiction of that administration by emissions from a single aeronautical ESIM shall not exceed:

Note - Pfd values that shall be complied with by an aeronautical ESIM need to take into account the effect of aggregate interference from multiple aeronautical ESIM. “This fact needs to be verified” / “Views were expressed that this fact needs to be verified”.

Note - The validity and accuracy of these masks to adequately protect terrestrial services are yet to be verified and agreed upon.

### Option 1

$\text{pfd}(\delta) = -124.7$	(dB(W/m <sup>2</sup> · 14 MHz))	for	$0^\circ \leq \delta \leq 0.01^\circ$
$\text{pfd}(\delta) = -120.9 + 1.9 \cdot \log_{10}(\delta)$	(dB(W/m <sup>2</sup> · 14 MHz))	for	$0.01^\circ \leq \delta \leq 0.3^\circ$
$\text{pfd}(\delta) = -116.2 + 11 \cdot \log_{10}(\delta)$	(dB(W/m <sup>2</sup> · 14 MHz))	for	$0.3^\circ < \delta \leq 1^\circ$
$\text{pfd}(\delta) = -116.2 + 18 \cdot \log_{10}(\delta)$	(dB(W/m <sup>2</sup> · 14 MHz))	for	$1^\circ < \delta \leq 2^\circ$
$\text{pfd}(\delta) = -117.9 + 23.7 \cdot \log_{10}(\delta)$	(dB(W/m <sup>2</sup> · 14 MHz))	for	$2^\circ < \delta \leq 8^\circ$
$\text{pfd}(\delta) = -96.5$	(dB(W/m <sup>2</sup> · 14 MHz))	for	$8^\circ < \delta \leq 90.0^\circ$

where  $\delta$  is the angle of arrival of the radio-frequency wave (degrees above the horizon).

**Option 2**

$$\begin{aligned} \text{pfd}(\delta) &= -111.1 && (\text{dB(W/m}^2 \cdot 14 \text{ MHz)}) && \text{for} && 0^\circ \leq \delta \leq 2^\circ \\ \text{pfd}(\delta) &= -111.1 + 1.5 * (\delta - 2) && (\text{dB(W/m}^2 \cdot 14 \text{ MHz)}) && \text{for} && 2^\circ < \delta \leq 13.6^\circ \\ \text{pfd}(\delta) &= -93.7 && (\text{dB(W/m}^2 \cdot 14 \text{ MHz)}) && \text{for} && 13.6^\circ < \delta \leq 90^\circ \end{aligned}$$

where  $\delta$  is the angle of arrival of the radio-frequency wave (degrees above the horizon).

Note - This potential pfd mask applicable to aeronautical ESIM for the protection of terrestrial services is still under consideration and may be revised.

**Option 3**

$$\begin{aligned} \text{pfd}(\delta) &= -121.3 + 1.5 * \delta && (\text{dB(W/m}^2 \cdot \text{MHz)}) && \text{for} && 0^\circ \leq \delta < 5^\circ \\ \text{pfd}(\delta) &= -113.7 && (\text{dB(W/m}^2 \cdot \text{MHz)}) && \text{for} && 5^\circ \leq \delta \leq 90^\circ \end{aligned}$$

where  $\delta$  is the angle of arrival of the radio-frequency wave (degrees above the horizon).

**Option 1**

1.2 Unless agreement from concerned administrations, aeronautical ESIM shall not transmit below (X) km of altitude above the territory of the administration concerned.

An example of X = 6 was given.

Note - The validity and accuracy of an altitude approach to adequately protect terrestrial services are yet to be verified and agreed upon.

**Option 2**

1.2 is not needed. A minimum altitude is not required since the compliance with a pfd mask in 1.1 above is sufficient to protect terrestrial services.

Note - Due to lack of time, the text beyond this point has not been discussed in detail and needs to be given further consideration.

2.2 higher pfd levels produced by aeronautical ESIM on the surface of the Earth than provided in 2.1 above shall be subject to the prior agreement of the administration within line-of-sight of the aeronautical ESIM.

Note - The pfd levels provided in provision 2.1 above relate to the pfd and angles of arrival that would be obtained using free-space propagation, atmospheric absorption and any attenuation due to the aircraft fuselage.

**ANNEX 3 TO DRAFT NEW RESOLUTION [A15] (WRC-19)**

**Land ESIM and overall responsibilities for  
the operation of all three ESIM types**

or

## **Guidelines to assist administrations to authorize ESIM in the frequency band 27.5-29.5 GHz**

Note: The title needs to be revised in order to align with the responsibilities stipulated in the ITU CS.

Note: It is necessary to carefully review the responsibility and obligation of each entity in this Annex with regard to the mandatory actions mentioned below.

Note: Once the content of this Annex is reviewed and agreed, the list of administrations below could be reduced or deleted, as appropriate, to reflect only the entities involved.

Note: For the operation of ESIM, the technical, operational and regulatory responsibilities of entities operating various types of ESIM (on board aircraft, on board vessels and on board land vehicle) need to be defined:

- a) notifying administration of the ESIM assignments corresponding to the satellite networks on which the ESIM operate;
- b) satellite operators of ESIM assignments;
- c) the gateway administration which facilitates the radiocommunication connection between the ESIM terminal and the satellite space station;
- d) administrations on territory (air space, territorial water and land) of which the ESIM terminal will operate.

How the responsibilities mentioned above are assumed by each of these four entities and how the interference management system would be performed need to be defined.

It is understood that there would be a monitoring and control station to take necessary actions in regard with “enabling” and “disabling” the operation of the ESIM terminals. If such actions are envisaged to be performed by the entities mentioned in a), b) and c) above, then it should be clear how such responsibilities are shared between these entities. On the other hand if such “enabling” and “disabling” functions are divided or shared by these three entities, then the responsibility of the fourth entity (the entity on the territory under the jurisdiction of which the ESIM terminals would be located) could act? Suppose that such “enabling” and “disabling” functions are totally performed outside the control of the fourth entity, then that entity which, in fact, licensed the operation of the ESIM terminals has no authority or responsibility on the function of the ESIM terminals that it authorized/licensed. However, according to the *resolves* of Resolution **1 (Rev.WRC-03)** that fourth entity is legally responsible towards other administrations in regard with any potential interference that may occur.

In addition, in case that interference caused by the operation of ESIM terminals to the terrestrial or space services of other administrations, the appropriate course of action and operational procedure on how rapidly reduce the interference to the acceptable level or its elimination is also not addressed, at all.

Shared responsibilities among various entities and administrations need to be defined.

1 For the purpose of this Annex, the entities below are defined as follows:

- a) Administration A is the administration on the territory of which an ESIM operates.
- b) Administration B is the administration on the territory of which a potentially interfered-with FS receiver is located.
- c) Administration C is the administration on the territory of which the ESIM gateway is located. The ESIM gateway is [...].

*d)* Administration D is the notifying administration of the GSO FSS network with which the ESIM communicate.

*e)* Administration E is the administration on the territory of which the Network Control and Monitoring Centre (NCMC) is located. The NCMC is [...].

*f)* Administration F is the administration whose licence is mutually recognized by Administration A when an ESIM is operating on the territory under the jurisdiction of Administration A.

Note - An additional guideline may be considered to suggest that administrations authorizing ESIM should notify so to the Bureau.

*g)* the ESIM network operator is [...].

or

*g)* the ESIM network operator is the service provider that uses capacity on the satellite communicating with the ESIM.

The following guidelines are provided for all administrations involved in the authorization and operation of ESIM in the 27.5-29.5 GHz and 17.7-19.7 GHz frequency bands:

2 With regard to Land ESIM (L-ESIM), the administration authorizing L-ESIM has the right to require:

*a)* That L-ESIM operate within the territory under the jurisdiction of another administration shall only do so if authorized by that administration.

*b)* The operator of any ESIM network within which the L-ESIM operate ensure that such L-ESIM only have the capability to [limit operations to/operate within] the territory of administrations having authorized those L-ESIM.

or

*b)* That the ESIM network operator ensures that such L-ESIM have the capability to limit operations to the territory of administrations having authorized those L-ESIM.

*c)* The administration authorizing L-ESIM shall require that the ESIM network operator put in place all necessary measures so that its L-ESIM are subject to permanent monitoring and control by a NCMC or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility.

*d)* The operator of the ESIM network within which the L-ESIM operate provide a point of contact for the purpose of tracing any suspected cases of interference from L-ESIM.

3 With regard to Maritime ESIM (M-ESIM), the administration authorizing M-ESIM has the right to require:

*a)* That M-ESIM operating within the territorial waters under the jurisdiction of another administration shall only do so if authorized by that administration.

*b)* The operator of any ESIM network within which the M-ESIM operate ensure that such M-ESIM only have the capability to [limit operations/operate] within the territorial waters of administrations having authorized those M-ESIM.

*c)* The administration authorizing M-ESIM shall require that the ESIM network operator put in place all necessary measures so that its M-ESIM are subject to permanent monitoring and control by an NCMC or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility.

*d)* The administration authorizing M-ESIM shall require that the ESIM network operator provide a point of contact for the purpose of tracing any suspected cases of interference from M-ESIM.

3.1 The Administration C on the territory of which the ESIM Gateway is located and the network operator of M-ESIM operating in the international waters are responsible for compliance with all necessary actions related to the implementation of the M-ESIM licensing procedures adopted in the “Flag of the Vessel” State.

4 With regard to Aeronautical ESIM (A-ESIM), the administration authorizing A-ESIM has the right to require:

*a)* That A-ESIM operate within the territorial airspace under the jurisdiction of an administration only if authorized by that administration.

or

*a)* The administration authorizing A-ESIM shall require that A-ESIM operating within the national controlled airspace under the jurisdiction of another administration shall only do so if authorized by that administration.

*b)* That the ESIM network operator ensures that such A-ESIM have the capability to limit operations to the territorial airspace of administrations having authorized those A-ESIM.

or

*b)* The administration authorizing A-ESIM shall require that the ESIM network operator ensure that such A-ESIM only have the capability to operate within the national controlled airspace of administrations having authorized those A-ESIM.

or

*b)* The operator of any ESIM network within which the A-ESIM operate ensure that such A-ESIM have the capability to limit operations to the territorial airspace of administrations having authorized those A-ESIM.

*c)* That the ESIM network operator provide a point of contact for the purpose of tracing any suspected cases of interference from A-ESIM.

or

*c)* The administration authorizing A-ESIM shall require that the ESIM network operator put in place all necessary measures so that its A-ESIM are subject to permanent monitoring and control by an NCMC or equivalent facility and are capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility.

*d)* The administration authorizing A-ESIM shall require that the ESIM network operator provide a point of contact for the purpose of tracing any suspected cases of interference from A-ESIM.

4.1 The Administration C on the territory of which the ESIM Gateway is located and the network operator of A-ESIM operating in the international airspace are responsible for compliance with all necessary actions related to the implementation of the A-ESIM licensing procedures adopted in the “Flag of the Aircraft” State.

5 At the regional or multi-country level, mutual recognition of national licences (authorizations) for the operation of ESIM is allowed subject to bilateral or multilateral agreements between the interested States on free circulation, cross-border movement and use of different types of ESIM considered in the Resolution.

Note: Due to lack of time the guidelines for the A-ESIM case have not been considered in detail. Conditions similar to the L-ESIM and M-ESIM cases, but tailored for A-ESIM operational characteristics, need to be given further consideration.

**3/1.5/5.2.2 Example modification to Appendix 4 to implement *resolves 1.1.2* to draft new Resolution [A15] (WRC-19)**

APPENDIX 4 (REV.WRC-15)

**Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III**

ANNEX 2

**Characteristics of satellite networks, earth stations  
or radio astronomy stations<sup>2</sup> (Rev.WRC-12)**

**Footnotes to Tables A, B, C and D**

MOD

**TABLE A**  
**GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,**  
**EARTH STATION OR RADIO ASTRONOMY STATION** (Rev.WRC-19)

Items in Appendix	A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.18	<b>COMPLIANCE WITH NOTIFICATION OF AIRCRAFT EARTH STATION(S)</b>										A.18	
A.18.a	a commitment that the characteristics of the aircraft earth station (AES) in the aeronautical mobile-satellite service are within the characteristics of the specific and/or typical earth station published by the Bureau for the space station to which the AES is associated  Required only for the band 14-14.5 GHz, when an aircraft earth station in the aeronautical mobile-satellite service communicates with a space station in the fixed-satellite service				+	+					A.18.a	
A.19	<b>COMPLIANCE WITH § 6.26 OF ARTICLE 6 OF APPENDIX 30B</b>										A.19	
A.19.a	a commitment that the use of the assignment shall not cause unacceptable interference to, nor claim protection from, those assignments for which agreement still needs to be obtained  Required if the notice is submitted under § 6.25 of Article 6 of Appendix 30B									+	A.19.a	
A.20	<b>COMPLIANCE WITH <i>resolves</i> 1.1.2 OF DRAFT NEW RESOLUTION [A15] (WRC-19)</b>										A.20	
A.20.a	indicator (yes) if an assignment for the 27.5-29.5 GHz and/or 17.7-19.7 GHz band in the satellite network will be used by ESIM						O				A.20.a	
A.20.b	if yes under A.20.a, a commitment that the ESIM operation would be in conformity with the Radio Regulations and <b>draft new Resolution [A15] (WRC-19)</b> (including its Annexes)						+				A.20.b	





**3/1.5/5.2.3 Example consequential suppression of Resolution 158 (WRC-15)**

**SUP**

**RESOLUTION 158 (WRC-15)**

**Use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service**

## Agenda item 1.6

**(WP 4A / WP 4C, WP 5A, WP 5B, WP 5C, WP 5D, WP 6A, WP 7B, WP 7C, WP 7D,  
(WP 3M), (WP 4B))**

*1.6 to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), in accordance with Resolution 159 (WRC-15);*

*Resolution 159 (WRC-15) – Studies of technical, operational issues and regulatory provisions for non-geostationary fixed-satellite services satellite systems in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space).*

### **3/1.6/1 Executive summary**

WRC-19 agenda item 1.6 addresses the development of technical, operational and regulatory provisions in the 50/40 GHz frequency bands to facilitate sharing between non-GSO and GSO fixed-satellite services (FSS)/broadcasting-satellite service (BSS)/mobile-satellite service (MSS) systems.

There are currently no regulatory provisions for sharing between non-GSO systems and GSO networks in the 50/40 GHz frequency bands. In addition, there are no mechanisms in the RR establishing coordination procedures applicable to non-GSO systems operating within the FSS and BSS allocations in frequency bands in the 37.5 to 51.4 GHz frequency range.

ITU-R studies in the 50/40 GHz frequency bands have been conducted on sharing between non-GSO systems and GSO FSS and BSS networks. These studies concluded that developing efd limits based on the operational parameters for a single, specific, non-GSO system results in spectrum inefficiencies for other non-GSO systems.

On the other hand, these studies identify a more efficient sharing methodology in the 50/40 GHz frequency bands and conclude that the protection of GSO networks is possible based on an assessment of aggregate interference from multiple non-GSO systems, with different configurations and orbits.

Other ITU-R studies were unable to conclude on the appropriate efd limits to protect GSO FSS and BSS networks from the operation of non-GSO FSS systems, due to the number of possible configurations and the complexity of the non-GSO FSS systems that can be considered.

While there may not be an agreement on efd limits, there is general consensus that it is possible to achieve compatibility in the 50/40 GHz frequency bands that would allow non-GSO FSS systems to operate while ensuring protection to GSO satellite networks in the FSS, MSS, and BSS, based on a decrease in availability and capacity loss.

WRC-19 agenda item 1.6 also considered the protection of the Earth exploration-satellite service (EESS) (passive) and radio astronomy services in adjacent bands.

ITU-R studies of compatibility between non-GSO FSS systems and EEES (passive) have shown that the limits currently in Resolution 750 (Rev.WRC-15) are not sufficient for the protection of EEES (passive). Methods to address compatibility between non-GSO FSS and EEES (passive) propose new unwanted emission limits for inclusion in Resolution 750 (Rev.WRC-15).

New limits to Resolution **750 (Rev.WRC-15)** have also been proposed to address compatibility issues between GSO FSS and EESS (passive), although this may be out of the scope of this agenda item.

Four methods have been proposed to respond to this agenda item.

### **3/1.6/2 Background**

Advances in satellite design, manufacturing and launch service capabilities have enabled the deployment of non-GSO FSS constellations. Additionally, the advances in antenna and terminal technology have enabled the development of the 50/40 GHz frequency bands for both GSO FSS/BSS and non-GSO FSS.

There are currently no regulatory provisions for sharing between non-GSO systems and GSO networks in the 50/40 GHz frequency bands. Moreover, there are no existing mechanisms in the RR establishing coordination procedures applicable to non-GSO systems operating within the FSS allocations in frequency bands in the 37.5 to 51.4 GHz range, such as the application of RR No. **9.12**. This also contributes to uncertainty among potential operators of non-GSO satellite systems in these bands.

To address these issues, WRC-15 established agenda item 1.6 for WRC-19: *“to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) in accordance with Resolution **159 (WRC-15)**”*.

### **3/1.6/3 Summary and analysis of the results of ITU-R studies**

#### **Non-GSO FSS and GSO FSS/BSS studies**

The results of the studies carried out in ITU-R showed that compatibility between non-GSO FSS satellite systems using circular orbits and GSO FSS/BSS networks in the 50/40 GHz frequency bands is achievable. The results of all studies demonstrated that the criterion of a 10% increase in the unavailability caused by interference was met taking into account the operational scenarios for tracking the non-GSO satellites and operational mitigation techniques.

#### **Non-GSO FSS and EESS (passive) studies**

Several compatibility studies carried out in ITU-R between non-GSO FSS systems and EESS (passive) have shown that the limits currently in Resolution **750 (Rev.WRC-15)** are not sufficient for the protection of EESS (passive) in the adjacent band 50.2-50.4 GHz. These studies showed that unwanted emission limits in the range of  $-61.9\dots-69.8$  dBW/200 MHz for non-GSO FSS user equipment and in the range of  $-27\dots-66$  dBW/200 MHz for gateways would be required to meet the EESS (passive) protection criteria in Recommendation ITU-R RS.2017; these studies did not exhaustively explore possible mitigation methods. One study demonstrated that a 3 dB decrease of the input power to the non-GSO FSS earth station antenna flange may be appropriate to meet the EESS (passive) protection criteria.

#### **3/1.6/3.1 Studies regarding propagation and sharing considerations between non-GSO and GSO systems**

ITU-R studies have shown that in the 50/40 GHz frequency bands, propagation impairments such as rain, cloud and gaseous absorption exist that can substantially affect FSS and BSS satellite links. Not only are rain fade and gaseous absorption propagation effects more severe than in lower frequency bands, but effects such as cloud attenuation can also have a significant impact to the FSS and BSS intra-service sharing environment in the 50/40 GHz frequency bands. Thus, higher

margins of atmospheric fade can exist as compared to lower frequency bands when evaluating sharing criteria between non-GSO and GSO systems in the 50/40 GHz frequency bands. These propagation impairments should be taken into account on both the wanted and interfering paths, noting that there is a difference in the attenuation experienced by each path, but it has a limited impact on the total degradation of the link for some specific scenarios.

### **3/1.6/3.2 Studies regarding non-GSO FSS and GSO FSS/BSS sharing**

The objective is to identify the means to enable use of the 50/40 GHz frequency bands by non-GSO systems that will ensure protection of co-frequency GSO FSS and BSS networks from unacceptable interference, thereby enhancing spectrum use. Ten studies have been presented including discussions of the derivation of epfd masks and propagation considerations that must be taken into account for the development of appropriate regulatory provisions in the 50/40 GHz frequency bands.

Non-GSO and GSO FSS Study 1 presents an analysis of the generation of an epfd profile mask based on generic low-Earth orbit (LEO) constellations of 2 000 and 4 000 satellites. The LEO constellations are at an altitude of 1 200 km and a minimum service elevation angle of 45°.

The analysis presents a background on the methodology for deriving aggregate epfd limits based on procedures carried out in lower frequency bands using Recommendations ITU-R S.1503, ITU-R P.618 and the sharing considerations given in Recommendation ITU-R S.1323. Given that this analysis deduced epfd masks based on a particular representative LEO constellation, the epfd masks are system specific and they are variable, depending on the particular operations of the non-GSO constellation chosen for defining a particular mask. The analysis shows that situations can arise where a particular system cannot meet a specific limit mask (deduced from a different system) but meets the GSO protection criteria given in Recommendation ITU-R S.1323. An analysis is also presented that shows the effect of accounting for propagation losses on the interfering path. The result of this study shows that there can be a significant operational margin available to the GSO when propagation impairments are taken into account.

Non-GSO and GSO FSS Study 2 provides a simulation and results of a study of the sharing between a non-GSO FSS satellite system in a circular equatorial orbit and a GSO network in the 48/38 GHz frequency bands. The results show the epfd and  $I/N$  statistics, the  $C/N$  and  $C/(N+I)$  curves of the GSO network, and the effect on availability due to interference from the non-GSO system. Based on the input assumptions, the results show that the unavailability targets in Recommendation ITU-R S.1323 of 10% increase are met and suggest that the epfd levels for the non-GSO system could be acceptable. It is noted that the results are based on a single non-GSO FSS system. This study acknowledges that it is necessary to consider aggregation affects taking into account different constellation types rather than a single equatorial circular orbit non-GSO system.

This study was expanded to consider the methodology of percentage increase in unavailability described in Recommendation ITU-R S.1323 which was used as the basis for the preliminary draft new Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY]. The results demonstrated that the percentage increase in unavailability caused by interference from a non-GSO system was below the proposed 3% metric which suggests this metric could serve as the single-entry limit for new non-GSO FSS systems to protect GSO satellite networks in the subject frequency ranges.

Non-GSO and GSO FSS Study 3 presents a comparison of the LEO system presented in non-GSO and GSO FSS Study 1 and the MEO system presented in non-GSO and GSO FSS Study 2. The purpose of the comparison in this study is to present an assessment of potential sharing between these two systems, with a view to maximize spectral efficiency in the 50/40 GHz frequency bands.

The analysis provides a comparison of the representative interference profiles derived in the studies from non-GSO and GSO FSS Study 1 and non-GSO and GSO FSS Study 2 relating to non-GSO constellations in LEO and MEO orbits. The analysis shows that the methodology used in both studies derives a potential epfd mask on the basis of the relevant non-GSO system considered, therefore, they are completely dependent on the characteristics of the systems being evaluated. While using this methodology, potential epfd masks can be developed for a particular system, it is difficult to define epfd masks that would allow all non-GSO systems to operate and provide for maximum spectrum efficiency, while still assuring that GSO protection criteria will always be observed.

The analysis also shows that if masks are developed for the operation of one particular non-GSO system, a separate non-GSO system may not be able to meet the requirements from that mask. However, each system independently, and even in composite form, is able to meet the protection criteria given in Recommendation ITU-R S.1323 with excess margin available.

Non-GSO and GSO FSS Study 4 considers both the uplink and downlink interference from two different non-GSO systems into a GSO network at varying elevation angles. The two non-GSO systems modelled were a LEO system at 1 200 km and a MEO system at 8 062 km. Two sets of five earth stations with five different elevation angles to the GSO were simulated, with the victim and interfering earth stations always being co-located. This study did not include any propagation impairments other than free-space path loss. If other attenuation losses such as rain and cloud attenuation, which have significant impact on both the wanted and interfering signal, are taken into account, then the resulting  $I/N$  ratios would be lower.

- For the first interference scenario (LEO and GSO), in the downlink, the study shows that the receiving GSO earth stations at lower elevation angles to the GSO satellite were more susceptible to interference from non-GSO systems. In the uplink, the interference into a GSO satellite from LEO earth stations was studied showing low levels of interference at the GSO satellite from earth stations located at most elevation angles to the GSO. When the elevation angles of the earth stations to the GSO were increased, the results showed higher levels of interference, but for small percentages of time.
- For the second interference scenario (MEO and GSO), the study shows that receiving GSO earth stations at lower elevation angles to the satellite receive lower  $I/N$  ratios from the equatorial MEO system. When earth stations with higher elevation angles to the GSO were studied, higher levels of interference were received, with the greatest impact to earth stations with elevation angles of  $10^\circ$  and  $0^\circ$  to the GSO. No geostationary arc avoidance was used in the MEO study. In terms of the uplink interference to the GSO satellite the  $I/N$  levels were found to be relatively low (under the conditions assumed), except for when the interfering earth stations were located at high elevation angles to the GSO.

Non-GSO and GSO FSS Study 5 is an analysis with a circular orbit LEO non-GSO FSS system using parameters similar to the 3ECom-2 satellite network (BR IFIC 2788), as an example of a typical non-GSO constellation deployment. The system consists of 12 orbits with 28 satellites in each orbit, which provides a total of 336 satellites in the system.

Assuming that the protection criterion for GSO FSS networks is a 10% increase to unavailability caused by the interference, the criterion was not exceeded for GSO beams from both low latitude and medium latitude scenarios in this study. The level of emissions from the non-GSO system depicted in this document were acceptable based on the assumptions in this study. Although the downlink pfd values of the non-GSO system exceeded the pfd requirement in RR Table 21-4, the compatibility between these two FSS systems depicted in this document was achieved. Given that the non-GSO FSS system downlink transmitting power would need to be decreased to meet the RR

Table 21-4 pfd limits, this lower power would further aid the sharing of non-GSO and GSO systems.

With the parameters of non-GSO and GSO systems depicted in Study 5, the calculated epfd limits were  $-152 \text{ dB(W/(m}^2 \cdot \text{MHz))}$  for uplink and  $-148 \text{ dB(W/(m}^2 \cdot \text{MHz))}$  for downlink. These calculated results are for this specific case of frequency sharing between non-GSO and GSO systems. Additional analysis and calculation for different cases may be conducted in the future research of WRC-19 agenda item 1.6.

Non-GSO and GSO FSS Study 6 is an analysis regarding interference by a non-GSO system to a GSO system in 50/40 GHz frequency bands under different conditions in two scenarios.

The configuration and orbital parameters of the simulated non-GSO system is extracted from 3ECom-3 filing with some characteristics modification to scale it in the 50/40 GHz frequency bands. The worst-case geometry location for the non-GSO system is calculated based on Recommendation ITU-R S.1503 and standard propagation models are used for simulations as referenced in Recommendation ITU-R P.525 and Recommendation ITU-R P.618 to model free-space loss and rain attenuation.

The operational scenarios for tracking the non-GSO satellites are as follows:

**Scenario 1:**

- Minimum elevation angle:  $20^\circ$
- GSO avoidance angle:  $2^\circ$
- The interfering non-GSO satellite is chosen based on the highest elevation angle.

**Scenario 2:**

- Minimum elevation angle:  $40^\circ$
- GSO avoidance angle:  $10^\circ$
- The interfering non-GSO satellite is chosen based on the highest elevation angle.

Based on Recommendation ITU-R S.1323, if the criterion is a 10% increase in the unavailability caused by interference, the increase in unavailability from a non-GSO system for Scenario 1 has not been met but for Scenario 2 it has been met. Then the interference from non-GSO system with Scenario 2 tracking strategy depicted in this document is acceptable.

The effects of interference on the user terminal antenna are greater than on the gateway antenna.

By the change in some of the parameters in tracking strategy, it is possible to decrease interference from a non-GSO system. Therefore, it could be concluded that frequency sharing between GSO and non-GSO satellite systems is possible provided that appropriate changes would be made on some of the parameters in the tracking strategy.

Non-GSO and GSO FSS Study 7 is an analysis of the operation of non-GSO systems into GSO networks that use adaptive coding and modulation (ACM). This analysis discusses the operation of ACM in next-generation GSO systems and potential procedures in terms of impact on data rate that can be taken into account for protection of these types of ACM operations. The analysis produces several results regarding the impact of non-GSO systems on GSO operations using ACM. The analysis concludes that further work is required to address how to account for the operations of non-GSO systems and the protection of GSO operations employing ACM.

In non-GSO and GSO FSS Study 8, for every  $C/(N+I)$  value of any GSO link, it is possible to determine the corresponding unavailability purely due to propagation effects using Recommendation ITU-R P.618. Limiting the increase of such unavailability (or decrease in capacity

for networks using adaptive coding) is the basis to establish the constraints to be imposed to non-GSO systems. Indeed, the non-GSO interference on the GSO links should be limited in a way that the unavailability of the GSO systems is not increased above a defined level that is often expressed in percentage of the unavailability due to propagation effects. For GSO networks using ACM, the non-GSO interference should be limited in a way that it is at the origin of a specific maximum percentage of decrease in the amount of throughput of the GSO network. Using this approach, the permissible interference levels induced by non-GSO systems on a GSO link may be completely independent of the characteristics or number of non-GSO system(s) and are only dependent on the GSO link to be protected. Based on this approach, maximum interference levels can be transformed into aggregate efd limits.

Given that this approach assumes that deep rain fades on the GSO link may occur at the same time as high interference events from the non-GSO systems, the method might be overprotective for GSO links.

Non-GSO and GSO FSS Study 9 verifies the applicability of the methodology to calculate the increase in unavailability of three identical forward GSO reference links (gateway-to-user) from interference of non-GSO systems. It was assumed that the rain fade of the wanted links and the interference links was 100% correlated in the space-to-Earth direction given the limitations of the software. The percentage of unavailability due to the combined impact of the rain and the non-GSO interference was determined for the overall uplink and downlink, using the respective  $C/N$  objective for each system. The increase in unavailability is given by the ratio of the percentage of unavailability with interference and without interference. Results demonstrate that the highest increase in unavailability created by one non-GSO system for the overall uplink and downlink was 0.7%, using the respective  $C/N$  objective for each system. The increase in unavailability is given by the ratio of the percentage of unavailability with interference and without interference. It is also shown that when a larger GSO arc avoidance angle is applied, the increase in unavailability of the GSO link is reduced. The absence of GSO arc avoidance leads to high increases in unavailability. Finally, it is noted that most of the increase in unavailability is caused by interference into the downlink segments of the GSO links, while the impact on the uplink is almost negligible. Consequently, mitigation measures or regulatory limits to protect GSO networks would be more effective in the space-to-Earth direction.

Non-GSO and GSO FSS Study 10 is a sharing study on the long-term impact to the spectral efficiency of a GSO system employing ACM that is subjected to interference from a non-GSO system. The results show that during rain fading events, the reduction in spectral efficiency is mostly due to the degradation in the carrier-to-noise ratio due to rain attenuation.

Two interference scenarios from a non-GSO system into the downlink of a GSO network were considered. In the first case, the GSO earth station was at a higher latitude (Saskatoon, Canada) and the interference had minimal impact on the spectral efficiency of a link employing ACM. In the second case, the GSO earth station was assumed to be at a lower latitude (Lima, Peru). The analysis and calculations show that even with high peaks in  $I/N$  (up to 33 dB), the long-term reduction in spectral efficiency for the second case was about 2%.

In addition, an analysis relating to the degradation in spectral efficiency of a link employing ACM to the duration of  $I/N$  interference burst was performed. Taking into account the wide dynamic range of  $C/N$  over which ACM systems can operate, short bursts of interference with high  $I/N$  levels do not substantially degrade the performance of an ACM system.

### **3/1.6/3.3 Studies regarding non-GSO FSS and EESS (passive) considerations**

Resolution **159 (WRC-15)** also calls for studies regarding protection of EESS (passive) systems in the frequency bands 36-37 GHz and 50.2-50.4 GHz from planned non-GSO systems, including the

study of aggregate FSS interference effects from networks and systems operating or planning to operate in these bands. Current out-of-band limits for FSS earth stations operating in the channels adjacent to the 50.2-50.4 GHz EESS (passive) band are specified in Resolution **750 (Rev.WRC-15)**.

FSS-EESS (passive): Study 1 examined the interference into the 50.2-50.4 GHz frequency band through two methodologies and determined that interference caused by the four specific non-GSO systems analysed does not aggregate on a power basis for small percentages of time but that the aggregate interference environment is from the dominant link. This study demonstrated that to maintain the non-GSO contribution to the established aggregate FSS interference environment allowed by Resolution **750 (Rev.WRC-15)**, the aggregate power in excess of  $-166$  dBW/200 MHz for no more than 0.01% of the time over an area of 2 000 000 km<sup>2</sup> in the frequency band 50.2-50.4 GHz was calculated to be 0.2 dB higher than what is currently experienced from a single FSS non-GSO system with MEOSAT-X characteristics. To remove this minor excess and maintain the existing non-GSO FSS interference profile, a 3 dB decrease of the input power to the antenna flange may be appropriate for the new FSS non-GSO satellite systems.

FSS-EESS (passive): Study 2 examined the interference into the 36-37 GHz frequency band and indicated that the probability of exceeding the acceptable EESS interference level is at least two orders of magnitude lower than the 0.1% criterion in the 36-37 GHz frequency band.

FSS-EESS (passive): Study 3 was an interference analysis in the 50.2-50.4 GHz frequency band examining all four EESS sensor types over nine different measurement areas across the world. This study explored the effects of gateway and user terminal and additionally considered the aggregate effects of multiple non-GSO systems. This study determined that the worst-case aggregate interference for gateways exceeded the protection criteria specified by Recommendation ITU-R RS.2017 by 74.3 dB using an out-of-band power of 0 dBW/200 MHz reducing the out-of-band power to  $-10$  dBW/200 MHz, which is the current limit for gateways in Resolution **750 (Rev.WRC-15)**, the exceedance would be 64.3 dB, however, the needed out-of-band limit to meet the protection criteria would be the same. When considering GSO and non-GSO interference separately, it was demonstrated that the GSO FSS gateway earth stations can cause 25.3 dB of exceedance at elevation angles below 70 degrees and as much as 74.3 dB with elevation angles above 70 degrees when considering an input power of 0 dBW/200 MHz. Non-GSO FSS earth stations (aggregate of gateways and user terminals) caused 58.8 dB of exceedance of the protection criteria when considering an input power of 0 dBW/200 MHz reducing the out-of-band power to  $-10$  dBW/200 MHz, which is the current limit for gateways in Resolution **750 (Rev.WRC-15)**, the exceedance would be 48.8 dB, however the needed out-of-band limit to meet the protection criteria would be the same. When considering how interference from multiple non-GSO systems aggregates, the analyses demonstrated that aggregation could increase the exceedance of the EESS protection criteria by more than 11 dB over the exceedance that was calculated for a single system, depending on specific systems considered and in what order they are analysed.

FSS-EESS (passive): Study 4 examined the interference in the 50.2-50.4 GHz frequency band and determined that limits provided in Resolution **750 (Rev.WRC-15)** were not sufficient to meet the interference criteria. An additional attenuation of up to 17 dB for gateway links and up to 44 dB for service links would still be required. These values are determined by the sensitivity of the push-broom sensor. To protect the conical and the mechanical nadir sensors, attenuation of 3.3 dB and 18 dB would be required for gateways and user terminals, respectively. With respect to the 36-37 GHz frequency band, the study showed that when using a worst-case of out-of-band emission (OOBE) mask, the interference criteria was not exceeded for the EESS sensors studied in the 36-37 GHz frequency band and for the non-GSO FSS systems modelled. As such, a more refined study



to better model OOB into the EESS (passive) systems was not undertaken. These results suggest that non-GSO FSS systems and EESS (passive) systems in the 37 GHz range are compatible.

FSS-EESS (passive): Study 5 determined that an out-of-band limit to protect the EESS (passive) in the 50.2-50.4 GHz band of  $-65.9$  dBW/200 MHz would be needed for GSO FSS earth stations (without any constraint on the GSO FSS elevation angle, to possibly relax the out-of-band limits for the GSO FSS earth stations),  $-63$  dBW/200 MHz for non-GSO gateway earth stations and a limit of  $-61.9$  dBW/200 MHz is needed for user terminals. This is assuming a 3 dB apportionment of the EESS (passive) protection criterion. It is noted that the value obtained for non-GSO systems in Study 5 is similar to the one obtained for non-GSO systems in Study 3 and for non-GSO service links in Study 4 (none of these two studies considered apportionment).

FSS-EESS (passive): Study 6 results have shown that the protection criteria for GSO EESS (passive) systems is exceeded by 46 dB. Therefore  $-66$  dBW/200 MHz for non-GSO gateway earth stations is needed if there is no avoidance angle for the non-GSO FSS earth stations. In order to protect GSO EESS (passive) systems in the 50.2-50.4 GHz frequency band, the GSO avoidance angle for the non-GSO FSS earth stations should not be less than  $10^\circ$  when the OOB emissions from each FSS ES is limited to  $-20$  dBW/200 MHz.

These studies did not consider the impact on GSO FSS networks or non-GSO FSS systems of constraining operations to not exceed the EESS (passive) protection criteria in Recommendation ITU-R RS.2017. Additionally, studies between the EESS (passive) and FSS did not fully consider all possible interference mitigation techniques.

### **3/1.6/3.4 Studies regarding non-GSO FSS and RAS considerations**

Studies have been carried out in working document towards a PDN Report ITU-R S.[50/40 GHz ADJACENT BAND STUDIES] to assess the impact of a LEO and MEO non-GSO system into RAS operations in the 42.5-43.5 GHz, 48.94-49.04 GHz and 51.4-54.25 GHz frequency bands.

#### **3/1.6/3.4.1 Non-GSO (Earth-to-space)**

One study provided generic calculations for separation distances between a single non-GSO FSS earth station operating in the 50.4-51.4 GHz frequency band and a RAS station operating at 48.94-49.04 GHz and 51.4-53.4 GHz frequency bands. The study investigated in-band sharing and also compatibility in the out-of-band and spurious domains.

The separation distances for protection of the spectral-line observation of RAS stations in the frequency band 48.94-49.04 GHz from the in-band emission of non-GSO FSS ES in single emitter scenario vary from 46 km up to 129 km. Separation distances for protection of the RAS stations operating in the frequency band 51.4-53.4 GHz from the out-of-band emission of non-GSO FSS ES operating in the frequency band 50.4-51.4 GHz vary from 14 km up to 120 km. Separation distances for protection of the RAS stations operating in the frequency band 51.4-54.25 GHz from the spurious emissions of non-GSO FSS ES operating in the frequency band 50.4-51.4 GHz vary from distances less than 1 km up to 37 km.

These separation distances were obtained using technical parameters directly from Recommendation ITU-R SM.1541-6 for the non-GSO FSS ES and do not take into account the terrain profile for the interfering signal and also the deployment density of the earth stations. The separation distances could be adjusted to more realistic values by taking into account actual terrain profiles and more realistic non-GSO FSS ES parameters.

#### **3/1.6/3.4.2 Non-GSO (space-to-Earth)**

Studies of non-GSO FSS system downlinks operating in the frequency band 37.5-42.5 GHz showed that substantial filtering of the satellite emissions, or other operational measures by FSS operators,

would be needed to satisfy the requirements of RR Nos. **5.551H** and **5.551I** to protect the RAS operating in the frequency band 42.5-43.5 GHz.

### **3/1.6/3.5 Studies regarding non-GSO FSS to non-GSO FSS mitigation considerations**

The objective of this study was to determine the effectiveness of mitigation techniques such as orbital avoidance angles and earth station diversity in reducing in-line interference events, thereby allowing for sharing between next-generation non-GSO FSS constellations. Up to three non-GSO FSS systems were simulated simultaneously. The study concludes that these mitigation techniques are effective in reducing the number of in-line interference events that exceed an  $I/N$  threshold of  $-12.2$  dB, as well as the duration of the longest and average interference events and the value of the worst-case exceedance.

### **3/1.6/4 Methods to satisfy the agenda item**

Four methods are proposed to address WRC-19 agenda item 1.6. These methods are described below.

With regard to the protection of the EESS (passive) service in the 50.2-50.4 GHz frequency band, methods A-C below only address the potential modification of the limits in Resolution **750 (Rev.WRC-15)** on non-GSO unwanted emissions from the 47.9-50.2 GHz and 50.4-50.9 GHz frequency bands into the 50.2-50.4 GHz frequency band. Method D includes the consideration of modifications to GSO FSS systems as well.

Some administrations are of the view that modifications to Resolution **750 (Rev.WRC-15)** for GSO systems are not within the scope of this agenda item since the agenda item is in respect of non-GSO FSS systems.

If modifications to Resolution **750 (Rev.WRC-15)** with respect to FSS earth stations were to be made, an appropriate time-frame for these modifications to become effective would need to be determined.

Note: Due consideration may be given to those systems whose advance publication information or notification information, as appropriate, has been received by the Bureau prior to the entry into force of the Final Acts of WRC-19.

#### **3/1.6/4.1 Method A**

This method presents a regulatory and technical implementation to modify RR Article **22** to include a regulatory framework to enable non-GSO systems based upon a maximum allowable per cent increase in GSO unavailability specified in the short-term and long-term performance objectives of the GSO links. Previous methods to define sharing limits for non-GSO systems resulted in large variability for potential technical sharing limits based on the operational parameters of the non-GSO system at the time that the regulatory provisions are identified. Despite the obligation in RR No. **22.5K** to ensure that the actual aggregate interference into the GSO FSS and GSO BSS networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate power levels shown in Tables 1A to 1D of Resolution **76 (WRC-2000)**, there are no technical mechanisms to ensure that aggregate protection limits are not exceeded for GSO systems.

The technical approaches to developing sharing criteria for the 50/40 GHz frequency bands should focus on providing approaches that maximize spectrum efficiency for non-GSO FSS systems, while protecting GSO networks. This method provides the regulatory provisions that ITU-R sharing studies have found to be an efficient manner of promoting maximum spectrum use in the 50/40 GHz frequency bands. Applying this method results in additional spectrum efficiency gained

when designing non-GSO protection based on multiple configurations and orbits and the ability to keep track of aggregation factors.

This method includes the following modifications to the Radio Regulations:

- Add RR No. **5.A16** to subject the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) to the provisions of RR No. **9.12** to address the coordination between non-GSO FSS systems.
- Modify RR Article **22** to include a single-entry permissible time allowance for degradation in terms of *C/N* of GSO FSS networks in the 50/40 GHz frequency bands, in order to protect GSO FSS satellite networks from non-GSO FSS systems operating in the subject frequency ranges.
- Modify RR Article **22** to include aggregate time allowance for degradation in terms of *C/N* of GSO FSS networks in order to protect GSO FSS satellite networks from non-GSO FSS systems operating in the subject frequency ranges, and develop a new WRC Resolution providing the procedure to ensure that aggregate limits will not be exceeded.
- Incorporate GSO reference links into an ITU-R Recommendation, which will be used as the basis for the calculation of single-entry and aggregate limits.
- Add a new footnote RR No. **5.B16** in the frequency band 39.5-40.5 GHz in all Regions to address the coordination between MSS and non-GSO FSS systems under RR No. **9.11A**.
- Modify the unwanted emission limits for the FSS in Resolution **750 (Rev.WRC-15)** to protect EESS (passive) systems operating in the band 50.2-50.4 GHz from harmful interference from non-GSO FSS systems operating in the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz.

### 3/1.6/4.2 Method B

This method presents a regulatory and technical implementation to modify RR Article **22** to include a regulatory framework to enable non-GSO systems based upon a maximum allowable per cent increase in GSO unavailability based on the time allowance for *C/N* specified in the short-term performance objectives of the GSO links. Previous methods to define sharing limits for non-GSO systems resulted in large variability for potential technical sharing limits based on the operational parameters of the non-GSO system at the time that the regulatory provisions are identified. Despite the obligation in RR No. **22.5K** to ensure that the actual aggregate interference into the GSO FSS and GSO BSS networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate power levels shown in Tables 1A to 1D of Resolution **76 (WRC-2000)**, there are no technical mechanisms to ensure that aggregate protection limits are not exceeded for GSO systems.

The technical approaches to developing sharing criteria for the 50/40 GHz frequency bands should focus on providing approaches that maximize spectrum efficiency for non-GSO FSS systems, while protecting GSO networks. This method provides the regulatory provisions that ITU-R sharing studies have found to be an efficient manner of promoting maximum spectrum use in the 50/40 GHz frequency bands. Applying this method results in additional spectrum efficiency gained when designing non-GSO protection based on multiple configurations and orbits and the ability to keep track of aggregation factors.

This method includes the following modifications to the Radio Regulations:

- Add RR No. **5.C16** to subject the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz

(Earth-to-space) to the provisions of RR No. **9.12** to address the coordination between non-GSO FSS systems.

- Modify RR Article **22** to include a single-entry permissible time allowance for degradation in terms of  $C/N$  of GSO FSS networks in the 50/40 GHz frequency bands, in order to protect GSO FSS satellite networks from non-GSO FSS systems operating in the subject frequency ranges.
- Modify RR Article **22** to include aggregate time allowance for degradation in terms of  $C/N$  of GSO FSS networks in order to protect GSO FSS satellite networks from non-GSO FSS systems operating in the subject frequency ranges, and develop a new WRC Resolution providing the procedure to ensure that aggregate limits will not be exceeded.
- Develop and maintain a list of GSO reference links, which will be used as the basis for the calculation of single-entry and aggregate limits.
- Add a new footnote RR No. **5.D16** in the frequency band 39.5-40.5 GHz in all Regions to address the coordination between MSS and non-GSO FSS systems under RR No. **9.11A**.
- Modify the unwanted emissions limits for the FSS in Resolution **750 (Rev.WRC-15)** to protect EESS (passive) systems operating in the band 50.2-50.4 GHz from harmful interference from non-GSO FSS systems operating in the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz.

### **3.1.6/4.3 Method C**

Add a new footnote to RR Article **5** to require coordination among non-GSO FSS systems in the bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space).

Modify RR Article **22** to include:

- a new provision to limit each non-GSO FSS system to a 3% maximum increase of unavailability as associated with the short-term performance objective for reference GSO links;
- a new provision to limit the maximum allowable aggregate 10% increase in unavailability for GSO reference links caused by all operational or soon-to-be operational non-GSO FSS systems;
- a new provision to limit each non-GSO FSS system to a 3% reduction in throughput (spectral efficiency) as associated with the long-term performance objective for an adaptive coding and modulation GSO reference links (see RR No. **1.109A** for definition of adaptive system);
- a new provision to limit non-GSO FSS systems (operational or soon-to-be operational) to a 10% maximum reduction in throughput (spectral efficiency) as associated with the long-term performance objective for adaptive coding and modulation GSO reference links;

Develop a new WRC Resolution providing the procedure to ensure that aggregate limits will not be exceeded.

Incorporate GSO reference links into an ITU-R Recommendation, which will be used as the basis for the calculation of single-entry and aggregate limits.

Modify the unwanted emission limits for the FSS in Resolution **750 (Rev.WRC-15)** to protect EESS (passive) systems operating in the band 50.2-50.4 GHz from harmful interference from non-GSO FSS systems operating in the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz.

The amount of attenuation that should be implemented in a revision to Resolution **750 (Rev.WRC-15)** would need to strike a balance between protection of the EESS and not causing undue constraints to the FSS as per RR No. **5.340**. Furthermore, the reduction in OOBE for non-GSO FSS systems needs to take into account the relative impact of such systems against that caused by GSO networks operating at the existing levels in that Resolution.

### 3.1.6/4.4 Method D

Method D is identical with Method A with the exception of modifications to Resolution **750 (Rev.WRC-15)**. Some studies considered the impact on EESS (passive) operations from GSO FSS unwanted emissions. These studies have demonstrated that GSO FSS systems have exhausted all of the EESS (passive) interference margin, therefore this method proposes to modify both the GSO and the non-GSO earth station out-of-band emission limits in Resolution **750 (Rev.WRC-15)** to allow the aggregate interference to meet the protection criteria.

However, the appropriateness of modifying the GSO out-of-band emission limits is still under consideration.

### 3/1.6/5 Regulatory and procedural considerations

The regulatory and procedural considerations to satisfy the agenda item are considered below for each of the proposed methods defined in section 3/1.6/4.

#### 3/1.6/5.1 For Method A

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations (See No. 2.1)

#### MOD

#### 34.2-40 GHz

Allocation to services		
Region 1	Region 2	Region 3
<b>37.5-38</b>	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.A16 MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547	
<b>38-39.5</b>	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.A16 MOBILE Earth exploration-satellite (space-to-Earth) 5.547	

<b>39.5-40</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.A16 MOBILE MOBILE-SATELLITE (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547 ADD 5.B16
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**MOD**

**40-47.5 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>40-40.5</b>	EARTH EXPLORATION-SATELLITE (Earth-to-space) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.A16 MOBILE MOBILE-SATELLITE (space-to-Earth) SPACE RESEARCH (Earth-to-space) Earth exploration-satellite (space-to-Earth) ADD 5.B16	
<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.A16 BROADCASTING BROADCASTING-SATELLITE Mobile  5.547	<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.A16 BROADCASTING BROADCASTING-SATELLITE Mobile Mobile-satellite (space-to-Earth) 5.547	<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.A16 BROADCASTING BROADCASTING-SATELLITE Mobile  5.547
<b>41-42.5</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.A16 BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 5.551F 5.551H 5.551I	
...		
<b>47.2-47.5</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.A16 MOBILE 5.552A	

**MOD**

**47.5-51.4 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>47.5-47.9</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.A16 (space-to-Earth) 5.516B 5.554A MOBILE	<b>47.5-47.9</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.A16 MOBILE	
<b>47.9-48.2</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.A16 MOBILE 5.552A	
<b>48.2-48.54</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.A16 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE	<b>48.2-50.2</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.338A 5.552 ADD 5.A16 MOBILE	
<b>48.54-49.44</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.A16 MOBILE 5.149 5.340 5.555		
<b>49.44-50.2</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.338A 5.552 ADD 5.A16 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE		
...		
<b>50.4-51.4</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.338A ADD 5.A16 MOBILE Mobile-satellite (Earth-to-space)	

**ADD**

**5.A16** The use of the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by a non-geostationary-satellite system in the fixed-satellite service is subject to the application of the provisions of No. **9.12** for coordination with other non-geostationary-satellite systems in the fixed-

satellite service, but not with non-geostationary systems in other services. Draft new Resolution [A16] (WRC-19) shall also apply, and No. 22.2 shall continue to apply. (WRC-19)

**ADD**

**5.B16** The use of the frequency bands 39.5-40 and 40-40.5 GHz by the mobile-satellite service (space-to-Earth) and non-geostationary-satellite systems in the fixed-satellite service (space-to-Earth) is subject to coordination under No. 9.11A. (WRC-19)

## ARTICLE 22

### Space services<sup>1</sup>

#### Section II – Control of interference to geostationary-satellite systems

**ADD**

**22.5L** 9) A non-geostationary-satellite system in the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz shall not exceed a single-entry permissible allowance of 3% of the time allowance for the degradation in terms of  $C/N$  specified in the short-term and long-term performance objectives of reference GSO FSS networks. The calculation procedures given in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] and the GSO reference links contained in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] shall be used for the calculation. (WRC-19)

**ADD**

**22.5M** 10) Administrations operating or planning to operate non-geostationary-satellite systems in the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz shall apply the provisions of draft new Resolution [A16] (WRC-19) to ensure that the aggregate interference effect into geostationary fixed and broadcasting-satellite service networks caused by all non-geostationary fixed-satellite systems operating co-frequency in these frequency bands should not exceed 10% of the time allowance for the degradation in terms of  $C/N$  specified in the short-term and long-term performance objectives of the geostationary reference links listed in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS]. (WRC-19)



## ARTICLE 9

### **Procedure for effecting coordination with or obtaining agreement of other administrations**<sup>1, 2, 3, 4, 5, 6, 7, 8, 9</sup> (WRC-15)

#### **Section II – Procedure for effecting coordination**<sup>12, 13</sup>

##### **Sub-Section IIA – Requirement and request for coordination**

###### **MOD**

**9.35** a) examine that information with respect to its conformity with No. **11.31**<sup>MOD 19</sup>; (WRC-19)

###### **MOD**

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<sup>19</sup> **9.35.1** The Bureau shall include the detailed results of its examination under No. **11.31** of compliance with the limits in Tables **22-1** to **22-3** and the single-entry limits in No. **22.5L** of Article **22** in the publication under No. **9.38**. (WRC-19)

###### **ADD**

#### **DRAFT NEW RESOLUTION [A16] (WRC-19)**

### **Protection of geostationary FSS and BSS networks from the maximum aggregate equivalent power flux-density produced by multiple non-geostationary FSS networks and systems in the 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz frequency bands**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz are allocated, *inter alia*, on a primary basis to the fixed-satellite service (FSS) in all Regions;
- b) that Article **22** contains regulatory and technical provisions on sharing between GSO and non-GSO FSS systems in these bands in *considering a*);
- c) that, in accordance with No. **22.2**, non-GSO systems shall not cause unacceptable interference to GSO FSS and broadcasting-satellite service (BSS) networks and, unless otherwise specified in the Radio Regulations, shall not claim protection from GSO FSS and BSS satellite networks;

- d) that non-GSO FSS systems would benefit from increased certainty that would result from the quantification of regulatory measures required to protect GSO FSS and BSS satellite networks from unacceptable interference under No. **22.2**;
- e) that the Radio Regulations should enable the introduction of new applications of radiocommunication technology to ensure the operation of as many systems as practicable in order to maximize the efficient use of the spectrum;
- f) that GSO FSS systems can be protected without placing undue constraints on non-GSO FSS systems in the bands in *considering a*);
- g) that single-entry and aggregate limits for the protection of GSO networks from non-geostationary FSS satellite systems are contained in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY];
- h) that this conference modified Article **22** to include single-entry and aggregate permissible time allowances for degradation in terms of *C/N* of GSO FSS networks in the bands in *considering a*);
- i) that the aggregate efd levels from multiple non-geostationary FSS systems will be directly related to the actual number of systems sharing a frequency band based on the single-entry operational use of each system;
- j) that the aggregate interference caused by all co-frequency non-GSO FSS systems into these bands into GSO FSS networks should not exceed the maximum aggregate levels given in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] *recommends 3,*

*recognizing*

that non-geostationary FSS systems are likely to need to implement interference mitigation techniques, such as orbital avoidance angles, earth station site diversity, and GSO arc avoidance, to mutually share frequencies and to protect GSO FSS networks,

*noting*

- a) that PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] contains the methodology for determining conformity to the single-entry and aggregate limits to protect the GSO networks;
- b) that Recommendation ITU-R S.1503 provides recommendations on how to compute the efd from a non-GSO system into victim earth stations and satellites;
- c) that administrations may use their own software in conjunction with any approved ITU-R software tools for the calculation and verification of the aggregate limits given in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY], noting that the aggregation of all systems can be performed from these results without a specialized software tool. They are invited to provide the Radiocommunication Bureau and all participants to the consultation meetings with access to their software;
- d) that WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] contains satellite system characteristics to be considered in frequency sharing analyses within the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz,

*resolves*

- 1 that administrations operating or planning to operate non-geostationary FSS systems in the frequency bands referred to in *considering a*) above, shall, in collaboration, take all necessary

steps, including, if necessary, by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference into geostationary FSS and BSS satellite networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate protection limits as determined pursuant to No. **22.5M** of the Radio Regulations;

2 that to carry out the obligations in *resolves* 1 above, administrations operating or planning to operate non-geostationary FSS systems shall agree cooperatively through regular consultation discussions to ensure that operations of all non-GSO networks do not exceed the aggregate level of protection for geostationary FSS satellite networks;

3 that to carry out the obligations of *resolves* 2 above, administrations shall take into account the GSO FSS satellite characteristics listed in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] when applying the methodology contained in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] and the epfd results calculated by an epfd validation software;

4 that administrations, in carrying out their obligations under *resolves* 1 above, shall take into account only those non-geostationary FSS systems with frequency assignments in the frequency bands referred to in *considering a)* above that have met the criteria listed in Annex 2 to this Resolution through appropriate information provided to consultation discussions referred to in *resolves* 2;

5 that administrations, in developing agreements to carry out their obligations under *resolves* 1 above, shall establish mechanisms to ensure that all potential FSS system and network notifying administrations and operators are given full visibility of and the opportunity to participate in the process;

6 that in the absence of an agreement reached at consultation discussions referred to in *resolves* 2, each non-geostationary FSS system shall be operated in accordance with single-entry unavailability limits calculated by the apportionment of the aggregate levels commensurate to the number of non-GSO systems operating so as to assure equitable sharing of the aggregate limit among all non-GSO systems in operation;

7 that the administrations participating at the consultation discussion referred to in *resolves* 2 shall designate one convener to be responsible for communicating to the Bureau, such as shown in Annex 1 that the results of the aggregate non-GSO system operational calculation and sharing determinations made in application of *resolves* 1 above, without regard to whether such determinations result in any modifications to the published characteristics of their respective systems, providing a draft record of each consultation meeting, and posting the approved record,

*instructs the Radiocommunication Bureau*

1 to observe the results of the aggregate epfd calculation performed according to *resolves* 1;

2 to publish in the International Frequency Information Circular (BR IFIC), the information referred to in *resolves* 7.

## ANNEX 1 TO DRAFT NEW RESOLUTION [A16] (WRC-19)

### **List of GSO FSS and GSO BSS system characteristics and format of the result of the aggregate calculation to be provided to BR for publication for information**

#### **I GSO FSS, GSO BSS and non-GSO system characteristics to be used in the calculation of aggregate emissions from non-GSO FSS systems**

##### **I-1 GSO FSS and GSO BSS characteristics**

WDPDN Recommendation ITU-R S.[50/40 REFERENCE LINKS].

##### **I-2 Non-GSO satellite system constellation parameters**

For each non-GSO satellite system, the following parameters should be provided to BR for publication in the aggregate calculation:

- system administration;
- number of space stations used in aggregate calculations;
- single-entry use of each non-GSO FSS system.

#### **II Results of the aggregate epfd calculation**

## ANNEX 2 TO DRAFT NEW RESOLUTION [A16] (WRC-19)

### **List of criteria for the application of *resolves* 3**

- 1 Submission of appropriate advance publication information.
- 2 Entry into satellite manufacturing or procurement agreement, and entry into satellite launch agreement.

The non-geostationary FSS system operator should possess:

- i) evidence of a binding agreement for the manufacture or procurement of its satellites, and
- ii) evidence of a binding agreement to launch its satellites.

The manufacturing or procurement agreement should identify the contract milestones leading to the completion of manufacture or procurement of satellites required for the service provision, and the launch agreement should identify the launch date, launch site and launch service provider. The notifying administration is responsible for authenticating the evidence of agreement.

The information required under this criterion may be submitted in the form of a written commitment by the responsible administration.

- 3 As an alternative to satellite manufacturing or procurement and launch agreements, evidence of guaranteed funding arrangements for the implementation of the project would be accepted. The notifying administration is responsible for authenticating the evidence of these arrangements and for providing such evidence to other interested administrations in furtherance of its obligations under this Resolution.

MOD

RESOLUTION 750 (REV.WRC-19)

**Compatibility between the Earth exploration-satellite service (passive)  
and relevant active services**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

...

TABLE 1-1

EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band <sup>1</sup>
1 400-1 427 MHz	1 427-1 452 MHz	Mobile	–72 dBW in the 27 MHz of the EESS (passive) band for IMT base stations –62 dBW in the 27 MHz of the EESS (passive) band for IMT mobile stations <sup>2,3</sup>
23.6-24.0 GHz	22.55-23.55 GHz	Inter-satellite	–36 dBW in any 200 MHz of the EESS (passive) band for non-geostationary (non-GSO) inter-satellite service (ISS) systems for which complete advance publication information is received by the Bureau before 1 January 2020, and –46 dBW in any 200 MHz of the EESS (passive) band for non-GSO ISS systems for which complete advance publication information is received by the Bureau on or after 1 January 2020
31.3-31.5 GHz	31-31.3 GHz	Fixed (excluding HAPS)	For stations brought into use after 1 January 2012: –38 dBW in any 100 MHz of the EESS (passive) band. This limit does not apply to stations that have been authorized prior to 1 January 2012
50.2-50.4 GHz	49.7-50.2 GHz	Fixed-satellite (E-to-s) <sup>4</sup>	Option 1: For stations brought into use after the date of entry into force of the Final Acts of WRC-07: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi Option 2: For GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and GSO stations with complete coordination information submitted before the date of entry into force of the Final Acts of WRC-19: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi

EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band <sup>1</sup>
50.2-50.4 GHz	49.7-50.2 GHz	Fixed-satellite non-GSO (E-to-s) <sup>4</sup>	<p>Option 1: TBD</p> <p>Option 2: For stations brought into use after the date of entry into force of the Final Acts of WRC-19: –63 dBW into the 200 MHz of the EESS (passive) band</p> <p>Option 3: For stations brought into use after the date of entry into force of 22 November 2019: –66 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi –69.8 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi</p> <p>Option 4: For stations with complete coordination information submitted after the date of entry into force of the Final Acts of WRC-19: –13 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –23 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p>
50.2-50.4 GHz	50.4-50.9 GHz	Fixed-satellite (E-to-s) <sup>4</sup>	<p>Option 1: For stations brought into use after the date of entry into force of the Final Acts of WRC-07: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p> <p>Option 2: For GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and non-GSO stations with complete coordination information submitted before the date of entry into force of the Final Acts of WRC-19: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p>

EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band <sup>1</sup>
50.2-50.4 GHz	50.4-50.9 GHz	Fixed-satellite non-GSO (E-to-s) <sup>4</sup>	Option 1: TBD Option 2: For stations brought into use after the date of entry into force of the Final Acts of WRC-19: –63 dBW into the 200 MHz of the EESS (passive) band Option 3: For stations brought into use after the date of entry into force of 22 November 2019: –66 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi –69.8 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi Option 4: For stations with complete coordination information submitted after the date of entry into force of the Final Acts of WRC-19: –13 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –23 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi
52.6-54.25 GHz	51.4-52.6 GHz	Fixed	For stations brought into use after the date of entry into force of the Final Acts of WRC-07: –33 dBW in any 100 MHz of the EESS (passive) band

<sup>1</sup> The unwanted emission power level is to be understood here as the level measured at the antenna port.

<sup>2</sup> This limit does not apply to mobile stations in the IMT systems for which the notification information has been received by the Radiocommunication Bureau by 28 November 2015. For those systems, –60 dBW/27 MHz applies as the recommended value.

<sup>3</sup> The unwanted emission power level is to be understood here as the level measured with the mobile station transmitting at an average output power of 15 dBm.

<sup>4</sup> The limits apply under clear-sky conditions. During fading conditions, the limits may be exceeded by earth stations when using uplink power control.

### 3/1.6/5.2 For Method B

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations

(See No. 2.1)

**MOD**

**34.2-40 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>37.5-38</b>	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.C16 MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547	
<b>38-39.5</b>	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.C16 MOBILE Earth exploration-satellite (space-to-Earth) 5.547	
<b>39.5-40</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.C16 MOBILE MOBILE-SATELLITE (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547 ADD 5.D16	

**MOD**

**40-47.5 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>40-40.5</b>	EARTH EXPLORATION-SATELLITE (Earth-to-space) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.C16 MOBILE MOBILE-SATELLITE (space-to-Earth) SPACE RESEARCH (Earth-to-space) Earth exploration-satellite (space-to-Earth) ADD 5.D16	
<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.C16 BROADCASTING BROADCASTING-SATELLITE Mobile 5.547	<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.C16 BROADCASTING BROADCASTING-SATELLITE Mobile Mobile-satellite (space-to-Earth) 5.547	<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.C16 BROADCASTING BROADCASTING-SATELLITE Mobile 5.547



<b>41-42.5</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.C16 BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 5.551F 5.551H 5.551I
...	
<b>47.2-47.5</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.C16 MOBILE 5.552A

**MOD**

**47.5-51.4 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>47.5-47.9</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.C16 (space-to-Earth) 5.516B 5.554A MOBILE	<b>47.5-47.9</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.C16 MOBILE	
<b>47.9-48.2</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.C16 MOBILE 5.552A	
<b>48.2-48.54</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.C16 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE	<b>48.2-50.2</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.338A 5.552 ADD 5.C16 MOBILE	
<b>48.54-49.44</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.C16 MOBILE 5.149 5.340 5.555		
<b>49.44-50.2</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.338A 5.552 ADD 5.C16 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE		5.149 5.340 5.555

...	
<b>50.4-51.4</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.338A ADD 5.C16 MOBILE Mobile-satellite (Earth-to-space)

**ADD**

**5.C16** The use of the bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by a non-geostationary-satellite system in the fixed-satellite service is subject to the application of the provisions of No. **9.12** for coordination with other non-geostationary-satellite systems in the fixed-satellite service, but not with non-geostationary systems in other services. Draft new Resolution **[B16] (WRC-19)** shall also apply, and No. **22.2** shall continue to apply. (WRC-19)

**ADD**

**5.D16** The use of the frequency bands 39.5-40 and 40-40.5 GHz by the mobile-satellite service (space-to-Earth) and non-geostationary-satellite systems in the fixed-satellite service (space-to-Earth) is subject to coordination under No. **9.11A**. (WRC-19).

## ARTICLE 22

### Space services<sup>1</sup>

#### Section II – Control of interference to geostationary-satellite systems

**ADD**

**22.5L** 9) A non-geostationary-satellite system in the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz shall not exceed a single-entry permissible allowance of 3% of the time allowance for the degradation in terms of *C/N* specified in the short-term and long-term performance objectives of reference GSO FSS networks. The calculation procedures given in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] and the GSO reference links contained in a list maintained by the BR shall be used for the calculation. (WRC-19)

**ADD**

**22.5M** 10) Administrations operating or planning to operate non-geostationary-satellite systems in the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz shall apply the provisions of draft new Resolution **[B16] (WRC-19)** to ensure that the aggregate interference effect into geostationary fixed and broadcasting-satellite service networks caused by all non-geostationary fixed-satellite systems operating co-frequency in these frequency bands should not exceed 10% of the time allowance for the degradation in terms of

*C/N* specified in the short-term and long-term performance objectives of the geostationary reference links maintained by the Bureau. (WRC-19)

## ARTICLE 9

### **Procedure for effecting coordination with or obtaining agreement of other administrations**<sup>1, 2, 3, 4, 5, 6, 7, 8, 9</sup> (WRC-15)

#### **Section II – Procedure for effecting coordination**<sup>12, 13</sup>

##### **Sub-Section IIA – Requirement and request for coordination**

#### **MOD**

**9.35** *a)* examine that information with respect to its conformity with No. **11.31**<sup>MOD 19</sup>; (WRC-19)

#### **MOD**

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<sup>19</sup> **9.35.1** The Bureau shall include the detailed results of its examination under No. **11.31** of compliance with the limits in Tables **22-1** to **22-3** and the single-entry limits in No. **22.5L** of Article **22** in the publication under No. **9.38**. (WRC-19)

#### **ADD**

### DRAFT NEW RESOLUTION [B16] (WRC-19)

#### **Protection of geostationary FSS and BSS networks from the maximum aggregate equivalent power flux-density produced by multiple non-geostationary FSS networks and systems in the 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz frequency bands**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a)* that the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz are allocated, *inter alia*, on a primary basis to the fixed-satellite service (FSS) in all Regions;
- b)* that Article **22** contains regulatory and technical provisions on sharing between GSO and non-GSO FSS systems in these bands in *considering a)*;

c) that, in accordance with No. **22.2**, non-GSO systems shall not cause unacceptable interference to GSO FSS and broadcasting-satellite service (BSS) networks and, unless otherwise specified in the Radio Regulations, shall not claim protection from GSO FSS and BSS satellite networks;

d) that non-GSO FSS systems would benefit from increased certainty that would result from the quantification of regulatory measures required to protect GSO FSS and BSS satellite networks from unacceptable interference under No. **22.2**;

e) that the Radio Regulations should enable the introduction of new applications of radiocommunication technology to ensure the operation of as many systems as practicable in order to maximize the efficient use of the spectrum;

f) that GSO FSS systems can be protected without placing undue constraints on non-GSO FSS systems in the bands in *considering a*);

g) that single-entry and aggregate limits for the protection of GSO networks from non-geostationary FSS satellite systems are contained in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY];

h) that this Conference modified Article **22** to include single-entry and aggregate permissible time allowances for degradation in terms of  $C/N$  of GSO FSS networks in the bands in *considering a*);

i) that, the aggregate efd levels from multiple non-geostationary FSS systems will be directly related to the actual number of systems sharing a frequency band based on the single-entry operational use of each system;

j) that the aggregate interference caused by all co-frequency non-GSO FSS systems into these bands into GSO FSS networks should not exceed the maximum aggregate levels given in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] *recommends 3,*

*recognizing*

that non-geostationary FSS systems are likely to need to implement interference mitigation techniques, such as orbital avoidance angles, earth station site diversity, and GSO arc avoidance, to mutually share frequencies and to protect GSO FSS networks,

*noting*

a) that PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] contains the methodology for determining conformity to the single-entry and aggregate limits to protect the GSO networks;

b) that Recommendation ITU-R S.1503 provides recommendations on how to compute the efd from a non-GSO system into victim earth stations and satellites;

c) that administrations may use their own software in conjunction with any approved ITU-R software tools for the calculation and verification of the aggregate limits given in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY], noting that the aggregation of all systems can be performed from these results without a specialized software tool. They are invited to provide the Radiocommunication Bureau and all participants to the consultation meetings with access to their software,

*resolves*

1 that administrations operating or planning to operate non-geostationary FSS systems in the frequency bands referred to in *considering a*) above, shall, in collaboration, take all necessary

steps, including, if necessary, by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference into geostationary FSS and BSS satellite networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate protection limits as determined pursuant to No. **22.5M** of the Radio Regulations;

2 that to carry the obligations in *resolves* 1 above, administrations operating or planning to operate non-geostationary FSS systems shall agree cooperatively through regular consultation discussions to ensure that operations of all non-GSO networks do not exceed the aggregate level of protection for geostationary FSS satellite networks;

3 that to carry out the obligations of *resolves* 2 above, administrations shall take into account the GSO FSS satellite characteristics maintained by the BR when applying the methodology contained in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] and the epfd results calculated by an epfd validation software;

4 that administrations, in carrying out their obligations under *resolves* 1 above, shall take into account only those non-geostationary FSS systems with frequency assignments in the frequency bands referred to in *considering a)* above that have met the criteria listed in Annex 2 to this Resolution through appropriate information provided to consultation discussions referred to in *resolves* 2;

5 that administrations, in developing agreements to carry out their obligations under *resolves* 1 above, shall establish mechanisms to ensure that all potential FSS system and network notifying administrations and operators are given full visibility of and the opportunity to participate in the process;

6 that in the absence of an agreement reached at consultation discussions referred to in *resolves* 2, each non-geostationary FSS system shall be operated in accordance with single-entry unavailability limits calculated by the apportionment of the aggregate levels commensurate to the number of non-GSO systems operating so as to assure equitable sharing of the aggregate limit among all non-GSO systems in operation;

7 that the administrations participating at the consultation discussion referred to in *resolves* 2 shall designate one convener to be responsible for communicating to the Bureau, such as shown in Annex 1 that the results of the aggregate non-GSO system operational calculation and sharing determinations made in application of *resolves* 1 above, without regard to whether such determinations result in any modifications to the published characteristics of their respective systems, providing a draft record of each consultation meeting, and posting the approved record,

*instructs the Radiocommunication Bureau*

1 to observe the results of the aggregate epfd calculation performed according to *resolves* 1;

2 to publish in the International Frequency Information Circular (BR IFIC), the information referred to in *resolves* 7;

3 to review and maintain in a list, reference GSO link budgets provided by administrations.

## ANNEX 1 TO DRAFT NEW RESOLUTION [B16] (WRC-19)

### **List of GSO FSS and GSO BSS system characteristics and format of the result of the aggregate calculation to be provided to BR for publication for information**

#### **I GSO FSS, GSO BSS and non-GSO system characteristics to be used in the calculation of aggregate emissions from non-GSO FSS systems**

##### **I-1 GSO FSS and GSO BSS characteristics**

##### **I-2 Non-GSO satellite system constellation parameters**

For each non-GSO satellite system, the following parameters should be provided to BR for publication in the aggregate calculation:

- system administration;
- number of space stations used in aggregate calculations;
- single-entry use of each non-GSO FSS system.

#### **II Results of the aggregate epdf calculation**

## ANNEX 2 TO DRAFT NEW RESOLUTION [B16] (WRC-19)

### **List of criteria for the application of *resolves* 3**

- 1 Submission of appropriate advance publication information.
- 2 Entry into satellite manufacturing or procurement agreement, and entry into satellite launch agreement.

The non-geostationary FSS system operator should possess:

- i) evidence of a binding agreement for the manufacture or procurement of its satellites, and
- ii) evidence of a binding agreement to launch its satellites.

The manufacturing or procurement agreement should identify the contract milestones leading to the completion of manufacture or procurement of satellites required for the service provision, and the launch agreement should identify the launch date, launch site and launch service provider. The notifying administration is responsible for authenticating the evidence of agreement.

The information required under this criterion may be submitted in the form of a written commitment by the responsible administration.

- 3 As an alternative to satellite manufacturing or procurement and launch agreements, evidence of guaranteed funding arrangements for the implementation of the project would be accepted. The notifying administration is responsible for authenticating the evidence of these arrangements and for providing such evidence to other interested administrations in furtherance of its obligations under this Resolution.

**MOD**

**RESOLUTION 750 (REV.WRC-19)**

**Compatibility between the Earth exploration-satellite service (passive)  
and relevant active services**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

...

TABLE 1-1

<b>EESS (passive) band</b>	<b>Active service band</b>	<b>Active service</b>	<b>Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band<sup>1</sup></b>
1 400-1 427 MHz	1 427-1 452 MHz	Mobile	–72 dBW in the 27 MHz of the EESS (passive) band for IMT base stations –62 dBW in the 27 MHz of the EESS (passive) band for IMT mobile stations <sup>2, 3</sup>
23.6-24.0 GHz	22.55-23.55 GHz	Inter-satellite	–36 dBW in any 200 MHz of the EESS (passive) band for non-geostationary (non-GSO) inter-satellite service (ISS) systems for which complete advance publication information is received by the Bureau before 1 January 2020, and –46 dBW in any 200 MHz of the EESS (passive) band for non-GSO ISS systems for which complete advance publication information is received by the Bureau on or after 1 January 2020
31.3-31.5 GHz	31-31.3 GHz	Fixed (excluding HAPS)	For stations brought into use after 1 January 2012: –38 dBW in any 100 MHz of the EESS (passive) band. This limit does not apply to stations that have been authorized prior to 1 January 2012
50.2-50.4 GHz	49.7-50.2 GHz	Fixed-satellite (E-to-s) <sup>4</sup>	Option 1: For stations brought into use after the date of entry into force of the Final Acts of WRC-07: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi Option 2: For GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and GSO stations with complete coordination information submitted before the date of entry into force of the Final Acts of WRC-19: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi

EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band <sup>1</sup>
50.2-50.4 GHz	49.7-50.2 GHz	Fixed-satellite non-GSO (E-to-s) <sup>4</sup>	<p>Option 1: TBD</p> <p>Option 2: For stations brought into use after the date of entry into force of the Final Acts of WRC-19: –63 dBW into the 200 MHz of the EESS (passive) band</p> <p>Option 3: For stations brought into use after the date of entry into force of 22 November 2019: –20 dBW into the 200 MHz of the GSO EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –69.8 dBW into the 200 MHz of the non-GSO EESS (passive) band for earth stations having an antenna gain greater than or equal to 62 dBi</p> <p>Option 4: For stations with complete coordination information submitted after the date of entry into force of the Final Acts of WRC-19: –13 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –23 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p>
50.2-50.4 GHz	50.4-50.9 GHz	Fixed-satellite (E-to-s) <sup>4</sup>	<p>Option 1: For stations brought into use after the date of entry into force of the Final Acts of WRC-07: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p> <p>Option 2: For GSO stations brought into use after the date of entry into force of the Final Acts of WRC-07 and GSO stations with complete coordination information submitted before the date of entry into force of the Final Acts of WRC-19: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p>



EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band <sup>1</sup>
50.2-50.4 GHz	50.4-50.9 GHz	Fixed-satellite non-GSO (E-to-s) <sup>4</sup>	<p>Option 1: TBD</p> <p>Option 2: For stations brought into use after the date of entry into force of the Final Acts of WRC-19: –63 dBW into the 200 MHz of the EESS (passive) band</p> <p>Option 3: For stations brought into use after the date of entry into force of 22 November 2019: –20 dBW into the 200 MHz of the GSO EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –69.8 dBW into the 200 MHz of the non-GSO EESS (passive) band for earth stations having an antenna gain greater than or equal to 62 dBi</p> <p>Option 4: For stations with complete coordination information submitted after the date of entry into force of the Final Acts of WRC-19: –13 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –23 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi</p>
52.6-54.25 GHz	51.4-52.6 GHz	Fixed	<p>For stations brought into use after the date of entry into force of the Final Acts of WRC-07: –33 dBW in any 100 MHz of the EESS (passive) band</p>

<sup>1</sup> The unwanted emission power level is to be understood here as the level measured at the antenna port.

<sup>2</sup> This limit does not apply to mobile stations in the IMT systems for which the notification information has been received by the Radiocommunication Bureau by 28 November 2015. For those systems, –60 dBW/27 MHz applies as the recommended value.

<sup>3</sup> The unwanted emission power level is to be understood here as the level measured with the mobile station transmitting at an average output power of 15 dBm.

<sup>4</sup> The limits apply under clear-sky conditions. During fading conditions, the limits may be exceeded by earth stations when using uplink power control.

### 3/1.6/5.3 For Method C

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations

(See No. 2.1)

**MOD**

**34.2-40 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>37.5-38</b>	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.E16 MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547	
<b>38-39.5</b>	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.E16 MOBILE Earth exploration-satellite (space-to-Earth) 5.547	
<b>39.5-40</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.E16 MOBILE MOBILE-SATELLITE (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547	

**MOD**

**40-47.5 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>40-40.5</b>	EARTH EXPLORATION-SATELLITE (Earth-to-space) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.E16 MOBILE MOBILE-SATELLITE (space-to-Earth) SPACE RESEARCH (Earth-to-space) Earth exploration-satellite (space-to-Earth)	
<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.E16 BROADCASTING BROADCASTING-SATELLITE Mobile 5.547	<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.E16 BROADCASTING BROADCASTING-SATELLITE Mobile Mobile-satellite (space-to-Earth) 5.547	<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.E16 BROADCASTING BROADCASTING-SATELLITE Mobile 5.547

<b>41-42.5</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.E16 BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 5.551F 5.551H 5.551I
...	
<b>47.2-47.5</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.E16 MOBILE 5.552A

**MOD**

**47.5-51.4 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>47.5-47.9</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.E16 (space-to-Earth) 5.516B 5.554A MOBILE	<b>47.5-47.9</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.E16 MOBILE	
<b>47.9-48.2</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.E16 MOBILE 5.552A	
<b>48.2-48.54</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.E16 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE	<b>48.2-50.2</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.338A 5.552 ADD 5.E16 MOBILE	
<b>48.54-49.44</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.E16 MOBILE 5.149 5.340 5.555		
<b>49.44-50.2</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.338A 5.552 ADD 5.E16 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE		5.149 5.340 5.555

...	
<b>50.4-51.4</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.338A ADD 5.E16 MOBILE Mobile-satellite (Earth-to-space)

**ADD**

**5.E16** The use of the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by a non-geostationary-satellite system in the fixed-satellite service is subject to the application of the provisions of No. **9.12** for coordination with other non-geostationary-satellite systems in the fixed-satellite service. (WRC-19)

## ARTICLE 22

### Space services<sup>1</sup>

#### Section II – Control of interference to geostationary-satellite systems

**ADD**

**22.5L** The operation of a non-geostationary system in the fixed-satellite service in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) shall be responsible for at most 3% of the time allowance for the *C/N* specified in the short-term performance objectives of the GSO reference links contained in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS]. The increase in unavailability shall be derived using the GSO FSS reference links in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] and the methodology provided in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY]. (WRC-19)

**ADD**

**22.5L1** The operation of a non-geostationary system in the fixed-satellite service in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) shall be responsible for at most 3% reduction in throughput (spectral efficiency) as associated with the long-term performance objective for GSO reference links using adaptive coding and modulation contained in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS]. The decrease in throughput (spectral efficiency) shall be derived using the GSO FSS reference links in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] and the methodology provided in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY]. (WRC-19)

**ADD**

**22.5M** Administrations operating or planning to operate non-geostationary-satellite systems in the fixed-satellite service in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) will apply the provisions of draft new Resolution [C16] (WRC-19) to ensure that the aggregate interference into geostationary fixed and broadcasting-satellite service networks caused by all non-geostationary fixed-satellite systems operating co-frequency in these frequency bands should not exceed the time allowance for degradation provided in draft new Resolution [C16] (WRC-19). In the event that an administration operating a geostationary-satellite network in conformity with the Radio Regulations identifies an increase in unavailability from non-geostationary-satellite systems in the fixed-satellite service that may be in excess of the aggregate limit contained in draft new Resolution [C16] (WRC-19), the administration responsible for the non-geostationary-satellite systems in the fixed-satellite service will apply the provisions contained in *resolves* 1-4 of draft new Resolution [C16] (WRC-19). (WRC-19)

**ADD**

**22.5M1** Administrations operating or planning to operate non-geostationary-satellite systems in the fixed-satellite service in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) will apply the provisions of draft new Resolution [C16] (WRC-19) to ensure that the aggregate long-term interference into geostationary fixed and broadcasting-satellite service networks using adaptive coding and modulation caused by all non-geostationary fixed-satellite systems operating in these frequency bands shall not decrease the throughput (spectral efficiency) beyond the value provided in draft new Resolution [C16] (WRC-19). In the event that an administration operating a geostationary-satellite network in conformity with the Radio Regulations identifies a decrease in throughput (spectral efficiency) from non-geostationary-satellite systems in the fixed-satellite service that may be in excess of the aggregate limit contained in draft new Resolution [C16] (WRC-19), the administration responsible for the non-geostationary-satellite systems in the fixed-satellite service will apply the provisions contained in *resolves* 1-4 of draft new Resolution [C16] (WRC-19). (WRC-19)

**ADD**

**DRAFT NEW RESOLUTION [C16] (WRC-19)**

**Protection of geostationary fixed-satellite service systems/networks and broadcasting-satellite service systems/networks from the maximum aggregate increase in unavailability caused by all non-geostationary-satellite systems in the fixed-satellite service in the bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space)**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) are allocated to the fixed-satellite service on a primary basis;
- b) that technical studies have demonstrated the feasibility of, and conditions for, non-GSO FSS satellite systems to share the frequency bands in *considering a)* with GSO satellite networks and with other non-GSO FSS satellite systems;
- c) that these studies have shown that it is feasible for non-GSO FSS systems to operate in a way that would not increase the unavailability of GSO links beyond the limits specified in accordance with No. **22.5L**;
- d) that to allow multiple non-GSO FSS systems to operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), no single non-GSO system can increase the unavailability or decrease the long-term throughput (spectral efficiency) of a GSO reference link in the FSS by more than 3%;
- e) that the operating parameters and orbital characteristics on non-GSO FSS systems are usually inhomogeneous;
- f) that, as a result of this inhomogeneity, the increase in unavailability or decrease the long-term throughput (spectral efficiency) caused to reference GSO FSS links by non-GSO FSS systems is likely to vary between such systems;
- g) that the aggregate level of unavailability to a GSO FSS link is likely to be the summation of single-entry level of unavailability caused by non-GSO FSS systems;
- h) that to achieve the level of protection of GSO FSS links given in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY], administrations operating or planning to operate non-GSO FSS systems will need to agree cooperatively through consultation meetings,

*recognizing*

- a) that non-GSO FSS systems will need to implement mitigation techniques such as orbital angle avoidance, satellite and earth station site diversity, and satellite selection strategies to mutually share frequencies;
- b) that the implementation of such mitigation techniques facilitates the sharing of frequencies between non-GSO FSS systems and may allow these systems to mitigate interference to GSO FSS systems;
- c) that the implementation of GSO arc avoidance significantly decreases the interference of non-GSO FSS systems into GSO FSS systems by avoiding main-beam-to-main-beam coupling;
- d) that at certain latitudes, the larger the GSO arc avoidance angle, the smaller the increase in unavailability of the GSO link;
- e) that depending on the non-GSO orbital characteristics and tracking strategy, GSO arc avoidance may no longer be required for non-GSO FSS earth stations located above a certain latitude due to geometric separation between earth station transmissions;
- f) that in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), signals experience high levels of attenuation due to atmospheric effects such as rain, cloud cover and gaseous absorption;

g) that to counteract such high levels of fading, it is desirable for FSS systems to implement fade compensation/power control,

*noting*

a) that PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] contains the methodology for determining conformity to the single-entry and aggregate limits to protect the GSO networks;

b) that WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] contains satellite system characteristics to be used in frequency sharing analyses within the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz,

*resolves*

1 that administrations operating or planning to operate non-GSO FSS systems in the frequency bands in *considering a)* above, individually or in collaboration through consultation meetings shall take all possible steps, including, if necessary, by means of appropriate modifications to their systems, to ensure that the aggregate interference into GSO FSS and BSS networks caused by such systems operating in these bands does not increase the time allowance for the *C/N* specified in the short-term performance objectives of the GSO reference links listed in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] by more than 10%;

2 that, in the event that the aggregate interference levels increase the *C/N* specified in the short-term performance objectives of GSO reference links listed in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] beyond 10%, administrations operating non-GSO FSS systems in these frequency bands shall take all necessary measures to reduce the aggregate unavailability allowance for the non-GSO FSS systems to ensure the aggregate interference allowance is met;

3 that administrations operating or planning to operate non-GSO FSS systems in the frequency bands in *considering a)* above, individually or in collaboration through consultation meetings shall take all possible steps, including, if necessary, by means of appropriate modifications to their systems, to ensure that the aggregate long-term interference into adaptive coding and modulation GSO FSS and BSS networks caused by such systems operating in these bands does not decrease the throughput (spectral efficiency) beyond the value specified in the long-term performance objectives of the adaptive coding and modulation GSO reference links listed in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] by more than 10%;

4 that administrations, in carrying out their obligations under *resolves* 1, 2 and 3 above, shall take into account only those GSO FSS systems with frequency assignments in the frequency bands listed in *considering a)* and that have met the criteria listed in Annex A;

5 that administrations operating and planning to operate non-GSO FSS systems in the frequency bands listed in *considering a)* provide simulation parameters and results of simulations of aggregate interference generated by the non-GSO systems to the Radiocommunication Bureau in an appropriate time-frame,

*invites the Radiocommunication Bureau*

to develop software, if required, to calculate aggregate levels of interference into GSO FSS systems,

*invites administrations*

TBD

ANNEX A TO DRAFT NEW RESOLUTION [C16] (WRC-19)

TBD – Criteria for application of Resolution. See Method A.

**MOD**

**RESOLUTION 750 (REV.WRC-19)**

**Compatibility between the Earth exploration-satellite service (passive) and relevant active services**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

...

TABLE 1-1

<b>EESS (passive) band</b>	<b>Active service band</b>	<b>Active service</b>	<b>Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band<sup>1</sup></b>
1 400-1 427 MHz	1 427-1 452 MHz	Mobile	–72 dBW in the 27 MHz of the EESS (passive) band for IMT base stations –62 dBW in the 27 MHz of the EESS (passive) band for IMT mobile stations <sup>2,3</sup>
23.6-24.0 GHz	22.55-23.55 GHz	Inter-satellite	–36 dBW in any 200 MHz of the EESS (passive) band for non-geostationary (non-GSO) inter-satellite service (ISS) systems for which complete advance publication information is received by the Bureau before 1 January 2020, and –46 dBW in any 200 MHz of the EESS (passive) band for non-GSO ISS systems for which complete advance publication information is received by the Bureau on or after 1 January 2020
31.3-31.5 GHz	31-31.3 GHz	Fixed (excluding HAPS)	For stations brought into use after 1 January 2012: –38 dBW in any 100 MHz of the EESS (passive) band. This limit does not apply to stations that have been authorized prior to 1 January 2012
50.2-50.4 GHz	49.7-50.2 GHz	Fixed-satellite GSO (E-to-s) <sup>4</sup>	For stations brought into use after the date of entry into force of the Final Acts of WRC-07: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi
50.2-50.4 GHz	49.7-50.2 GHz	Fixed-satellite non-GSO (E-to-s) <sup>4</sup>	For stations brought into use after the date of entry into force of the Final Acts of WRC-19: A range between –13 to –27* dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi A range between –38 to –64* dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi



50.2-50.4 GHz	50.4-50.9 GHz	Fixed-satellite GSO (E-to-s) <sup>4</sup>	For stations brought into use after the date of entry into force of the Final Acts of WRC-07: –10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi –20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi
50.2-50.4 GHz	50.4-50.9 GHz	Fixed-satellite non-GSO (E-to-s) <sup>4</sup>	For stations brought into use after the date of entry into force of the Final Acts of WRC-19: A range between –13 to –27* dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi A range between –38 to –64* dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi
52.6-54.25 GHz	51.4-52.6 GHz	Fixed	For stations brought into use after the date of entry into force of the Final Acts of WRC-07: –33 dBW in any 100 MHz of the EESS (passive) band

<sup>1</sup> The unwanted emission power level is to be understood here as the level measured at the antenna port.

<sup>2</sup> This limit does not apply to mobile stations in the IMT systems for which the notification information has been received by the Radiocommunication Bureau by 28 November 2015. For those systems, –60 dBW/27 MHz applies as the recommended value.

<sup>3</sup> The unwanted emission power level is to be understood here as the level measured with the mobile station transmitting at an average output power of 15 dBm.

<sup>4</sup> The limits apply under clear-sky conditions. During fading conditions, the limits may be exceeded by earth stations when using uplink power control.

\* The more stringent value would protect the push-broom sensor. The least stringent value would protect other types of sensors.

The amount of attenuation that should be implemented in a revision to Resolution **750 (Rev.WRC-15)** would need to strike a balance between protection of the EESS and not causing undue constraints to the FSS as per No. **5.340.1**. Furthermore, the reduction in the out-of-band emission level for non-GSO FSS systems needs to take into account the relative impact of such systems against that caused by GSO networks operating at the existing levels in that Resolution.

**3/1.6/5.4 For Method D**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**34.2-40 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>37.5-38</b>	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.F16 MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547	
<b>38-39.5</b>	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.F16 MOBILE Earth exploration-satellite (space-to-Earth) 5.547	
<b>39.5-40</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.F16 MOBILE MOBILE-SATELLITE (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547 ADD 5.G16	

**MOD**

**40-47.5 GHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>40-40.5</b>	EARTH EXPLORATION-SATELLITE (Earth-to-space) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.F16 MOBILE MOBILE-SATELLITE (space-to-Earth) SPACE RESEARCH (Earth-to-space) Earth exploration-satellite (space-to-Earth) ADD 5.G16	

<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.F16 BROADCASTING BROADCASTING-SATELLITE Mobile  5.547	<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.F16 BROADCASTING BROADCASTING-SATELLITE Mobile Mobile-satellite (space-to-Earth) 5.547	<b>40.5-41</b> FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.F16 BROADCASTING BROADCASTING-SATELLITE Mobile  5.547
<b>41-42.5</b>	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B ADD 5.F16 BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 5.551F 5.551H 5.551I	
...		
<b>47.2-47.5</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.F16 MOBILE 5.552A	

**MOD**

**47.5-51.4 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>47.5-47.9</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.F16 (space-to-Earth) 5.516B 5.554A MOBILE	<b>47.5-47.9</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.F16 MOBILE	
<b>47.9-48.2</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.F16 MOBILE 5.552A	

<b>48.2-48.54</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.F16 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE	<b>48.2-50.2</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.338A 5.552 ADD 5.F16 MOBILE
<b>48.54-49.44</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.552 ADD 5.F16 MOBILE 5.149 5.340 5.555	
<b>49.44-50.2</b> FIXED FIXED-SATELLITE (Earth-to-space) 5.338A 5.552 ADD 5.F16 (space-to-Earth) 5.516B 5.554A 5.555B MOBILE	5.149 5.340 5.555
...	
<b>50.4-51.4</b>	FIXED FIXED-SATELLITE (Earth-to-space) 5.338A ADD 5.F16 MOBILE Mobile-satellite (Earth-to-space)

**ADD**

**5.F16** The use of the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by a non-geostationary-satellite system in the fixed-satellite service is subject to the application of the provisions of No. **9.12** for coordination with other non-geostationary-satellite systems in the fixed-satellite service, but not with non-geostationary systems in other services. Draft new Resolution **[A16] (WRC-19)** shall also apply, and No. **22.2** shall continue to apply. (WRC-19)

**ADD**

**5.G16** The use of the frequency bands 39.5-40 GHz and 40-40.5 GHz by the mobile-satellite service (space-to-Earth) and non-geostationary-satellite systems in the fixed-satellite service (space-to-Earth) is subject to coordination under No. **9.11A**. (WRC-19)

## ARTICLE 22

### Space services<sup>1</sup>

#### Section II – Control of interference to geostationary-satellite systems

##### ADD

**22.5L** 9) A non-geostationary-satellite system in the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz shall not exceed a single-entry permissible allowance of 3% of the time allowance for the degradation in terms of *C/N* specified in the short-term and long-term performance objectives of reference GSO FSS networks. The calculation procedures given in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] and the GSO reference links contained in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] shall be used for the calculation. (WRC-19)

##### ADD

**22.5M** 10) Administrations operating or planning to operate non-geostationary-satellite systems in the fixed-satellite service in the frequency bands 37.5-39.5, 39.5-42.5, 47.2-50.2 and 50.4-51.4 GHz shall apply the provisions of draft new Resolution [A16] (WRC-19) to ensure that the aggregate interference effect into geostationary fixed and broadcasting-satellite service networks caused by all non-geostationary fixed-satellite systems operating co-frequency in these frequency bands should not exceed 10% of the time allowance for the degradation in terms of *C/N* specified in the short-term and long-term performance objectives of the geostationary reference links listed in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS]. (WRC-19)

## ARTICLE 9

### Procedure for effecting coordination with or obtaining agreement of other administrations<sup>1, 2, 3, 4, 5, 6, 7, 8, 9</sup> (WRC-15)

#### Section II – Procedure for effecting coordination<sup>12, 13</sup>

##### Sub-Section IIA – Requirement and request for coordination

##### MOD

**9.35** a) examine that information with respect to its conformity with No. **11.31**<sup>MOD 19</sup>; (WRC-19)

##### MOD

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<sup>19</sup> **9.35.1** The Bureau shall include the detailed results of its examination under No. **11.31** of compliance with the limits in Tables **22-1** to **22-3** and the single-entry limits in No. **22.5L** of Article **22** in the publication under No. **9.38**. (WRC-19)

**ADD**

**DRAFT NEW RESOLUTION [A16] (WRC-19)**

**Protection of geostationary FSS and BSS networks from the maximum aggregate equivalent power flux-density produced by multiple non-geostationary FSS networks and systems in the 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz frequency bands**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz are allocated, *inter alia*, on a primary basis to the fixed-satellite service (FSS) in all Regions;
- b) that Article **22** contains regulatory and technical provisions on sharing between GSO and non-GSO FSS systems in these bands in *considering a*);
- c) that, in accordance with No. **22.2**, non-GSO systems shall not cause unacceptable interference to GSO FSS and broadcasting-satellite service (BSS) networks and, unless otherwise specified in the Radio Regulations, shall not claim protection from GSO FSS and BSS satellite networks;
- d) that non-GSO FSS systems would benefit from increased certainty that would result from the quantification of regulatory measures required to protect GSO FSS and BSS satellite networks from unacceptable interference under No. **22.2**;
- e) that the Radio Regulations should enable the introduction of new applications of radiocommunication technology to ensure the operation of as many systems as practicable in order to maximize the efficient use of the spectrum;
- f) that GSO FSS systems can be protected without placing undue constraints on non-GSO FSS systems in the bands in *considering a*);
- g) that single-entry and aggregate limits for the protection of GSO networks from non-geostationary FSS satellite systems are contained in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY];
- h) that this Conference modified Article **22** to include single-entry and aggregate permissible time allowances for degradation in terms of *C/N* of GSO FSS networks in the bands in *considering a*);
- i) that, the aggregate efd levels from multiple non-geostationary FSS systems will be directly related to the actual number of systems sharing a frequency band based on the single-entry operational use of each system;

j) that the aggregate interference caused by all co-frequency non-GSO FSS systems into these bands into GSO FSS networks should not exceed the maximum aggregate levels given in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] *recommends* 3, *recognizing*

that non-geostationary FSS systems are likely to need to implement interference mitigation techniques, such as orbital avoidance angles, earth station site diversity, and GSO arc avoidance, to mutually share frequencies and to protect GSO FSS networks,

*noting*

a) that PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] contains the methodology for determining conformity to the single-entry and aggregate limits to protect the GSO networks;

b) that Recommendation ITU-R S.1503 provides recommendations on how to compute the epfd from a non-GSO system into victim earth stations and satellites;

c) that administrations may use their own software in conjunction with any approved ITU-R software tools for the calculation and verification of the aggregate limits given in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY], noting that the aggregation of all systems can be performed from these results without a specialized software tool. They are invited to provide the Radiocommunication Bureau and all participants to the consultation meetings with access to their software;

d) that WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] contains satellite system characteristics to be considered in frequency sharing analyses within the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz,

*resolves*

1 that administrations operating or planning to operate non-geostationary FSS systems in the frequency bands referred to in *considering a)* above, shall, in collaboration, take all necessary steps, including, if necessary, by means of appropriate modifications to their systems or networks, to ensure that the aggregate interference into geostationary FSS and BSS satellite networks caused by such systems operating co-frequency in these frequency bands does not exceed the aggregate protection limits as determined pursuant to No. **22.5M** of the Radio Regulations;

2 that to carry out the obligations in *resolves 1* above, administrations operating or planning to operate non-geostationary FSS systems shall agree cooperatively through regular consultation discussions to ensure that operations of all non-GSO networks do not exceed the aggregate level of protection for geostationary FSS satellite networks;

3 that to carry out the obligations of *resolves 2* above, administrations shall take into account the GSO FSS satellite characteristics listed in WD PDN Recommendation ITU-R S.[50/40 REFERENCE LINKS] when applying the methodology contained in PDN Recommendation ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] and the epfd results calculated by an epfd validation software;

4 that administrations, in carrying out their obligations under *resolves 1* above, shall take into account only those non-geostationary FSS systems with frequency assignments in the frequency bands referred to in *considering a)* above that have met the criteria listed in Annex 2 to this Resolution through appropriate information provided to consultation discussions referred to in *resolves 2*;

5 that administrations, in developing agreements to carry out their obligations under *resolves 1* above, shall establish mechanisms to ensure that all potential FSS system and network notifying administrations and operators are given full visibility of and the opportunity to participate in the process;

6 that in the absence of an agreement reached at consultation discussions referred to in *resolves 2*, each non-geostationary FSS system shall be operated in accordance with single-entry unavailability limits calculated by the apportionment of the aggregate levels commensurate to the number of non-GSO systems operating so as to assure equitable sharing of the aggregate limit among all non-GSO systems in operation;

7 that the administrations participating at the consultation discussion referred to in *resolves 2* shall designate one convener to be responsible for communicating to the Bureau, such as shown in Annex 1 that the results of the aggregate non-GSO system operational calculation and sharing determinations made in application of *resolves 1* above, without regard to whether such determinations result in any modifications to the published characteristics of their respective systems, providing a draft record of each consultation meeting, and posting the approved record,

*instructs the Radiocommunication Bureau*

1 to observe the results of the aggregate efd calculation performed according to *resolves 1*;

2 to publish in the International Frequency Information Circular (BR IFIC), the information referred to in *resolves 7*.

## ANNEX 1 TO DRAFT NEW RESOLUTION [A16] (WRC-19)

### **List of GSO FSS and GSO BSS system characteristics and format of the result of the aggregate calculation to be provided to BR for publication for information**

#### **I GSO FSS, GSO BSS and non-GSO system characteristics to be used in the calculation of aggregate emissions from non-GSO FSS systems**

##### **I-1 GSO FSS and GSO BSS characteristics**

WDPDN Recommendation ITU-R S.[50/40 REFERENCE LINKS].

##### **I-2 Non-GSO satellite system constellation parameters**

For each non-GSO satellite system, the following parameters should be provided to BR for publication in the aggregate calculation:

- system administration;
- number of space stations used in aggregate calculations;
- single-entry use of each non-GSO FSS system.



## **II Results of the aggregate epfd calculation**

### **ANNEX 2 TO DRAFT NEW RESOLUTION [A16] (WRC-19)**

#### **List of criteria for the application of *resolves* 3**

- 1 Submission of appropriate advance publication information.
- 2 Entry into satellite manufacturing or procurement agreement, and entry into satellite launch agreement.

The non-geostationary FSS system operator should possess:

- i) evidence of a binding agreement for the manufacture or procurement of its satellites, and
- ii) evidence of a binding agreement to launch its satellites.

The manufacturing or procurement agreement should identify the contract milestones leading to the completion of manufacture or procurement of satellites required for the service provision, and the launch agreement should identify the launch date, launch site and launch service provider. The notifying administration is responsible for authenticating the evidence of agreement.

The information required under this criterion may be submitted in the form of a written commitment by the responsible administration.

- 3 As an alternative to satellite manufacturing or procurement and launch agreements, evidence of guaranteed funding arrangements for the implementation of the project would be accepted. The notifying administration is responsible for authenticating the evidence of these arrangements and for providing such evidence to other interested administrations in furtherance of its obligations under this Resolution.

#### **Method D, option 1:**

#### **MOD**

### **RESOLUTION 750 (REV.WRC-19)**

#### **Compatibility between the Earth exploration-satellite service (passive) and relevant active services**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

...

TABLE 1-1

EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band <sup>1</sup>
1 400-1 427 MHz	1 427-1 452 MHz	Mobile	-72 dBW in the 27 MHz of the EESS (passive) band for IMT base stations -62 dBW in the 27 MHz of the EESS (passive) band for IMT mobile stations <sup>2,3</sup>
23.6-24.0 GHz	22.55-23.55 GHz	Inter-satellite	-36 dBW in any 200 MHz of the EESS (passive) band for non-geostationary (non-GSO) inter-satellite service (ISS) systems for which complete advance publication information is received by the Bureau before 1 January 2020, and -46 dBW in any 200 MHz of the EESS (passive) band for non-GSO ISS systems for which complete advance publication information is received by the Bureau on or after 1 January 2020
31.3-31.5 GHz	31-31.3 GHz	Fixed (excluding HAPS)	For stations brought into use after 1 January 2012: -38 dBW in any 100 MHz of the EESS (passive) band. This limit does not apply to stations that have been authorized prior to 1 January 2012
50.2-50.4 GHz	49.7-50.2 GHz	Fixed-satellite (E-to-s) <sup>4</sup>	For stations brought into use after the date of entry into force of the Final Acts of WRC-07: -10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi -20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi
50.2-50.4 GHz	49.7-50.2 GHz	Fixed-satellite GSO (E-to-s) <sup>4</sup>	TBD
50.2-50.4 GHz	49.7-50.2 GHz	Fixed-satellite non-GSO (E-to-s) <sup>4</sup>	TBD
50.2-50.4 GHz	50.4-50.9 GHz	Fixed-satellite (E-to-s) <sup>4</sup>	For stations brought into use after the date of entry into force of the Final Acts of WRC-07: -10 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain greater than or equal to 57 dBi -20 dBW into the 200 MHz of the EESS (passive) band for earth stations having an antenna gain less than 57 dBi
50.2-50.4 GHz	50.4-50.9 GHz	Fixed-satellite GSO (E-to-s) <sup>4</sup>	TBD
50.2-50.4 GHz	50.4-50.9 GHz	Fixed-satellite non-GSO (E-to-s) <sup>4</sup>	TBD
52.6-54.25 GHz	51.4-52.6 GHz	Fixed	For stations brought into use after the date of entry into force of the Final Acts of WRC-07: -33 dBW in any 100 MHz of the EESS (passive) band

EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band <sup>1</sup>
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<sup>1</sup> The unwanted emission power level is to be understood here as the level measured at the antenna port.

<sup>2</sup> This limit does not apply to mobile stations in the IMT systems for which the notification information has been received by the Radiocommunication Bureau by 28 November 2015. For those systems,  $-60$  dBW/27 MHz applies as the recommended value.

<sup>3</sup> The unwanted emission power level is to be understood here as the level measured with the mobile station transmitting at an average output power of 15 dBm.

<sup>4</sup> The limits apply under clear-sky conditions. During fading conditions, the limits may be exceeded by earth stations when using uplink power control.

**Method D, option 2:**

**NOC**

**RESOLUTION 750 (REV.WRC-15)**

**Compatibility between the Earth exploration-satellite service (passive) and relevant active services**

## Agenda item 7

### (WP 4A / WP 4C)

7 *to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution 86 (Rev.WRC-07), in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit;*

Resolution 86 (Rev.WRC-07) – Implementation of Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference

### Agenda item 7(A)

#### **3/7/1 Issue A – Bringing into use of frequency assignments to all non-GSO systems, and consideration of a milestone-based approach for the deployment of non-GSO systems in specific frequency bands and services**

##### **3/7/1.1 Executive summary**

The ITU-R studied both the bringing into use of frequency assignments to non-geostationary satellite (non-GSO) systems, and the possibility of adopting a milestone-based approach for the deployment of non-GSO systems composed of multiple, multi-satellite constellations, in particular frequency bands. The ITU-R studies have led to two general conclusions, one related to the concept of the bringing into use and the other related to the milestone-based approach for the deployment of non-GSO systems, each with multiple options for implementation.

The first general conclusion is that the bringing into use of frequency assignments to non-GSO systems should continue to be achieved by the deployment of one satellite into one of the notified orbital planes within seven years of the date of receipt of the advance publication of information (API) or request for coordination, as applicable. This conclusion applies for frequency assignments for all non-GSO systems in all frequency bands and services. However, three options are proposed with respect to the minimum period during which a satellite has to be maintained in a notified orbital plane: 90 days (as currently required for fixed-satellite service (FSS) and mobile-satellite service (MSS) non-GSO systems in the Rule of Procedure (RoP) for RR No. 11.44), some period less than 90 days or no fixed period.

The second general conclusion is that a new WRC Resolution should be adopted to implement a milestone-based approach for the deployment of non-GSO systems in specific frequency bands and services. This milestone-based approach would provide an additional period beyond the seven-year regulatory period for the deployment of the number of satellites, as notified and/or recorded, with the objective to help ensure that the Master International Frequency Register (MIFR) reasonably reflects the actual deployment of such non-GSO systems. Several options are proposed with respect to the number of milestones, the milestone periods, the required percentage of satellites deployed to satisfy each milestone, the consequences of failing to meet a milestone, and appropriate transitional measures to fairly and equitably address the case of the recorded frequency assignments to non-GSO systems already brought into use, and that have reached the end of their seven-year regulatory period, but where the non-GSO system has not been fully deployed.

### **3/7/1.2 Background**

WRC-12 and WRC-15 adopted into the RR a series of specific provisions, including RR No. **11.44B**, that clarified the requirements for the bringing into use (BIU) and the bringing back into use (BBIU) of frequency assignments to a space station in a GSO satellite network. However, there are no provisions in the RR that specifically address the BIU of frequency assignments to space stations in non-GSO systems. In this context and in order to complete the recording of frequency assignments to non-GSO systems, it has been the practice of the Bureau to declare their BIU successfully completed when one satellite is deployed into a notified orbital plane and capable of transmitting and/or receiving those frequency assignments. This practice, reflected for FSS and MSS non-GSO systems in section 2 of the Rules of Procedure for RR No. **11.44**, has been used for a number of years. Furthermore, it has been used irrespective of the number of satellites or of the number of orbital planes indicated in the notification information provided under RR No. **11.2**.

However, in its report to WRC-15 on the experience in the application of regulatory procedures and other related matters, the Director of the Radiocommunication Bureau stated that:

“Taking into account of the numerous non-GSO systems received so far by the Bureau, and the possible speculative nature of such submissions that could lead to spectrum warehousing and resurgence of so-called “paper satellite networks” the conference may wish to consider redefining the notion of bringing into use for non-GSO satellite networks.”

WRC-15 invited the ITU-R to examine, under the standing WRC agenda item 7, the possible development of regulatory provisions beyond those under RR Nos. **11.25** and **11.44** on the non-GSO FSS/MSS systems and the implications of the application of such milestones to non-GSO FSS/MSS systems brought into use after WRC-15.

### **3/7/1.3 Summary and analysis of the results of ITU-R studies**

Under RR No. **11.44**, frequency assignments to non-GSO systems, irrespective of service or frequency band, are to be brought into use within the seven-year regulatory period, and no studies considered changing the seven-year period. However, the studies concluded that it would be unrealistic to expect to have all the satellites of a system, in some cases consisting of hundreds or thousands of satellites, to be deployed within this seven-year regulatory period. Therefore, the BIU of frequency assignments of non-GSO systems cannot always be considered as a confirmation of the full deployment of these systems, but instead may in some cases be just an indication of the commencement of deployment of satellites capable of using the frequency assignments.

The BIU of frequency assignments to a non-GSO system is a prerequisite for securing rights and protections for the frequency assignments for the entire non-GSO system. The studies concluded that the BIU would be achieved with the deployment of one satellite into one of the notified orbital planes within the seven-year period. However, the rights and associated protections for the frequency assignments as initially recorded would continue to be retained if further actions are taken within a reasonable period of time following the end of the seven-year regulatory period to ensure that the characteristics of the recorded frequency assignments of the non-GSO system reflect its deployment. These actions could consist of a series of deployment milestones that would apply for a specified period after the end of the seven-year regulatory period. A milestone-based approach would balance the need to prevent spectrum warehousing, especially in congested frequency bands, and the need to recognize the technical and operational challenges associated with this type of non-GSO system.

To assist in resolving issue A under WRC-19 agenda item 7, the following guiding principles were developed:

- 1) The BIU process should be separate from any follow-up actions required to maintain the rights and protections for the recorded frequency assignments to non-GSO systems.
- 2) The successful completion of the BIU process for non-GSO systems does not require the deployment of all satellites in the system by the end of the seven-year regulatory period.
- 3) Appropriate time should be given to allow the completion of the deployment of non-GSO systems.
- 4) Appropriate transitional measures should be considered to address the implications of any new milestones adopted by WRC-19.
- 5) The milestone-based approach should be applied to all non-GSO systems in specific space services in specific frequency bands.
- 6) Concurrently with the development of a milestone-based approach, methodologies should be developed for the implementation of RR Nos. **9.58**, **11.43A**, and **11.43B** relating to the regulatory treatment of the adjustments to the characteristics of frequency assignments to non-GSO systems.
- 7) The milestone-based approach should provide incentives to notifying administrations to deploy satellites in a timely manner, as a failure to meet a given milestone for a non-GSO system will result in consequences.

These principles also advance the efficient, rational and economical use of spectrum and orbital resources and improve the transparency of the deployment of non-GSO systems.

### **3/7/1.3.1 Bringing into use of frequency assignments to non-GSO systems**

The ITU-R concluded that the BIU of frequency assignments to non-GSO systems, as reflected in RR Article **11**, should apply equally to all non-GSO systems, whether the frequency assignments are, for example, to a single-satellite non-GSO system/network, or to a multi-plane, multi-satellite constellation non-GSO system. One advantage to focusing on the large-system implementation issues separate from BIU under RR No. **11.44** is the avoidance of creating differences in BIU between non-GSO systems.

In addition, the BIU of frequency assignments to non-GSO systems should mean that at least one satellite capable of transmitting or receiving the frequency assignments has been deployed in a notified orbital plane<sup>22</sup> (see RoP on RR No. **11.44**, applicable to FSS and MSS) (Ed. of 2017)). For the purposes of the studies a satellite qualifies as deployed in a notified orbital plane when its orbital characteristics are in accordance with the RR Appendix **4** parameters that describe the notified orbital plane, in particular the orbit altitude(s) and inclination. The ITU-R studies led to the development of an understanding on the meaning of the term “notified orbital plane” in the context of BIU (see the examples in section 3/7/1.5.1.1 below). This understanding also has significance for the discussion of the milestone-based deployment approach described in section 3/7/1.3.2 below.

In addition to the continuous-operation options for non-GSO systems that use satellites in circular or elliptical orbital planes, there may need to be some special considerations for BIU of frequency assignments to non-GSO systems that do not ultimately operate in an orbital plane around the Earth. For example, some non-GSO satellites in the space operations service and or space research service are designed for non-Earth orbit missions, including deep-space missions, that either never enter

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<sup>22</sup> The term “notified orbital plane” is understood to mean the actual orbit of the satellites within the plane and not the orbital plane *stricto sensu* i.e. the two-dimensional infinite surface that contains the orbit of the satellite.

orbit around the Earth or are in Earth orbit for relatively short periods of time. The frequency assignments to such non-GSO systems must be considered brought into use when the notifying administration confirms a successful launch of a space station with the capability of transmitting or receiving the frequency assignments, or by some mechanism other than deployment into a notified orbital plane for some period up to 90 days. An exception to the general BIU conclusion expressed above may be needed for such systems.

The issue of BIU for overlapping frequency assignments of more than one non-GSO system by the use of the same spacecraft is being studied by the ITU-R.

The ITU-R identified three options for the period for which the satellite capable of transmitting or receiving the frequency assignments must be deployed in a notified orbital plane for the purposes of the BIU of frequency assignments to a non-GSO satellite system. The three options are shown in Table 3/7/1.3.1-1 below:

TABLE 3/7/1.3.1-1  
Options relating to the continuous period for confirming BIU

Options	Descriptions
A	A continuous period of at least 90 days in a notified orbital plane of a satellite with the capability of transmitting or receiving the frequency assignments. <i>Applicable to some non-GSO systems based on RoP on RR No. 11.44 (Ed. of 2017).</i>
B	A continuous period of X (one day to 90 days) of deployment in a notified orbital plane of a satellite with the capability of transmitting or receiving the frequency assignments may be sufficient. <i>The 90-day duration may not be required for the non-GSO administration/operator to determine that a space station with the capability has been deployed in a notified orbital plane.</i>
C	No fixed period. <i>Administration informs the Bureau of BIU once it confirms deployment of a space station with the capability of transmitting/receiving the frequency assignments into one of the notified orbital planes<sup>1</sup>.</i>

<sup>1</sup> The studies have shown that for some services, e.g., the radionavigation-satellite service, no fixed period is required. Instead, the administration/operator requires only as long as it takes to confirm the deployment into a notified orbital plane of a satellite with the capability of transmitting or receiving the frequency assignments. This can vary from system to system, but will not require 90 or more continuous days of deployment. For this reason, no fixed continuous period is required for these particular systems.

The studies confirmed, however, that whichever of the three options is selected for the BIU aspect, there should be only one option that applies to frequency assignments to all non-GSO systems that ultimately orbit the Earth.

### 3/7/1.3.2 Establishment of a milestone-based approach for alignment of non-GSO system deployment with MIFR entries in specific frequency bands and services

#### 3/7/1.3.2.1 Description of the milestone-based approach and options

The ITU-R concluded that there is a need for a milestone-based approach for specific services in specific frequency bands that recognizes that constellations of non-GSO systems may generally take more time than seven years to be fully deployed in accordance with the notified characteristics of the frequency assignments.

The milestone-based approach would only apply to frequency assignments of a given non-GSO system in specific frequency bands and services, that have been brought into use in accordance with RR No. 11.44 (and any other associated provisions adopted by WRC-19).

The milestone-based approach does not impact the BIU status, but instead defines further actions to be taken within a set period of time following the end of the seven-year regulatory period to ensure that the characteristics of the recorded frequency assignments of the non-GSO system reflect its deployment.

In defining the timeline and objectives of the milestone-based approach, a balance has been sought between the need to prevent warehousing of the orbital/spectrum resources and the operational requirements related to the deployment of a non-GSO system.

Additionally, the issue of the same spacecraft counting for milestones of more than one non-GSO system with overlapping frequency assignments is being studied by the ITU-R.

Under each of the milestones of this process, the number of satellites deployed into one or more notified orbital planes, with the confirmed capability of transmitting or receiving the frequency assignments, will be compared with the minimum number of satellites required as per the milestone.

If the number of satellites deployed is equal to or greater than the number of satellites required, the characteristics of recorded assignments, in particular the total number of satellites recorded in the MIFR as comprising the non-GSO system, will be kept unchanged. Otherwise, failing to meet a milestone will result in consequences (e.g., reduction of time between milestones and/or adjustments to the MIFR entry based on a deployment factor<sup>23</sup>). The options are presented in Table 3/7/1.3.2-1 below:

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<sup>23</sup> A “Deployment Factor” (DF) is considered to address the consequences of failing to meet a particular milestone, and leads to a scaling of the constellation based on the number of satellites actually deployed as of a milestone date. For example, should an administration with a 1 000 satellite system deploy 250 satellites as of a milestone requiring 33% of a system’s satellites to have been deployed, a deployment factor of “three” would mean that the MIFR entry for the 1 000 satellites would be reduced to 750 satellites (reflecting 250 deployed satellites multiplied by the deployment factor associated with that milestone).



TABLE 3/7/1.3.2-1

**Options for the milestone-based approach**

Milestone timing (*1) Number of years after the end of the seven-year regulatory period		Minimum required percentage of satellites to be deployed to meet the milestone (*2)		Deployment Factor	
M1	1	P1	A1 & F1: 10%	DF1	10
			B1: 8.33%		12
	2		C1 & D1: 10%		10
			G1: 30%		3.33
	4		E1: 10%		10
M2	3	P2	A2 & F2: 33%	DF2	3.03
	4		C2: 30%		3.33
			B2: 25%		4
	5		D2: 50%		2
	7		E2: 75%		1.34
	2+A (*3 and *4)		G2: 60%		1.66
M3	5	P3	A3: 75%	DF3	1.34
			B3: 75%		1.34
	6		F3: 100%		1
	7		C3: 90%		1.11
			D3: 100%		1
	8		E3: 100%		1
	2+A+B (*5)		G3: 100%		1

(\*1) Initial timing is the date of receipt by the Bureau of the relevant complete information under RR No. 9.1 or No. 9.1A of Article 9, as appropriate.

(\*2) In this column, (A1, A2, A3) (B1, B2, B3), (C1, C2, C3), (D1, D2, D3), (E1, E2, E3), (F1, F2, F3) and (G1, G2, G3) represents all the combinations of three milestones identified in the studies for the implementation of the milestone-based approach. For all options, except option (F1, F2, F3), the date for commencement of the milestone process based on the end of the seven-year regulatory period is 1 January 2021. For Option (D1, D2, D3 & F1, F2, F3) an alternative date of commencement is 23 November 2019. For option (B1, B2, B3), it could be a date between 1 January 2021 to 1 January 2024, and may be considered for other options, as the case may be.

(\*3) A & B are variables: 12 months ≤ A, B ≤ 30 months based on the conditions met.

(\*4) A = (number of satellites launched / 30% of the total number of satellites in the MIFR) \*30.

Where the resulting number calculated should be rounded up to the greatest whole number.

(\*5) B = (number of satellites launched / 60% of the total number of satellites in the MIFR) \*30.

Where the resulting number calculated should be rounded up to the greatest whole number.

**3/7/1.3.2.2 Descriptions of the transitional measures and associated options**

WRC-15 also invited the ITU-R to study the possibility of adopting a milestone-based approach for the deployment of non-GSO FSS/MSS systems, and the implications of applying these milestones to non-GSO FSS/MSS systems brought into use after WRC-15. One aspect of these implications relates to the consideration of transitional measures for non-GSO systems with frequency assignments brought into use and having reached the end of their seven-year regulatory period prior to the entry into force of the provisions adopted by WRC-19 related to the milestone-based approach.

Depending on the non-GSO systems to which WRC-19 decides to apply the milestone-based approach, transitional measures may be required to ensure that the operators of systems subject to this approach have enough time to re-evaluate and adjust their deployment plans. In this context, the transitional measures may also depend on the characteristics of the milestone-based approach adopted by WRC-19 and more specifically the timelines and associated level of deployment for each milestone. Two options have been identified for transitional measures:

### 3/7/1.3.2.2.1 Option 1

This option would consist of applying identical milestones, associated timelines and required levels of deployment both to non-GSO systems with frequency assignments that have reached the end of their regulatory period prior to a date to be set by the conference, and to non-GSO systems for which the regulatory periods end on or after that date. In this context, the only difference between the two categories of non-GSO systems referred to above with respect to the application of any potential milestone-based approach described in Table 3/7/1.3.2-1 will be the reference point for the commencement of the milestone period. For non-GSO systems with frequency assignments reaching the end of their seven-year regulatory period after a date to be set by the Conference, the commencement of the milestone period will be the actual date of the end of the seven-year regulatory period. For the non-GSO systems with a regulatory period that ends before the date to be set by the Conference, the commencement of the milestone process is based on that date. Options studied for the date to be set include 23 November, 2019 (the first day after the end of the conference), 1 January 2021 and 1 January 2024. In some cases, the date selected is directly connected to an option in Table 3/7/1.3.2-1.

### 3/7/1.3.2.2.2 Option 2

This option would consist of having different sets of milestones for which timing and duration, depend on whether or not the non-GSO systems with frequency assignments brought into use have reached the end of their seven-year regulatory period prior to the entry into force of the relevant provisions adopted by WRC-19 under Issue A. In this context, not only would there be a different reference point for the commencement of the milestone-based approach but the actual approach (i.e. associated timelines) would be different and would depend upon the date of the end of their seven-year regulatory period.

The regular milestone-based approach would have a duration, referred to as “ $d$ ”. The exact duration  $d$  depends on the option in Table 3/7/1.3.2-1 which needs to be decided by WRC-19.

Extra time would be granted to non-GSO systems for which the end of the seven-year regulatory period comes before the date of the commencement of the regular milestone-based approach.

Considering that:

- $R$  designates the date of the end of the seven-year regulatory period;
- $M_{transitional}$  ( $MT$ ) is the date of the beginning of the transitional milestone-based approach;
- $M_{regular}$  ( $MR$ ) is the date of the beginning of the regular milestone-based approach;
- $M_{final}$  ( $MF$ ) which corresponds to  $MR + d$  and is only used to describe the stretching as explained below.

Depending on the position of  $R$  with respect to  $MT$  and  $MR$ , three cases can be distinguished:

- non-GSO systems for which the end of the seven-year regulatory period  $R$  is after  $M_{regular}$  will have to apply the regular milestone-based approach with a duration of  $d$ . The milestone-based approach will start on day  $R$  and end on day  $R + d$ ;
- non-GSO systems for which the end of the seven-year regulatory period  $R$  is between  $MT$  and  $MR$  will benefit from stretched milestone timelines. The milestone process for such systems will start on day  $R$  and end on day  $MF = MR + d$ , and have a duration of  $D$  (with  $D = MF - R > d$ );
- non-GSO systems for which the end of the seven-year regulatory period  $R$  is before  $MT$  will also benefit from stretched milestone timelines, starting on  $MT$  and ending on  $MF = MR + d$ . In this case, the duration  $D = MF - MT > d$ .

The periods between the different milestones are stretched by a factor of  $D/d$ , compared to those under the regular milestone-based approach (see Table 3/7/1.3.2-1).

The dates  $MT$  and  $MR$  have to be chosen in a range between the end of WRC-19 and seven years after the end of WRC-19, which is the range where the end of the seven-year regulatory period can fall for systems submitted prior to the end of WRC-19.

Furthermore, the date  $MR$  should not be later than the end of WRC-19 +  $d$ . The networks which are submitted after WRC-15 and before the end of WRC-19 have had sufficient visibility on the implementation of the milestone-based approach.

The transitional milestone-based approach can be associated with any implementation of the regular milestone-based approach as shown in Table 3/7/1.3.2-1.

Option 2 is presented here in a generic form, which requires some calculations for the milestone duration where the transitional measures apply. Under this option, once WRC-19 has made a decision on the two dates,  $MT$  and  $MR$ , the milestones for the systems where the transitional measures apply can be calculated once and for all, and represented in a table format in the Resolution. The numerical examples below are provided for a better understanding of this methodology for transitional measures. They are based on the B1, B2, and B3 options as shown in Table 3/7/1.3.2-1 (with  $d = six$  years, and a milestone every two years).

So far, one date has been discussed for the beginning of the transitional measures ( $MT$ ) 1 July 2022 and another date has been discussed for the beginning of the regular milestones ( $MR$ ): 1 January 2024.

**Example:  $MT$  is 1 July 2022,  $MR$  is 1 January 2024,  $MF$  is 1 January 2030**

	End of regulatory period	Start of the process	1st milestone	2nd milestone	3rd milestone	Comment
<b>Network A</b>	01/01/2021	01/07/2022	30/12/2024	02/07/2027	01/01/2030	Transitional measure (stretched milestone process)
<b>Network B</b>	01/01/2024	01/01/2024	31/12/2025	01/01/2028	01/01/2030	Start of the regular milestone process
<b>Network C</b>	01/01/2027	01/01/2027	31/12/2028	01/01/2031	01/01/2033	Future networks (regular milestone process)
<b>Network D</b>	01/01/2018	01/07/2022	30/12/2024	02/07/2027	01/01/2030	Catch-all clause for networks where $R < MT$

**3/7/1.4 Methods to satisfy issue A**

To satisfy Issue A, one method was developed that comprises two separate elements. The first element addresses the BIU of frequency assignments to non-GSO systems. The second element introduces the implementation of milestones for maintaining the recording in the MIFR of assignments to non-GSO systems in specific frequency bands and services, which provide administrations with the ability to use a period longer than the regulatory period in RR No. **11.44** to complete deployment of all satellites and orbital planes in the notified non-GSO system. For both of these elements various options are described below.

### **3/7/1.4.1 Bringing into use**

For the BIU of frequency assignments to non-GSO systems of the method referred to above, three options have been identified.

These three options involve the incorporation of a form of Section 2 of the Rules of Procedure for RR No. **11.44** into the Radio Regulations. To this effect, one option requires deployment for a continuous period of at least 90 days in a notified orbital plane of a satellite with the capability of transmitting or receiving the frequency assignments. The second option requires such deployment for a continuous period of between one and 90 days. A third option is for deployment with no fixed period for BIU. For whichever of the three options is selected as the method for the BIU aspect of this issue, there should be only one option that applies to frequency assignments to all non-GSO systems that ultimately orbit the Earth.

In addition to the above, there may need to be some special considerations for BIU non-GSO systems that do not ultimately operate in an orbital plane around the Earth. These non-GSO systems and networks must be considered brought into use when the notifying administration confirms a successful launch of a space station with the capability of transmitting or receiving the frequency assignments, or by some mechanism other than deployment into a notified orbital plane for some period up to 90 days.

Modifications or addition of provisions in RR Article **11** for the implementation of this method would also be required.

Consideration should also be given to addressing tolerances for some of the orbital characteristics, such as the altitude and the inclination of orbits of non-GSO satellites, associated with recorded frequency assignments.

### **3/7/1.4.2 Milestone-based approach**

For the milestone-based approach, a single option and several examples of possible implementations have been identified to provide time beyond the seven-year regulatory period to complete the deployment of the satellites associated with recorded frequency assignments to a non-GSO system (see section 3/7/1.3.2.1 and Table 3/7/1.3.2-1).

A prerequisite for application of the milestone-based approach to the frequency assignments of a given non-GSO system is that the frequency assignments are considered to have been brought into use in accordance with RR No. **11.44** and any other associated provisions as may be adopted by WRC-19 for the BIU of frequency assignments to non-GSO systems.

Under this method, a new WRC Resolution would be adopted to specify the frequency bands and services to which the approach applies, the number of milestones, the milestone period, the required percentage of satellites deployed to satisfy the milestones, and the consequences of failing to meet a milestone (which results in reduction of time between milestones and/or adjustments to the MIFR entry based on a deployment factor). Appropriate transitional arrangements would also be included in the same new WRC Resolution. Following the non-compliance with a milestone, the Resolution will specify the timeline and the processing for the submission by a notifying administration of a consequential modification to the characteristics of the recorded frequency assignments to its non-GSO system.

Provisions for the implementation of this method would also be required.

The new WRC Resolution would be referred to in an appropriate Article of the Radio Regulations.

Since the number of satellites deployed could fluctuate after the milestone period, it may be important to update the information recorded in the MIFR. Such a process could be contained in the Resolution. However, there is no consensus on the need to include such a process in the Resolution.

### **3/7/1.5 Regulatory and procedural considerations for issue A**

#### **3/7/1.5.1 Bringing into use (BIU)**

Examples of regulatory implementation of the Method described in section 3/7/1.4.1 on the BIU of frequency assignments to non-GSO systems are provided below.

##### **3/7/1.5.1.1 BIU options A and B: incorporation of the RoP in Article 11 with a fixed period for BIU**

## ARTICLE 11

### **Notification and recording of frequency assignments<sup>1, 2, 3, 4, 5, 6, 7, 8</sup> (WRC-15)**

#### **Section II – Examination of notices and recording of frequency assignments in the Master Register**

#### **MOD**

**11.44** The notified date<sup>24</sup>, MOD <sup>25</sup>, MOD <sup>26</sup> of bringing into use of any frequency assignment to a space station of a satellite network or system shall be not later than seven years following the date of receipt by the Bureau of the relevant complete information under No. **9.1** or **9.2** in the case of satellite networks or systems not subject to Section II of Article **9** or under No. **9.1A** in the case of satellite networks or systems subject to Section II of Article **9**. Any frequency assignment not brought into use within the required period shall be cancelled by the Bureau after having informed the administration at least three months before the expiry of this period. (WRC-19)

#### **NOC**

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<sup>24</sup> **11.44.1**

#### **MOD**

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<sup>25</sup> **11.44.2** The notified date of bringing into use of a frequency assignment to a space station of a satellite network or system shall be the date of the commencement of the continuous period defined in No. **11.44B** or MOD No. **11.44C**, as applicable. (WRC-19)

## MOD

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<sup>26</sup> **11.44.3, 11.44B.1 and 11.44C.3** Upon receipt of this information and whenever it appears from reliable information available that a notified frequency assignment has not been brought into use in accordance with No. **11.44**, No. **11.44B** or MOD No. **11.44C**, as the case may be, the consultation procedures and subsequent applicable course of action prescribed in No. **13.6** shall apply, as appropriate. (WRC-19)

## MOD

**11.44C** A frequency assignment to a space station in a non-geostationary-satellite orbit shall be considered as having been brought into use when a space station in the non-geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained on one of the notified orbital planes<sup>ADD WW</sup> of the non-geostationary-satellite system for a continuous period of X days, (where  $1 \leq X \leq 90$ )<sup>ADD XX</sup>. The notifying administration shall so inform the Bureau within 30 days from the end of the X-day period<sup>MOD 26, ADD YY</sup>. On receipt of the information sent under this provision, the Bureau shall make that information available on the ITU website as soon as possible and shall publish it in the BR IFIC subsequently. (WRC-19)

*Note - For footnote WW, there are two options presented below. There has been no conclusion whether orbital tolerance elements are appropriate for consideration to non-GSO satellite systems in all services.*

*Option 1:*

## ADD

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<sup>WW</sup> **11.44C.1** In examining information provided by an administration in application of Nos. MOD **11.44C, 11.49** or ADD **11.51**, the following data items in Table A in Annex II of Appendix **4** shall be/are used, as appropriate, to determine if the orbital plane of the space stations in the non-geostationary-satellite system corresponds to one of the notified orbits:

- Item A.4.b.4.a, the inclination of the orbital plane of the space station, within  $\pm$ TBD degrees of the corresponding value notified for this item;
- Item A.4.b.4.d, the altitude of the apogee of the space station, within  $\pm$ TBD kilometres (% of apogee) of the corresponding value notified for this item;
- Item A.4.b.4.e, the altitude of the perigee of the space station, within  $\pm$ TBD kilometres (% of perigee) of the corresponding value notified for this item;
- Item A.4.b.5.c, the argument of the perigee within  $\pm$ TBD degrees of the corresponding value notified for this item. (WRC-19)

*Option 2:*

**ADD**

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**WW 11.44C.1** For the purposes of No. MOD **11.44C**, the term “notified orbital plane” means an orbital plane of the non-GSO system, as provided to the Bureau in the most recent advance publication, coordination or notification information for the system’s frequency assignments, that possesses the general characteristics of Items A.4.b.4.a through A.4.b.4.f in Table A of Annex 2 to Appendix 4. (WRC-19)

**ADD**

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**XX 11.44C.2** A frequency assignment to a space station in a non-geostationary-satellite system with a reference body that is not “Earth” shall be considered as having been brought into use when the notifying administration informs the Bureau that a space station with the capability of transmitting or receiving that frequency assignment has been deployed and operated in accordance with the notification information. (WRC-19)

**ADD**

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**YY 11.44C.4** A frequency assignment to a space station in a non-geostationary-satellite orbit with a notified date of bringing into use more than  $X + 30$  days, where  $1 \leq X \leq 90$  prior to the date of receipt of the notification information shall also be considered as having been brought into use if the notifying administration confirms, when submitting the notification information for this assignment, that a space station in a notified orbital plane (see also No. ADD **11.44C.1**) with the capability of transmitting or receiving that frequency assignment has been deployed and maintained as provided for in No. MOD **11.44C** for a continuous period of time from the notified date of bringing into use until the date of receipt of the notification information for this frequency assignment. (WRC-19)

**MOD**

**11.49** Wherever the use of a recorded frequency assignment to a space station is suspended for a period exceeding six months, the notifying administration shall inform the Bureau of the date on which such use was suspended. When the recorded assignment is brought back into use, the notifying administration shall, subject to the provisions of No. **11.49.1** when applicable, so inform the Bureau, as soon as possible. On receipt of the information sent under this provision, the Bureau shall make that information available as soon as possible on the ITU website and shall publish it in the BR IFIC. The date on which the recorded assignment is brought back into use<sup>28</sup>, ADD VV shall be not later than three years from the date on which the use of the frequency assignment was suspended, provided that the notifying administration informs the Bureau of the suspension within six months from the date on which the use was suspended. If the notifying administration informs the Bureau of the suspension more than six months after the date on which the use of the frequency assignment was suspended, this three-year time period shall be reduced. In this case, the amount by which the three-year period shall be reduced shall be equal to the amount of time that has elapsed between the end of the six-month period and the date that the Bureau is informed of the suspension. If the notifying

administration informs the Bureau of the suspension more than 21 months after the date on which the use of the frequency assignment was suspended, the frequency assignment shall be cancelled. (WRC-19)

## **ADD**

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**VV 11.49.2** The date of bringing back into use of a frequency assignment to a space station in the non-geostationary-satellite orbit shall be the date of the commencement of the X, where  $1 \leq X \leq 90$ -day period defined below. A frequency assignment to a space station in the non-geostationary-satellite orbit shall be considered as having been brought back into use when a space station in the non-geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained on one of the notified orbital planes (see also No. ADD **11.44C.1**) for a continuous period of X days, where  $1 \leq X \leq 90$ . The notifying administration shall so inform the Bureau within 30 days from the end of the X, where  $1 \leq X \leq 90$ -day period. (WRC-19)

### **3/7/1.5.1.2 BIU Option C: incorporation of the RoP in Article 11 with no fixed period for BIU**

## **ARTICLE 11**

### **Notification and recording of frequency assignments<sup>1, 2, 3, 4, 5, 6, 7, 8</sup> (WRC-15)**

#### **Section II – Examination of notices and recording of frequency assignments in the Master Register**

## **MOD**

**11.44** The notified date<sup>24, 25</sup>, MOD 26, ADD XX of bringing into use of any frequency assignment to a space station of a satellite network or system shall be not later than seven years following the date of receipt by the Bureau of the relevant complete information under No. **9.1** or **9.2** in the case of satellite networks or systems not subject to Section II of Article **9** or under No. **9.1A** in the case of satellite networks or systems subject to Section II of Article **9**. Any frequency assignment not brought into use within the required period shall be cancelled by the Bureau after having informed the administration at least three months before the expiry of this period. (WRC-19)

## **NOC**

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### **<sup>24</sup> 11.44.1**



## NOC

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<sup>25</sup> **11.44.2**

## MOD

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<sup>26</sup> **11.44.3, 11.44B.1 and 11.44C.3** Upon receipt of this information and whenever it appears from reliable information available that a notified frequency assignment has not been brought into use in accordance with No. **11.44** and/or No. **11.44B**, as the case may be, the consultation procedures and subsequent applicable course of action prescribed in No. **13.6** shall apply, as appropriate. (WRC-19)

## ADD

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<sup>XX</sup> **11.44.4 and 11.44C.1** The notified date of bringing into use of a frequency assignment to a space station in a non-geostationary-satellite orbit shall be the date on which the notifying administration confirms that a satellite with the capability of transmitting or receiving that frequency assignment has been deployed on one of the notified orbital planes of the non-geostationary-satellite system, or the date foreseen for bringing into use in item A.2.a of the information provided in Appendix 4, whichever date comes earlier. (WRC-19)

## MOD

**11.44C** A frequency assignment to a space station in a non-geostationary-satellite orbit shall be considered as having been brought into use when a space station in the non-geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed on one of the notified orbital planes<sup>ADD WW</sup> of the non-geostationary-satellite system<sup>ADD XX</sup>. The notifying administration shall so inform the Bureau within 30 days after the notified date of bringing into use<sup>MOD 26, ADD YY</sup>. On receipt of the information sent under this provision, the Bureau shall make that information available on the ITU website as soon as possible and shall publish it in the BR IFIC subsequently. (WRC-19)

*Note - Two options for footnote WW are presented below:*

*Option 1:*

## ADD

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<sup>WW</sup> **11.44C.2** In examining information provided by an administration in application of Nos. MOD **11.44C, 11.49** or ADD **11.51**, the following data items in Table A in Annex II of Appendix 4 shall be used, as appropriate, to determine if the orbital plane of the space stations in the non-geostationary-satellite system corresponds to one of the notified orbits:

- Item A.4.b.4.a, the inclination of the orbital plane of the space station, within  $\pm$ TBD degrees of the corresponding value notified for this item;

- Item A.4.b.4.d, the altitude of the apogee of the space station, within  $\pm$ TBD kilometres (% of apogee) of the corresponding value notified for this item;
- Item A.4.b.4.e, the altitude of the perigee of the space station, within  $\pm$ TBD kilometres (% of perigee) of the corresponding value notified for this item;
- Item A.4.b.5.c, the argument of the perigee within  $\pm$ TDB degrees of the corresponding value notified for this item. (WRC-19)

*Option 2:*

**ADD**

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**WW 11.44C.2** For the purposes of No. MOD **11.44C**, the term “notified orbital plane” means an orbital plane of the non-GSO system, as provided to the Bureau in the most recent advance publication, coordination or notification information for the system’s frequency assignments, that possesses the general characteristics of items A.4.b.4.a through A.4.b.4.f in Table A of Annex 2 to Appendix 4. (WRC-19)

**ADD**

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**XX 11.44C.4** A frequency assignment to a space station in a non-geostationary-satellite system with a reference body that is not “Earth” shall be considered as having been brought into use when the notifying administration informs the Bureau that a space station with the capability of transmitting or receiving that frequency assignment has been deployed and operated in accordance with the notification information. (WRC-19)

**ADD**

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**YY 11.44C.5** A frequency assignment to a space station in a non-geostationary-satellite orbit with a notified date of bringing into use more than 30 days prior to the date of receipt of the notification information shall also be considered as having been brought into use if the notifying administration confirms, when submitting the notification information for this assignment, that a space station in a notified orbital plane (see also No. ADD **11.44C.2**) with the capability of transmitting or receiving that frequency assignment has been deployed and maintained as provided for in No. MOD **11.44C**, for a continuous period of time from the notified date of bringing into use until the date of receipt of the notification information for this frequency assignment. (WRC-19)

**MOD**

**11.49** Wherever the use of a recorded frequency assignment to a space station is suspended for a period exceeding six months, the notifying administration shall inform the Bureau of the date on which such use was suspended. When the recorded assignment is brought back into use, the notifying administration shall, subject to the provisions of No. **11.49.1** when applicable, so inform the Bureau, as soon as possible. On receipt of the information sent under this provision, the Bureau shall make that information available as soon as possible on the ITU website and shall

publish it in the BR IFIC. The date on which the recorded assignment is brought back into use<sup>28</sup>, ADD VV shall be not later than three years from the date on which the use of the frequency assignment was suspended, provided that the notifying administration informs the Bureau of the suspension within six months from the date on which the use was suspended. If the notifying administration informs the Bureau of the suspension more than six months after the date on which the use of the frequency assignment was suspended, this three-year time period shall be reduced. In this case, the amount by which the three-year period shall be reduced shall be equal to the amount of time that has elapsed between the end of the six-month period and the date that the Bureau is informed of the suspension. If the notifying administration informs the Bureau of the suspension more than 21 months after the date on which the use of the frequency assignment was suspended, the frequency assignment shall be cancelled. (WRC-19)

## **ADD**

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VV **11.49.2** A frequency assignment to a space station in the non-geostationary-satellite orbit shall be considered as having been brought back into use when a space station in the non-geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained on one of the notified orbital planes (see also No. ADD **11.44C.2**). The notifying administration shall so inform the Bureau within 30 days from the date of the resumption of the use of this frequency assignment. (WRC-19)

### **3/7/1.5.2 Milestone-based approach**

#### **3/7/1.5.2.1 Modification of Radio Regulations to reference draft new Resolution [A7(A)-NGSO-MILESTONES] into Article 11**

For a milestone-based approach contained in a WRC Resolution to be mandatorily applied to non-GSO systems in specific frequency bands, the Resolution would need to be included in the Radio Regulations with a mandatory reference. The example proposed allows the implementation of any of the options listed in Table 3/7/1.3.2-1.

## **ARTICLE 11**

### **Notification and recording of frequency assignments<sup>1, 2, 3, 4, 5, 6, 7, 8</sup> (WRC-15)**

## **ADD**

#### **Section III – Maintenance of the recording of frequency assignments to non-GSO satellite systems in the Master Register (WRC-19)**

## **ADD**

**11.51** For frequency assignments to some non-GSO satellite systems in specific frequency bands and services, draft new Resolution [A7(A)-NGSO-MILESTONES] (WRC-19) shall apply. (WRC-19)

### **3/7/1.5.2.2 Modification of RR Article 13**

Based on the milestone-based approach, there may be a difference between the number of satellites deployed and the number of satellites recorded in the MIFR during the milestone process. This should be taken into account in the application of RR No. **13.6**.

## **ARTICLE 13**

### **Instructions to the Bureau**

#### **Section II – Maintenance of the Master Register and of World Plans by the Bureau**

#### **MOD**

**13.6** *b)* whenever it appears from reliable information available that a recorded assignment has not been brought into use, or is no longer in use, or continues to be in use but not in accordance with the notified required characteristics<sup>ADD 1</sup> as specified in Appendix 4, the Bureau shall consult the notifying administration and request clarification as to whether the assignment was brought into use in accordance with the notified characteristics or continues to be in use in accordance with the notified characteristics. Such a request shall include the reason for the query. In the event of a response and subject to the agreement of the notifying administration the Bureau shall cancel, suitably modify, or retain the basic characteristics of the entry. If the notifying administration does not respond within three months, the Bureau shall issue a reminder. In the event the notifying administration does not respond within one month of the first reminder, the Bureau shall issue a second reminder. In the event the notifying administration does not respond within one month of the second reminder, action taken by the Bureau to cancel the entry shall be subject to a decision of the Board. In the event of non-response or disagreement by the notifying administration, the entry will continue to be taken into account by the Bureau when conducting its examinations until the decision to cancel or modify the entry is made by the Board. In the event of a response, the Bureau shall inform the notifying administration of the conclusion reached by the Bureau within three months of the administration's response. When the Bureau is not in a position to comply with the three-month deadline referred to above, the Bureau shall so inform the notifying administration together with the reasons therefor. In case of disagreement between the notifying administration and the Bureau, the matter shall be carefully investigated by the Board, including taking into account submissions of additional supporting materials from administrations through the Bureau within the deadlines as established by the Board. The application of this provision shall not preclude the application of other provisions of the Radio Regulations. (WRC-19)

#### **ADD**

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<sup>1</sup> **13.6.1** See also No. ADD **11.51**, frequency assignments to non-geostationary-satellite systems recorded in the Master Register. (WRC-19)

### **3/7/1.5.2.3 Proposed regulatory example of draft new Resolution [A7(A)-NGSO-MILESTONES] (WRC-19)**

For the example Resolution below, “Effective Date” refers to the date on or after which the end of the seven-year regulatory period for non-geostationary systems subject to the Resolution marks the start of the milestone-based approach without transition measures. For the Resolution text, “Effective Date” would be replaced with a specific date decided by WRC-19.

*Note - The text in this Resolution needs to be refined and simplified without changing the meaning of the text and using the past practices of WRCs in drafting regulatory text at the CPM.*

**ADD**

#### **DRAFT NEW RESOLUTION [A7(A)-NGSO-MILESTONES] (WRC-19)**

### **A milestone-based approach for the implementation of frequency assignments to space stations in a non-geostationary-orbit satellite system in certain frequency bands and services**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that all frequency assignments to space stations in a non-geostationary orbit (non-GSO) system are considered to be brought into use when one space station with the capability of transmitting or receiving those frequency assignments has been deployed into one of the notified orbital planes within seven years of the initial advance publication or coordination filing, as appropriate;
- b) that in some cases, frequency assignments to space stations in non-GSO systems are recorded in the Master International Frequency Register (Master Register) without confirmation to the Radiocommunication Bureau (Bureau) by the notifying administration that space stations in all notified orbital planes and/or all space stations per notified orbital plane have been deployed;
- c) that design considerations, availability of launch vehicles to support multiple satellite launches, and other factors mean that notifying administrations may require longer than the regulatory period stipulated in No. **11.44** to complete implementation of non-GSO systems that contain the filed numbers of notified orbital planes and satellites per orbital plane;
- d) that any discrepancies between the deployed number of orbital planes/satellites per orbital plane of a non-GSO system and the Master Register have, to date, not significantly impinged upon the efficient use of the orbital/spectrum resource in any frequency band used by non-GSO systems;
- e) that recent filings of frequency assignments to multiple non-GSO systems employing hundreds to thousands of non-GSO satellites per system, in particular frequency bands allocated to the fixed-satellite service (FSS) or mobile-satellite service (MSS), have led to a re-examination by ITU-R of the impact of discrepancies mentioned in *considering d)* and the efficient use of the orbital/spectrum resource in those frequency bands;
- f) that ITU-R studies of the issue have shown that in certain frequency bands and services used or proposed for use by non-GSO systems, the adoption of a milestone-based system to facilitate deployment of non-GSO systems that correspond to Master Register entries in terms of the

number of orbital planes and the number of satellites per orbital plane will improve the efficient use of the orbital/spectrum resource in those frequency bands and services;

g) that there is a need to seek a balance between the prevention of spectrum warehousing, the proper functioning of coordination mechanisms and the operational requirements related to the deployment of a non-geostationary-satellite system;

h) that filings for frequency assignments to large FSS/MSS non-geostationary-satellite systems have been received by ITU since 2011;

i) that the deployment of these non-geostationary-satellite systems may require a longer period than the one stipulated in No. **11.44** of the Radio Regulations;

j) that extensions to milestones are undesirable, as they create uncertainty with respect to the configuration of the non-GSO FSS system deployment with which other systems must coordinate, and therefore any milestones that may be established should allow enough time to accommodate unforeseen difficulties such as launch failures,

*recognizing*

a) No. MOD **11.44C** addresses the bringing into use of frequency assignments to non-GSO satellite systems;

b) that new regulations for management of frequency assignments to non-GSO systems in the Master Register should not impose an unnecessary regulatory burden;

c) that the Bureau is required under No. **13.6**, whenever it appears from reliable information available that a recorded assignment continues to be in use but not in accordance with the notified required characteristics as specified in Appendix **4**, to consult the notifying administration and request clarification as to whether the assignment was brought into use in accordance with the notified characteristics or continues to be in use in accordance with the notified characteristics;

d) that the number of orbital planes in a non-GSO system (item A.4.b.1) and the number of satellites in each orbital plane (item A.4.b.4.b) are among the notified required characteristics as specified in Appendix **4**;

e) that since No. **13.6** is applicable to non-GSO systems with frequency assignments that were confirmed to have been brought into use prior to the Effective Date in the frequency bands and services to which this Resolution applies, transitional measures are required to enable affected notifying administrations the opportunity to either confirm deployment of satellites in accordance with the Appendix **4** characteristics specified in *recognizing d)* above, or to complete deployment in accordance with this Resolution;

f) that it is not necessary or appropriate for the Bureau, in the interest of improving the efficient use of the orbital/spectrum resource or otherwise, to routinely use the procedures of No. **13.6** to seek confirmation of the deployment of the number of satellites in notified orbital planes for non-geostationary-satellite orbit systems in frequency bands and services not listed in *resolves 1* of this Resolution,

*recognizing further*

that this Resolution relates to those aspects of non-GSO systems to which *resolves 1* applies with regard to the notified required characteristics as specified in Appendix **4**. The conformity of the notified required characteristics of the non-GSO systems other than those referred to in *recognizing d)* above is outside the scope of this Resolution,

*noting*

that for the purpose of this Resolution:

- the term “frequency assignments” is understood to refer to notified frequency assignments to a space station in a non-geostationary-satellite orbit with the capability of transmitting and receiving that frequency assignment either when the Bureau has not yet completed its examination under Section II of Article 11, or when the assignments are recorded in the Master Register;
- the “total number of satellites” is understood to mean the sum of the various values of Appendix 4 data item A.4.b.4.b associated with the notified orbital planes,

*resolves*

1 that this Resolution applies to frequency assignments to non-geostationary-satellite systems brought into use in accordance with Nos. 11.44 and/or MOD 11.44C, as applicable, in frequency bands and for services listed in the Table below:

**Frequency bands and services considered for application for the milestone-based approach**

<b>Bands (GHz)</b>	<b>Space radiocommunication services</b>
<b>Bands generally agreed for inclusion</b>	
10.7-11.45	Option 1: FSS Option 2: List all primary satellite services
11.45-11.7	Option 1: FSS Option 2: List all primary satellite services
11.7-12.75	Option 1: FSS Option 2: List all primary satellite services
12.75-13.25	Option 1: FSS Option 2: List all primary satellite services
13.75-14.5	Option 1: FSS Option 2: List all primary satellite services
17.3-17.7	Option 1: FSS Option 2: List all primary satellite services
17.7-19.7	Option 1: FSS (except non-GSO MSS feeder links) Option 2: List all primary satellite services
19.7-20.2	Option 1: FSS and MSS Option 2: List all primary satellite services
27-27.5	Option 1: FSS Option 2: List all primary satellite services
27.5-29.5	Option 1: FSS (except non-GSO MSS feeder links) Option 2: All satellite services
29.5-30	Option 1: FSS and MSS Option 2: List all primary satellite services
37.5-39.5	Option 1: FSS Option 2: List all primary satellite services
39.5-40.5	Option 1: FSS and MSS Option 2: List all primary satellite services
40.5-42.5	Option 1: FSS and BSS Option 2: List all primary satellite services

<b>Bands (GHz)</b>	<b>Space radiocommunication services</b>
47.2-50.2	Option 1: FSS Option 2: List all primary satellite services
50.4-51.4	Option 1: FSS Option 2: List all primary satellite services
<b>Bands not generally agreed for inclusion</b>	
1.980-2.010	Option 1: MSS Option 2: List all primary satellite services
2.170-2.200	Option 1: MSS Option 2: List all primary satellite services
3.400-4.200	Option 1: FSS Option 2: List all primary satellite services
5.091-5.250	Option 1: FSS Option 2: List all primary satellite services
5.725-7.075	Option 1: FSS Option 2: List all primary satellite services
7.250-7.750	Option 1: FSS Option 2: List all primary satellite services
7.900-8.400	Option 1: FSS Option 2: List all primary satellite services
20.2-21.2	Option 1: FSS Option 2: List all primary satellite services
30-31	Option 1: FSS Option 2: List all primary satellite services
42.5-43.5	Option 1: FSS Option 2: List all primary satellite services
43.5-47	Option 1: MSS Option 2: List all primary satellite services

2 that for notifying administrations of frequency assignments to non-geostationary-satellite systems to which *resolves 1* applies, and for which the end of the seven-year regulatory period is after “*Effective Date*”, the following provisions shall apply:

- a) no later than 30 days after the end of the regulatory period specified in No. **11.44** or 30 days after the end of the bringing into use period in No. **MOD 11.44C** whichever comes last, the notifying administration shall communicate to the Bureau the complete deployment information in accordance with Annex 1 to this Resolution;
- b) if the number of satellites communicated to the Bureau under subsection *a)* of *resolves 2* is not 100% of the total number of satellites indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system, the Bureau shall, after informing the notifying administration, add a remark to the Master Register entry for the frequency assignments to the system stating that the assignments are subject to the application of this Resolution;

*Note: The length of the BIU period will be decided at WRC-19.*



3 that, the notifying administrations of frequency assignments to non-geostationary-satellite systems to which subsection *b*) of *resolves* 2 applies shall communicate to the Bureau the complete deployment information in accordance with Annex 1 to this Resolution:

*Note: Values of M, P and DF are taken from the options 3/7/1.3.2-1.*

- a) no later than 30 days after the expiry of the “M1”-year period after the end of the seven-year period referred to in No. **11.44**;
  - b) no later than 30 days after the expiry of the “M2”-year period after the end of the seven-year period referred to in No. **11.44**;
  - c) no later than 30 days after the expiry of the “M3”-year period after the end of the seven-year period referred to in No. **11.44**;
- 3.1 that, if the number of space stations deployed under *resolves* 3*a*) is less than “P1”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system, the notifying administration shall also submit to the Bureau, no later than 90 days from the end of the “M1”-year period referred to in *resolves* 3*a*), modifications to the notified characteristics of the frequency assignments, taking into consideration that the modified total number of satellites shall not be greater than “DF1” times the number of space stations deployed under *resolves* 3*a*) and the Bureau shall, after informing the notifying administration and without removing the remark stating that the assignments are subject to the application of this Resolution, modify the Master Register entry for the frequency assignments to the system accordingly;
- 3.2 that, if the number of space stations deployed under *resolves* 3*b*) is less than “P2”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system, the notifying administration shall also submit to the Bureau, no later than 90 days from the end of the “M2”-year period referred to in *resolves* 3*b*), modifications to the notified characteristics of the recorded frequency assignments in the Master Register, taking into consideration that the modified total number of satellites shall not be greater than “DF2” times the number of space stations deployed under *resolves* 3*b*) and the Bureau shall, after informing the notifying administration and without removing the remark stating that the assignments are subject to the application of this Resolution, modify the Master Register entry for the frequency assignments to the system accordingly;
- 3.3 that, if the number of space stations deployed under *resolves* 3*c*) is less than “P3”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system, the notifying administration shall also submit to the Bureau, no later than 90 days from the end of the [M3]-year period referred to in *resolves* 3*c*), modifications to the notified characteristics of the recorded frequency assignments in the Master Register, taking into consideration that the modified total number of satellites shall not be greater than “DF3” times the number of space stations deployed under *resolves* 3*c*) and the Bureau shall, after informing the notifying administration, remove the remark stating that the assignments are subject to the application of this Resolution and modify the Master Register entry for the frequency assignments to the system accordingly;

*Note: If P3 is 100%, there would be no rounding down and no need to apply DF3 (which would be 1).*

### **Transition alternative 1**

4 that notifying administrations of frequency assignments to non-geostationary-satellite systems to which *resolves 1* applies, and for which the end of the regulatory period specified in No. **11.44** has expired prior to “Effective Date”, shall communicate to the Bureau the complete deployment information in accordance with Annex 1 to this Resolution:

- a) no later than “six months after the Effective Date”;
- b) no later than 30 days after the expiry of the “M1”-year period after the “Effective Date” (for systems to which *resolves 4.1* below applies);
- c) no later than 30 days after the expiry of the “M2”-year period after the “Effective Date” (for systems to which *resolves 4.1* below applies);
- d) no later than 30 days after the expiry of the “M3”-year period after the “Effective Date” (for systems to which *resolves 4.1* below applies);

4.1 that, if the number communicated to the Bureau under *resolves 4a)* is not 100% of the total number of satellites indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system, the Bureau shall, after informing the notifying administration, modify the Master Register entry for the frequency assignments to the system to add a remark stating that the assignments are subject to the application of this Resolution;

4.2 that, if the number of space stations deployed under *resolves 4b)* is less than “P1”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system, the notifying administration shall also submit to the Bureau, no later than 90 days from the end of the period referred to in *resolves 4b)*, modifications to the notified characteristics of the recorded frequency assignments in the Master Register, taking into consideration that the modified total number of satellites shall not be greater than “DF1” times the number of space stations deployed under *resolves 4b)* and the Bureau shall, after informing the notifying administration and without removing the remark stating that the assignments are subject to the application of this Resolution, modify the Master Register entry for the frequency assignments to the system accordingly;

4.3 that, if the number of space stations deployed under *resolves 4c)* is less than “P2”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system, the notifying administration shall also submit to the Bureau, no later than 90 days from the end of the period referred to in *resolves 4c)*, modifications to the notified characteristics of the recorded frequency assignments in the Master Register, taking into consideration that the modified total number of satellites shall not be greater than “DF2” times the number of space stations deployed under *resolves 4c)* and the Bureau shall, after informing the notifying administration and without removing the remark stating that the assignments are subject to the application of this Resolution, modify the Master Register entry for the frequency assignments to the system accordingly;

4.4 that, if the number of space stations deployed under *resolves 4d)* is less than “P3”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system, the notifying administration shall

also submit to the Bureau, no later than 90 days from the end of the period referred to in *resolves 4d*), modifications to the notified characteristics of the recorded frequency assignments in the Master Register, taking into consideration that the modified total number of satellites shall not be greater than “DF3” times the number of space stations deployed under *resolves 4d*) and the Bureau shall, after informing the notifying administration, remove the remark stating that the assignments are subject to the application of this Resolution and modify the Master Register entry for the frequency assignments to the system accordingly;

*Note: If P3 is 100%, there would be no rounding down and no need to apply DF3 (which would be 1).*

## **Transition alternative 2**

*Note: This alternative would replace resolves 2-4 above.*

2 that the notifying administrations of frequency assignments to non-geostationary-satellite systems to which *resolves 1* applies shall communicate to the Bureau the complete deployment information in accordance with Annex 1 to this Resolution, no later than thirty (30) days after the end of the regulatory period specified in No. **11.44** of the non-geostationary-satellite system, or the date of the beginning of the transitional milestone-based approach MT, whichever comes last. If the number of satellites communicated to the Bureau is not 100% of the total number of satellites indicated in the Master Register entry for the non-geostationary-satellite system, the Bureau shall, after informing the notifying administration, add a remark to the Master Register entry for the frequency assignments to the system stating that the assignments are subject to the application of this Resolution.

3 that the notifying administrations of frequency assignments to non-geostationary-satellite systems which mark in the Master Register stating that the assignments are subject to this Resolution shall communicate to the Bureau the complete deployment information in accordance with Annex 1 to this Resolution:

The start date “S” for a particular non-GSO system is either the end of its seven-year regulatory period (*R*) or the beginning of the transitional milestone-based approach (*MT*), whichever comes last.

The periods “D1”, “D2” and “D3” are calculated in Annex 2, depending on the position of the end of the seven-year regulatory period (*R*) with respect to the commencement date of the transitional milestone-based approach (*MT*) and the commencement date of the regular milestone-based approach (*MR*).

- a) no later than 30 days after the expiry of the “D1”-day period after the start date “S”;
- b) no later than 30 days after the expiry of the “D2”-day period after the start date “S”;
- c) no later than 30 days after the expiry of the “D3”-day period after the start date “S”;

3.1 that, if the number of space stations deployed under *resolves 3a*) is less than “P1”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system, the notifying administration shall also submit to the Bureau, no later than 90 days from the end of the “D1”-day period referred to in *resolves 3a*), modifications to the notified characteristics of the frequency

assignments, taking into consideration that the modified total number of satellites shall not be greater than “DF1” times the number of space stations deployed under *resolves 3a*) and the Bureau shall, after informing the notifying administration and without removing the remark stating that the assignments are subject to the application of this Resolution, modify the Master Register entry for the frequency assignments to the system accordingly;

3.2 that, if the number of space stations deployed under *resolves 3b*) is less than “P2”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system, the notifying administration shall also submit to the Bureau, no later than 90 days from the end of the “D2”-day period referred to in *resolves 3b*), modifications to the notified characteristics of the recorded frequency assignments in the Master Register, taking into consideration that the modified total number of satellites shall not be greater than “DF2” times the number of space stations deployed under *resolves 3b*) and the Bureau shall, after informing the notifying administration and without removing the remark stating that the assignments are subject to the application of this Resolution, modify the Master Register entry for the frequency assignments to the system accordingly;

3.3 that, if the number of space stations deployed under *resolves 3c*) is less than “P3”% of the total number of satellites (rounded down to the lower integer) indicated in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system, the notifying administration shall also submit to the Bureau, no later than 90 days from the end of the “D3”-day period referred to in *resolves 3c*), modifications to the notified characteristics of the recorded frequency assignments in the Master Register, taking into consideration that the modified total number of satellites shall not be greater than “DF3” times the number of space stations deployed under *resolves 3c*) and the Bureau shall, after informing the notifying administration, remove the remark stating that the assignments are subject to the application of this Resolution and modify the Master Register entry for the frequency assignments to the system accordingly;

*Note: If P3 is 100%, there would be no rounding down and no need to apply DF3 (which would be 1).*

#### —End of transition alternatives—

*Note - The resolves below contains numbering based on transition alternative 1. Renumbering is needed for transition alternative 2.*

5 that the Bureau shall, no later than forty-five (45) days before any deadline for submission by a notifying administration under subsection *a*) of *resolves 2*, subsections *a*), *b*) or *c*) of *resolves 3* and subsections *a*), *b*), *c*), or *d*) of *resolves 4*, send a reminder to the notifying administration to provide the information required;

*Note: There is no agreement on whether there should be any limitation on modification information beyond a reduction in the number of satellites following a milestone under resolves 3.1-3.3 and 4.2-4.4. Thus, the provisions on modification information below are listed as possible options.*

#### Option 1 for modification information

6 that for *resolves 3* (including *resolves 3.1* to *3.3*, as applicable), and *resolves 4* (including *resolves 4.2* to *4.4*, as applicable), modifications to notified orbital parameters shall be limited to

reduction of the number of orbital planes (item A.4.b.1 in Appendix 4), reduction of the number of satellites per plane (item A.4.b.4.b in Appendix 4), modification of the right ascension of the ascending node of each plane (item A.4.b.5.a in Appendix 4), modification of the initial phase angle of each satellite (item A.4.b.5.b in Appendix 4) until a suitable ITU-R Recommendation is adopted for the application of No. **11.43B**;

*6bis* that the notifying administration submits a commitment stating that the characteristics as modified under *resolves* 6 shall not cause more interference or require more protection than the initial notified characteristics, and the Bureau shall conduct an examination for conformity under No. **11.31**;

### **Option 2 for modification information**

6 that the provisions of No. **11.43B** shall not apply if modifications to notified orbital parameters in application of *resolves* 3 (including *resolves* 3.1 to 3.3, as applicable), *resolves* 4 (including *resolves* 4.2 to 4.4, as applicable), are limited to the following cases:

- a) reduction of the number of orbital planes (item A.4.b.1 in Appendix 4);
- b) reduction of the number of satellites per plane (item A.4.b.4.b in Appendix 4);
- c) modification of the right ascension of the ascending node of each plane (item A.4.b.5.a in Appendix 4);
- d) modification of the initial phase angle of each satellite (item A.4.b.5.b in Appendix 4);

*6bis* that the notifying administration submits a commitment stating that the characteristics as modified under *resolves* 6 shall not cause more interference or require more protection than the initial notified characteristics, and the Bureau shall conduct an examination for conformity under No. **11.31**;

### **Option 3 for modification information**

6 that, upon the submission by a notifying administration of the modification information called for in *resolves* 3 (including *resolves* 3.1 to 3.3, as applicable), *resolves* 4 (including *resolves* 4.2 to 4.4, as applicable), the Bureau shall conduct an examination for conformity under No. **11.31**, and, if favourable, conclude that the changes do not increase the probability of harmful interference to assignments already recorded, provided that the notifying administration submit a commitment stating that the characteristics as modified will not cause more interference or require more protection than the characteristics provided in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system characteristics;

*Note: The characteristics that may be modified under option 3 need to be identified.*

*Note: Any modification beyond the characteristics to be listed under options 1 to 3 will require the application of RR No **11.43B**. To this effect, in the absence of a valid ITU-R Recommendation dealing with calculation for interference as a result of modification the Bureau shall conduct an examination for conformity under RR No. **11.31** and if favourable, the Bureau will maintain the initial date of receipt provided that the notifying administration submits a commitment stating that the subject modification will not cause more interference or require more protection.*

### **—End of options for modification information—**

7 that the Bureau shall publish its findings in application of *resolves* 6/*6bis* in the BR IFIC and promptly make them available on the ITU website, and the modified assignments shall retain their original date of entry in the Master Register, if the changes do not increase the probability of harmful interference to assignments already recorded;

8 that, if the number communicated to the Bureau under subsection *a)* of *resolves 2*, subsections *a)*, *b)* or *c)* of *resolves 3* or subsections *a)*, *b)*, *c)*, or *d)* of *resolves 4*, is “100%/90%/75%” of the total number of satellites indicated in the Master Register entry for the non-geostationary-satellite system, the Bureau shall modify the Master Register entry for the frequency assignments to the system to remove the remark stating that the assignments are subject to the application of this Resolution;

9 that, if a notifying administration fails to communicate the information required under subsection *a)* of *resolves 2*, subsections *a)*, *b)* or *c)* of *resolves 3*, or subsections *a)*, *b)*, *c)*, or *d)* of *resolves 4*, and has not previously communicated to the Bureau that “100%/90%/75%” of the total number of satellites indicated in the Master Register entry or notification of the non-geostationary-satellite system, the Bureau shall promptly send to the notifying administration a reminder asking the administration to provide the required information within thirty (30) days from the date of reminder from the Bureau;

10 that, if a notifying administration fails to provide information after the reminder sent under *resolves 9*, the Bureau shall send to the notifying administration a second reminder asking it to provide the required information within fifteen (15) days from the date of the second reminder;

### **Consequences of non-submission Option 1**

11 that, if a notifying administration fails to provide the required information under *resolves 10*, the Bureau shall modify the Master Register entry to reduce the number of satellites to the total number communicated by the administration in its latest communication of deployment information, and inform the notifying administration accordingly;

### **Consequences of non-submission Option 2**

11 that if the notifying administration fails to provide the required information under *resolves 10*, the 90-day period referred to in *resolves 3* or *4*, as applicable, shall be reduced by the amount of time elapsed between the date as set forth in the relevant part of *resolves 3* or *4*, as applicable, and the actual date of the submission of the required modifications to the characteristics of the frequency assignments;

11*bis* that if the notifying administration fails to submit the modifications to the characteristics of the frequency assignments within the 90-day period referred to in *resolves 3* or *4*, or within any modified period of time resulting from the application of *resolves 11*, the frequency assignments shall no longer be considered by the Bureau when applying Nos. **9.36**, **11.32** or **11.32A** and, in the case of frequency assignments subject to subsection IA of Article **9**, shall not cause harmful interference to, nor claim protection from, other frequency assignments recorded in the Master Register with a favourable finding under No. **11.31**;

*Note: The 90-day period refers to the period to provide the information for the reduced constellation.*

### **Consequences of non-submission option 3**

11 that, if the notifying administration fails to provide the required information called for in subsection *a)* of *resolves 2*, subsection *a)*, of *resolves 3*, or subsection *a)* of *resolves 4*, following the application of *resolves 10*, the Bureau shall, while taking into account *resolves 6*, update the notified orbital parameters of the non-geostationary-satellite system contained in the Master Register by suppressing the notified parameters of all satellites except the first satellite of the first orbital plane. In such case, *resolves 11bis* does not apply;

11*bis* that, if the notifying administration fails to provide the required information called for in subsection *b)* or *c)* of *resolves 3*, or subsections *b)*, *c)*, or *d)* of *resolves 4*, following application of

*resolves 10*, the Bureau shall, while taking into account *resolves 6*, update the notified orbital parameters of the non-geostationary-satellite system contained in the Master Register by suppressing the notified orbital parameters of all satellites not listed in the last complete deployment information submitted under *resolves 3* or *4*, as appropriate;

—End of options for non-submission consequences—

**Resolves to address counting the same spacecraft for more than one filing with overlapping frequency assignments**

12 that the same spacecraft shall not be used under *resolves 3* and *4* for overlapping frequency assignments of more than one filing;

*Note: The implications of resolves 12 are under study within ITU. No conclusions have yet been reached. The methodology and course of action to implement this method need to be specified.*

—End of options for single spacecraft with overlapping filings—

**Option for suspensions**

13 that frequency assignments brought into use in accordance with Nos. **11.44** and MOD **11.44C**, no longer in use shall be considered suspended until the next milestone in *resolves 3* or *resolves 4*;

14 that the suspension of frequency assignments under *resolves 13* does not extend the milestone period as specified in *resolves 3* or *4*, as applicable, nor reduce the requirements associated with any of the remaining milestones as derived from *resolves 3* or *4*, as appropriate;

—End of options for suspension—

*Note: In the discussion of this Resolution, the need to address the post-milestone approach was raised. To this effect additional resolves were suggested. No consensus was reached for the inclusion of these resolves in the Resolution.*

**Option for post-milestone procedures:**

*Note: There would be a need for a new or modified remark associated with the post-milestone procedures to be included in the MIFR. This may be included in resolves 8, if appropriate.*

15 that every two years after the date specified in *resolves 2c*) or *resolves 4d*), the notifying administration shall communicate to the Bureau, within thirty days after the end of each two-year period, the complete deployment information in accordance with Annex 1 to this Resolution;

16 that, if a notifying administration fails to implement *resolves 5*, the Bureau shall send to the notifying administration a reminder asking it to provide the required information within thirty days;

17 that, if the notifying administration does not apply No. **11.49** for the non-geostationary-satellite system and if the total number of satellites provided under *resolves 15* and *16*, as appropriate, is for the second consecutive time lower than “90%” of the total number of satellites (rounded down to the lower integer) indicated in the Master Register, *resolves 18* to *21* apply;

18 that, in application of *resolves 17*, the Bureau shall request the notifying administration to provide, within thirty days, the update notified orbital parameters in order to adjust them to the total number of satellites provided under *resolves 15* or *16*;

19 that, if the notifying administration fails to implement *resolves* 18, the Bureau shall send to the notifying administration a reminder asking it to provide the required information within thirty days;

20 that, if the notifying administration does not answer the reminder sent under *resolves* 19, the frequency assignments shall be cancelled by the Bureau;

21 that, based on information provided by the notifying administration under *resolves* 18, the Bureau shall, while taking into account *resolves* 6, update the notified orbital parameters of the non-geostationary-satellite system accordingly,

**—End of options for post-milestone procedure—**

*instructs the Radiocommunication Bureau*

*To be further developed.*

2 to take the necessary actions to implement this Resolution and report to subsequent WRCs on the results of the implementation of this Resolution.

**ANNEX 1 TO DRAFT NEW  
RESOLUTION [A7(A)-NGSO-MILESTONES] (WRC-19)**

**Information to be submitted about the deployed space stations**

**Option 1 for Annex 1**

**A Identity of the satellite system**

- a) Name of the satellite system
- b) Name of the notifying administration
- c) Country symbol
- d) Reference to the advance publication information or to the request for coordination, as applicable
- e) Reference to the notification.

**B Spacecraft manufacturer**

In cases where a contract for satellite procurement covers more than one satellite, the relevant information shall be submitted for each satellite:

- a) Name of the spacecraft manufacturer
- b) Number of satellites procured.

**C Launch services provider**

In cases where a contract for launch procurement covers more than one satellite, the relevant information shall be submitted for each satellite:

- a) Name of the launch vehicle provider
- b) Name of the launch vehicle
- c) Name and location of the launch facility
- d) Launch date.



## **D Space station characteristics**

For each spacecraft:

- a) Name of the spacecraft
- b) Orbital characteristics of the spacecraft (see **11.44C.4**)
- c) Frequency assignments that the space station can transmit or receive.

## **Option 2 for Annex 1**

### ANNEX 1 TO DRAFT NEW RESOLUTION [A7(A)-NGSO-MILESTONES] (WRC-19)

#### **Information to be submitted about the deployed space stations**

##### **A Satellite system information**

- a) Name of the satellite system
- b) Name of the notifying administration
- c) Country symbol
- d) Reference to the advance publication information or to the request for coordination, as applicable
- e) Reference to the notification
- f) Number of space stations currently deployed.

##### **B Space station information to be provided for each space station currently deployed**

###### *Special Section information*

- a) Orbital plane Id number
- b) Satellite Id number in the relevant orbital plane.

###### *Space station manufacturer*

- a) Name of the space station manufacturer
- b) Date of execution of the contract
- c) Contractual “delivery window”
- d) Number of space stations procured.

###### *Launch services provider*

- a) Name of the launch vehicle provider
- b) Date of execution of the contract
- c) Name of the launch vehicle
- d) Name and location of the launch facility
- e) Launch date.

###### *Space station characteristics*

- a) Name of the space station
- b) Orbital characteristics of the spacecraft

- c) Frequency band(s) present on board the spacecraft (i.e. frequency bands within which frequency assignments are capable to be transmitted or received by the spacecraft).

### Option 3 for Annex 1

## ANNEX 1 TO DRAFT NEW RESOLUTION [A7(A)-NGSO-MILESTONES] (WRC-19)

### Information to be submitted about the deployed space stations

#### A Satellite system information

- 1 Name of the satellite system
- 2 Name of the notifying administration
- 3 Country symbol
- 4 Number of space stations deployed in each notified orbital plane of the system with the capability of transmitting or receiving the frequency assignments.

#### B Space station information to be provided for each deployed space station

- 1 Name of the space station manufacturer
- 2 Name of the launch vehicle provider
- 3 Name and location of the launch facility
- 4 Launch date.

*Note: Annex 2 is associated exclusively with transition alternative 2 above, and would not be included in transition alternative 1.*

## ANNEX 2 TO DRAFT NEW RESOLUTION [A7(A)-NGSO-MILESTONES] (WRC-19)

### Calculation of the milestone periods

Considering that:

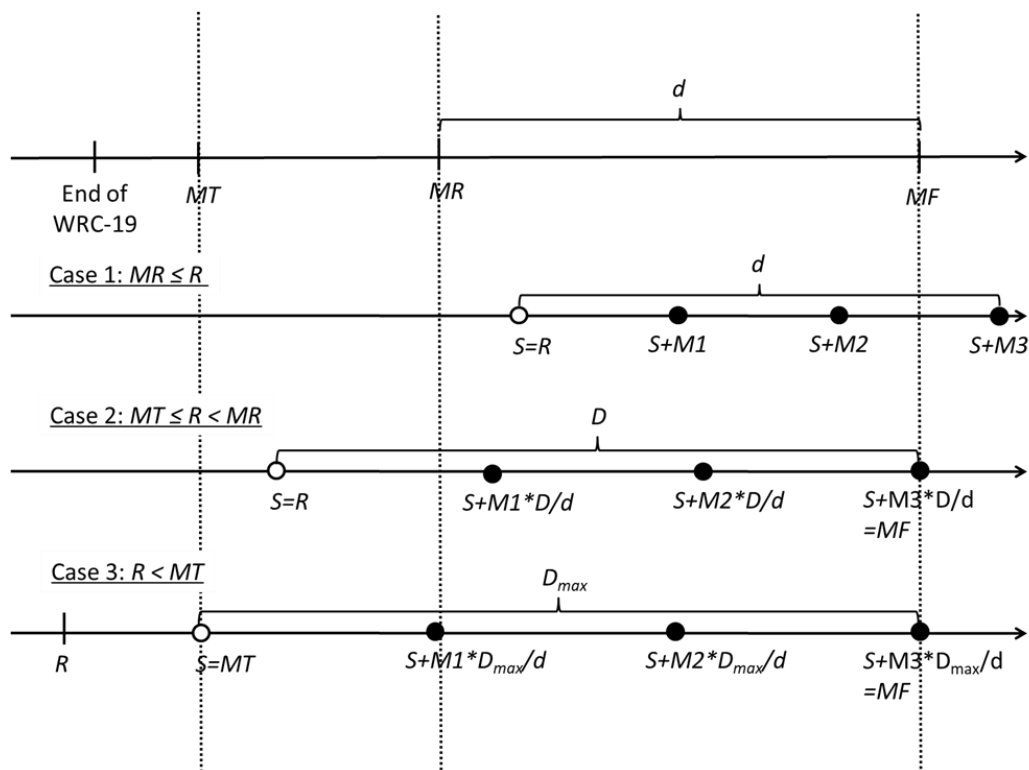
$R$  designates the date of the end of the seven-year regulatory period:

- $MT$  is the date of the beginning of the transitional milestone-based approach;
- $MR$  is the date of the beginning of the regular milestone-based approach;
- $MF$  which corresponds to  $MR + d$  and is only used to describe the stretching;
- $d$  is the duration of the regular milestone-based approach.

Depending on the position of end of the seven-year regulatory period ( $R$ ) with respect to the beginning of the transitional milestone-based approach ( $MT$ ) and the beginning of the regular milestone-based approach ( $MR$ ), one can distinguish three cases:

- non-GSO systems for which the end of the seven-year regulatory period  $R$  is after  $MR$  will have to apply the regular milestone-based approach with a duration of  $d$ . The milestone-based approach will start on day  $R$  and end on day  $R + d$ ;

- non-GSO systems for which the end of the seven-year regulatory period  $R$  is between  $MT$  and  $MR$  will benefit from stretched milestone timelines. The milestone process for such systems will start on day  $R$  and end on day  $MF = MR + d$ , and have a duration of  $D$  (with  $D = MF - R > d$ );
- non-GSO systems for which the end of the seven-year regulatory period  $R$  is before  $MT$  will also benefit from stretched milestone timelines, starting on  $MT$  and ending on  $MF = MR + d$ . In this case, we note the duration  $D_{max}$  with ( $D_{max} = MF - MT > d$ ).



For systems for which the end of the seven-year regulatory period is before the beginning of the regular milestone-based approach ( $MR$ ), the periods between the different milestones are stretched by a factor of  $D/d$ , compared to those under the regular milestone-based approach as shown in the table below:

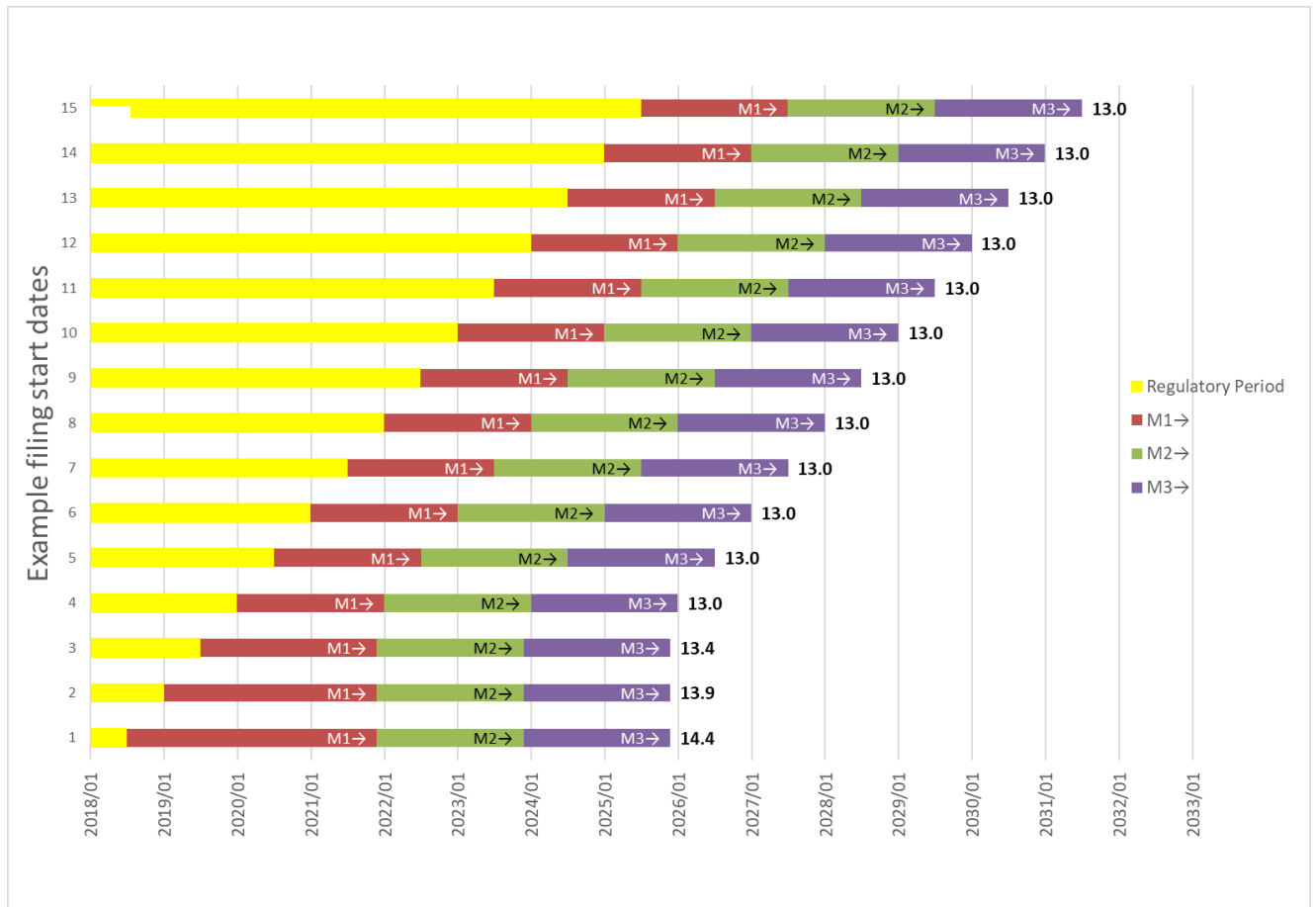
	Milestone in years	Stretched process		Regular process
		$R < MT$	$MT \leq R < MR$	$MR \leq R$
<b>Start S</b>		$S = MT$	$S = R$	$S = R$
<b>Milestone 1</b>	M1 years	$D1 = M1 * 365 * D_{max}/d$	$D1 = M1 * 365 * D/d$	$D1 = M1 * 365$
<b>Milestone 2</b>	M2 years	$D2 = M2 * 365 * D_{max}/d$	$D2 = M2 * 365 * D/d$	$D2 = M2 * 365$
<b>Milestone 3</b>	M3 years	$D3 = M3 * 365 * D_{max}/d$	$D3 = M3 * 365 * D/d$	$D3 = M3 * 365$

*Note: The following diagrams have been prepared in a common format to illustrate the transitional measures. For the purpose of these illustrations the milestone period has been assumed to be six years (option B). The diagrams are shown for a better understanding of the different options, and the diagrams should not be considered as part of the Resolution text.*

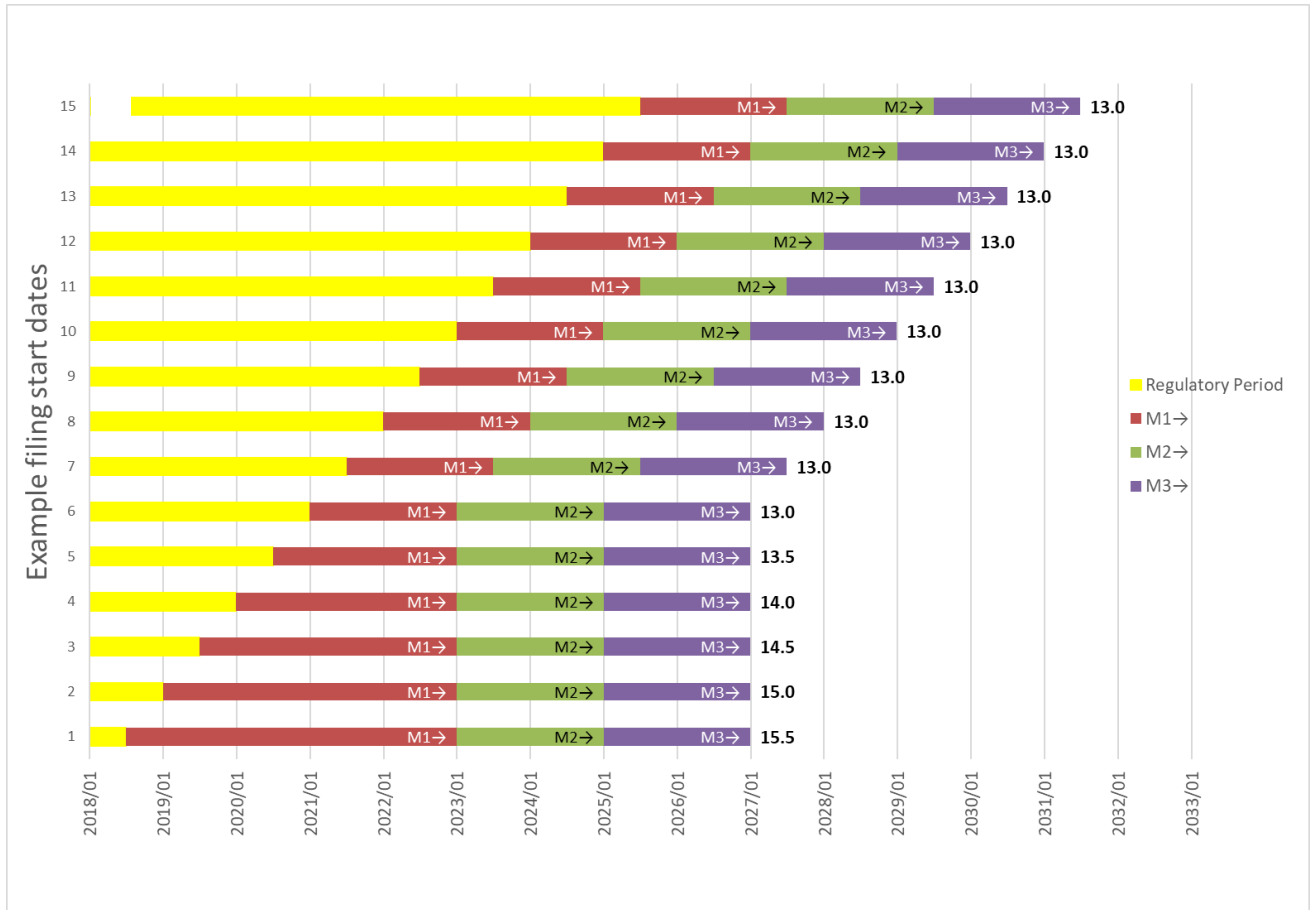
Each diagram consists of separate horizontal bars that would define the milestones for a non-GSO system depending on the date of its initial filing. The yellow portion of the bar shows the remaining

period of the seven-year regulatory period of the filing. The coloured portions of the bars to the right of the yellow portion are intended to show the three milestones, M1 (in dark red), M2 (in green) and M3 (in purple) as shown by the legend. The right-hand end of each of these milestone portions is the actual milestone date that applies, as shown by the label on each bar. The printed number shown to the right of each bar (e.g. 13.0 in the upper bars of the first example below) is the length of time in years from the original ITU filing to the last milestone.

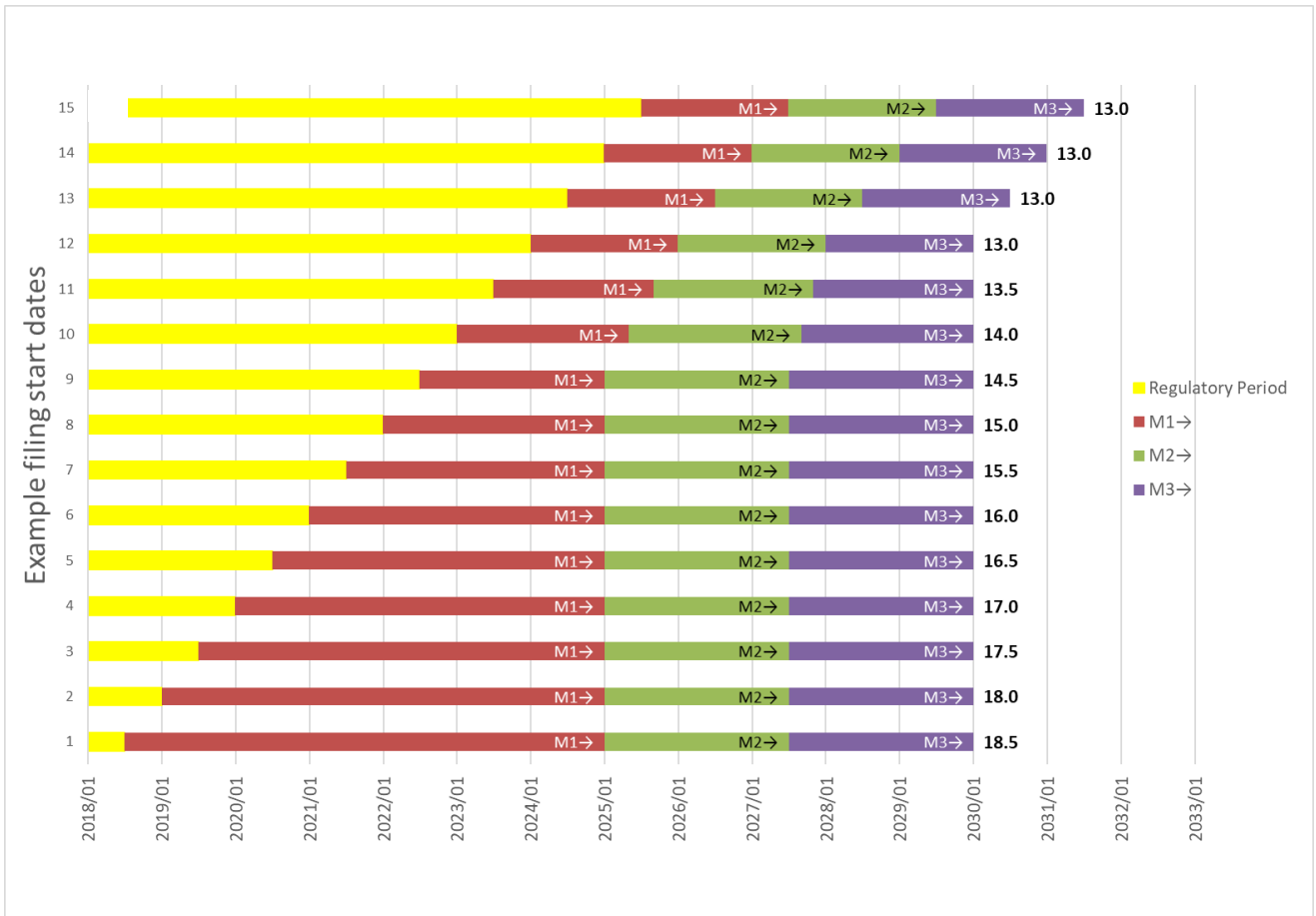
Example 1: Option 2 from section 3/7/1.3.2.2,  
with *MT* is 23 November 2019 and *MR* is 23 November 2019  
this is equivalent to option 1 with effective date set to be 23 November 2019



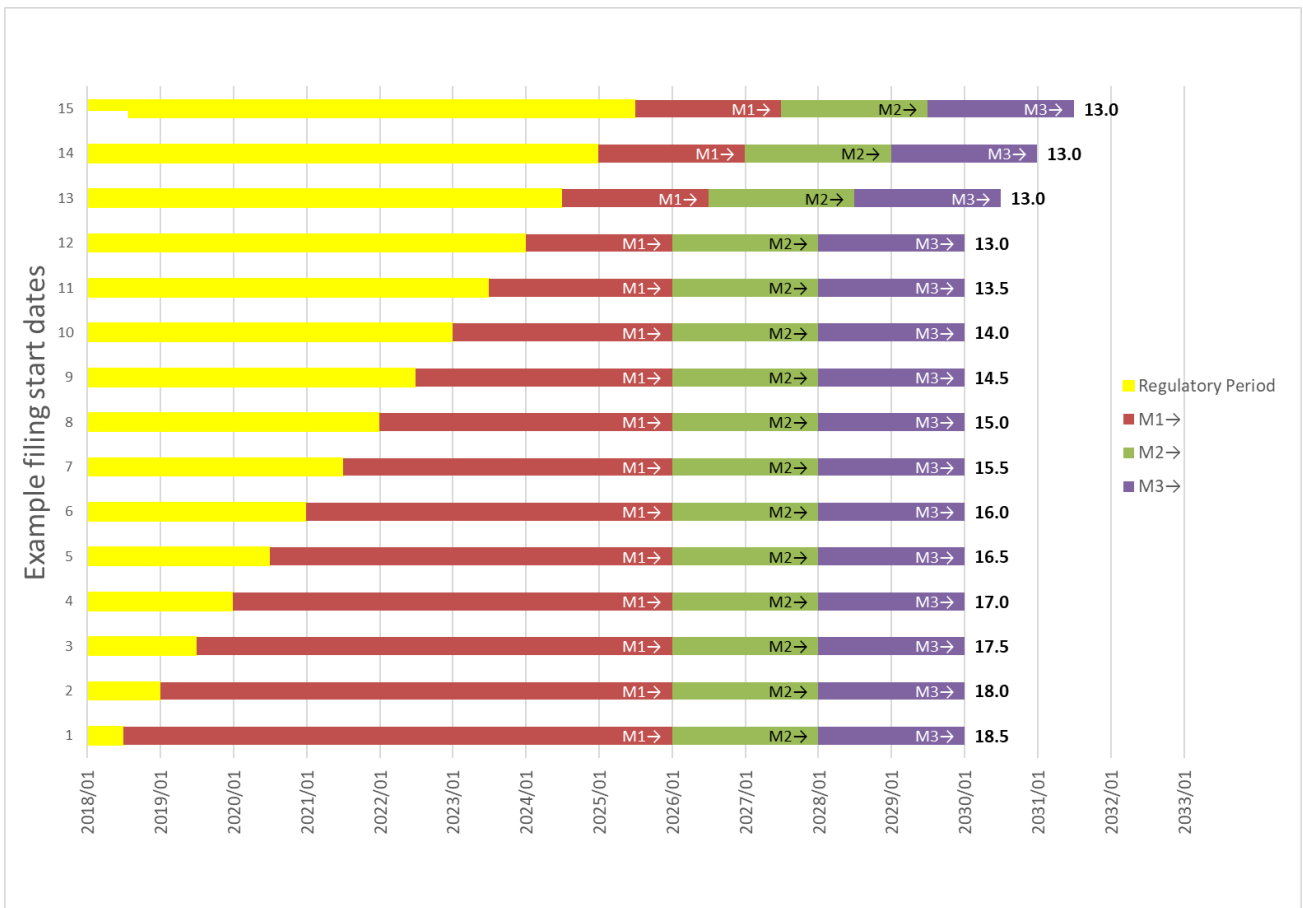
Example 2: Option 2 from section 3/7/1.3.2.2,  
with *MT* is 1 January 2021 and *MR* is 1 January 2021  
this is equivalent to option 1 with effective date set to be 1 January 2021



**Example 3:** Option 2 from section 3/7/1.3.2.2,  
with *MT* is 1 July 2022 and *MR* is 1 January 2024



Example 4: Option 2 from section 3/7/1.3.2.2,  
with *MT* is 1 January 2024 and *MR* is 1 January 2024  
this is equivalent to Option 1 with effective date set to be 1 January 2024



## Agenda item 7(B)

### **3/7/2 Issue B – Application of coordination arc in the Ka-band, to determine coordination requirements between the FSS and other satellite services**

#### **3/7/2.1 Executive summary**

WRC-19 agenda item 7, Issue B, proposes the introduction of the coordination arc with a value of 8 degrees as coordination criteria between fixed-satellite service (FSS) and mobile-satellite service (MSS) systems and MSS systems, in the frequency bands 29.5-30 GHz (Earth-to-space)/19.7-20.2 GHz (space-to-Earth) in all 3 Regions, as substitution of the existing trigger of coordination  $\Delta T/T > 6\%$ . Considering that according to the current RR, to determine whether coordination under RR No. **9.7** is required between FSS vs FSS satellite networks, a coordination arc of  $8^\circ$  is the coordination criteria applied in this same frequency band, the proposal is based on the following principles:

- Results of studies show that earth station terminals used in the MSS and FSS in the Ka-band are quite similar. Therefore, it can be considered that the coordination arc that currently trigger coordination between FSS systems in an effective and efficient manner, can be applied to trigger coordination between MSS and FSS systems and MSS systems.
- Introduction of the coordination arc will reduce the number of administrations identified for coordination, reducing the number of coordination processes and resulting in a reduction of required resources in administrations, operators, Bureau, etc.
- Administration will always have the possibility to request application of RR No. **9.41** to include additional satellite networks affected, taking into account the  $\Delta T/T > 6\%$  criteria.

#### **3/7/2.2 Background**

Evolution of technology and in particular the development of precise tracking systems, has allowed that terminals on board of systems in motion used in the MSS have characteristics comparable to fixed earth stations. As a result of this, WRC-15 approved the use of earth stations in motion under the FSS (Resolution **156 (WRC-15)**) in the same frequency bands considered under WRC-19 agenda item 7, Issue B.

Currently in the Radio Regulations, to determine whether coordination under RR No. **9.7** is required, in the frequency bands 29.5-30 GHz (Earth-to-space)/19.7-20.2 GHz (space-to-Earth) in all 3 Regions the following criteria is applied:

- FSS vs FSS: Coordination arc of  $8^\circ$
- FSS vs MSS:  $\Delta T/T > 6\%$
- MSS vs MSS:  $\Delta T/T > 6\%$

In addition, in the FSS vs FSS coordination, administrations can always request application of RR No. **9.41** to include additional satellite networks that would be affected taking into account the  $\Delta T/T > 6\%$  criteria.

Taking into account that the coordination arc criteria is used to determine coordination between FSS systems and it works in an effective and efficient way, WRC-19 agenda item 7, Issue B studies the possibility to apply this same coordination criteria to determine if coordination is required between MSS systems and between MSS and FSS systems.



### **3/7/2.3 Summary and analysis of the results of ITU-R studies**

Studies comparing all MSS and FSS earth stations contained in the ITU SRS database, in the portion of the Ka frequency band under consideration, in terms of antenna patterns and antenna sizes (maximum gain) used in each service, showed that MSS earth station parameters are quite similar to those used by the FSS earth stations. The studies also showed that all satellite networks with frequency assignments in the MSS also have frequency assignments in the FSS.

Another study analysed, case by case, the regulatory implications when substituting  $\Delta T/T > 6\%$  by coordination arc, analysing the different situations of coordination between the FSS and MSS services that may occur, taking also into account the status of the existing and incoming FSS and MSS assignments. As a result of these two studies, Issue B proposes the introduction of the coordination arc with a value of 8 degrees as coordination criteria between FSS and MSS systems and between MSS systems, in the frequency bands 29.5-30 GHz (Earth-to-space)/19.7-20.2 GHz (space-to-Earth) in all 3 Regions, as substitution of the existing trigger of coordination  $\Delta T/T > 6\%$  without referring to the status of the existing and/or incoming FSS and MSS assignments.

### **3/7/2.4 Methods to satisfy Issue B**

#### **3/7/2.4.1 Method B1**

No change to the Radio Regulations.

#### **3/7/2.4.2 Method B2**

Use of the coordination arc with a value of 8 degrees as coordination criteria, to determine if coordination is required between FSS and MSS systems and between MSS systems in the frequency bands 29.5-30 GHz (Earth-to-space)/19.7-20.2 GHz (space-to-Earth), in all 3 Regions, replacing the existing coordination criteria  $\Delta T/T > 6\%$ .

Administrations can always request application of RR No. **9.41** to include additional satellite networks that would be affected taking into account the  $\Delta T/T > 6\%$  criteria.

### **3/7/2.5 Regulatory and procedural considerations for Issue B**

#### **3/7/2.5.1 Method B1**

NOC

## **APPENDICES**

#### **3/7/2.5.2 Method B2**

### **APPENDIX 5 (Rev.WRC-15)**

## **Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9**

MOD

TABLE 5-1 (Rev.WRC-19)

Technical conditions for coordination  
(see Article 9)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. 9.7 GSO/GSO	A station in a satellite network using the geostationary-satellite orbit (GSO), in any space radiocommunication service, in a frequency band and in a Region where this service is not subject to a Plan, in respect of any other satellite network using that orbit, in any space radiocommunication service in a frequency band and in a Region where this service is not subject to a Plan, with the exception of the coordination between earth stations operating in the opposite direction of transmission	1) 3 400-4 200 MHz 5 725-5 850 MHz (Region 1) and 5 850-6 725 MHz 7 025-7 075 MHz  2) 10.95-11.2 GHz 11.45-11.7 GHz 11.7-12.2 GHz (Region 2) 12.2-12.5 GHz (Region 3) 12.5-12.75 GHz (Regions 1 and 3) 12.7-12.75 GHz (Region 2) and 13.75-14.8 GHz	i) Bandwidth overlap, and ii) any network in the fixed-satellite service (FSS) and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 7^\circ$ of the nominal orbital position of a proposed network in the FSS  i) Bandwidth overlap, and ii) any network in the FSS or broadcasting-satellite service (BSS), not subject to a Plan, and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 6^\circ$ of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan  iii) in the frequency band 14.5-14.8 GHz any network in the space research service (SRS) or FSS not subject to a Plan and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of $\pm 6^\circ$ of the nominal orbital position of a proposed network in the SRS or FSS not subject to a Plan		With respect to the space services listed in the threshold/condition column in the frequency bands in 1), 2), 2bis), 3), 3bis), 4), 5), 6), 7) and 8), an administration may request, pursuant to No. 9.41, to be included in requests for coordination, indicating the networks for which the value of $\Delta T/T$ calculated by the method in § 2.2.1.2 and 3.2 of Appendix 8 exceeds 6%. When the Bureau, on request by an affected administration, studies this information pursuant to No. 9.42, the calculation method given in § 2.2.1.2 and 3.2 of Appendix 8 shall be used

TABLE 5-1 (continued) (Rev.WRC-19)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. 9.7 GSO/GSO (cont.)		<p>2bis) 13.4-13.65 GHz (Region 1)</p> <p>3) 17.7-19.7 GHz, (Regions 2 and 3), 17.3-19.7 GHz (Region 1) and 27.5-29.5 GHz</p> <p>3bis) 19.7-20.2 GHz and 29.5-30 GHz</p> <p>4) 17.3-17.7 GHz (Regions 1 and 2)</p>	<p>i) Bandwidth overlap, and</p> <p>ii) any network in the space research service (SRS) or any network in the FSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of <math>\pm 6^\circ</math> of the nominal orbital position of a proposed network in the FSS or SRS</p> <p>i) Bandwidth overlap, and</p> <p>ii) any network in the FSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of <math>\pm 8^\circ</math> of the nominal orbital position of a proposed network in the FSS</p> <p>i) Bandwidth overlap, and</p> <p>ii) any network in the FSS or in the MSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of <math>\pm 8^\circ</math> of the nominal orbital position of a proposed network in the FSS or in the MSS.</p> <p>i) Bandwidth overlap, and</p> <p>ii) a) any network in the FSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of <math>\pm 8^\circ</math> of the nominal orbital position of a proposed network in the BSS,</p> <p>or</p> <p>b) any network in the BSS and any associated space operation functions</p>		

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 (see No. **1.23**) with a space station  
 within an orbital arc of  $\pm 8^\circ$  of the  
 nominal orbital position of a  
 proposed network in the FSS

TABLE 5-1 (continued) (Rev.WRC-19)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. 9.7 GSO/GSO (cont.)		5) 17.7-17.8 GHz	i) Bandwidth overlap, and ii) a) any network in the FSS and any associated space operation functions (see No. <b>1.23</b> ) with a space station within an orbital arc of $\pm 8^\circ$ of the nominal orbital position of a proposed network in the BSS, or b) any network in the BSS and any associated space operation functions (see No. <b>1.23</b> ) with a space station within an orbital arc of $\pm 8^\circ$ of the nominal orbital position of a proposed network in the FSS NOTE – No. <b>5.517</b> applies in Region 2.		
		6) 18.0-18.3 GHz (Region 2) 18.1-18.4 GHz (Regions 1 and 3)	i) Bandwidth overlap, and ii) any network in the FSS or meteorological-satellite service and any associated space operation functions (see No. <b>1.23</b> ) with a space station within an orbital arc of $\pm 8^\circ$ of the nominal orbital position of a proposed network in the FSS or the meteorological-satellite service		

TABLE 5-1 (continued) (Rev.WRC-19)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. 9.7 GSO/GSO (cont.)		<p>6bis) 21.4-22 GHz (Regions 1 and 3)</p> <p>7) Bands above 17.3 GHz, except those defined in § 3), 3bis) and 6)</p> <p>8) Bands above 17.3 GHz except those defined in § 4), 5) and 6bis)</p>	<p>i) Bandwidth overlap; and ii) any network in the BSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of <math>\pm 12^\circ</math> of the nominal orbital position of a proposed network in the BSS (see also Resolutions 554 (WRC-12) and 553 (WRC-12)).</p> <p>i) Bandwidth overlap, and ii) any network in the FSS and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of <math>\pm 8^\circ</math> of the nominal orbital position of a proposed network in the FSS (see also Resolution 901 (Rev.WRC-07))</p> <p>i) Bandwidth overlap, and ii) any network in the FSS or BSS, not subject to a Plan, and any associated space operation functions (see No. 1.23) with a space station within an orbital arc of <math>\pm 16^\circ</math> of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan, except in the case of a network in the FSS with respect to a network in the FSS (see also Resolution 901 (Rev.WRC-07))</p>		No. 9.41 does not apply.

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CPM19-2/1-E  
TABLE 5-1 (continued) (Rev.WRC-19)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. 9.7 GSO/GSO (cont.)		9) All frequency bands, other than those in 1), 2), 2 <i>bis</i> ), 3), 3 <i>bis</i> ), 4), 5), 6), 6 <i>bis</i> ), 7) and 8), allocated to a space service, and the frequency bands in 1), 2), 2 <i>bis</i> ), 3), 3 <i>bis</i> ), 4), 5), 6), 6 <i>bis</i> ), 7) and 8) where the radio service of the proposed network or affected networks is other than the space services listed in the threshold/condition column, or in the case of coordination of space stations operating in the opposite direction of transmission	i) Bandwidth overlap, and  ii) Value of $\Delta T/T$ exceeds 6%	Appendix 8	In application of Article 2A of Appendix 30 for the space operation functions using the guardbands defined in § 3.9 of Annex 5 of Appendix 30, the threshold/condition specified for the FSS in the frequency bands in 2) applies.  In application of Article 2A of Appendix 30A for the space operation functions using the guardbands defined in § 3.1 and 4.1 of Annex 3 of Appendix 30A, the threshold/condition specified for the FSS in the frequency bands in 7) applies

**Reasons:** Extend the coordination arc to consider MSS in the frequency bands 29.5-30 GHz and 19.7-20.2 GHz.

## Agenda item 7(C)

### **3/7/3 Issue C – Issues for which consensus was achieved in ITU-R and a single method has been identified**

#### **3/7/3.1 Executive summary**

Issue C is a collection of several different topics that are viewed as being straightforward and for which consensus was readily achieved within ITU-R and a single method has been identified. The issues address such things as resolving inconsistencies in regulatory provisions, clarifying certain existing practices, or increasing transparency in the regulatory process. The issues are separately numbered in the following sections.

#### **3/7/3.2 Background**

##### **3/7/3.2.1 Background for Issue C1**

Further review of the provisions dealing with any changes to the characteristics of an assignment submitted under provisions of RR No. **11.43A** of RR Article **11**, and that submitted under paragraph 8.13 of Article 8 of RR Appendix **30B** and confirmed as having been brought into use, reveals that there is a regulatory inconsistency between the objectives of the two provisions/paragraph as follows:

*“8.13 A notice of a change in the characteristics of an assignment already recorded, as specified in Appendix 4, shall be examined by the Bureau under § 8.8 and § 8.9, as appropriate. Any changes to the characteristics of an assignment that has been notified and confirmed as having been brought into use shall be brought into use within eight years from the date of the notification of the modification. Any changes to the characteristics of an assignment that has been notified but not yet brought into use shall be brought into use within the period provided for in §§ 6.1, 6.31 or 6.31bis of Article 6. (WRC-12)”*

*“11.43A A notice of a change in the characteristics of an assignment already recorded, as specified in Appendix 4, shall be examined by the Bureau under Nos. 11.31 to 11.34, as appropriate. Any change to the characteristics of an assignment that has been recorded and confirmed as having been brought into use shall be brought into use within five years from the date of the notification of the modification. Any change to the characteristics of an assignment that has been recorded but not yet brought into use shall be brought into use within the period provided for in No. 11.44. (WRC-07)”*

It is to be emphasized that the concept of the text of paragraph 8.13 of Article 8 of RR Appendix **30B** was borrowed/taken from provisions of RR No. **11.43A** of RR Article **11**. However, in so doing an important element as contained in RR No. **11.43A** which referred to any change to the characteristics of an assignment that has been *recorded* and confirmed as having been brought into use was changed to *notified* and confirmed as having been brought into use, which is quite different.

An assignment may be notified but due to one or other reasons not yet recorded in the MIFR, but the notifying administration might have brought that assignment into use and its date of bringing it into use might have been confirmed.

It is also worth mentioning that an assignment may be notified but being returned to its notifying administration on relevant regulatory grounds. That assignment shall not be benefited as being recorded.

### 3/7/3.2.2 Background for Issue C2

RR Appendix **30B** consists of two blocks/sub-bands of 250 MHz each in the 13-11 GHz frequency band, i.e. 10.70-10.95 GHz, 11.2-11.45 GHz for downlink and 12.75-13.0 GHz, 13.0-13.25 GHz for uplink. Submission from administrations when applying Article 6 of RR Appendix **30B** for additional use usually covers both blocks/sub-bands of 250 MHz mentioned above or may only submit either of the two blocks for additional use or while successfully applying Article 6 for the two blocks/sub-bands, when applying Article 8, only bring into use one block/sub-band of the 13-11 GHz.

There is no provision in the Appendix prohibiting, strictly speaking, to allow administrations to submit an application for one of the blocks/sub-bands in an explicit submission of one of the blocks/sub-bands under RR Appendix **30B**. This concept is analogous to that stipulated in footnote 4 associated with paragraph 6.1 of Article 6 of the Appendix. However, there is no specific provision authorizing that application when submitting RR Appendix **4** for either of two sub-bands. Nevertheless, the Rules of Procedure relating to paragraphs 6.5 of Article 6 of the RR Appendix **30B** in its sub-paragraph 1 stipulates that:

#### Quote

*“1 The planning exercise and the interference analysis were made by WARC Orb-88 for the whole band of 300 MHz (6/4 GHz) or 500 MHz (13/11 GHz) on a co-channel basis. It may happen that two administrations conclude agreement on the shared use of the frequency bands. In the compatibility examination by the Bureau, the mutual interference between non-overlapping frequency assignments shall not be taken into consideration in formulating findings”.*

#### Unquote

The Rules of Procedure were established in order that a dispute between two administrations relating to the use of the entire frequency bands (two blocks/sub-bands) on a given orbital position could be satisfactorily resolved. The adoption of the Rules mentioned above permitted each of these two administrations using one of the two blocks/sub-bands, each of 250 MHz be used at two closely orbital positions.

### 3/7/3.2.3 Background for Issue C3

Issue C3 addresses the consequences for not replying to the letters from the Bureau initiated by a request for its assistance by a notifying administration seeking the inclusion of the territory of a foreign administration under § 6.6 of RR Appendix **30B**.

An administration intending to convert an RR Appendix **30B** allotment into an assignment, introduce an additional system<sup>24</sup> or modify the characteristics of an assignment in the RR Appendix **30B** List, must submit the information specified in RR Appendix **4** to the Bureau. Following the receipt of the notice, the Bureau examines and publishes it in a Special Section of the BR IFIC. Among other things, this Special Section can contain two types of requirements to seek and obtain the agreement of those affected administrations whose:

- allotments in the RR Appendix **30B** Plan or assignments in the RR Appendix **30B** List or those already examined by the Bureau (requirements identified under § 6.5 of RR Appendix **30B**), or
- territories have been included in the service area of the assignment under consideration (requirements associated with § 6.6 of RR Appendix **30B**).

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<sup>24</sup> See § 2.6 of RR Appendix **30B**.



It is important to note that under the current regulatory framework, there is a specific provision (§ 6.13) in RR Appendix **30B** to seek the assistance of the Bureau in case of a non-response of an affected administration identified under § 6.5 of RR Appendix **30B** within the four-month comment period. In case of a non-response to the letters from the Bureau initiated under § 6.13, 6.14 and 6.14*bis* of RR Appendix **30B**, it will be deemed that this administration, identified under § 6.5 of RR Appendix **30B** has agreed as per § 6.15 of RR Appendix **30B**. However, none of the provisions referred above (§ 6.13 to 6.15) applies in the case of affected administrations identified under § 6.6 of RR Appendix **30B**. In fact, there is not a single regulatory mechanism in RR Appendix **30B** to seek the assistance of the Bureau in this case. For a request for the assistance of the Bureau on issue relating to the inclusion of the territory of an administration, the notifying administration, in its request to the Bureau and the Bureau, in its subsequent letters to the affected administration, have to invoke RR No. **13.1** for this matter. Furthermore, the current Radio Regulations do not specify any action from the Bureau with respect to an administration that did not respond to any of its letters initiated under RR No. **13.1**. This implies that the inclusion of the territory of an administration identified under § 6.6 of RR Appendix **30B** can only result from a formal agreement of this administration and, in no circumstance, results from a non-response to neither the original request for inclusion of its territory nor any subsequent letters from the Bureau on this matter.

#### **3/7/3.2.4 Background for Issue C4**

Normally, at the end of the coordination process for Regions 1 and 3 under Article 4 of RR Appendices **30** and **30A** and when a network is about to be implemented, systems are submitted for entry into the List under § 4.1.12 and for Notification under §§ 5.1.1 and 5.1.2 of RR Appendices **30** and **30A**, respectively at the same time. This is logical since both these two provisions refer to actions following the completion of the coordination process and since they are both required to implement the network.

It would therefore reduce the workload of both administrations and the Bureau if one physical submission could be treated as, and examined in respect of both these provisions. In respect of RR Appendix **30A**, it would seem that this would be in particular of value for notification of receiving space stations and typical earth stations while specific earth stations probably in many cases would be subject to separate notices as the requirements change with time.

Looking at the RR Appendix **4** information required for submission under § 4.1.12 and § 5.1.1/5.1.2, these would seem to be identical for entry into the List and notification. The data requirements of RR Appendix **4** therefore should not create any practical difficulties in achieving this goal.

#### **3/7/3.2.5 Background for Issue C5**

Pursuant to RR No. **11.46**, the Bureau allows notifying administrations six months to resubmit their notified frequency assignments which were returned due to an unfavourable finding with respect to RR Nos. **11.32**, **11.32A** or **11.33**. Any notification resubmitted beyond six months is considered as a new notification with a new date of receipt and would be subject to cost-recovery fees. However, neither RR No. **11.46** nor any other provision in the Radio Regulations requires the Bureau to send a reminder to the notifying administration at any point during the six-month period. If the notifying administration resubmits the notice to the Bureau beyond the required six-month period, the Bureau assigns a new date of receipt and reviews whether the notice complies with the period in RR No. **11.44.1** or RR No. **11.43A** and takes the appropriate action. In the case that a notice resubmitted beyond the six-month deadline is receivable, cost-recovery fees would be required for the resubmitted assignments. Addressing this lack of a reminder would be beneficial to administrations who may have experienced difficulties receiving or addressing the Bureau's return

of notice and the need to ensure that frequency assignments that are in use are properly recorded in the Master Register.

### **3/7/3.2.6 Background for Issue C6**

Normally, at the end of the coordination process under Article 6 of RR Appendix **30B** and when a network is about to be implemented, systems are submitted for entry into the List under § 6.17 and for notification under § 8.1 at the same time. This is logical since both these two provisions refer to actions following the completion of the coordination process and since they are both required to implement the network.

Enabling, as an option, administrations to submit one notice and request in a letter to the Bureau that it should be treated both in respect of entry into the List and notification would simplify the processing and reduce the workload of the Bureau and administrations. However, this is not possible under the current provisions of RR Appendix **30B** (§ 6.17). In addition, the data items required for the submission under § 6.17 and for notification under § 8.1 are not the same.

### **3/7/3.2.7 Background for Issue C7**

Taking into account that the possibility of obtaining agreement from affected administrations for a specified period would considerably facilitate the tasks of those administrations applying Article 4 of RR Appendices **30** and **30A** as well as Article 6 of RR Appendix **30B**, it is proposed to amend RR Appendices **30A** and **30B** to be harmonized among RR Appendices **30**, **30A** and **30B**.

## **3/7/3.3 Summary and analysis of the results of ITU-R studies**

### **3/7/3.3.1 Summary and analysis of the results of ITU-R studies for Issue C1**

ITU-R has analysed the implications of aligning the text of paragraph 8.13 of Article 8 of RR Appendix **30B** with that of RR No. **11.43A** of RR Article **11** and found no disadvantages with such alignment.

### **3/7/3.3.2 Summary and analysis of the results of ITU-R studies for Issue C2**

It will be helpful for administrations to reach agreement on the shared use of the frequency bands if an explicit submission of one of the blocks/sub-bands under RR Appendix **30B** is allowed. ITU-R has analysed the implications of adding the text of paragraph **6.1bis** of Article 6 of RR Appendix **30B** and found that an additional provision would be beneficial to the administrations.

### **3/7/3.3.3 Summary and analysis of the results of ITU-R studies for Issue C3**

The possibility of modifying the Radio Regulations to clearly stipulate that an administration identified under § 6.6 of Appendix **30B** cannot be subject to § 6.13 to § 6.15 of Appendix **30B** was analysed and does not seem to be problematic although not essential.

### **3/7/3.3.4 Summary and analysis of the results of ITU-R studies for Issue C4**

Given that the RR Appendix **4** information required for submission under § 4.1.12 and § 5.1.1/5.1.2, are identical for entry into the List and Notification, respectively, there are no negative consequences to allowing a single notice to be treated for, and examined in respect of, both of these provisions.

### **3/7/3.3.5 Summary and analysis of the results of ITU-R studies for Issue C5**

When the Bureau determines unfavourable findings for notified frequency assignments under RR Nos. **11.37** or **11.38**, a notice can be resubmitted within the six-month period pursuant to RR

No. **11.46** from the date of the Bureau notice to avoid a new date of receipt. Such timely resubmission would not require additional cost-recovery fees.

In addition to the Part III-S publication, the Bureau will transmit a communication to the notifying administration informing them of the returned assignments. While the Part III-S publication will identify the specific assignments and administrations for which the unfavourable finding was given, there is no clear indication in Part III-S under which provision (RR Nos. **11.36**, **11.37**, or **11.38**) the assignments are being returned. However, the communication that the Bureau transmits to notifying administrations provides a specific indication of which assignments are being returned, the relevant administrations for which the unfavourable finding was determined, and the provision under which the assignments are returned. Pursuant to RR No. **11.46**, a six-month deadline is established from the date of the letter from the Bureau to resubmit the assignments returned under RR No. **11.37** or **11.38**.

If there is a difficulty in receiving the Bureau's communication returning the notified frequency assignments with an unfavourable finding or the notifying administration has not yet successfully addressed the matter, the notifying administration may fail to timely resubmit its notice and lose its initial date of receipt for those frequency assignments and ultimately be treated as a new notification. A late filed resubmission triggers a review of whether those assignments comply with the seven-year period required in RR No. **11.44.1** and could result in those assignments being suppressed requiring a restart of the RR Articles **9** and **11** satellite registration process.

#### **3/7/3.3.6 Summary and analysis of the results of ITU-R studies for Issue C6**

If one submission is to be treated both in respect of entry into the RR Appendix **30B** List (under § 6.17) and notification (under § 8.1), it is important that the Bureau has the required information as specified by RR Appendix **4** for both types of submission.

If an administration requests the submission under § 6.17 to be treated in respect of both provisions § 6.17 and § 8.1:

- For items C.2.a.1 and C.3.a, the same pre-defined standard value used in the submission under § 6.17 can be assumed for the submission under § 8.1.
- For item C.7.a, the pre-defined standard values used in the submission under § 6.17 include only the necessary bandwidth while the values required for submission under § 8.1 are necessary bandwidth and class of emission for each carrier. To allow one submission to be treated in respect of both provisions § 6.17 and § 8.1, administrations need to provide the class of emission (e.g., G7W), it is possible to make a change in RR Appendix **4** such that item C.7.a is also provided for submission under § 6.17.
- For item C.8.a.2, the value in item C.8.b.2 shall be submitted for each carrier for submission under § 8.1.

#### **3/7/3.3.7 Summary and analysis of the results of ITU-R studies for Issue C7**

In order to implement the possibility of obtaining agreement from affected administrations for a specified period to considerably facilitate the tasks of those administrations applying Article 4 of RR Appendices **30** and **30A** as well as Article 6 of RR Appendix **30B**, it is proposed to amend RR Appendices **30A** and **30B** to be harmonized among RR Appendices **30**, **30A** and **30B**.

### 3/7/3.4 Method to satisfy Issue C

#### 3/7/3.4.1 Method to satisfy Issue C1

A single method has been identified to address this issue. The method to address the regulatory inconsistency identified in this issue is to align the text of paragraph 8.13 of Article 8 of RR Appendix 30B with that of RR No. 11.43A of RR Article 11.

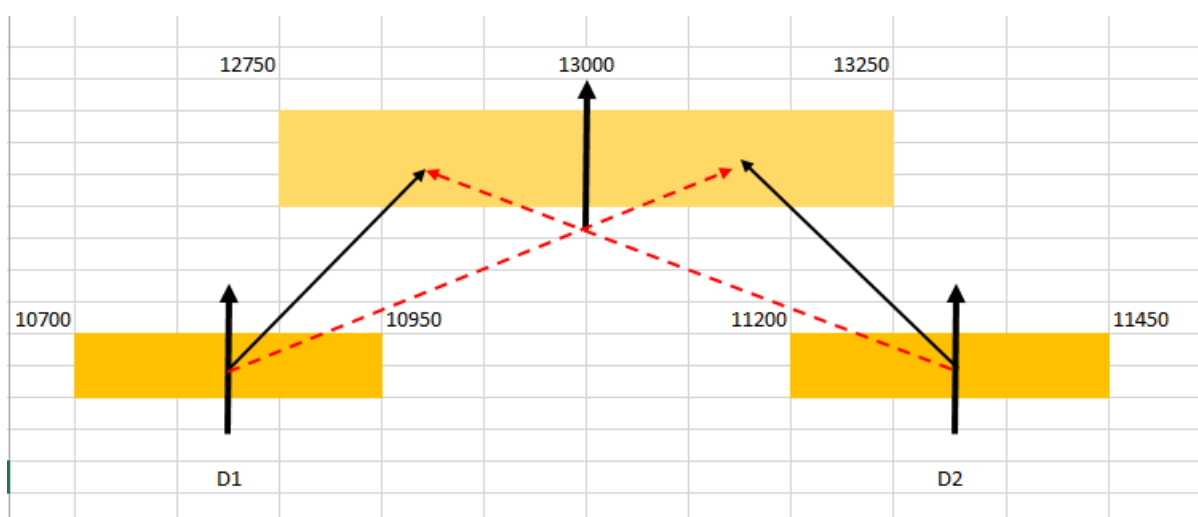
#### 3/7/3.4.2 Method to satisfy Issue C2

A single method has been identified to address this issue. The method is to add another footnote to paragraph 6.1 of Article 6 of RR Appendix 30B to allow the administration as follows:

- a) to submit under paragraph 6.1 an additional use for the two blocks/sub-bands in 10-11 GHz but only bring into use one of the blocks/one sub-band or,
- b) to submit under paragraph 6.1 an application of an additional use for only one of the two blocks/sub-bands in 10-11 GHz and notify and bring into use that block/sub-band only;
- c) to allow/authorize the Bureau, in applying Article 6, to act according to the nature of submission and further process them accordingly, i.e. to process the two blocks/sub-bands or process one of the two block/sub-bands and further process the submission as received;
- d) to allow/authorize the Bureau, in applying Article 8, to maintain one of the two blocks/sub-bands as notified even though the entire two blocks/sub-bands were submitted under Article 6 and successfully coordinated under that Article but only one of the block/sub-bands is notified or brought into use.

To continue providing the same level of protection to allotments and assignments with 500 MHz and to reflect the possibility of cross-strapping, the following strapping scheme for the 13/10-11 GHz frequency bands will be used:

(Frequency values are indicated in MHz)



This scheme will be reflected in the following calculated values of reference *C/I*.

*CI* reference values

Reference value	Downlink frequency band (GHz)	Uplink frequency band (GHz)
Downlink single entry	10.70-10.95	–
	11.20-11.45	–
Uplink single entry	–	12.75-13.00
	–	13.00-13.25
Overall aggregate	10.70-10.95	12.75-13.00
	11.20-11.45	13.00-13.25
	11.20-11.45	12.75-13.00
	10.70-10.95	13.00-13.25

### 3/7/3.4.3 Method to satisfy Issue C3

A single method has been identified to address this issue. The method is to add a new provision in Article 6 of RR Appendix **30B** to clearly state that § 6.13 to 6.15 of RR Appendix **30B** do not apply in the context of requirements associated with § 6.6 of RR Appendix **30B**.

### 3/7/3.4.4 Method to satisfy Issue C4

A single method has been identified to address this issue. The method is to modify § 4.1.12*bis* to allow administrations to request the Bureau to examine the submission made under § 4.1.12 also in respect of notification under § 5.1.1.

### 3/7/3.4.5 Method to satisfy Issue C5

A single method has been identified to address this issue. It would be considered advantageous to notifying administrations if the Bureau sends a reminder of the option to resubmit returned frequency assignments under RR No. **11.37** or **11.38**. Modification of RR No. **11.46** requiring the Bureau to remind the notifying administration of the six-month deadline would aid administrations who may have had difficulties in receiving the communication of returned frequency assignments.

### 3/7/3.4.6 Method to satisfy Issue C6

A single method has been identified to address this issue. This method would modify § 6.17 to allow one submission to be treated in respect of both provisions and modify RR Appendix **4** to enable this.

### 3/7/3.4.7 Method to satisfy Issue C7

A single method has been identified to address this issue. This method would add a new provision 6.15*bis* to Article 6 and a new provision § 8.16*bis* to Article 8 of RR Appendix **30B** in order to recognize the possibility of obtaining agreement from affected administrations for a specified period.

In addition, in order to make harmonization of RR Appendix **30B** and RR Appendices **30** and **30A**, modification to § 5.2.6 to Article 5 of RR Appendix **30A** would be necessary.

**3/7/3.5 Regulatory and procedural considerations for Issue C**

**3/7/3.5.1 Regulatory and procedural considerations for Issue C1**

**APPENDIX 30B (REV.WRC-15)**

**Provisions and associated Plan for the fixed-satellite service  
in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz,  
10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

**ARTICLE 8 (REV.WRC-15)**

**Procedure for notification and recording in the Master Register  
of assignments in the planned bands for the  
fixed-satellite service<sup>11, 12</sup> (WRC-15)**

**MOD**

8.13 A notice of a change in the characteristics of an assignment already recorded, as specified in Appendix 4, shall be examined by the Bureau under § 8.8 and § 8.9, as appropriate. Any changes to the characteristics of an assignment that has been recorded and confirmed as having been brought into use shall be brought into use within eight years from the date of the notification of the modification. Any changes to the characteristics of an assignment that has been recorded but not yet brought into use shall be brought into use within the period provided for in §§ 6.1, 6.31 or 6.31*bis* of Article 6. (WRC-19)

**3/7/3.5.2 Regulatory and procedural considerations for Issue C2**

**APPENDIX 30B (REV.WRC-15)**

**Provisions and associated Plan for the fixed-satellite service  
in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz,  
10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

**ARTICLE 6 (REV.WRC-15)**

**Procedures for the conversion of an allotment into an assignment, for  
the introduction of an additional system or for the modification of  
an assignment in the List<sup>1, 2</sup> (WRC-15)**

**ADD**

6.1*bis* Administrations, in submitting an additional use under paragraph 6.1 of Appendix 30B, may submit Appendix 4 for both blocks/sub-bands each with 250 MHz (10.7-10.95 GHz or 11.2-11.45 GHz for downlink and 12.75-13.0 GHz or 13.0-13.25 GHz for uplink) and notify under Article 8 and bring into use only one of the two blocks/sub-bands each with 250 MHz (10.7-

10.95 GHz or 11.2-11.45 GHz for downlink and 12.75-13.0 GHz or 13.0-13.25 GHz for uplink) or submit under paragraph 6.1 either of the two blocks/sub-bands each with 250 MHz (10.7-10.95 GHz or 11.2-11.45 GHz for downlink and 12.75-13.0 GHz or 13.0-13.25 GHz for uplink) and notify and bring into use under Article 8 that block/sub-band. The Bureau shall process that block/sub-band as it has been submitted under Article 6 and shall apply Article 8 for that notified and brought into use block/sub-band and cancel the other block/sub-band from its database. (WRC-19)

#### **ADD**

6.17*bis* An administration that has submitted the notice for an additional use under § 6.1 may request the Bureau to enter into the List only one block/sub-band of 250 MHz (10.7-10.95 GHz or 11.2-11.45 GHz for downlink and 12.75-13.0 GHz or 13.0-13.25 GHz for uplink). (WRC-19)

#### **3/7/3.5.3 Regulatory and procedural considerations for Issue C3**

### **APPENDIX 30B (REV.WRC-15)**

#### **Provisions and associated Plan for the fixed-satellite service in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

### **ARTICLE 6 (REV.WRC-15)**

#### **Procedures for the conversion of an allotment into an assignment, for the introduction of an additional system or for the modification of an assignment in the List<sup>1,2</sup> (WRC-15)**

#### **ADD**

6.15*bis* The course of actions described in §§ 6.13 to 6.15 do not apply to the agreement requested under § 6.6. (WRC-19)

**3/7/3.5.4 Regulatory and procedural considerations for Issue C4**

**APPENDIX 30 (REV.WRC-15)\***

**Provisions for all services and associated Plans and List<sup>1</sup> for  
the broadcasting-satellite service in the frequency bands  
11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1)  
and 12.2-12.7 GHz (in Region 2) (WRC-03)**

**ARTICLE 4 (REV.WRC-15)**

**Procedures for modifications to the Region 2 Plan or  
for additional uses in Regions 1 and 3<sup>3</sup>**

**4.1 Provisions applicable to Regions 1 and 3**

**NOC**

4.1.12 If agreement has been reached with the administrations identified in the publication referred to under § 4.1.5 above, the administration proposing the new or modified assignment may continue with the appropriate procedure in Article 5, and shall so inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-15)

**MOD**

4.1.12*bis* In application of § 4.1.12, an administration may indicate the changes to the information communicated to the Bureau under § 4.1.3 and published under § 4.1.5. In submitting such information, noting the requirements of § 5.1.2, the administration may also request the Bureau to examine the submission in respect of notification under § 5.1.1. (WRC-19)



APPENDIX 30A (REV.WRC-15)\*

**Provisions and associated Plans and List<sup>1</sup> for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz<sup>2</sup> and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-03)**

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan or for additional uses in Regions 1 and 3**

**4.1 Provisions applicable to Regions 1 and 3**

**NOC**

4.1.12 If agreement has been reached with the administrations identified in the publication referred to under § 4.1.5 above, the administration proposing the new or modified assignment may continue with the appropriate procedure in Article 5 and shall inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-15)

**MOD**

4.1.12*bis* In application of § 4.1.12, an administration may indicate the changes to the information communicated to the Bureau under § 4.1.3 and published under § 4.1.5. In submitting such information, noting the requirements of § 5.1.6, the administration may also request the Bureau to examine the submission in respect of notification under § 5.1.2. (WRC-19)

**3/7/3.5.5 Regulatory and procedural considerations for Issue C5**

ARTICLE 11

**Notification and recording of frequency assignments<sup>1, 2, 3, 4, 5, 6, 7, 8</sup> (WRC-15)**

**Section II – Examination of notices and recording of frequency assignments in the Master Register**

**MOD**

**11.46** In applying the provisions of this Article, any resubmitted notice which is received by the Bureau more than six months after the date on which the original notice was returned by the Bureau shall be considered to be a new notification with a new date of receipt<sup>ADDx</sup>. For frequency assignments to a space station, should the new date of receipt of such a notice not comply with the period specified in No. **11.44.1** or No. **11.43A**, as appropriate, the notice shall be

returned to the notifying administration in the case of No. **11.44.1**, and the notice shall be examined as a new notice of a change in the characteristics of an assignment already recorded with a new date of receipt in the case of No. **11.43A**. (WRC-19)

## ADD

<sup>x</sup> **11.46.1** If the resubmitted notice is not received by the Bureau within four months from the date on which the original notice was returned by the Bureau, the Bureau shall promptly send a reminder to the notifying administration. (WRC-19)

### 3/7/3.5.6 Regulatory and procedural considerations for Issue C6

## APPENDIX 4 (REV.WRC-15)

### Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III

## ANNEX 2

### Characteristics of satellite networks, earth stations or radio astronomy stations<sup>2</sup> (Rev.WRC-12)

#### Footnotes to Tables A, B, C and D

## MOD

### TABLE A

#### GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION (Rev.WRC-19)

Items in Appendix	<i>A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION</i>	::	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)
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<b>Items in Appendix</b>	<b>A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION</b>	...	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)
<b>A.2</b>	<b>DATE OF BRINGING INTO USE</b>		
A.2.a	<p>the date (actual or foreseen, as appropriate) of bringing the frequency assignment (new or modified) into use</p> <p>For a frequency assignment to a GSO space station, including frequency assignments in Appendices <b>30</b>, <b>30A</b> and <b>30B</b>, the date of bringing into use is as defined in Nos. <b>11.44B</b> and <b>11.44.2</b></p> <p>Whenever the assignment is changed in any of its basic characteristics (except in the case of a change under A.1.a, the date to be given shall be that of the latest change (actual or foreseen, as appropriate)</p> <p>Required only for notification and, in the case of Appendix <b>30B</b>, also for simultaneous submissions for entry into the List under § 6.17 and notification under § 8.1</p>		+
...			
<b>A.3</b>	<b>OPERATING ADMINISTRATION OR AGENCY</b>		
A.3.a	the symbol for the operating administration or agency (see the Preface) that is in operational control of the space station, earth station or radio astronomy station		X
A.3.b	the symbol for the address of the administration (see the Preface) to which communication should be sent on urgent matters regarding interference, quality of emissions and questions referring to the technical operation of the network or station (see Article 15)		X
...			

**MOD**

**TABLE C**

**CHARACTERISTICS TO BE PROVIDED FOR EACH GROUP OF FREQUENCY ASSIGNMENTS  
FOR A SATELLITE ANTENNA BEAM OR AN EARTH STATION OR  
RADIO ASTRONOMY ANTENNA (Rev.WRC-19)**

<b>Items in Appendix</b>	<b>C - CHARACTERISTICS TO BE PROVIDED FOR EACH GROUP OF FREQUENCY ASSIGNMENTS FOR A SATELLITE ANTENNA BEAM OR AN EARTH STATION OR RADIO ASTRONOMY ANTENNA</b>		Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)
...			

Items in Appendix	<p><b>C - CHARACTERISTICS TO BE PROVIDED FOR EACH GROUP OF FREQUENCY ASSIGNMENTS FOR A SATELLITE ANTENNA BEAM OR AN EARTH STATION OR RADIO ASTRONOMY ANTENNA</b></p>	<p>Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)</p>
C.7	<p><b>NECESSARY BANDWIDTH AND CLASS OF EMISSION</b> (in accordance with Article 2 and Appendix 1)</p> <p>For advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9, changes to this information within the limits specified under C.1 shall not affect consideration of notification under Article 11</p> <p>Not required for active or passive sensors</p>	
C.7.a	<p>the necessary bandwidth and the class of emission: for each carrier</p> <p>In the case of Appendix 30B, required only for notification under Article 8 (including simultaneous submissions for entry into the List under § 6.17 and notification under § 8.1)</p> <p>NOTE – For simultaneous submissions, the Bureau will use predefined values for the necessary bandwidth when examining the notice under § 6.17 of Article 6 of Appendix 30B</p>	+
..		
C.8.a.2	<p>the maximum power density, in dB(W/Hz), supplied to the input of the antenna for each carrier type<sup>2</sup></p> <p>In the case of Appendix 30B, required only for notification under Article 8, or simultaneous submissions for entry into the List under § 6.17 and notification under § 8.1</p> <p>Required if neither C.8.b.2 nor C.8.b.3.b is provided</p>	+

## APPENDIX 30B (REV.WRC-15)

### Provisions and associated Plan for the fixed-satellite service in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz

#### ARTICLE 6 (REV.WRC-15)

#### **Procedures for the conversion of an allotment into an assignment, for the introduction of an additional system or for the modification of an assignment in the List<sup>1, 2</sup> (WRC-15)**

#### **MOD**

6.17 If agreements have been reached with administrations published in accordance with § 6.7, the administration proposing the new or modified assignment may request the Bureau to have the assignment entered into the List, indicating the final characteristics of the assignment together with the names of the administrations with which agreement has been reached. For this purpose, it shall send to the Bureau the information specified in Appendix 4. In submitting the notice, the administration may request the Bureau to examine this notice under § 6.19, 6.21 and 6.22

(entry into the List) and to automatically generate the notice for examination under Article 8 of this Appendix (notification). (WRC-19)

### **3/7/3.5.7 Regulatory and procedural considerations for Issue C7**

#### **APPENDIX 30B (REV.WRC-15)**

#### **Provisions and associated Plan for the fixed-satellite service in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

#### **ARTICLE 6 (REV.WRC-15)**

#### **Procedures for the conversion of an allotment into an assignment, for the introduction of an additional system or for the modification of an assignment in the List<sup>1, 2</sup> (WRC-15)**

#### **ADD**

*6.15bis* The agreement of the administrations affected may also be obtained in accordance with this Article, for a specified period. When this specific period of agreement expires for an assignment in the List, the assignment in question shall be maintained in the List until the end of the period referred to in § 6.1 above. After that date this assignment in the List shall lapse unless the agreement of the administrations affected is renewed. (WRC-19)

**MOD**

**ARTICLE 8** (REV.WRC-15)

**Procedure for notification and recording in the Master Register  
of assignments in the planned bands for the  
fixed-satellite service**<sup>MOD 11, 12</sup> (WRC-19)

**ADD**

8.16bis In the event that the Bureau has been informed of agreement to new or modified frequency assignments in the List for a specified period of time in accordance with Article 6, the frequency assignment shall be recorded in the Master Register with a note indicating that the frequency assignment is valid only for the period specified. The notifying administration using the frequency assignment over a specified period shall not subsequently invoke this fact to justify the continued use of the frequency beyond the period specified unless it obtains the agreement of the administration(s) concerned. (WRC-19)

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<sup>11</sup> If the payments are not received in accordance with the provisions of Council Decision 482, as amended, on the implementation of cost recovery for satellite network filings, the Bureau shall cancel the publication specified in § 8.5 and 8.12 and the corresponding entries in the Master Register under § 8.11 or 8.16*bis*, as appropriate, after informing the administration concerned. The Bureau shall inform all administrations of such action and that any resubmitted notice shall be considered to be a new notice. The Bureau shall send a reminder to the notifying administration not later than two months prior to the deadline for the payment in accordance with the above-mentioned Council Decision 482, unless the payment has already been received. See also Resolution **905 (WRC-07)**\*. (WRC-19)

\* *Note by the Secretariat:* This Resolution was abrogated by WRC-12.

APPENDIX 30A (REV.WRC-15)\*

**Provisions and associated Plans and List<sup>1</sup> for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz<sup>2</sup> and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2** (WRC-03)

MOD

ARTICLE 5 (REV.WRC-15)

**Coordination, notification, examination and recording in the Master International Frequency Register of frequency assignments to feeder-link transmitting earth stations and receiving space stations in the fixed-satellite service<sup>21, MOD 22</sup>** (WRC-19)

**5.2 Examination and recording**

MOD

5.2.6 If the notifying administration resubmits the notice without modification and insists on its reconsideration, and if the Bureau's finding with respect to § 5.2.1 remains unfavourable, the notice is returned to the notifying administration in accordance with § 5.2.4. In this case, the notifying administration undertakes not to bring into use the frequency assignment until the condition specified in § 5.2.5 is fulfilled. For Regions 1, 2 and 3, in the event that the Bureau has been informed of agreement to new or modified frequency assignments to the Plan for a specified period of time in accordance with Article 4, the frequency assignment shall be recorded in the Master Register with a note indicating that the frequency assignment is valid only for the period specified. The notifying administration using the frequency assignment over a specified period shall not subsequently invoke this fact to justify the continued use of the frequency beyond the period specified unless it obtains the agreement of the administration(s) concerned. (WRC-19)

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<sup>22</sup> If the payments are not received in accordance with the provisions of Council Decision 482, as amended, on the implementation of cost recovery for satellite network filings, the Bureau shall cancel the publication specified in § 5.1.10 and the corresponding entries in the Master Register under § 5.2.2, 5.2.2.1, 5.2.2.2 or 5.2.6, as appropriate, and the corresponding entries included in the Plan on and after 3 June 2000 or in the List, as appropriate, after informing the administration concerned. The Bureau shall inform all administrations of such action. The Bureau shall send a reminder to the notifying administration not later than two months prior to the deadline for the payment in accordance with the above-mentioned Council Decision 482 unless the payment has already been received. See also Resolution **905 (WRC-07)**\*. (WRC-19)

\* *Note by the Secretariat:* This Resolution was abrogated by WRC-12.

## Agenda item 7(D)

### **3/7/4 Issue D – Identification of those specific satellite networks and systems with which coordination needs to be effected under RR Nos. 9.12, 9.12A and 9.13**

#### **3/7/4.1 Executive summary**

Currently, when an administration sends a coordination request (a new one or a modification to an existing one, as appropriate) for frequency assignments subject to RR Nos. **9.12**, **9.12A** and **9.13**, the Bureau publishes in the CR/C Special Section only a list of (potentially) affected administrations in the cases covered by the provisions under RR No. **9.36.1**. This differs from the current course of action of publishing in the same CR/C Special Section a list of specific satellite networks or earth stations in the cases covered by the provisions under RR No. **9.36.2**.

It may be easier for administrations if the two courses of action above were aligned. By doing so, the Bureau would publish a list of potentially affected satellite networks and/or systems following the receipt of a coordination request (a new one or a modification to an existing one, as appropriate) for frequency assignments subject to RR Nos. **9.12**, **9.12A** and **9.13**, rather than a list of affected administrations only.

#### **3/7/4.2 Background**

The 2012 World Radiocommunication Conference (WRC-12) decided to modify RR No. **9.36.2**. Following this provision, the Bureau now publishes a “definitive list” of those networks, systems and earth stations with which coordination under RR Nos. **9.7**, **9.7A** and **9.7B** needs to be effected once a coordination request (a new one or a modification to an existing one, as appropriate) for a satellite network or system is processed. Such a list is published in the relevant Special Section annexed to the BR International Frequency Information Circular (BR IFIC).

The above-mentioned provision (RR No. **9.36.2**) is very useful, because, in the cases of coordination under RR Nos. **9.7**, **9.7A** and **9.7B**, it reduces the administrative workload of identifying the names of specific satellite networks, systems and earth stations with which a new satellite network or system needs to effect coordination.

However, in the cases of coordination under RR Nos. **9.12**, **9.12A** and **9.13**, the Bureau does not publish a list of the satellite networks or systems potentially affected to complement the list of administrations potentially affected by incoming satellite networks or systems that it provides.

#### **3/7/4.3 Summary and analysis of the results of ITU-R studies**

RR No. **9.36.2** significantly decreased the administrative workload related to the identification of the satellite networks, systems and earth stations, as applicable, with which coordination needs to be effected under RR Nos. **9.7**, **9.7A** and **9.7B**. As noted above, the Bureau compiles, in the relevant Special Sections annexed to the BR IFIC, a list including all the specific networks, systems and earth stations with which coordination is required under the following cases:

- a) for a station in a satellite network using the geostationary-satellite orbit (GSO), in any space radiocommunication service, in a frequency band and in a region where this service is not subject to a plan, in respect of any other satellite network using that orbit, in any space radiocommunication service in a frequency band and in a Region where this service is not subject to a plan, with the exception of coordination between earth stations operating in the opposite direction of transmission (see RR No. **9.7**);



- b) for a specific earth station in a geostationary-satellite network in the fixed-satellite service in certain frequency bands, in respect of a non-geostationary-satellite system in the fixed-satellite service (see RR No. **9.7A**);
- c) for a non-geostationary-satellite system in the fixed-satellite service in certain frequency bands, in respect of a specific earth station in a geostationary-satellite network in the fixed-satellite service (see RR No. **9.7B**).

However, for the cases of coordination under RR Nos. **9.12**, **9.12A** and **9.13**, the CR/C Special Section includes only a list of administrations potentially affected and not a list of potentially affected GSO networks or non-GSO systems, as appropriate, for which those administrations are responsible.

Bearing in mind that, according to RR No. **9.36.1**, the list of administrations referred to above is only for information purposes, each of those potentially affected administrations needs to carry out the following tasks:

- 1) identify, together with each of its operators, those GSO networks and non-GSO systems that may be affected by the new satellite system requesting coordination;
- 2) compile, in case the administration is responsible for more than one operator, a comprehensive list covering all the GSO networks and non-GSO systems with which coordination is required;
- 3) transmit to the administration having filed a CR/C (a new one or a modification to an existing one, as appropriate) and to the Bureau its comments on or disagreement to the request for coordination pursuant to RR No. **9.52**.

It should be noted that the tasks above should be carried out within four months from the date of publication of the BR IFIC, so as to avoid the application of the provisions of RR No. **9.52C**. In particular, concerning the application of RR Nos. **9.12**, **9.12A** and **9.13**, it is noted that the number of coordination requests for new non-GSO systems has recently increased, and exchanging the relevant correspondence with other administrations and the Bureau for each of them within the time limit specified in RR No. **9.52** is becoming challenging.

The above process could be simplified if a pre-compiled list of satellite networks or systems considered as potentially affected would be available, for information purposes only, in the cases of coordination under RR Nos. **9.12**, **9.12A** and **9.13** as it is currently for the cases of RR Nos. **9.7**, **9.7A** and **9.7B** in the CR/C Special Section.

Furthermore, consideration may also be given to require the potentially affected administrations to identify in their comments under RR Nos. **9.51** or **9.52**, as appropriate, the list of the affected satellite networks or systems on the basis of the lists published in the CR/C Special Section. It should be noted that an affected administration could also submit comments as per the provisions of RR No. **9.52** to include additional networks or systems that may have been omitted in the lists published in the CR/C Special Section. The Bureau would then compile and publish these comments in a CR/D Special Section according to RR No. **9.53A**. The process would therefore be similar to the current one but it would offer two main advantages:

- 1) the comments under RR Nos. **9.51** or **9.52**, as appropriate, would be much simpler to make as they would entail an examination of a pre-compiled list published, for information purposes only, in the CR/C Special Section, and
- 2) the CR/D Special Section would contain a “definitive list” of satellite systems instead of a simple list of administrations that may further ease the work of administrations in trying to assess the status of the coordination under RR Nos. **9.12**, **9.12A** and **9.13** prior to the notification under RR Article **11**.

It should be noted that the identification of the potentially affected satellite networks or systems would not require any additional tools since the coordination trigger for RR Nos. **9.12**, **9.12A** and **9.13** in RR Appendix 5 is based on frequency overlap<sup>25</sup>.

#### **3/7/4.4 Methods to satisfy Issue D**

##### **3/7/4.4.1 Method D1**

Under this method, no change is proposed to the RR.

##### **3/7/4.4.2 Method D2**

Under this method, it is proposed to add the requirements to have:

- a) a pre-compiled list of potentially affected satellite networks and/or systems, published for information only, included in the CR/C Special Section for coordination under RR Nos. **9.12**, **9.12A** and **9.13**, by stipulating it in RR No. **9.36.1**;
- b) the definitive list of affected satellite networks or systems to be considered when effecting coordination under RR Nos. **9.12**, **9.12A** and **9.13** to be included in the CR/D Special Section by stipulating it in RR No. **9.53A**.

The list of potentially affected satellite networks/systems provided in the CR/C is for information only, and to also avoid a different status compared to the list of affected administrations. Under the current regulatory regime, the definitive list of administrations is provided in the CR/D. Under this method, it is proposed to also include the definitive list of satellite networks/systems in the CR/D.

##### **3/7/4.4.3 Method D3**

Under this method, it is proposed to add the requirements to have the list of satellite networks or systems potentially affected included in the CR/C Special Section for coordination under RR Nos. **9.12**, **9.12A** and **9.13** for information only, by stipulating it in RR No. **9.36.1**. As opposed to Method D2, no further action will be required from the notifying administrations for the list of satellite networks/systems following the publication of the CR/C.

#### **3/7/4.5 Regulatory and procedural considerations for Issue D**

##### **3/7/4.5.1 Method D1**

**NOC**

## ARTICLE 9

### **Procedure for effecting coordination with or obtaining agreement of other administrations<sup>1, 2, 3, 4, 5, 6, 7, 8, 9</sup> (WRC-15)**

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<sup>25</sup> The only exception is the coordination trigger for RR No. **9.13** in the frequency band 1 668-1 668.4 MHz but developing a tool to address this very specific case should not lead to any major difficulty.

### 3/7/4.5.2 Method D2

## ARTICLE 9

### **Procedure for effecting coordination with or obtaining agreement of other administrations**<sup>1, 2, 3, 4, 5, 6, 7, 8, 9</sup> (WRC-15)

#### **Section II – Procedure for effecting coordination**<sup>12, 13</sup>

##### **Sub-Section IIA – Requirement and request for coordination**

###### **MOD**

**9.36**        *b)*        identify in accordance with No. **9.27** any administration with which coordination may need to be effected<sup>MOD 20, 21</sup>; (WRC-19)

###### **MOD**

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<sup>20</sup> **9.36.1**    In the case of coordination under Nos. 9.12, 9.12A and 9.13, the Bureau shall also identify the satellite networks or systems with which coordination may need to be effected. The list of administrations identified by the Bureau under Nos. **9.11** to **9.14** and **9.21**, and the list of satellite networks or systems identified by the Bureau under Nos. **9.12**, **9.12A** and 9.13 are only for information purposes, to help administrations comply with this procedure. (WRC-19)

##### **Sub-Section IIC – Action upon a request for coordination**

###### **MOD**

**9.52C**        For coordination requests under Nos. **9.11** to **9.14** and **9.21**, an administration not responding under No. **9.52** within the same four-month period shall be regarded as unaffected and, in the cases of Nos. **9.11** to **9.14**, the provisions of Nos. **9.48** and **9.49** shall apply. Furthermore, for coordination under Nos. **9.12**, **9.12A** and **9.13**, any satellite networks or systems identified under No. 9.36.1 but not confirmed in the response provided by the administration under No. 9.52 within the same four-month period shall be regarded as unaffected and the provisions of Nos. 9.48 and 9.49 shall also apply. (WRC-19)

###### **MOD**

**9.53A**        Upon expiry of the deadline for comments in respect of a coordination request under Nos. **9.11** to **9.14** and **9.21**, the Bureau shall, according to its records, publish a Special Section, indicating the list of administrations having submitted their disagreement and the list of satellite networks or systems upon which this disagreement is based, as appropriate, or other comments within the regulatory deadline. (WRC-19)

### **3/7/4.5.3 Method D3**

Same as Method D2 for RR No. **9.36.1** but NOC for the rest of RR Article **9**.

## **ARTICLE 9**

### **Procedure for effecting coordination with or obtaining agreement of other administrations<sup>1, 2, 3, 4, 5, 6, 7, 8, 9</sup> (WRC-15)**

#### **Section II – Procedure for effecting coordination<sup>12, 13</sup>**

##### **Sub-Section IIA – Requirement and request for coordination**

#### **MOD**

**9.36**      *b)*      identify in accordance with No. **9.27** any administration with which coordination may need to be effected<sup>MOD 20, 21;</sup> (WRC-19)

#### **MOD**

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<sup>20</sup> **9.36.1** In the case of coordination under Nos. 9.12, 9.12A and 9.13, the Bureau shall also identify the satellite networks or systems with which coordination may need to be effected. The list of administrations identified by the Bureau under Nos. **9.11** to **9.14** and **9.21**, and the list of satellite networks or systems identified by the Bureau under Nos. **9.12**, **9.12A** and 9.13 are only for information purposes, to help administrations comply with this procedure. (WRC-19)

## Agenda item 7(E)

### **3/7/5 Issue E: Resolution related to RR Appendix 30B**

#### **3/7/5.1 Executive summary**

Considering Resolution **86 (Rev.WRC-07)** which *resolves to invite future world radiocommunication conferences:*

- a) to consider any proposals which deal with deficiencies and improvements in the advance publication, coordination, notification and recording procedures of the Radio Regulations for frequency assignments pertaining to space services which have either been identified by the Board and included in the Rules of Procedure or which have been identified by administrations or by the Radiocommunication Bureau, as appropriate;
- b) to ensure that these procedures, and the related appendices of the Radio Regulations reflect the latest technologies, as far as possible.

An administration wishing to convert its national allotment in RR Appendix **30B** to assignments with characteristics beyond those of the initial allotment or wishing to introduce a new network will be faced with several difficulties. Three of these are:

- there is a large number of networks already in the RR Appendix **30B** List and under coordination;
- due to the conservative criteria used in RR Appendix **30B**, a large number of coordination requirements will be identified;
- networks can be designed with combinations of characteristics, possibly unrealistic, to obtain a high sensitivity to interference from later submissions.

It is, therefore, considered to address the issue as a special one-time applied measure and procedure to be contained in a new WRC Resolution as an enhancement of equitable access to spectrum/orbital resources for developing countries to facilitate the processing of their submission in RR Appendix **30B**.

#### **3/7/5.2 Background**

ITU-R considered studies relating to the enhancement of regulatory provisions of RR Appendix **30B** to observe the principles based on which it was initially established.

An administration which decides to convert its national allotment into assignments in an economically viable manner very often needs to modify the initial characteristics of its national allotments, taking into account the latest available development and advancement in technology as well as the most economically viable solution.

In so doing, a) when the request for conversion is submitted, the application would be queued at the end of the last submission received before it and b) once its turn to be processed is reached, due to the nature of those additional systems/uses it would be extremely difficult, if not totally impossible, to succeed coordination within the regulatory deadline. In summary, as it could be noted from the above, the probability that an administration could successfully complete coordination for the conversion of its national allotment to assignments with characteristics beyond the initial allotment within that regulatory period is very low.

#### **3/7/5.3 Summary and analysis of the results of ITU-R studies**

In discussing these issues within ITU-R, a solution that addresses the underlying issue has been identified. This solution would be a possible WRC Resolution along the lines of Resolution **553**

**(Rev.WRC-15)** which addresses a similar issue for the 21.4-22 GHz BSS frequency band for Regions 1 and 3.

Key elements of Resolution **553 (Rev.WRC-15)** are:

- a) the procedure can be used only once by an administration;
- b) the privilege of using this procedure is limited to submissions with national service and coverage area;
- c) submissions will be examined ahead of regular submissions waiting to be processed (i.e. getting a higher priority date);
- d) relaxed coordination triggers in respect of certain categories of networks will be applied;
- e) coordination triggers are used that avoid certain combinations of technical parameters becoming very sensitive to new submissions thereby removing unnecessary coordination.

#### **3/7/5.4 Method to satisfy Issue E**

Establish special measures to be applied once with respect to the submission received from an administration having no frequency assignments in the RR Appendix **30B** List the details of which are to be contained in a WRC Resolution to facilitate the tasks of those administrations to provide an economically viable satellite service to its national territory as initially considered when the allotment Plan was established in 1988.

#### **3/7/5.5 Regulatory and procedural considerations for Issue E**

The following Resolution along with the related attachment and appendix, containing the criteria to determine whether an allotment or an assignment is considered to be affected by networks submitted to RR Appendix **30B** under this Resolution, are necessary to address the above-mentioned problems.

### APPENDIX 30B (REV.WRC-15)

#### **Provisions and associated Plan for the fixed-satellite service in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

**MOD**

#### ARTICLE 6 (REV.WRC-19)

#### **Procedures for the conversion of an allotment into an assignment, for the introduction of an additional system or for the modification of an assignment in the List<sup>1, 2, 2bis</sup> (WRC-19)**

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<sup>2bis</sup> Draft new Resolution [A7(E)-AP30B] (WRC-19) applies.

**ADD**

**DRAFT NEW RESOLUTION [A7(E)-AP30B] (WRC-19)**

**Additional measures for satellite networks in the fixed-satellite service  
in frequency bands subject to Appendix 30B for the enhancement  
of equitable access to these frequency bands**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that WARC Orb-88 created an allotment Plan for the use of the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz;
- b) that WRC-07 revised the regulatory regime governing the use of the frequency bands mentioned in *considering a)* above,

*considering further*

- a) the additional regulatory measures for the enhancement of equitable access included in Resolution **553 (WRC-15)**;
- b) that the Rule of Procedure on No. **9.6** of the Radio Regulations states that “the intent of Nos. **9.6 (9.7 to 9.21)**, **9.27** and Appendix **5** is to identify to which administrations a request for coordination is to be addressed, and not to state an order of priorities for rights to a particular orbital position”,

*recognizing*

- a) that Article 44 of the ITU Constitution lays down the basic principles for the use of the radio-frequency spectrum and the geostationary-satellite and other satellite orbits, taking into account the needs of developing countries;
- b) that the “first-come first-served” concept can restrict and sometimes prevent access to and use of certain frequency bands and orbit positions;
- c) the relative disadvantage for developing countries in coordination negotiations due to various reasons such as a lack of resources and expertise;
- d) that Resolution **2 (Rev.WRC-03)** resolves that “the registration with the Radiocommunication Bureau of frequency assignments for space radiocommunication services and their use do not provide any permanent priority for any individual country or groups of countries and do not create an obstacle to the establishment of space systems by other countries”,

*recognizing further*

- a) that information provided by the Bureau into ITU-R studies indicate that significant numbers of Appendix **30B** submissions have been received by the Bureau in the time period 1 January 2013 until 30 June 2018 and that the table below summarizes the data provided by the Bureau into those studies and shows the variations for the number of networks at the various stages;

	Request for conversion without change of initial allotment national service area	Request for conversion with changes within the envelope of initial allotment national service area	Request for conversion with changes outside the envelope of initial allotment national service area	Request for conversion with changes outside the envelope of initial allotment supra national service area	Request for additional use national service area	Request for additional use, with supra national service area and global coverage **
2013 Q1 + Q2	1	0	0	0	4	27
2013 Q3 + Q4	1	0	0	0	0	17
2014 Q1 + Q2	1	0	0	0	2	30
2014 Q3 + Q4	0	0	0	0	7	20
2015 Q1 + Q2	0	0	1	0	1	30
2015 Q3 + Q4	0	0	0	0	0	26
2016 Q1 + Q2	0	1	0	0	0	23
2016 Q3 + Q4	0	0	0	0	1	24
2017 Q1 + Q2	0	0	0	0	4	34
2017 Q3 + Q4	0	1	0	0	0	25
2018 Q1 + Q2	0	0	0	0	6	13

\*\* Notices for additional use with service area and coverage beyond the national territory of notifying administration.

b) that the number of Appendix **30B** submissions made by some administrations is large, which may not be realistic;

c) that the use of certain combinations of technical parameters in submissions (e.g. high-gain receiving space station antennas) can make the systems/submissions overly sensitive to interference in such a way that subsequent submissions for conversion from allotment into assignments with change would cause interference to those systems,

*taking into account*

that the majority of Appendix **30B** submissions under § 6.1 have global coverage and service area, which is typically changed limited service area with considerably wider coverage area at the time of § 6.17 submission, notwithstanding the Note to Appendix **4** data item B.3.b.1 which states “Taking due account of applicable technical restrictions and allowing some reasonable degree of flexibility for satellite operations, administrations should, to the extent practicable, align the areas the satellite steerable beams could cover with the service area of their networks with due regard to their service objectives” and this is complicating coordination for administrations attempting to convert their national allotments into assignments or introducing an additional system for national use in a technically and economically viable manner,

*resolves*

that as of the date (*yet to be decided by WRC-19*), the special procedure described in the Attachment to this Resolution for processing of submissions received by the Bureau under Article 6 of Appendix **30B** for conversion of the allotment of an administration into an assignment with modifications which are outside the envelope of the initial allotment while restricted to provide service to its national territory designated by test points as contained in the corresponding allotment, or submission by an administration of an additional system the service area of which is limited to its national territory designated by test points as contained in the allotment, in the frequency bands



4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz shall be applied if requested by an administration in respect of its submission as specified in the Attachment below.

## ATTACHMENT TO DRAFT NEW RESOLUTION [A7(E)-AP30B] (WRC-19)

### **Additional measures for satellite networks in the fixed-satellite service in frequency bands subject to Appendix 30B for the enhancement of equitable access to these frequency bands**

1 The special procedure described in this Attachment can only be applied once by an administration having no assignment in the List of Appendix **30B** or assignment submitted under § 6.1 of Appendix **30B**.

2 With regard to the latter case, in order to benefit from application of the special procedure, the submitting Administration may either withdraw or modify its submission previously sent to the Bureau under § 6.1 of Appendix **30B**.

3 Administrations seeking to apply this special procedure shall submit their request to the Bureau, with the information specified in § 6.1 of that Appendix. Specifically, this information shall contain:

- a) in the cover letter to the Bureau, the information that the administration requests the use of this special procedure;
- b) a service area limited to the territory as contained in its national allotment or submitted in the case that a new Member State of the Union does not have an allotment in the Plan and has not submitted a request under § 7.2 of Article 7 of Appendix **30B**;
- c) a minimum ellipse determined by the test points which designate the service area. An administration may request the Bureau to create such diagram.

4 If the information sent under § 3 above is found to be incomplete, the Bureau shall immediately seek from the administration concerned any clarification required and information not provided.

5 An administration using this special procedure shall effect coordination with other administrations as required in § 6 below before:

- i) submitting a request under § 6.17 of Appendix **30B** to have the satellite network entered into the Appendix **30B** List, and
- ii) bringing into use a frequency assignment.

6 Following the successful application of §§ 1 to 4 above, the Bureau shall, ahead of submissions not yet processed under § 6.3 of Appendix **30B**, promptly:

- a) examine the information with respect to its conformity with § 6.3 of Appendix **30B**;
- b) identify, in accordance with Appendix 1 of this Attachment, any administration with which coordination may need to be effected<sup>1</sup>;
- c) include their names in the publication under d) below;

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<sup>1</sup> The Bureau shall also identify the specific satellite networks with which coordination needs to be effected.

- d) publish<sup>2</sup>, as appropriate, the complete information in the International Frequency Information Circular (BR IFIC) within the time-limit as specified in Appendix **30B**;
- e) inform the administrations concerned of its actions and communicate the results of its calculations, drawing attention to the relevant BR IFIC.

7 In applying §§ 6.5, 6.12, 6.14, 6.21 and 6.22 of Appendix **30B**, the criteria in Annex 4 of Appendix **30B** shall be replaced by those given in Appendix 1 of this Attachment.

8 The provisions in this Attachment are supplementary to the provisions of Article 6 of Appendix **30B**.

## APPENDIX 1 TO ATTACHMENT TO DRAFT NEW RESOLUTION [A7(E)-AP30B] (WRC-19)

### **Criteria for determining whether an assignment is considered to be affected by networks submitted to Appendix 30B under this Resolution**

The criteria as contained in Annex 4 of Appendix **30B** continue to apply in order to determine if a proposed new assignment applying the procedures of this Attachment affects:

- a) national allotments in the Plan;
- b) an assignment stemming from the conversion of an allotment into an assignment without modification or with modification inside the envelope of the allotment;
- c) allotment requested under Article 7 of Appendix **30B** by a new Member State of the Union which has received unfavourable findings under Article 7 and has been subsequently treated as a submission under § 6.1 of Appendix **30B**;
- d) assignments stemming from the application of § 6.35 of Appendix **30B**;
- e) assignments for which the procedures of this Resolution have been previously applied.

An assignment which appears in the List or which the Bureau has previously examined after receiving complete information and published under § 6.7 of Appendix **30B**, which does not fall into any of the above categories and which is not applying the procedures of this Attachment is considered as being affected by a proposed new assignment that is applying the procedures of this Attachment:

- 1) if the orbital spacing between its orbital position and the orbital position of the proposed new assignment is equal to or less than:
  - 1.1) 10° in the 4 500-4 800 MHz (space-to-Earth) and 6 725-7 025 MHz (Earth-to-space) frequency bands;

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<sup>2</sup> If the payments are not received in accordance with the provisions of Council Decision 482, as amended, on the implementation of cost recovery for satellite network filings, the Bureau shall cancel the publication, after informing the administration concerned. The Bureau shall inform all administrations of such action and that the network specified in the publication in question no longer has to be taken into consideration by the Bureau and other administrations. The Bureau shall send a reminder to the notifying administration not later than two months prior to the deadline for the payment in accordance with the above-mentioned Council Decision 482 unless the payment has already been received.

1.2) 9° in the 10.70-10.95 GHz (space-to-Earth), 11.20-11.45 GHz (space-to-Earth) and 12.75-13.25 GHz (Earth-to-space) frequency bands.

2) however, an administration is considered as not being affected by a proposed new assignment that is applying the procedures of this Attachment if the conditions listed in 2.1 or 2.2 are satisfied:

2.1) the calculated<sup>3</sup> Earth-to-space single-entry carrier-to-interference  $(C/I)_u$  value at each test point associated with the assignment under consideration is greater than or equal to a reference value that is 27 dB, or  $(C/N)_u + 6$  dB<sup>4</sup>, whichever is the lowest and the calculated<sup>3</sup> space-to-Earth single-entry  $(C/I)_d$  value everywhere within the service area of the assignment under consideration is greater than or equal to a reference value<sup>5</sup> that is 23.65 dB, or  $(C/N)_d + 8.65$  dB<sup>6</sup>, whichever is the lowest, and

the calculated<sup>3</sup> overall aggregate  $(C/I)_{agg}$  value at each test point associated with the assignment under consideration, is greater than or equal to a reference value that is 21 dB, or  $(C/N)_t + 7$  dB<sup>7</sup>, or any already accepted overall aggregate  $(C/I)_{agg}$  value, whichever is the lowest, with a tolerance of 0.45 dB<sup>8</sup> in the case of assignments not stemming from the conversion of an allotment into an assignment without modification, or when the modification is within the envelope characteristics of the initial allotment;

2.2) in the 4 500-4 800 MHz (space-to-Earth) the pfd produced under assumed free-space propagation conditions, does not exceed the threshold values shown below, anywhere within the service area of the potentially affected assignment;

$\theta \leq 0.09$	-240.5	dB(W/(m <sup>2</sup> · Hz))
$0.09 < \theta \leq 3$	$-240.5 + 20\log(\theta/0.09)$	dB(W/(m <sup>2</sup> · Hz))
$3 < \theta \leq 5.5$	$-216.8 + 0.75 \cdot \theta^2$	dB(W/(m <sup>2</sup> · Hz))
$5.5 < \theta \leq 10$	$-193.8 + 25\log(\theta/5.6)$	dB(W/(m <sup>2</sup> · Hz))

where  $\theta$  denotes nominal geocentric separation (degrees) between interfering and interfered with satellite networks;

in the 6 725-7 025 MHz (Earth-to-space) the pfd produced at the location in the geostationary-satellite orbit of the potentially affected assignment under assumed free-space propagation conditions does not exceed -201.0 dB(W/(m<sup>2</sup> · Hz));

in the 10.7-10.95 and 11.2-11.45 GHz (space-to-Earth) frequency bands, the pfd produced under assumed free-space propagation conditions, does not exceed the

<sup>3</sup> Including a computational precision of 0.05 dB.

<sup>4</sup>  $C/N_u$  is calculated as in Appendix 2 to Annex 4 of Appendix **30B**.

<sup>5</sup> The reference values within the service area are interpolated from the reference values on the test points.

<sup>6</sup>  $C/N_d$  is calculated as in Appendix 2 to Annex 4 of Appendix **30B**.

<sup>7</sup>  $(C/N)_t$  is calculated as in Appendix 2 of Annex 4 of Appendix **30B**.

<sup>8</sup> Inclusive of the 0.05 dB computational precision.

threshold values shown below, anywhere within the service area of the potentially affected assignment:

$\theta \leq 0.05$	$-235.0$	$\text{dB(W/(m}^2 \cdot \text{Hz))}$
$0.05 < \theta \leq 3$	$-235.0 + 20\log(\theta/0.05)$	$\text{dB(W/(m}^2 \cdot \text{Hz))}$
$3 < \theta \leq 5$	$-207.9 + 0.95 \cdot \theta^2$	$\text{dB(W/(m}^2 \cdot \text{Hz))}$
$5 < \theta \leq 9$	$-184.2 + 25\log(\theta/5)$	$\text{dB(W/(m}^2 \cdot \text{Hz))}$

where  $\theta$  denotes nominal geocentric separation (degrees) between interfering and interfered with satellite networks;

in the 12.75-13.25 GHz (Earth-to-space) frequency band, the pfd produced at the location in the geostationary-satellite orbit of the potentially affected assignment under assumed free-space propagation conditions does not exceed  $-205.0 \text{ dB(W/(m}^2 \cdot \text{Hz))}$ .

## APPENDIX 2 TO ATTACHMENT TO DRAFT NEW RESOLUTION [A7(E)-AP30B] (WRC-19)

### Protection criteria for new incoming network

Incoming network	Allotments or assignments to be protected	Protection criteria
Assignment applying the special procedure	Allotment in the Plan	Annex 4
	Assignment converted from allotment without modification	Annex 4
	Assignment converted from allotment with modification within the envelope of the allotment	Annex 4
	Assignment converted from allotment with modification outside the envelope of the allotment and the special procedure applied	Annex 4
	Assignment converted from allotment with modification outside the envelope of the allotment and the special procedure NOT applied	New criteria
	Former existing system	New criteria
	Additional system for which the special procedure applied	Annex 4
	Additional system for which the special procedure NOT applied	New criteria
	Request under Article 7 but transferred to Article 6	Annex 4
	New allotment through the application of § 6.35	Annex 4
Conversion of allotment or new additional system for which the special procedure NOT applied	All	Annex 4

## Agenda item 7(F)

### **3/7/6 Issue F – Measures to facilitate entering new assignments into the RR Appendix 30B List**

#### **3/7/6.1 Executive summary**

An administration wishing to convert its national allotment in RR Appendix **30B** to assignments with characteristics beyond those of the initial allotment or wishing to introduce a new network will be faced with several difficulties. Two of these are:

- due to the conservative criteria used in RR Appendix **30B**, a large number of coordination requirements will be identified;
- networks can be designed with combinations of characteristics, possibly unrealistic, to obtain a high sensitivity to interference from later submissions.

In response to this issue, methods as outlined in sections 3/7/6.4 and 3/7/6.5 have been developed.

#### **3/7/6.2 Background**

Article 44 of the ITU Constitution stipulates that for countries to have equitable access to spectrum/orbit resources, administrations shall limit their use to the minimum required to provide services in a satisfactory manner and to endeavour to apply the latest technical advances.

An administration which wants to convert its national allotment of RR Appendix **30B** into assignments in an economically viable manner very often needs to modify the initial characteristics of its national allotments, taking into account the latest available development and advancement in technology. For this purpose, the administration will make a submission and follow the procedures of Article 6 of RR Appendix **30B**.

In so doing:

- a) when the submission is examined and published by the Bureau, the submission would need to coordinate with affected networks with higher priority;
- b) due to the conservative criteria used in RR Appendix **30B**, a large number of coordination requirements will be identified;
- c) networks can be designed with combinations of characteristics, possibly unrealistic, to obtain a high sensitivity to interference from later submissions of other administrations.

As a result, it may be difficult for an administration to successfully complete the coordination within the regulatory period.

#### **3/7/6.3 Summary and analysis of the results of ITU-R studies**

While the structure of the protection criteria for satellite networks submitted in the unplanned frequency bands as well as in RR Appendices **30** and **30A** has undergone significant modifications to take into account technological advances over the last decades, the structure used in RR Appendix **30B** has remained essentially unchanged.

In addition, with the structure of the protection criteria of RR Appendix **30B**, if e.g. the parameters of submitted satellite networks contain small receiving earth station antennas with low system noise temperatures combined with low e.i.r.p. levels or high gain receiving space station antennas with global coverage combined with low uplink e.i.r.p. levels, these additional systems/uses will become very sensitive to interference and overprotected. This may hinder successful coordination of later submissions.

To benefit from the homogeneity between satellite networks that has developed in C- and Ku-band over the years to facilitate new satellite networks, several WRCs have reduced the size of the coordination arc in the unplanned C- and Ku-band. Due to the planned nature of RR Appendix **30B**, the level of homogeneity in these frequency bands would be greater than that encountered in the unplanned frequency bands. Yet, the size of the coordination arc in RR Appendix **30B** remains unchanged at the levels as when the concept of coordination arc was first introduced by WRC-2000.

To allow new submissions to take advantage of the improvements offered by e.g. non-overlapping coverages, use of larger antennas, lower e.i.r.p. levels etc. between networks located within the coordination arc and also to avoid overprotection of networks, e.g. due to unrealistic combinations of technical parameters in submissions, WRC-2000, in revising RR Appendices **30** and **30A** structured the protection criteria such that unnecessary coordination requirements inside the coordination arc should not hinder introduction of new networks. Provisions to avoid unnecessary coordination in portions of the unplanned frequency bands have similarly been introduced by later WRCs. However, for RR Appendix **30B**, there are no such mechanisms to avoid unnecessary coordination which hinder introduction of new networks.

### Use of pfd and reduced coordination arc criteria

Protection criteria based upon coordination arc and pfd thresholds have been used in various parts of the Radio Regulations for several years. WRC-2000 introduced such criteria for RR Appendices **30** and **30A** and WRC-12 did the same for the 21.4-22 GHz BSS frequency band. WRC-2000 also introduced the coordination arc for unplanned FSS and in the revision of RR Appendix **30B** by WRC-07, the coordination arc was introduced also for these frequency bands.

During the 2007-2012 and 2012-2015 study cycles, revisions to the size of the coordination arc and use of pfd criteria were studied for unplanned FSS under WRC-12 agenda item 7, issue 2A, for the 2007-2012 study cycle and under WRC-15 agenda item 9.1, issue 9.1.2, for the 2012-2015 study cycle, respectively.

### Pfd criteria

Some effects of the current coordination mechanisms of RR Appendix **30B** are:

- 1) Networks at great orbital separations can request to be included in the coordination process even though these networks may have had to accept much higher interference levels from more closely spaced networks.
- 2) Special sensitive combinations of characteristics (e.g. low e.i.r.p. and very low system noise temperature combined with very small receiving earth station antennas) for submissions may complicate coordination for new networks.

The purpose of introducing a pfd criterion is to alleviate these difficulties to facilitate coordination of new networks while providing full protection of existing networks with reasonable technical parameters.

It can be seen that the relationship between the triggering  $\Delta T/T$  and the permissible interfering pfd is determined by the following equations:

$$Pfd_{downlink} = 10 \log \{ (\Delta T/T) \cdot k \cdot T_s \cdot 4 \cdot \pi \cdot f^2 / \Delta G \cdot c^2 \} \text{ dB(W/(m}^2 \cdot \text{Hz))}$$

$$Pfd_{uplink} = 10 \log \{ (\Delta T/T) \cdot k \cdot 4 \cdot \pi \cdot f^2 / (G/T) \cdot c^2 \} \text{ dB(W/(m}^2 \cdot \text{Hz))}$$

where:

$$\Delta T/T = \Delta T/T \text{ in a linear scale, i.e. } \Delta T/T (\%) / 100;$$

$$T_s = \text{Receiving earth station system noise temperature (K);}$$

$$f = \text{Frequency (Hz);}$$

- $\Delta G$  = Absolute off-axis gain of receiving earth station antenna towards interfering satellite in linear scale, i.e.  $10^{\Delta G(\text{dBi})/10}$ ; taking into account topocentric angle of RX antenna;
- $G/T$  = Interfered-with satellite figure of merit in linear scale, i.e.  $10^{G/T(\text{dB/K})/10}$ ;
- $k$  = Boltzmann's constant in linear scale ( $1.38 \cdot 10^{-23}$  J/K);
- $c$  = Speed of light ( $3 \cdot 10^8$  m/s).

It can thus be seen that the relationship between  $\Delta T/T$  and pfd is determined by only a few variables:

Downlink:

- Receiving earth station system noise temperature;
- Receiving earth station antenna off-axis absolute gain (determined by:
  - antenna diameter;
  - antenna pattern).

Uplink:

- Interfered-with satellite figure of merit ( $G/T$ ).

For the downlink, the resulting pfd will be a mask determined by the earth station antenna pattern where the large antennas will determine the critical pfd value at small orbital separations while smaller antennas will determine the critical pfd further out. The antenna patterns taken into account should appropriately protect all antenna diameters of Plan allotments and List assignments. Once the orbital separation is such that the interfering satellite is seen through the sidelobes of the earth station antenna, the critical pfd value will be the same for all antenna sizes (assuming that the antennas follow the same sidelobe template).

For the uplink, the critical pfd will be determined by the maximum satellite  $G/T$  within the range and will be one fixed value which will represent the worst  $G/T$  case in order to appropriately protect all Plan allotments and standard operational characteristics of List assignments.

During the 2012-2015 study cycle, under WRC-15 agenda item 9.1, issue 9.1.2, studies were conducted on what would constitute reasonable technical parameters for practical operational satellites, for which full protection should be expected and afforded. The agreed assumptions were as shown in Table 3/7/6.3-1. It can also be noted that several of the technical parameters used are taken from Annex 1 of RR Appendix **30B** since these represented the most up-to-date set of parameters available.

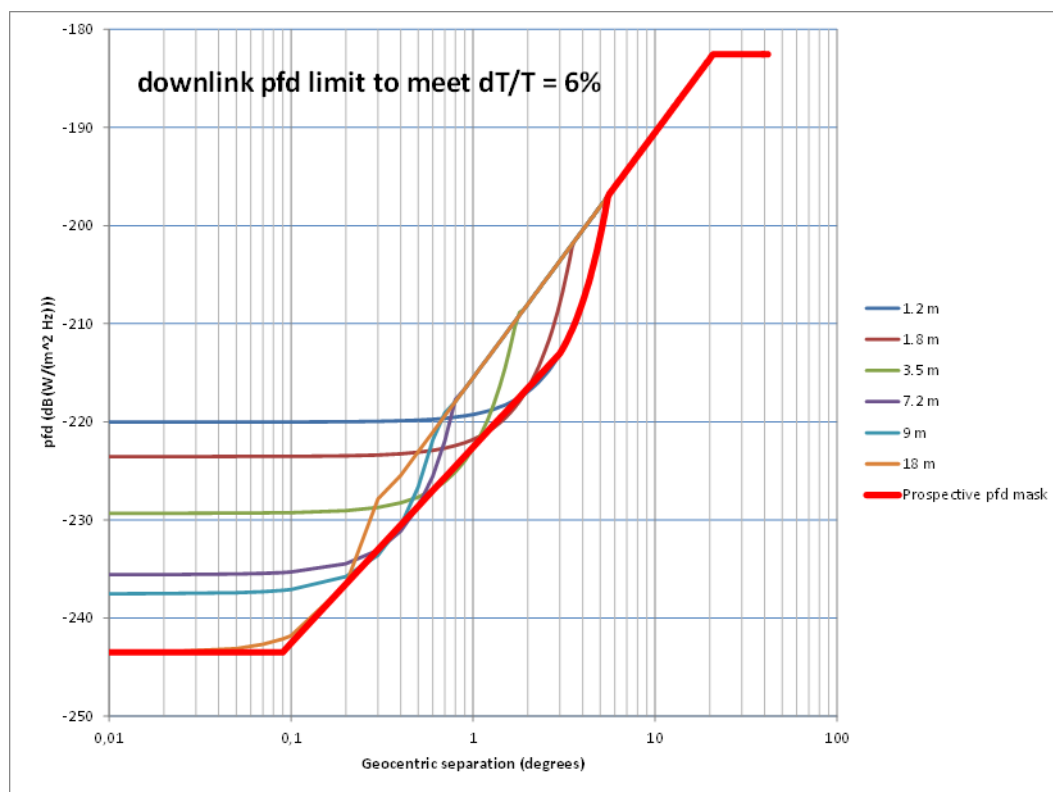
TABLE 3/7/6.3-1

Downlink	4 GHz	10/11/12 GHz
Earth station antenna diameter	1.2-18 m (5.5 m in RR AP <b>30B</b> Plan)	0.45-11 m (2.7 m in RR AP <b>30B</b> Plan)
Earth station antenna diagram	Main lobe: According to RR Appendix <b>8</b> , Section III Sidelobes: 29-25 log $\theta$ dBi (Recommendation ITU-R BO.1213, which implements these main and sidelobe characteristics, was used for the calculations)	
Earth station noise temperature	95 K (as per RR AP <b>30B</b> Plan)	125 K (as per RR AP <b>30B</b> Plan)
Earth station antenna efficiency	70% (as per RR AP <b>30B</b> Plan)	70% (as per RR AP <b>30B</b> Plan)
Equivalent $\Delta T/T$	6%	6%

Uplink	6 GHz	14 GHz
Maximum satellite $G/T$	0 dB/K	11 dB/K
Equivalent $\Delta T/T$	6%	6%

With these assumptions, using the above equations, the downlink pfd masks and the uplink pfd levels become as shown in Figures 3/7/6.3-1 and 3/7/6.3-2.

FIGURE 3/7/6.3-1



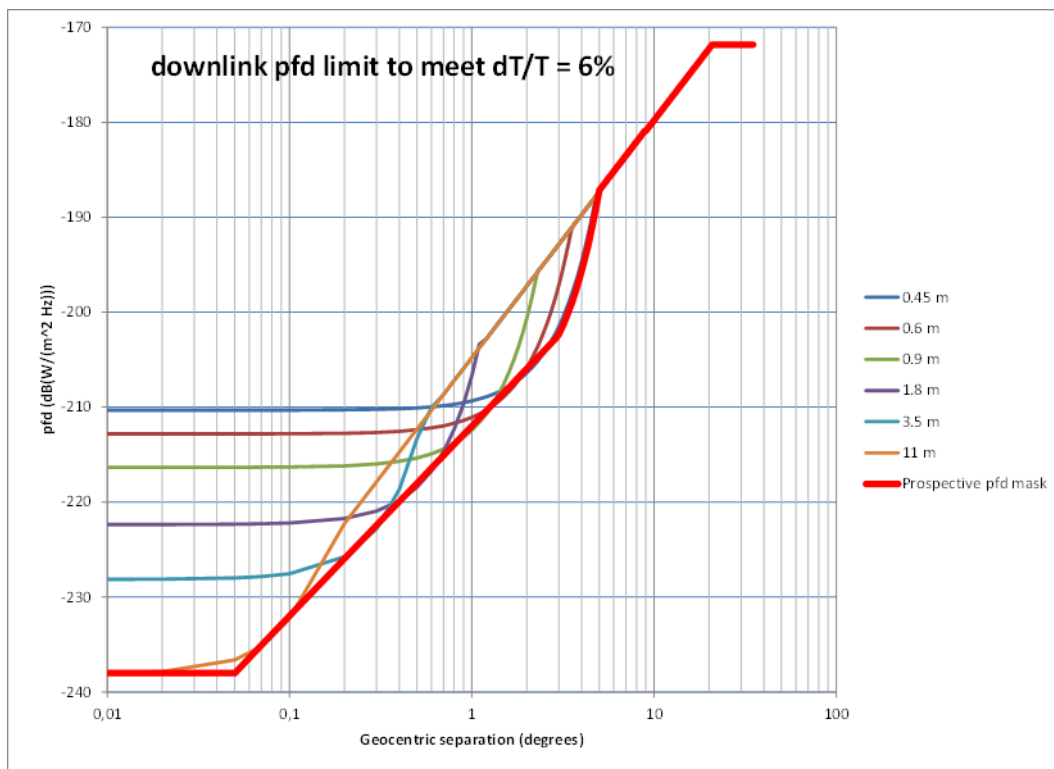
The thick red line in Figure 3/7/6.3-1 denotes the C-band downlink mask to protect the range of antenna diameters to a  $\Delta T/T \leq 6\%$  and is described by the mask:

$\theta$	$\leq$	0.09	-243.5	dB(W/(m <sup>2</sup> · Hz))
0.09	< $\theta$ $\leq$	3	$-243.5 + 20\log(\theta/0.09)$	dB(W/(m <sup>2</sup> · Hz))
3	< $\theta$ $\leq$	5.5	$-219.8 + 0.75 \cdot \theta^2$	dB(W/(m <sup>2</sup> · Hz))
5.5	< $\theta$ $\leq$	20.9	$-196.8 + 25\log(\theta/5.6)$	dB(W/(m <sup>2</sup> · Hz))
20.9	< $\theta$		-182.6	dB(W/(m <sup>2</sup> · Hz))

For the uplink, the pfd level is calculated as  $-204$  dB(W/(m<sup>2</sup> · Hz)).



FIGURE 3/7/6.3-2



The thick red line in Figure 3/7/6.3-2 denotes the Ku-band downlink mask to protect the range of antenna diameters to a  $\Delta T/T \leq 6\%$  and is described by the mask:

	$\theta \leq 0.05$	-238	dB(W/(m <sup>2</sup> · Hz))
0.05	$< \theta \leq 3$	$-238 + 20\log(\theta/0.05)$	dB(W/(m <sup>2</sup> · Hz))
3	$< \theta \leq 5$	$-210.9 + 0.95 \cdot \theta^2$	dB(W/(m <sup>2</sup> · Hz))
5	$< \theta \leq 20.9$	$-187.15 + 25\log(\theta/5)$	dB(W/(m <sup>2</sup> · Hz))
20.9	$< \theta$	-171.9	dB(W/(m <sup>2</sup> · Hz))

For the uplink, the pfd level is calculated as  $-208$  dB(W/(m<sup>2</sup> · Hz)).

### Reduction of the size of the coordination arc

Similar to pfd criteria, the coordination arc concept has the effect of facilitating coordination of new networks while offering good protection of existing networks with reasonable technical parameters. Since the introduction of the coordination arc by WRC-2000, the size of the coordination arc for unplanned C- and Ku-band has been studied and consequently reduced by two later WRCs; under WRC-12 agenda item 7, issue 2A, and WRC-15 agenda item 9.1, issue 9.1.2.

Size of coordination arc for unplanned	WRC-2000	WRC-12	WRC-15
C-band	10°	8°	7°
Ku-band	9°	7°	6°

When RR Appendix **30B** was revised by WRC-07, similar to what had already been done in the unplanned frequency bands and RR Appendices **30** and **30A**, the coordination arc was introduced also to these frequency bands. In doing so, the same size of the coordination arc was adopted as that of the other frequency bands at that time, i.e. 10° for C-band and 9° for Ku-band. However, in updating the size of the coordination arc for unplanned frequency bands, WRCs have failed to do the same thing for RR Appendix **30B**.

For C- and Ku-band, ITU-R studies show that with no e.i.r.p. difference between the networks, the coordination arc could be reduced to 4.8° and 3.7° respectively. With increasing e.i.r.p. difference, the required separation distance would increase. The coordination arc as adopted by WRC-15 of 7° and 6° for C- and Ku-band, respectively, would correspond to about 10 dB e.i.r.p. difference between the wanted and the interfering signals.

These studies were conducted with the smallest antenna size assumed in Recommendation ITU-R S.1524 (corresponding to 1.3 m at C-band and 90 cm at Ku-band). Observing that the RR Appendix **30B** Plan is based on 5.5 m and 2.7 m for C- and Ku-band, respectively, and also observing the higher degree of homogeneity of the e.i.r.p. values stemming from the planned nature of the RR Appendix **30B** frequency bands, with the same size of the coordination arc, the RR Appendix **30B** Plan and also submissions with reasonable variations from the parameters of the Plan would have a higher protection than those in the unplanned frequency bands.

### **Impact on RR Appendix 30B Plan and assignments emanating from the Plan**

The basis for the pfd criteria and the associated values is to provide full protection ( $\Delta T/T \leq 6\%$ ) to a reasonable range of parameters while avoiding unnecessary coordination and preventing unrealistic combinations of parameters from unduly blocking coordination or new networks. With the pfd masks suggested, C-band antennas down to 1.2 m in diameter and Ku-band antennas down to 45 cm in diameter will be fully protected.

Antennas smaller than this will encounter lower protection for incoming interfering signals at certain orbital separations (at the edge of the main lobe). However, these antenna sizes are significantly smaller than those of the Plan and also smaller than commonly used antenna sizes in practical satellite networks.

To enable efficient spectrum utilization and to facilitate coordination or new networks for administrations, some degree of homogeneity of technical parameters should be sought. For this reason, combinations of technical parameters which deviate largely from what is deemed a reasonable range should not be entitled to unduly block coordination of networks with reasonable technical parameters, i.e. these networks should expect a reduced protection.

Similar to the pfd criteria, the effect of the coordination arc is to remove unnecessary coordination and reduce the possibility of unrealistic combinations of parameters contained in filings unduly blocking coordination or new networks. As shown in ITU-R studies, networks with antenna diameters down to 1.3 m at C-band and 90 cm at Ku-band are protected for e.i.r.p. differences up to 10 dB between the wanted and the interfering signal with the coordination arcs of 6° and 5° for C- and Ku-band respectively.

Observing the 5.5 m and 2.7 m antenna sizes used in the RR Appendix **30B** Plan, allotments in the Plan can tolerate significantly larger e.i.r.p. differences while being protected with the same size of the coordination arc. Also, considerably smaller antennas can be introduced in conversions of allotments into assignments while being protected by the 6° and 5° coordination arcs for C- and Ku-band respectively.

Also, again, it should be borne in mind that full protection of infinitesimal antennas with very low e.i.r.p. at large orbital separations is what would block new networks from entering and is exactly what should be avoided.

### **3/7/6.4 Methods to satisfy Issue F**

#### **3/7/6.4.1 Method F1**

To facilitate coordination of submissions of new networks and ease access of administrations to the frequency bands of RR Appendix **30B**, a possible method has been identified to update the coordination triggers to take into account technological advances and avoid some unnecessary coordination while assuring adequate protection of other satellite networks. This method will be beneficial to all submissions for new networks, including those of newcomers and those of administrations seeking to convert their national allotments into assignments with changes. Specifically, the proposed changes include:

- Adopting the structure decided by WRC-2000 for RR Appendices **30** and **30A**, i.e. a reduced coordination arc and mechanisms to remove unnecessary coordination requirements inside the coordination arc.
- Bringing the size of the coordination arc in line with that used for the unplanned frequency bands, i.e. 7° for C-band and 6° for Ku-band and consequently align the Annex 3 limits to newly established coordination arcs.
- Introducing pfd masks and levels like in RR Appendices **30** and **30A** as well as in portions of the unplanned frequency bands to remove unnecessary coordination and prevent combinations of technical parameters leading to unrealistic links from hindering introduction of new networks. Proposed values for pfd masks and levels are those developed in preparation for WRC-15, based on a level of protection corresponding to  $\Delta T/T = 6\%$  for C-band antennas with a diameter between 1.2 and 18 m and Ku-band antennas with a diameter between 45 cm and 11 m).

#### **3/7/6.4.2 Method F2**

This method proposes no changes to the Radio Regulations.

The principle of the RR Appendix **30B** is to provide equitable access to the frequency bands. It is important to ensure protection of the assignments in the List and allotments in the Plan of RR Appendix **30B**. However, facilitation to enter new assignments into the RR Appendix **30B** List through revising the current protection criteria may reduce the protection of assignments in the List and allotments in the Plan of RR Appendix **30B**.

### **3/7/6.5 Regulatory and procedural considerations for Issue F**

#### **3/7/6.5.1 Method F1**

## **APPENDIX 30B (REV.WRC-15)**

### **Provisions and associated Plan for the fixed-satellite service in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

#### **MOD**

### **ANNEX 3 (REV.WRC-19)**

#### **Limits applicable to submissions received under Article 6 or Article 7<sup>MOD 15</sup>**

Under assumed free-space propagation conditions, the power flux-density (space-to-Earth) of a proposed new allotment or assignment produced on any portion of the surface of the Earth shall not exceed:

- –131.4\* dB(W/(m<sup>2</sup> · MHz)) in the 4 500-4 800 MHz frequency band; and
- –118.4\* dB(W/(m<sup>2</sup> · MHz)) in the 10.70-10.95 GHz and 11.20-11.45 GHz frequency bands.

Under assumed free-space propagation conditions, the power flux-density (Earth-to-space) of a proposed new allotment or assignment shall not exceed:

- –140.0 dB(W/(m<sup>2</sup> · MHz)) towards any location in the geostationary-satellite orbit located more than 7° from the proposed orbital position in the 6 725-7 025 MHz frequency band, and
- –133.0 dB(W/(m<sup>2</sup> · MHz)) towards any location in the geostationary-satellite orbit located more than 6° from the proposed orbital position in the 12.75-13.25 GHz frequency band.

\*NOTE – These are consequential changes to the proposed reduction of the coordination arc from 10° to 7° in the 4 GHz frequency band and from 9° to 6° in the 10/11 GHz frequency band. Should other sizes of the coordination arc be considered by WRC-19, the power flux-densities should be amended according to the equation:  $pdf_{new} = pdf_{current} - 25 \cdot \log(\text{current coordination arc} / \text{new coordination arc})$ .

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<sup>15</sup> These limits shall not apply to assignments recorded in the List before a date to be decided by WRC-19.

**MOD**

**ANNEX 4 (REV.WRC-19)**

**Criteria for determining whether an allotment or an assignment is considered to be affected**

An allotment or an assignment is considered as being affected by a proposed new allotment or assignment:

1 if the orbital spacing between its orbital position and the orbital position of the proposed new allotment or assignment is equal to or less than:

1.1 7° in the 4 500-4 800 MHz (space-to-Earth) and 6 725-7 025 MHz (Earth-to-space) frequency bands;

1.2 6° in the 10.70-10.95 GHz (space-to-Earth), 11.20-11.45 GHz (space-to-Earth) and 12.75-13.25 GHz (Earth-to-space) frequency bands.

2 However, an administration is considered as not being affected if at least one of the following conditions is satisfied:

2.1 the calculated<sup>16</sup> Earth-to-space single-entry carrier-to-interference  $(C/I)_u$  value at each test point associated with the allotment or assignment under consideration is greater than or equal to a reference value that is 30 dB, or  $(C/N)_u + 9$  dB<sup>17</sup>, whichever is the lowest and the calculated<sup>16</sup> space-to-Earth single-entry  $(C/I)_d$  value everywhere within the service area of the allotment or assignment under consideration is greater than or equal to a reference value<sup>19</sup> that is 26.65 dB, or  $(C/N)_d + 11.65$  dB<sup>20</sup> whichever is the lowest and the calculated<sup>16</sup> overall aggregate  $(C/I)_{agg}$  value at each test point associated with the allotment or assignment under consideration, is greater than or equal to a reference value that is 21 dB, or  $(C/N)_t + 7$  dB<sup>21</sup>, or any already accepted overall aggregate  $(C/I)_{agg}$  value, whichever is the lowest, with a tolerance of 0.25 dB<sup>22</sup> in the case of assignments not stemming from the conversion of an allotment into an assignment without modification, or when the modification is within the envelope characteristics of the initial allotment.

2.2 in the 4 500-4 800 MHz (space-to-Earth) frequency band, the pfd produced under assumed free-space propagation conditions does not exceed the threshold values shown below, anywhere within the service area of the allotment or assignment under consideration:

	$\theta$	$\leq$	0.09	-243.5	dB(W/(m <sup>2</sup> · Hz))
0.09	<	$\theta$	$\leq$ 3	$-243.5 + 20\log(\theta/0.09)$	dB(W/(m <sup>2</sup> · Hz))
3	<	$\theta$	$\leq$ 5.5	$-219.8 + 0.75 \cdot \theta^2$	dB(W/(m <sup>2</sup> · Hz))
5.5	<	$\theta$	< 7	$-196.8 + 25\log(\theta/5.6)$	dB(W/(m <sup>2</sup> · Hz))

where  $\theta$  denotes nominal geocentric separation (degrees) between interfering and interfered-with satellite networks;

<sup>18</sup>(SUP – WRC-19)

in the 6 725-7 025 MHz (Earth-to-space) frequency band, the pfd produced at the location in the geostationary-satellite orbit of the allotment or assignment under consideration under assumed free-space propagation conditions does not exceed  $-204.0 \text{ dB(W/(m}^2 \cdot \text{Hz))}$ ;

in the 10.7-10.95 and 11.2-11.45 GHz (space-to-Earth) frequency bands, the pfd produced under assumed free-space propagation conditions does not exceed the threshold values shown below, anywhere within the service area of the allotment or assignment under consideration:

	$\theta$	$\leq$	0.05	$-238.0$	$\text{dB(W/(m}^2 \cdot \text{Hz))}$	
0.05	$<$	$\theta$	$\leq$	3	$-238.0 + 20\log(\theta/0.05)$	$\text{dB(W/(m}^2 \cdot \text{Hz))}$
3	$<$	$\theta$	$\leq$	5	$-210.9 + 0.95 \cdot \theta^2$	$\text{dB(W/(m}^2 \cdot \text{Hz))}$
5	$<$	$\theta$	$<$	6	$-187.2 + 25\log(\theta/5)$	$\text{dB(W/(m}^2 \cdot \text{Hz))}$

where  $\theta$  denotes nominal geocentric separation (degrees) between interfering and interfered-with satellite networks;

in the 12.75-13.25 GHz (Earth-to-space) frequency band, the pfd produced at the location in the geostationary-satellite orbit of the allotment or assignment under consideration under assumed free-space propagation conditions does not exceed  $-208.0 \text{ dB(W/(m}^2 \cdot \text{Hz))}$ .

### 3/7/6.5.2 Method F2

No changes to the Radio Regulations.

**NOC**

## APPENDIX 30B (REV.WRC-15)

## Agenda item 7(G)

### **3/7/7 Issue G – Updating the reference situation for Regions 1 and 3 networks under RR Appendices 30 and 30A when provisionally recorded assignments are converted into definitive recorded assignments**

#### **3/7/7.1 Executive summary**

The protection criteria in the Regions 1 and 3 RR Appendices **30** and **30A** frequency bands are based upon a reference situation which takes into account the aggregation of interference from all other networks in the Plan and the List and prescribes a protection based upon an equivalent protection margin (EPM) (a measure for aggregated interference relative to a predefined acceptable level) which should not fall more than 0.45 dB below 0 dB, or if already negative, should not be degraded by more than 0.45 dB. Studies show that networks would have the best protection against interference when the reference situation is about  $\pm 5$  dB around zero and will be lower for both higher and lower EPMs.

§ 4.1.18 of RR Appendices **30** and **30A** prescribes that in the case of recording in the List with outstanding coordination requirements, this recording shall be provisional, but that the entry shall be changed from provisional to definitive recording in the List if the Bureau is informed that the new assignment in the Regions 1 and 3 List has been in use, together with the assignment which was the basis for the disagreement, for at least four months without any complaint of harmful interference being made.

§ 4.1.18*bis* prescribes that when entering assignments of a network provisionally into the List, the reference situation of interfered-with networks with which coordination is not completed is not updated. However, RR Appendices **30** and **30A** currently do not state whether or not the Bureau should update the reference situation of the network with which there is still outstanding disagreement if the provisionally recorded assignments are changed to definitively recorded, and the Bureau has never been faced with such a situation.

Depending on the initial reference situation of the affected network and what would be the reference situation if taking into account the interference from the network for which the agreement has not been given, it can be seen that updating or not updating the reference situation can have different effects on its protection against later submissions.

In response to Issue G, three methods have been identified:

#### **Method G1**

The administration with an interfered-with network, depending on the specific situation of its network, will determine whether or not the reference situation shall be updated.

#### **Method G2**

Quantification of when § 4.1.18 may be used, requirements for both existing and new network to operate exactly at notified parameters, and a Resolution which involves exchange of measurements and outlines how networks can be recorded under § 4.1.18.

#### **Method G3**

No change to the Radio Regulations.

### 3/7/7.2 Background

§§ 4.1.18 to 4.1.20 were included in the RR based on a WRC-2000 decision, to be used in exceptional cases to overcome continuing disagreement of administrations of the affected networks to enter provisionally into the List and after being four months in use without complaint of harmful interference to give a chance to new or modified Article 4 networks to enter definitively in the Lists of RR Appendices **30** and **30A**.

The issue of updating the reference situation for Regions 1 and 3 networks under RR Appendices **30** and **30A** when provisionally recorded assignments are converted into definitive assignments was first raised during the CPM15-2 meeting. It was therefore too late to have this issue captured in the CPM Report. Subsequently, this issue was brought to the attention of the RRB-70 meeting in October 2015 (Document RRB-70/10), requesting that a Rule of Procedure (RoP) be prepared to outline the desired practice to be followed by the Bureau. RRB-70 however was of the view that such a RoP would consist in a change of the Radio Regulations and therefore was outside the authority of the RRB.

Following this decision, a proposal on this issue was submitted to WRC-15, which has the authority to make changes to the Radio Regulations (Document WRC-15/169). Since this proposal was made directly to the conference with no previous ITU-R studies, WRC-15 decided that:

*“...it was felt that further study of this issue is required if this current practice is to be changed. ITU-R is therefore invited to study this issue under the standing agenda item 7 with the aim of finding an appropriate regulatory and technical solution to this issue.”*

This Issue G is in response to these activities before and during the last WRC and the decision of WRC-15.

### 3/7/7.3 Summary and analysis of the results of ITU-R studies

The protection criteria in the Regions 1 and 3 RR Appendices **30** and **30A** frequency bands are based upon a reference situation which takes into account the aggregation of interference from all other networks in the Plan and the List and prescribes a protection based upon an equivalent protection margin (a measure for aggregated interference relative to a predefined acceptable level) which should not fall more than 0.45 dB below 0 dB, or if already negative, should not be degraded by more than 0.45 dB.

If the reference situation of an assignment of a network in the List, as a result of including the interference from the network to which it has not given its agreement, falls below 0 dB, interference from later submissions may be higher before reaching the further 0.45 dB degradation which triggers coordination. The further below 0 dB the reference situation falls, the higher the interference can be before coordination is triggered, making the interfered-with network less and less sensitive to interference from later submissions.

Table 3/7/7.3-1 below shows the allowable interference in terms of  $C/I$  (carrier-to-interference ratio,  $C/I_{new}$ ) and interference power ( $I_{new}$ ) derived by EPM criteria (RR Appendix **30**). When the carrier level is constant (e.i.r.p. of 59 dBW), the allowable interference is almost constant for high *Ref. EPM* (above 5 dB). However, the allowable interference increases drastically for low *Ref. EPM* (below 0 dB).



TABLE 3/7/7.3-1

**Relation between reference (*Ref.*) *EPM* and the allowable interference derived by *EPM* criteria  
(RR Appendix 30)**

C e.i.r.p. (dBW)	59.0	59.0	59.0	59.0	59.0	59.0	59.0	51.0
PR (dB)	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
$C/I_{aggr}$ (dB)	36.0	31.0	26.0	21.0	16.0	11.0	6.0	2.0
$I_{aggr}$ (dBW)	23.0	28.0	33.0	38.0	43.0	48.0	53.0	49.0
<i>Ref. EPM</i> (dB)	15.0	10.0	5.0	-0.0	-5.0	-10.0	-15.0	-19.0
$C/I_{new}$ (dB)	20.7	21.0	22.0	30.6	25.6	20.6	15.6	11.6
$I_{new}$ (dBW)	38.3	38.0	37.0	28.4	33.4	38.4	43.4	39.4
$C/(I_{aggr}+I_{new})$ (dB)	20.5	20.6	20.5	20.5	15.5	10.6	5.5	1.5
<i>EPM</i> ( $I_{aggr}+I_{new}$ ) (dB)	-0.45	-0.45	-0.45	-0.45	-5.45	-10.45	-15.45	-19.45
Degradation in <i>EPM</i> (dB)	-15.45	-10.45	-5.45	-0.45	-0.45	-0.45	-0.45	-0.45

*PR*: Protection ratio. It is 21 dB for co-channel signals adopted in the WRC-2000 Plan (RR Appendix 30 Annex 5 section 3.4)

Table 3/7/7.3-1 shows that networks would have the best protection when the reference situation is about  $\pm 5$  dB around zero and will be lower for both higher and lower *EPM*s.

This means that if the reference situation of a network in the RR Appendix 30 or 30A List is updated to take into account the interference situation of a network which has entered through § 4.1.18 and if this brings the reference situation significantly below 0 dB, the network in the List will encounter a reduced protection from later submissions due to a network to which it has not given its agreement.

On the other hand, if the *EPM* of a network is high, it could tolerate a relatively high interference before the *EPM* is brought down to 0.45 dB below zero and triggering coordination. If the reference situation is not updated to take into account the interference from the network which has used § 4.1.18 against it, a later submission can take up this interference tolerance while it is not recognized that this interference allowance is already taken up by the network using § 4.1.18. In this situation, not updating the reference situation will lead to a reduced protection against later submissions.

It can also be noted that for an assignment in the Regions 1 and 3 List which already has a very low reference *EPM*, the further latecomer could enter into the List without applying the § 4.1.18 procedure. In this situation, the issue of updating of the reference situation when networks are entered into the List applying § 4.1.18 becomes irrelevant.

Note that the last column in Table 3/7/7.3-1 shows a network with low e.i.r.p. of 51 dBW. In this case, compared to a network with nominal e.i.r.p. of 59 dBW, the wanted carrier is 8 dB low and the interference is 8 dB high. As a result,  $C/I_{aggr}$  is 16 dB less than the nominal network (e.i.r.p. of 59 dBW). In Table 3/7/7.3-1, another interference from the opposite side satellite is considered, which creates an additional 3 dB degradation and results in the *Ref. EPM* of -19 dB. The allowable interference power is 39.4 dBW, which corresponds to the *Ref. EPM* of -10 dB for the network with nominal e.i.r.p. of 59 dBW.

The *EPM* criteria contribute to alleviate the problem of “sensitive satellite network”, which has a low transmitting power and permits a very low interference power. A satellite network with a low transmitting power generally has to accept a low *EPM* to enter into the List. Then such a sensitive satellite network has to allow a high interference power as seen in the last column of

Table 3/7/7.3-1, and has no chance to block others. As a result, it becomes easier for a new-comer to enter the List. However, if a “sensitive network” has managed to get into the List without getting a low EPM, in not updating the reference EPM for such a “sensitive satellite network”, it will continue to enjoy a higher degree of sensitivity against later submissions and in respect of the EPM criterion, triggering more coordination than if the reference EPM was updated.

In consideration of updating of the reference EPM, in combination with the other coordination criteria used in RR Appendices **30** and **30A**, the effect on the network having § 4.1.18 used against it by a later network, as well as the effect of “sensitive parameters” contained in networks in the List, should be taken into account.

§§ 4.1.18-4.1.20 of RR Appendix **30** describes the requirements and conditions for recording in the Regions 1 and 3 List of a network with outstanding coordination requirements.

§ 4.1.18 prescribes that in the case of recording in the List with outstanding coordination requirements, this recording shall be provisional, but that the entry shall be changed from provisional to definitive recording in the List if the Bureau is informed that the new assignment in the Regions 1 and 3 List has been in use, together with the assignment which was the basis for the disagreement, for at least four months without any complaint of harmful interference being made. It was noted during the studies that, while a number of networks have entered the List provisionally through the use of § 4.1.18, the Bureau has never been requested to change a provisional entry to definitive.

§ 4.1.18*bis* prescribes that when entering assignments of a network provisionally into the List, the reference situation of interfered-with networks with which coordination is not completed is not updated. However, RR Appendices **30** and **30A** currently do not state whether or not the Bureau should update the reference situation of the network with which there is still outstanding disagreement if the provisionally recorded assignments are changed to definitively recorded.

There may be many reasons why harmful interference does not occur during the first four months of operation, e.g. during this period, the interfered-with network may not operate with its most sensitive characteristics among its assignments in the List (use of larger antennas, modulation/coding that is more robust, e.i.r.p. levels higher than the minimum values, etc.) or the interfering network may not operate with its most interfering characteristics (lower e.i.r.p. levels, transponders with no emissions, steerable beams pointing in another direction, etc.).

However, if at the end of this four-month period, the reference situation of the interfered-with network is updated to incorporate the maximum interference (as contained in the submission to ITU, even if during the four-month period actual operation may have been with parameters causing less interference) from the network to which it has not given its agreement, depending on the situation of the affected network, this could severely affect the reference situation and thereby the protection of the interfered-with network such that later submissions could impose significantly more interference upon the interfered-with network before exceeding the relative degradation which triggers coordination. As a result, the interfered-with network may find itself with reduced protection due to a network which has not completed the required coordination with the interfered-with network and to which it has not given its agreement.

On the other hand, for other affected networks, not updating the reference situation could keep networks at a high reference situation where they would be required to accept higher levels of interference from latecomers than if the reference situation had been updated. For these cases, the interfered-with network may find itself with reduced protection due to a network which has not completed the required coordination with the interfered-with network and to which it has not given its agreement if the reference situation is not updated.

Depending on the initial reference situation of the affected network and what would be the reference situation if taking into account the interference from the network for which the agreement has not been given, it can be seen that updating or not updating the reference situation can have different effects on its protection against later submissions.

### **3/7/7.4 Methods to satisfy Issue G**

#### **3/7/7.4.1 Method G1**

To avoid administrations receiving a reduced protection due to a network to which they have not given their agreement, this method prescribes that when a network has entered into the List using § 4.1.18, and when the recording of the associated assignment transitions from provisional to definitive while there is still disagreement, the reference situation of the interfered-with network should be updated in consultation with, and only with the agreement of, the affected administration. To this effect, this method proposes to modify § 4.1.18*bis* of RR Appendices **30** and **30A**.

#### **3/7/7.4.2 Method G2**

Under this method, the core of the current situation would be kept unchanged, however, the application of the provisions in §§ 4.1.18-4.1.20 of RR Appendices **30** and **30A** would be modified to exclude their improper use. This method is based upon the following points:

- 1) With technology evolving, the cases of the findings of the BR for the need of coordination based on unrealistic analyses results will increase.
- 2) This discrepancy can be removed only by revising the reference values of the basic parameters of BSS systems. Meanwhile, it is not acceptable for new networks to have no possibility to be included definitively in the Lists based on unrealistic analyses results.
- 3) Realizing that §§ 4.1.18-4.1.20 are of a particular importance in case the disagreement is not based on a real concern of interference impact, but rather to prevent appearance of new entrant on the market of satellite services, the efforts have to be directed to prevent from unacceptable consequences the networks identified as potentially affected. Such an approach will be more constructive and consistent with the RR Resolution **2 (Rev.WRC-03)**, Resolution **80 (Rev.WRC-07)**, Article 44 of the Constitution, the main principle of the RR, etc. allowing frequency-orbital resources for Regions 1 and 3 to be used for BSS networks of new operators.
- 4) One of the measures should be that the continuing disagreement has to be proven through providing proper correspondence and/or meetings for coordination.
- 5) Another necessary measure should be the requirement that both the existing and new incoming systems should operate with their notified parameter values.
- 6) The third measure related to the reference situation update would be the restriction of EPM degradation value up to 5 dB allowing the application of the provisions in §§ 4.1.18-4.1.20.

Considerations and calculations were presented about the appropriate value of EPM degradation limit for entering provisionally in the Lists. An analysis regarding the discrepancy between the interference impact calculated by MSPACEg and the protection requirements of a typical BSS network, with example MODCOD QPSK3/4, was submitted. The key assumptions of this analysis were: i) as the interference impact exhibits a long-term effect it should be calculated during the available time of the links, ii) both wanted and interfering signals were assumed to be digital with noise-like equalized spectrum, iii) with error correction coding, less than 1 dB margin above *C/N* threshold is needed to operate effectively. The analysis concluded that, for the particular case

analysed, an EPM degradation of about 5 dB should be tolerable, however, it was also noted that the value of the tolerable EPM degradation has to be arrived at through a trade-off between three considerations: i) allowance to enter assignments provisionally in the List, ii) the discrepancy between MSPACEg interference results and the real case-by-case interference impact when accounting for a real network protection requirements and iii) the consequences for the interfered-with network after updating the reference situation in case of successful measurements, which is closely related to the previous two points.

### **3/7/7.4.3 Method G3**

The EPM criterion contributes to alleviate the problem of “sensitive satellite network” having very low transmitting power. In not updating the reference EPM for a “sensitive satellite network” with still not having a very low reference EPM, this network would continue to enjoy a higher degree of sensitivity against later submissions and, in respect of the EPM criterion, triggering more coordination than if the reference EPM was updated.

The current provisions of RR Appendices **30** and **30A** contribute to update the reference EPM of satellite networks including “sensitive satellite networks”, therefore, this method prescribes that the current provisions in §§ 4.1.18-4.1.20 of RR Appendices **30** and **30A** should be kept unchanged.

### **3/7/7.5 Regulatory and procedural considerations for Issue G**

#### **3/7/7.5.1 Method G1**

## **APPENDIX 30 (REV.WRC-15)\***

### **Provisions for all services and associated Plans and List<sup>1</sup> for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)**

## **ARTICLE 4 (REV.WRC-15)**

### **Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3<sup>3</sup>**

#### **4.1 Provisions applicable to Regions 1 and 3**

##### **MOD**

4.1.18*bis* When requesting the application of § 4.1.18, the notifying administration shall undertake to meet the requirements of § 4.1.20 and provide to the administration in respect of which § 4.1.18 is applied, with a copy to the Bureau, a description of the steps by which it undertakes to meet these requirements. Once an assignment is entered in the List provisionally under the provisions of § 4.1.18, the calculation of the equivalent protection margin (EPM)<sup>9</sup> of an assignment in the Regions 1 and 3 List or for which the procedure of Article 4 has been initiated and which was the basis for the disagreement shall not take into account the interference produced by the assignment for which the provisions of § 4.1.18 have been applied. When the recording of an assignment entered into the List is changed from provisional to definitive in accordance with § 4.1.18, but there is still continuing disagreement between the administrations, the Bureau will consult with the administration responsible for the assignments which were the basis for the disagreement and will only update the EPM to take

into account interference produced by the assignment for which the provisions of § 4.1.18 have been applied with the agreement of the administration responsible for the assignments which were the basis for the disagreement. (WRC-19)

**ARTICLE 4** (REV.WRC-15)

**Procedures for modifications to the Region 2 Plan or  
for additional uses in Regions 1 and 3<sup>3</sup>**

**4.2 Provisions applicable to Region 2**

**NOC**

4.2.21A

**APPENDIX 30A (REV.WRC-15)\***

**Provisions and associated Plans and List<sup>1</sup> for feeder links for the broadcasting-  
satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz  
in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands  
14.5-14.8 GHz<sup>2</sup> and 17.3-18.1 GHz in Regions 1 and 3,  
and 17.3-17.8 GHz in Region 2** (WRC-03)

**ARTICLE 4** (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan  
or for additional uses in Regions 1 and 3**

**4.1 Provisions applicable to Regions 1 and 3**

**MOD**

4.1.18*bis* When requesting the application of § 4.1.18, the notifying administration shall undertake to meet the requirements of § 4.1.20 and provide to the administration in respect of which § 4.1.18 is applied, with a copy to the Bureau, a description of the steps by which it undertakes to meet these requirements. Once an assignment is entered in the feeder-link List provisionally under the provisions of § 4.1.18, the calculation of the equivalent protection margin (EPM)<sup>11</sup> of an assignment in the Regions 1 and 3 feeder-link List or for which the procedure of Article 4 has been initiated and which was the basis for the disagreement shall not take into account interference produced by the assignment for which the provisions of § 4.1.18 have been applied. When the recording of an assignment entered into the List is changed from provisional to definitive in accordance with § 4.1.18, but there is still continuing disagreement between the administrations, the Bureau will consult with the administration responsible for the assignments which were the basis for the disagreement and will only update the EPM to take into account interference produced by the assignment for which the provisions of § 4.1.18 have been applied with the agreement of the administration responsible for the assignments which were the basis for the disagreement. (WRC-19)

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan  
or for additional uses in Regions 1 and 3**

**4.2 Provisions applicable to Region 2**

**NOC**

4.2.21A

**3/7/7.5.2 Method G2**

APPENDIX 30 (REV.WRC-15)\*

**Provisions for all services and associated Plans and List<sup>1</sup> for  
the broadcasting-satellite service in the frequency bands  
11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1)  
and 12.2-12.7 GHz (in Region 2) (WRC-03)**

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 Plan or  
for additional uses in Regions 1 and 3<sup>3</sup>**

**4.1 Provisions applicable to Regions 1 and 3**

**MOD**

4.1.18 If, in spite of the application of § 4.1.16 and 4.1.17, there is still continuing disagreement proven by correspondence<sup>ADDXX</sup> and the assignment which was the basis of the disagreement is not an assignment in the Regions 1 and 3 Plan, or in the Region 2 Plan or for which the procedure of § 4.2 has been initiated, and if the notifying administration insists that the proposed assignment be included in the Regions 1 and 3 List if the EPM degradation is less than 5 dB, the Bureau shall provisionally enter the assignment in the Regions 1 and 3 List with an indication of those administrations whose assignments were the basis of the disagreement; however, the entry shall be changed from provisional to definitive recording in the List only if the Bureau is informed that the new assignment in the Regions 1 and 3 List has been in use, together with the assignment which was the basis for the disagreement, and both assignments have been in operation with the notified parameter values<sup>ADDYY</sup> for at least four months without any complaint of harmful interference being made. (WRC-19)

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XX Three or more attempts to obtain agreement by correspondence and/or by meetings including the assistance by the Bureau. (WRC-19)

YY This shall be proven by measurement results sent to the Bureau. The procedure is subject to draft new Resolution [A7(G)-YYY] (WRC-19). (WRC-19)

## **MOD**

4.1.18*bis* When requesting the application of § 4.1.18, the notifying administration shall undertake to meet the requirements of § 4.1.20 and provide to the administration in respect of which § 4.1.18 is applied, with a copy to the Bureau, a description of the steps by which it undertakes to meet these requirements<sup>ADDZZ</sup>. Once an assignment is entered in the List provisionally under the provisions of § 4.1.18, the calculation of the equivalent protection margin (EPM)<sup>9</sup> of an assignment in the Regions 1 and 3 List or for which the procedure of Article 4 has been initiated and which was the basis for the disagreement shall not take into account the calculated interference impact due to the assignment for which the provisions of § 4.1.18 have been applied. (WRC-19)

## **ARTICLE 4** (REV.WRC-15)

### **Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3<sup>3</sup>**

#### **4.2 Provisions applicable to Region 2**

#### **NOC**

##### **4.2.21A**

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<sup>ZZ</sup> They shall be proven by measurement results sent to the Bureau. The procedure is subject to draft new Resolution [A7(G)-YYY] (WRC-19). (WRC-19)

APPENDIX 30A (REV.WRC-15)\*

**Provisions and associated Plans and List<sup>1</sup> for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz<sup>2</sup> and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-03)**

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan or for additional uses in Regions 1 and 3**

**4.1 Provisions applicable to Regions 1 and 3**

**MOD**

4.1.18 If, in spite of the application of § 4.1.16 and 4.1.17, there is still continuing disagreement proven by correspondence<sup>ADDXX1</sup> and the assignment which was the basis of the disagreement is not an assignment in the Regions 1 and 3 Plan, or in the Region 2 Plan or for which the procedure of § 4.2 has been initiated, and if the notifying administration insists that the proposed assignment be included in the Regions 1 and 3 feeder-link List if the EPM degradation is less than 5 dB, the Bureau shall provisionally enter the assignment in the Regions 1 and 3 feeder-link List with an indication of those administrations whose assignments were the basis of the disagreement; however, the entry shall be changed from provisional to definitive recording in the feeder-link List only if the Bureau is informed that the new assignment in the Regions 1 and 3 feeder-link List has been in use, together with the assignment which was the basis for the disagreement, and both assignments have been in operation with the notified parameter values<sup>ADDYY1</sup> for at least four months without any complaint of harmful interference being made. (WRC-19)

**MOD**

4.1.18*bis* When requesting the application of § 4.1.18, the notifying administration shall undertake to meet the requirements of § 4.1.20 and provide to the administration in respect of which § 4.1.18 is applied, with a copy to the Bureau, a description of the steps by which it undertakes to meet these requirements.<sup>ADDZZ1</sup> Once an assignment is entered in the feeder-link List provisionally under the provisions of § 4.1.18, the calculation of the equivalent protection margin (EPM)<sup>11</sup> of an assignment in the Regions 1 and 3 feeder-link List or for which the procedure of Article 4 has been initiated and which was the basis for the disagreement shall not take into account calculated

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XX1 Three or more attempts to obtain agreement by correspondence and/or by meetings including the assistance by the Bureau. (WRC-19)

YY1 This shall be proven by measurement results sent to the Bureau. The procedure is subject to draft new Resolution [A7(G)-YYY] (WRC-19). (WRC-19)

ZZ1 This shall be proven by measurement results sent to the Bureau. The procedure is subject to draft new Resolution [A7(G)-YYY] (WRC-19). (WRC-19)



interference impact due to the assignment for which the provisions of § 4.1.18 have been applied. (WRC-19)

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan  
or for additional uses in Regions 1 and 3**

**4.2 Provisions applicable to Region 2**

**NOC**

4.2.21A

**ADD**

DRAFT NEW RESOLUTION [A7(G)-YYY] (WRC-19)

**Relating to the procedure for application of the provisions in §§ 4.1.18  
and 4.1.18bis in Article 4 of Appendices 30 and 30A**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that the provisions in §§ 4.1.18 and 4.1.18bis in Article 4 of Appendices **30** and **30A** are giving an opportunity to assignments identified as potentially affected to enter definitively in the Appendices **30** and **30A** Lists for Regions 1 and 3 to obtain protection from the new submitted assignments in case of continuing disagreement;
- b) that the provisions in §§ 4.1.18 and 4.1.18bis in Article 4 of Appendices **30** and **30A** are not enough defined in their details and this gives rise to some uncertainty in their application from one side and creates an opportunity for manipulation of the measurement results on the other;
- c) that there is an increasing need for specifying a clear guidance for the application of the provisions, defined in *considering a)* in order that any suspicion in their improper use be avoided,

*considering further*

- a) that it is not realistic that the provisions in §§ 4.1.18 and 4.1.18bis in Article 4 of Appendices **30** and **30A** be applied at high levels of identified EPM (equivalent protection margin) degradation;
- b) that it is not acceptable to apply the provisions in §§ 4.1.18 and 4.1.18bis in Article 4 of Appendices **30** and **30A** if there has been no demonstration of continuing disagreement by the administration(s) identified as potentially affected,

*noting*

- a) that there is an increasing overload of BSS planned frequency bands in some part of the geostationary orbit because of the numerous BSS networks for additional use submitted under the provisions of Article 4 of Appendices **30** and **30A**;
- b) that many national assignments in the BSS and FL Plans are blocked by closely situated networks for additional use of the planned frequency bands;
- c) that there are administrations which are not keen to give coordination agreement even for a very low excess of the coordination criteria, in this case of EPM degradation;
- d) that continuously evolving progress in technologies related to the BSS networks leads to increasing remoteness of real system capabilities to deal with interference from the technical parameters of the BSS networks in Appendices **30** and **30A** on the basis of which the need for coordination is identified by the Radiocommunication Bureau,

*recognizing*

- a) that there are in Appendix **10** of the Radio Regulations a description of some parameters of mainly terrestrial stations for measurement purposes and by the view of interference impact;
- b) that there is some guidance in Report ITU-R SM.2181 for presentation of the measurement results of emissions from space stations that can be used for description of measured parameter values for the purpose of §§ 4.1.18 and 4.1.18bis,

*resolves*

that an administration may submit a request for provisions of § 4.1.18 to be applied to its BSS/FL network in case:

- a) this network is identified as affecting but causing EPM degradation of no more than 5 dB of the reference situation at any test point of other BSS/FL network(s), and
- b) continuing disagreement is available with the notifying administration of the identified as potentially affected BSS/FL network(s) proven by at least three letters/faxes or coordination meetings with a proposal to this administration for coordination agreement sent by the notifying administration of the network identified as potentially affecting.

## ANNEX TO DRAFT NEW RESOLUTION [A7(G)-YYY] (WRC-19)

1 An administration which assignment(s) is included provisionally in the Regions 1 and 3 List of Appendix **30** or **30A** as a result of a request for application of the provisions of § 4.1.18 wishing to change the recording from provisional to definitive recording in the List has to provide for transmission of this assignment under the following conditions:

- 1.1 Informs the notifying administration(s) of the potentially affected network(s), with a copy to the Bureau, for the time period, which has to be at least four months, intended to carry out transmission of assignment(s) identified as potentially affecting, indicating exactly which of them will be the subject of transmission;
- 1.2 Both or all involved administrations must provide transmission of the specified assignment(s) during the agreed time period with the notified values of its parameters;

- 1.3 At the end of the agreed time period a report<sup>1</sup> has to be prepared and sent to the Radiocommunication Bureau by the initiating administration comprising information of:
- a) e.i.r.p. value of the transmitted assignment(s) wishing to be definitively recorded in the List, beginning with 10 dB lower than and increasing up to the notified values of e.i.r.p. observing the requirements in § 4.1.20 to avoid harmful interference to any recorded assignment in the Master Register;
  - b) measured carrier levels at the output of the receiving antenna with notified parameters at at least three different points in the service area(s) of the assignments of the network identified as potentially affecting and the network(s) identified as potentially affected, subject to continuing disagreement from its notifying administrations;
  - c) measured values of any other network-related parameters aiming to prove that the assignment subject to the submission under the provisions of § 4.1.18 has no interference impact on the network(s) identified as potentially affected as measured  $C/N$ ,  $C/(N+I)$ , BER, etc. for the emission(s) of this network at several levels of e.i.r.p. of the subject assignment;
- 1.4 The Radiocommunication Bureau has to examine the submitted measurement report and if no degradation of the reception of the emission(s) of the network assignment(s) identified as potentially affected is found, the Bureau shall continue as in § 4.1.18 with the updating of the reference situation of the corresponding assignment(s) of this network(s) and to convert the provisional status in the Regions 1 and 3 List(s) of the assignment(s) identified as potentially affecting and which is the subject to the measurement report into definitive recording.

### 3/7/7.5.3 Method G3

## APPENDIX 30 (REV.WRC-15)\*

### **Provisions for all services and associated Plans and List<sup>1</sup> for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)**

## ARTICLE 4 (REV.WRC-15)

### **Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3<sup>3</sup>**

#### 4.1 Provisions applicable to Regions 1 and 3

#### NOC

#### 4.1.18

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<sup>1</sup> Refer to Appendix 10 and Report ITU-R SM.2181.

**NOC**

4.1.18*bis*

**ARTICLE 4** (REV.WRC-15)

**Procedures for modifications to the Region 2 Plan or  
for additional uses in Regions 1 and 3<sup>3</sup>**

**4.2 Provisions applicable to Region 2**

**NOC**

4.2.21A

**APPENDIX 30A (REV.WRC-15)\***

**Provisions and associated Plans and List<sup>1</sup> for feeder links for the broadcasting-  
satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz  
in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands  
14.5-14.8 GHz<sup>2</sup> and 17.3-18.1 GHz in Regions 1 and 3,  
and 17.3-17.8 GHz in Region 2** (WRC-03)

**ARTICLE 4** (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan  
or for additional uses in Regions 1 and 3**

**4.1 Provisions applicable to Regions 1 and 3**

**NOC**

4.1.18

**NOC**

4.1.18*bis*

**ARTICLE 4** (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan  
or for additional uses in Regions 1 and 3**

**4.2 Provisions applicable to Region 2**

**NOC**

**4.2.21A**

## Agenda item 7(H)

### **3/7/8 Issue H – Modifications to RR Appendix 4 items to be provided for non-geostationary satellite systems not subject to the procedures of Section II of RR Article 9**

#### **3/7/8.1 Executive summary**

Issue H relates to the need to ensure that enough orbital characteristics are provided in the advance publication information (API) for frequency assignments to non-geostationary-satellite orbit (non-GSO) systems in frequency bands not subject to coordination under Section II of RR Article 9 which would allow potentially affected administrations to model a non-GSO system as soon as the API is published. With the results of its analysis, they will be able to present their concerns to the notifying administration and the Radiocommunication Bureau under RR No. 9.3.

As a result, the ITU-R identified a single method to address this Issue. This method proposes to extend the requirement to provide items for frequency assignments of non-GSO systems in frequency bands subject to coordination under Section II of RR Article 9 of RR Appendix 4 parameters (namely the right ascension of the ascending node, the longitude of the ascending node and the associated date and time, the argument of the perigee) to API and notification filings for frequency assignments to non-GSO systems in frequency bands not subject to coordination under Section II of RR Article 9. Those requirements would apply only for non-GSO systems, for which the relative distribution of the orbital planes and satellites is known, identified by additional RR Appendix 4 data items. It is also proposed to add new RR Appendix 4 data items for frequency assignments to non-GSO systems in frequency bands not subject to coordination under Section II of RR Article 9: mandatory items, identifying whether the orbit is sun-synchronous or not, and optional items, providing the local time of the ascending node (LTAN) for sun-synchronous orbits.

#### **3/7/8.2 Background**

The RR Appendix 4 items provided in the API for frequency assignments to non-GSO networks or systems in frequency bands not subject to coordination under Section II of RR Article 9 are used initially by administrations to identify potential interference scenarios to their existing and planned systems and to formulate their comments under RR No. 9.3. The capability of these administrations to identify such potential scenarios depends, amongst other things, on whether the satellite orbits can be properly modelled based on the information provided in the API. The modelling of the orbit of satellites of non-GSO systems requires significantly more information than a GSO satellite network. Recent analysis performed for non-GSO satellite networks or systems based on APIs as published in the Radiocommunication Bureau International Frequency Information Circular (BR IFIC) have shown that, in some instances, there is a need for additional information in order to properly model the satellite orbits.

#### **3/7/8.3 Summary and analysis of the results of ITU-R studies**

Frequency assignments to a non-GSO network or system for which an API is required are not subject to the procedures of Section II in RR Article 9. However, any affected administration shall communicate their concerns with respect to any anticipated interference involving any of its existing or planned systems in accordance with RR No. 9.3. The formulation of these concerns requires modelling the orbit of the non-GSO satellites for the identification of potential interference scenarios.

In general, to model a satellite orbit, a set of parameters typically referred to as the classical orbital elements are required, as follows:

- 1) semimajor axis ( $a$ );
- 2) eccentricity ( $\epsilon$ );
- 3) inclination angle ( $i$ );
- 4) right ascension of the ascending node ( $\Omega$ ), the point where the satellite crosses the equatorial plane in the south-to-north direction;
- 5) argument of the perigee ( $\omega$ ), the angle between the ascending node and the perigee, measured in the orbital plane in the direction of the motion;
- 6) epoch time ( $t$ ), is the time at which the orbital elements are observed, and
- 7) mean anomaly ( $M$ ), gives the position of the satellite in its orbital path.

The first two parameters relate to the shape of the orbit. The third, fourth and fifth elements relate to the orientation of the orbit with respect to the Earth. The seventh element relates to the actual position of the satellite in the orbit. Furthermore, some of these elements (including  $\Omega$ ,  $\omega$  and  $M$ ) are time-dependent and specifically associated with an epoch time.

Under the current RR Appendix 4, each API shall contain information about the following RR Appendix 4 items:

- Item A.4.b.4.a, the angle of inclination of the orbital plane with respect to the Earth's equatorial plane;
- Item A.4.b.4.c, the period;
- Item A.4.b.4.d, the altitude, in kilometres, of the apogee of the space station, and
- Item A.4.b.4.e, the altitude, in kilometres, of the perigee of the space station.

These RR Appendix 4 items provide information on the shape of the orbit but not the complete information on the actual orientation of the orbit with respect to the Earth. In fact, of the four RR Appendix 4 items referred to above, only one of the three parameters required to define the orientation of the satellite orbit with respect to the Earth is provided (i.e. the angle of inclination of orbital planes).

In order to assess the impact of such limited information on the ability to properly model a non-GSO satellite orbit, there is a need to consider the different type of orbits case-by-case.

#### **Case 1: API for non-GSO satellites with a circular orbit**

In the case of a circular orbit, characterized by a constant altitude, there is no perigee and, as a result, information about the argument of the perigee is not relevant.

The right ascension of the ascending node (RAAN) appears to be important in the case of a repeating ground track orbit. In this case, the non-GSO satellite passes periodically over the same locations on the globe. For other types of non-GSO circular orbits, the RAAN may not be critical for the identification of potential interference scenarios. However, it may play a more fundamental role in the detailed discussions amongst administrations/operators during the coordination process.

In the case of a constellation of non-GSO satellites with a circular orbit, additional information is required to properly model the constellation. This includes:

- 1) the distribution of the orbital planes around the Earth;
- 2) the distribution of the non-GSO satellites within each plane, and
- 3) the phasing between satellites in adjacent planes.

However, we note that in the current RR Appendix 4, the additional information referred to above, could be derived from the CR/C. To illustrate, the inclusion of the RAAN for each orbital plane (item A.4.b.5.a of RR Appendix 4) in the CR/C provides sufficient information to conclude on the distribution of the orbital planes around the Earth. The same conclusion applies for the initial phase angle for each satellite of the constellation (item A.4.b.5.b of RR Appendix 4) with respect to the distribution of the non-GSO satellites within each plane and the phasing between non-GSO satellites in adjacent planes. As a result, the extension of the requirement to provide items A.4.b.5.a and A.4.b.5.b in APIs appears to be a potential option. However, as indicated earlier, some of these RR Appendix 4 data elements (e.g. the RAAN) are associated to an epoch time and, as such, are not time invariant. In fact, the requirement to provide the RAAN for each plane at an early stage of the system design and prior to their launch appears to be problematic. As an alternative to the RAAN, it may be possible to use the longitudes of the ascending node for all orbital planes given at the same reference time (no need to provide a specific date or a specific time at the location corresponding to the longitudes of the ascending node). It is noted that this item already exists in RR Appendix 4 and is required for the calculations of the epfd in some frequency bands (see item A.4.b.6.g).

It should be noted that provision of the additional information on orbit parameters is only possible for constellation-type non-GSO systems, for which the relative distribution of the orbital planes and satellites is known. For some cases, when non-GSO systems contain a set of typical orbits implemented on a case-by-case basis, the relative distribution of the orbital planes and satellites could not be described (i.e. TT&C systems for launch vehicles with different trajectories, manned missions, etc.).

#### **Case 2: API for non-GSO satellites with a highly elliptical orbit (HEO)**

The HEO type of orbit for a non-GSO system is generally selected to ensure that the satellite system to be launched will have some very specific attributes, such as the ability to cover certain specific land mass or other portions of the Earth. In this context, the orbital characteristics related to the orientation of the orbital planes, including the RAAN and the argument of the perigee, cannot all be randomly selected.

In a relatively recent BR IFIC (# 2833), an API was filed for a HEO system with the following orbital characteristics:

- A.4.b.4.a, the angle of inclination of the orbital plane with respect to the Earth equatorial plane: 63.435 degrees;
- A.4.b.4.c, the period: 17 hours and 47 minutes;
- A.4.b.4.d, the altitude in kilometres of the apogee of the space station: 53 795 km;
- A.4.b.4.e, the altitude in kilometres of the perigee of the space station: 26 313.4 km.

It is important to note that, in theory, there is a limitless number of non-GSO satellite orbits that can be derived from this information resulting from the multiple combinations of RAAN (that can vary from 0 to 360 degrees) and the argument of the perigee (that can vary from 0 to 360 degrees). However, as for the circular orbit, the RAAN would be critical in case of a repeating ground track. For other types of HEO orbits, the RAAN may not be critical for the identification of potential interference scenario. As for Case 1 above, an alternative to the RAAN could be the longitudes of the ascending node for all of the orbital planes at the same reference time, removing the need to provide a specific date or a specific time at the location corresponding to the longitudes of the ascending node.

The argument of the perigee provides administrations with critical information on the positioning of the Earth with respect to the two foci of the ellipse describing the trajectory of the HEO satellite. To illustrate, in the context of the example referred above, an argument of the perigee of 90 degrees



will indicate an intention to provide radiocommunication services in the Southern hemisphere while an argument of the perigee of 270 degrees will be for services in the Northern hemisphere.

Adding the argument of the perigee to the list of RR Appendix 4 items to be provided in APIs will certainly help potentially affected administrations to formulate their comments without creating too much burden for the notifying administration.

It was noted that HEO non-GSO systems are usually used for radiocommunication services providing instantaneous coverage, and therefore also represent a constellation of several satellites.

In order to address Issue H and avoid complex modifications to RR Appendix 4, it may be advisable to simply extend the current requirements to provide items A.4.b.5.b (initial phase angle at a reference time), A.4.b.5.c (argument of the perigee) and the longitude of the ascending node for all orbital planes at a reference time (see A.4.b.6.g) to APIs for frequency assignments to non-GSO systems in frequency bands not subject to coordination under Section II of RR Article 9.

### **3/7/8.4 Method to satisfy Issue H**

Under this method, it is proposed to extend the requirement to provide the following items in RR Appendix 4 for APIs and notifications for frequency assignments to non-GSO systems in frequency bands not subject to coordination under Section II of RR Article 9:

- Items A.4.b.5.b (initial phase angle at a reference time) and A.4.b.5.c (argument of the perigee, which can be set to 0 for any circular or equatorial orbits). It should be noted that these items are currently required for CR/Cs for frequency assignments to non-GSO systems in frequency bands subject to coordination under Section II of RR Article 9.
- Item A.4.b.6.g (longitudes of the ascending node for all orbital planes will be required at the same reference time). It should be noted that this item is currently required for the evaluation of the epfd in some frequency bands. Furthermore, although there is a requirement to provide a date and a time in association with this item (see items A.4.b.6.h and A.4.b.6.i), it does not appear to be critical in the assessment of the epfd nor the identification of potential scenario of interference. As a result, the longitude of the ascending node does not have to be associated with a specific date and time to be useful for modelling non-GSO systems as long as the same reference time is used when providing this information (i.e.: the longitude of the ascending node at the reference time  $t = 0$  without further indication).

The above items would only be mandatory for constellation-type non-GSO systems, as shown by a new RR Appendix 4 item.

It is also proposed to add the following new items in RR Appendix 4 for APIs and notifications for frequency assignments to non-GSO systems in frequency bands not subject to coordination under Section II of RR Article 9:

- new mandatory item, identifying whether the orbit is sun-synchronous or not;
- new optional item, providing the local time of the ascending node (LTAN) for sun-synchronous orbits.

**3/7/8.5 Regulatory and procedural considerations for Issue H**

**APPENDIX 4 (REV.WRC-15)**

**Consolidated list and tables of characteristics for use in the  
application of the procedures of Chapter III**

**ANNEX 2**

**Characteristics of satellite networks, earth stations  
or radio astronomy stations<sup>2</sup> (Rev.WRC-12)**

**Footnotes to Tables A, B, C and D**

MOD

TABLE A  
GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,  
EARTH STATION OR RADIO ASTRONOMY STATION (Rev.WRC-19)

Items in Appendix	A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.4.b	<b>For space station(s) onboard non-geostationary satellite(s):</b>										A.4.b	
A.4.b.1	the number of orbital planes			X		X					A.4.b.1	
A.4.b.1.a	Indicator of whether the non-geostationary satellite system represents a “constellation”, where a term “constellation” describes a satellite system, for which the relative distribution of the orbital planes and satellites is defined. <i>only required in frequency bands not subject to the provisions of Nos. 9.11A, 9.12 or 9.12A, or Nos. 22.5C, 22.5D or 22.5F</i> <u>Note: Non-geostationary satellite systems in frequency bands subject to the provisions of Nos. 9.11A, 9.12 or 9.12A, or Nos. 22.5C, 22.5D or 22.5F are always considered as “constellations”.</u>			X		+					A.4.b.1.a	
A.4.b.2	the reference body code		X	X		X					A.4.b.2	
A.4.b.3	<b>For space stations of a non-geostationary fixed-satellite service system operating in the frequency band 3 400-4 200 MHz:</b>										A.4.b.3	
A.4.b.3.a	the maximum number of space stations ( $N_N$ ) in a non-geostationary-satellite system simultaneously transmitting on a co-frequency basis in the fixed-satellite service in the Northern Hemisphere			X		X					A.4.b.3.a	

Items in Appendix	A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.4.b.3.b	the maximum number of space stations ( $N_S$ ) in a non-geostationary-satellite system simultaneously transmitting on a co-frequency basis in the fixed-satellite service in the Southern Hemisphere			X		X					A.4.b.3.b	
A.4.b.4	<b>For each orbital plane, where the Earth is the reference body:</b>										A.4.b.4	
A.4.b.4.a	the angle of inclination ( $i_j$ ) of the orbital plane with respect to the Earth's equatorial plane ( $0^\circ \leq i_j < 180^\circ$ )			X		X					A.4.b.4.a	
A.4.b.4.b	the number of satellites in the orbital plane			X		X					A.4.b.4.b	
A.4.b.4.c	the period			X		X					A.4.b.4.c	
A.4.b.4.d	the altitude, in kilometres, of the apogee of the space station			X		X					A.4.b.4.d	
A.4.b.4.e	the altitude, in kilometres, of the perigee of the space station			X		X					A.4.b.4.e	
A.4.b.4.f	the minimum altitude of the space station above the surface of the Earth at which any satellite transmits			X		X					A.4.b.4.f	
A.4.b.4.g	the right ascension of the ascending node ( $\Omega_j$ ) for the $j$ -th orbital plane, measured counter-clockwise in the equatorial plane from the direction of the vernal equinox to the point where the satellite makes its South-to-North crossing of the equatorial plane ( $0^\circ \leq \Omega_j < 360^\circ$ ) <i>Only required for space stations operating in a frequency band subject to the provisions of Nos. 9.11A, 9.12 or 9.12A</i>					+					A.4.b.4.g	
A.4.b.4.h	the initial phase angle ( $\omega_i$ ) of the $i$ -th satellite in its orbital plane at reference time $t = 0$ , measured from the point of the ascending node ( $0^\circ \leq \omega_i < 360^\circ$ ) <i>only required in case of a non-geostationary satellite system representing a "constellation" (A.4.b.1.a), or in frequency bands subject to the provisions of Nos. 9.11A, 9.12 or 9.12A, or Nos. 22.5C, 22.5D or 22.5F)</i>			+		+					A.4.b.4.h	

Items in Appendix	A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.4.b.4.i	the argument of perigee ( $\omega_p$ ), measured in the orbital plane, in the direction of motion, from the ascending node to the perigee ( $0^\circ \leq \omega_p < 360^\circ$ ) <i>only required in case of a non-geostationary satellite system representing a "constellation" (A.4.b.1.a), or in frequency bands subject to the provisions of Nos. 9.11A, 9.12 or 9.12A, or Nos. 22.5C, 22.5D or 22.5F)</i>			+		+					A.4.b.4.i	
A.4.b.4.j	the longitude of the ascending node ( $\theta_j$ ) for the $j$ -th orbital plane, measured counter-clockwise in the equatorial plane from the Greenwich meridian to the point where the satellite orbit makes its South-to-North crossing of the equatorial plane ( $0^\circ \leq \theta_j < 360^\circ$ ) <i>only required in case of a non-geostationary satellite system representing a "constellation" (A.4.b.1.a), or in frequency bands subject to Nos. 22.5C, 22.5D or 22.5F</i> <i>Note - All satellites in all orbital planes must use the same reference time. If no reference time is provided in A.4.b.4.k and A.4.b.4.l, it is assumed to be <math>t=0</math></i>			+		+					A.4.b.4.j	
A.4.b.4.k	the date (day:month:year) at which the satellite is at the location defined by the longitude of the ascending node ( $\theta_j$ ), (see Note under A.4.b.4.j)			O		O					A.4.b.4.k	
A.4.b.4.l	the time (hours:minutes) at which the satellite is at the location defined by the longitude of the ascending node ( $\theta_j$ ), (see Note under A.4.b.4.j)			O		O					A.4.b.4.l	
A.4.b.4.m	indicator of whether the space station uses sun-synchronous orbit or not <i>only required in frequency bands not subject to the provisions of Nos 9.11A, 9.12 or 9.12A</i>			X		+					A.4.b.4.m	
A.4.b.4.n	if the space station uses sun-synchronous orbit (A.4.b.4.m), the local time of the ascending node (solar local time when the space station is crossing the equator plane in the South-North direction in hours:minutes format)			O		O					A.4.b.4.n	
A.4.b.5	<b>Not used</b>											

Items in Appendix	A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.4.b.6	<b>For space stations operating in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F, additional data elements to characterize properly the orbital operation of the non-geostationary-satellite system:</b>										A.4.b.6	
A.4.b.6.a	<b>For each range of latitudes:</b>										A.4.b.6.a	
A.4.b.6.a.1	the maximum number of non-geostationary satellites transmitting with overlapping frequencies to a given location					X					A.4.b.6.a.1	
A.4.b.6.a.2	the associated start of the latitude range					X					A.4.b.6.a.2	
A.4.b.6.a.3	the associated end of the latitude range					X					A.4.b.6.a.3	
A.4.b.6.b	<b>Not used</b>										A.4.b.6.b	
A.4.b.6.c	an indicator showing whether the space station uses station-keeping to maintain a repeating ground track					X					A.4.b.6.c	
A.4.b.6.d	if the space station uses station-keeping to maintain a repeating ground track, the time in seconds that it takes for the constellation to return to its starting position, i.e. such that all satellites are in the same location with respect to the Earth and each other					+					A.4.b.6.d	
A.4.b.6.e	an indicator showing whether the space station should be modelled with a specific precession rate of the ascending node of the orbit instead of the $J_2$ term					X					A.4.b.6.e	
A.4.b.6.f	if the space station is to be modelled with a specific precession rate of the ascending node of the orbit instead of the $J_2$ term, the precession rate in degrees/day, measured counter-clockwise in the equatorial plane					+					A.4.b.6.f	
A.4.b.6.g	the longitudinal tolerance of the longitude of the ascending node					X					A.4.b.6.g	



## Agenda item 7(I)

### **3/7/9 Issue I – Additional RR Appendix 4 data items to be provided for non-geostationary satellite systems with multiple orbital planes**

#### **3/7/9.1 Executive summary**

Nowadays, when an administration submits the coordination request (CR/C) of a non-geostationary-satellite (non-GSO) system under RR Appendix 4, more information is needed by the Radiocommunication Bureau to ensure the correct CR/C type that the notifying administration has sent. As the Bureau has to seek clarification to properly identify the CR/C type, the possible affected administrations also do not have all the technical information needed to make their own analysis.

WRC-19 agenda item 7, Issue I relates to the need to include specific RR Appendix 4 data items to clarify whether the advance publication information (API) or the CR/C submitted by administrations represents a single non-GSO system or multiple, mutually exclusive configurations of a non-GSO system. It was identified that if more technical information about the frequency assignments of a non-GSO system is given in the submission of API or CR/C, as appropriate, it would increase the capability of the administrations to model a non-GSO system in such a way that they will be able to formulate comments to the notifying administration and the Radiocommunication Bureau under RR Nos. 9.3 or 9.52. A more complete filing would also reduce the Bureau's necessity to request additional information from the notifying administration.

As a result, the ITU-R identified a single method to address this Issue. Under this method, it is proposed to add two new RR Appendix 4 data items: an indicator of whether all of the orbital planes define a single non-GSO system or multiple mutually exclusive configurations and in the case of the latter, another RR Appendix 4 data item for the provision of an exhaustive list of the potential orbital plane configurations.

#### **3/7/9.2 Background**

WRC-15 endorsed the recommendation of the Radiocommunication Bureau Director to allow two types of submissions for the coordination request (CR/C) for frequency assignments to non-GSO systems:

- 1) CR/C for frequency assignments to a non-GSO system with one (or more than one) set(s) of orbital characteristics with an indication that all frequency assignments of the system would be operated simultaneously;
- 2) CR/C for frequency assignments to a non-GSO system with different sets of orbital characteristics with an indication that the different sets of orbital planes would be mutually exclusive, i.e. satellites on these sets of orbits would not be operated simultaneously and only one of these sets of orbital planes would be implemented.

However, no modification was made to RR Appendix 4 to ensure the proper identification of the type of CR/C, leading the Bureau to systematically seek clarification from notifying administrations in case of a submission of a CR/C for frequency assignments to a non-GSO system with multiple orbital planes. Subsequently, the Radio Regulations Board adopted a Rules of Procedure for the receivability of non-GSO systems which implements the two types of submissions endorsed by WRC-15.

Although WRC-15 did not specifically address the case of frequency assignments to non-GSO systems with multiple planes in frequency bands not subject to coordination under Section II of RR



Article 9, it is important to consider the same level of flexibility for the submission of API and to reflect it in RR Appendix 4.

### **3/7/9.3 Summary and analysis of the results of ITU-R studies**

Under the current RR Appendix 4, frequency assignments can be linked to multiple orbital planes in a single API or CR/C, as appropriate. Therefore, the challenge for potentially affected administrations would be to be able to determine if the API or CR/C is:

- describing a single non-GSO system, or
- describing the multiple potential configurations of a single non-GSO system to be implemented.

To illustrate the bullets above, in an API or CR/C filing containing four orbital planes, the goal of the operator may be to implement:

- a non-GSO system consisting of all the orbital planes;
- a non-GSO system consisting of only one of the four orbital planes, or
- a non-GSO system consisting of any grouping of the orbital planes provided in the filing.

Ultimately, the various implementation plans have to be communicated to the Bureau. Under the current practice, the Radiocommunication Bureau is seeking this information from the notifying administration by letters after the receipt of an API or a CR/C filing containing multiple orbital planes.

One potential improvement may consist in providing the relevant information in the initial submission to the Radiocommunication Bureau to avoid unnecessary correspondence amongst the involved parties.

### **3/7/9.4 Method to satisfy Issue I**

Under this method, it is proposed to include two new items in RR Appendix 4 for the provision of information relating to the multiple orbital planes and their relationship with respect to the non-GSO system:

- new item A.4.b.1.a: indicator of whether all of the orbital planes identified under A.4.b.1 describe a single configuration where all orbits are operated simultaneously or multiple, mutually exclusive configurations identified at the coordination stage with the expectation to select a single configuration at the notification stage. This new item is required for both APIs and CR/Cs as appropriate, when the filing contains more than one orbital plane;
- new item A.4.b.1.b: in case the number of orbital planes identified under A.4.b.1 describe multiple mutually exclusive configurations, this new item allows for the identification of the orbital planes that are associated with each of the mutually exclusive configurations. This new item is required for both APIs and CR/Cs as appropriate, only if the proposed new item A.4.b.1.a is different from 1.

**3/7/9.5 Regulatory and procedural considerations for Issue I**

**APPENDIX 4 (REV.WRC-15)**

**Consolidated list and tables of characteristics for use in the  
application of the procedures of Chapter III**

**ANNEX 2**

**Characteristics of satellite networks, earth stations  
or radio astronomy stations<sup>2</sup> (Rev.WRC-12)**

**Footnotes to Tables A, B, C and D**

**Table of characteristics to be submitted for space and radio astronomy services**  
(Rev.WRC-12)

**MOD**

**TABLE A**  
**GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,**  
**EARTH STATION OR RADIO ASTRONOMY STATION** (Rev.WRC-19)

Items in Appendix	<i>A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION</i>	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.4.b	<b>For space station(s) onboard non-geostationary satellite(s):</b>										A.4.b	
A.4.b.1	the number of orbital planes			X		X					A.4.b.1	
A.4.b.1.a	Indicator of whether all the orbital planes identified under A.4.b.1 describe a single configuration, multiple configurations that will operate simultaneously, or multiple configurations that are mutually exclusive  Required only for the advance publication information and coordination request of non-geostationary-satellite systems			X		+					A.4.b.1.a	
A.4.b.1.b	In case the orbital planes identified under A.4.b.1 describe multiple mutually exclusive configurations, identification of the orbital planes that are associated with each of the mutually exclusive configurations  Required in the advance publication information and coordination request for non-geostationary-satellite systems			X		+					A.4.b.1.a.1	
A.4.b.2	the reference body code		X	X		X					A.4.b.2	
A.4.b.3	<b>For space stations of a non-geostationary fixed-satellite service system operating in the frequency band 3 400-4 200 MHz:</b>										A.4.b.3	



## Agenda item 7(J)

### **3/7/10 Issue J – Pfd limit in Section 1, Annex 1 of RR Appendix 30**

#### **3/7/10.1 Executive summary**

Issue J deals with the possibility of the exceedance of the power flux-density (pfd) limit for the broadcasting-satellite service (BSS) networks in the List.

The pfd limit of  $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  was established for additional use in Regions 1 and 3 in order to protect BSS networks outside the coordination arc of  $\pm 9$  degrees. In the case that an administration applies the relevant provisions of RR Article 23 to request the exclusion of its territory from the service areas of BSS networks of other administrations, such BSS networks of other administrations are not entitled to be protected within the territory of the objecting administration. According to the idea above, the pfd limit of  $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  may be exceeded only within the national territory of the notifying administration providing that, on the border areas and other territory of another country, this pfd limit is not exceeded.

Under WRC-19 agenda item 7 Issue J, two methods are provided. Method J1 proposes modifications to Section 1, Annex 1 of RR Appendix 30 and Method J2 proposes no changes to the Radio Regulations.

#### **3/7/10.2 Background**

Although WRC-2000 adopted a revised Plan that generally assigned ten channels per administration in Region 1 and twelve channels per administration in Region 3, this channel capacity may not be enough to meet a national requirement in terms of spectrum for UHD TV or any future generation of HDTV.

In order to provide the advanced BSS applications like UHD TV (see Recommendation [ITU-R BT.2020](#)), a modulation scheme with high spectrum efficiency (e.g. APSK) and high required C/N (carrier-to-noise ratio) is necessary (see Recommendation [ITU-R BO.2098](#) and Report [ITU-R BO.2397](#)). In that situation, a pfd value exceeding the limit of  $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  within the service area is required in order to achieve the same service availability as the conventional BSS.

§ 5.2.1 d) of RR Appendix 30, specifies that the limit of  $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  could be exceeded under some conditions.

- *in the case of the notification of Plan assignments, use of an e.i.r.p. which produces a pfd that exceeds the limit of  $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  given in Section 1 of Annex 1 to Appendix 30 on the territory of the notifying administration under the condition that the calculated pfd at test points of any Plan assignment, List assignment or proposed assignment submitted under Article 4 are equal to or below that of the original Plan assignments in the same channel of the administration applying this section.*

This Issue J is in response to these requirements for providing new BSS applications.

#### **3/7/10.3 Summary and analysis of the results of ITU-R studies**

##### **3/7/10.3.1 Current practice in the Bureau's examination**

The current practice in the Bureau's examination on the pfd limit is as follows.

In accordance with the first paragraph of Annex 1 to RR Appendix 30, "Under assumed free-space propagation conditions, the power flux-density of a proposed new or modified assignment in the

List shall not exceed the value of  $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ ”, the pfd produced by each assignment of an incoming Article 4 BSS submission under examination is calculated at any downlink test point located in Regions 1 and 3 and is compared with the value of  $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$ .

The downlink test points used by the Bureau in this examination are those associated with all BSS assignments:

- in Regions 1 and 3 BSS Plan and List;
- of any previous Regions 1 and 3 Article 4 BSS submissions, which are still at the stage of application of that Article;
- of the incoming Article 4 BSS submission under examination.

Any excess leads to an unfavourable finding, even if the limit is exceeded only at a test point located inside the territory of the notifying administration.

In this connection, it should be noted that, except for some test points associated with assignments in Regions 1 and 3 BSS Plan, which were adopted by WARC-77 and WRC-2000, any other above-mentioned test point has to be located on land inside the associated service area(s) and be visible from the associated satellite. If it is determined through GIMS (Graphical Interference Management System) that a submitted test point is located at sea, irrespective of how close it is to the territory of an administration, that test point is not accepted by the Bureau.

### **3/7/10.3.2 Results of ITU-R studies on the pfd limit**

The Rules of Procedure addresses implementation of the pfd limit referred to in the first paragraph of Section 1 of Annex 1 to RR Appendix 30 as a hard limit that shall not be exceeded in order to protect BSS assignments from interference that may be caused by BSS networks located outside an arc of  $\pm 9^\circ$  around a wanted BSS network.

In the case that an administration applies the relevant provisions of RR Article 23 to request the exclusion of its territory from the service areas of BSS networks of other administrations, such BSS networks of other administrations are not entitled to be protected within the territory of the objecting administration (i.e. the notifying administration mentioned above). It should be also noted that coordination among BSS networks belonging to the same notifying administration is an internal matter of that administration.

If that limit is not exceeded outside the territory of the notifying administration, the BSS networks outside the coordination arc of other administrations are protected outside the territory of the notifying administration. For the BSS networks inside the coordination arc of other administrations, the current coordination procedure continues to be applied.

According to the idea above, the pfd limit of  $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  may be exceeded only within the national territory of the notifying administration providing that, on the border areas and other territory of another country, this pfd limit is not exceeded. Therefore, this pfd exceedance should not be allowed for networks submitted by an international satellite organization or an administration that acts on behalf of a group of named administrations.

From the viewpoint of spectrum, the frequency assignment should not overlap with the guardbands in order to ensure the protection of services in adjacent frequency bands.

### **3/7/10.4 Methods to satisfy Issue J**

#### **3/7/10.4.1 Method J1**

It is proposed that Section 1, Annex 1 of RR Appendix **30** needs to be modified in order to allow List assignments to exceed the pfd limit given in Section 1 of Annex 1 to RR Appendix **30** only within the national territory of the notifying administration under the condition that the assignment does not overlap with the Regions 1 and 3 guardbands as defined in § 3.9 of Annex 5 to RR Appendix **30** and also under the condition that, on the border areas and other territory of another country, this pfd limit is not exceeded.

#### **3/7/10.4.2 Method J2**

Under this method, there is no change to the Radio Regulations since the pfd limit referred to in the first paragraph of Section 1 of Annex 1 to RR Appendix **30** is a hard limit that shall not be exceeded in order to protect BSS assignments from interference that may be caused by BSS networks located outside an arc of  $\pm 9^\circ$  around a wanted BSS network.

### **3/7/10.5 Regulatory and procedural considerations for Issue J**

#### **3/7/10.5.1 Method J1**

## **APPENDIX 30 (REV.WRC-15)\***

### **Provisions for all services and associated Plans and List<sup>1</sup> for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)**

## **ANNEX 1 (REV.WRC-15)**

### **Limits for determining whether a service of an administration is affected by a proposed modification to the Region 2 Plan or by a proposed new or modified assignment in the Regions 1 and 3 List or when it is necessary under this Appendix to seek the agreement of any other administration<sup>25</sup>**

#### **MOD**

#### **1 Limits for the interference into frequency assignments in conformity with the Regions 1 and 3 Plan or with the Regions 1 and 3 List or into new or modified assignments in the Regions 1 and 3 List**

Under assumed free-space propagation conditions, the power flux-density of a proposed new or modified assignment in the List shall not exceed the value of  $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}^{26}$ .

...

---

<sup>26</sup> The limit of  $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  may be exceeded only within the territory under the jurisdiction of the notifying administration, under the condition that the frequency assignment does not overlap with the Regions 1 and 3 guardbands. This power flux-density (pfd) exceedance is limited to assignments submitted by an administration acting on its own behalf.

The limit of  $-103.6 \text{ dB(W/(m}^2 \cdot 27 \text{ MHz))}$  on the border areas and other territory under jurisdiction of any other administration shall not be exceeded. In the case that any administration reports that this limit is exceeded over the territory under its jurisdiction, the administration which operates assignments with exceedance of pfd upon receipt of the report of exceedance of the pfd shall immediately reduce the exceedance to an acceptable level over the territory of the administration which reported the exceedance of pfd. (WRC-19)



**3/7/10.5.2 Method J2**

**APPENDIX 30 (REV.WRC-15)\***

**Provisions for all services and associated Plans and List<sup>1</sup> for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-03)**

**ANNEX 1 (REV.WRC-15)**

**Limits for determining whether a service of an administration is affected by a proposed modification to the Region 2 Plan or by a proposed new or modified assignment in the Regions 1 and 3 List or when it is necessary under this Appendix to seek the agreement of any other administration<sup>25</sup>**

**NOC**

- 1 Limits for the interference into frequency assignments in conformity with the Regions 1 and 3 Plan or with the Regions 1 and 3 List or into new or modified assignments in the Regions 1 and 3 List**

## Agenda item 7(K)

### **3/7/11 Issue K – Difficulties for Part B examinations under § 4.1.12 or 4.2.16 of RR Appendices 30 and 30A and § 6.21 c) of RR Appendix 30B**

#### **3/7/11.1 Executive summary**

To address the difficulties encountered by the notifying administration in the Part B examination of its junior network (herein after referred to as “Network JR”) under RR Appendices **30** and **30A** § 4.1.12 or § 4.2.16 or RR Appendix **30B** § 6.21 c), it is proposed to add one more examination under § 4.1.12 or § 4.2.16 RR Appendices **30** and **30A** and § 6.21 c) of RR Appendix **30B** such that should any remaining affected networks whose assignments have been entered in the List or Plan, as appropriate, before the submission under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.17 of RR Appendix **30B**, the Bureau shall further examine if the remaining corresponding assignments in the List or Plan are still considered as being affected.

In this way, like the current practice today, if examination under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.21 c) of RR Appendix **30B** of Part B of a junior network (herein after referred to as “Network JR-Part B”) in respect of Part A of a senior network (herein after referred to as “Network SR-Part A”) is favourable, the senior network (herein after referred to as “Network SR”) is considered as not being affected like today and no further examination will be conducted.

Meanwhile, it addresses the difficulties experienced by the notifying administration and allows its notice submitted under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.17 of RR Appendix **30B** (Network JR-Part B) to receive favourable findings in respect of Network SR if Network SR-Part B is considered as not affected in the further examination based on the method of Annex 1 (RR Appendix **30**), Annex 1 (RR Appendix **30A**) or Annex 4 (RR Appendix **30B**). This avoids overprotection of Network SR based on the characteristics which are outdated and no longer valid while ensuring Network SR is adequately protected.

The following sections, 3/7/11.2 Background as well as 3/7/11.3 Summary and analysis of the results of ITU-R studies, describe this Issue using RR Appendix **30B** as an example. However, the same principle applies to RR Appendices **30** and **30A**.

Only one method is proposed to satisfy Issue K.

#### **3/7/11.2 Background**

Examination under RR Appendix **30B** § 6.21 c) is based on the assignments for which the Bureau has previously received complete information in accordance with § 6.1 (i.e. Network SR-Part A) even though the Network SR-Part B has already been published under § 6.23 or § 6.25 with much reduced characteristics (e.g. reduced service area and coverage area) and from that Part B publication, Network SR-Part A no longer exists in the Appendix **30B** databases.

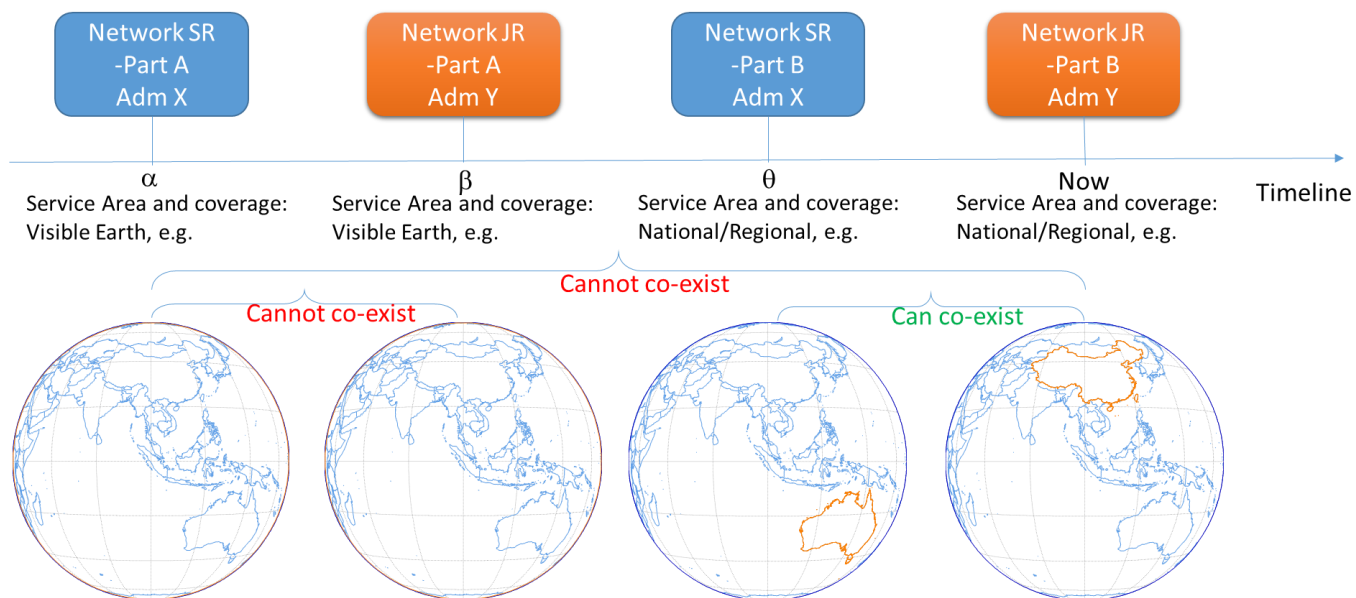
This creates difficulties to the notifying administration and may prevent its notice submitted under § 6.17 (Network JR-Part B) from entering into the List with favourable findings as the examination of its submission in respect of the senior network (Network SR-Part A) is unfavourable even though in reality, its network (Network JR-Part B) can coexist with the senior network in the List (Network SR-Part B) and if examination in respect of Network SR is based on its Part B, the examination result will become favourable.

#### **3/7/11.3 Summary and analysis of the results of ITU-R studies**

The diagram in Figure 3/7/11.3-1 illustrates the difficulties encountered by the notifying administration in its Part B examination under RR Appendix **30B** § 6.21 c).

FIGURE 3/7/11.3-1

Assumptions: Network SR and Network JR are neighboring satellite networks within the coordination arc



At this point of time, Network SR-Part A has been replaced by Network SR-Part B in the latest database.

In respect of any newly submitted networks, protection of Network SR is based on the characteristics in Network SR-Part B

**Current RR:**  
Examination under RR Appendix **30B** § 6.21 c) is based on Network SR-Part A's characteristics with which both networks cannot coexist.

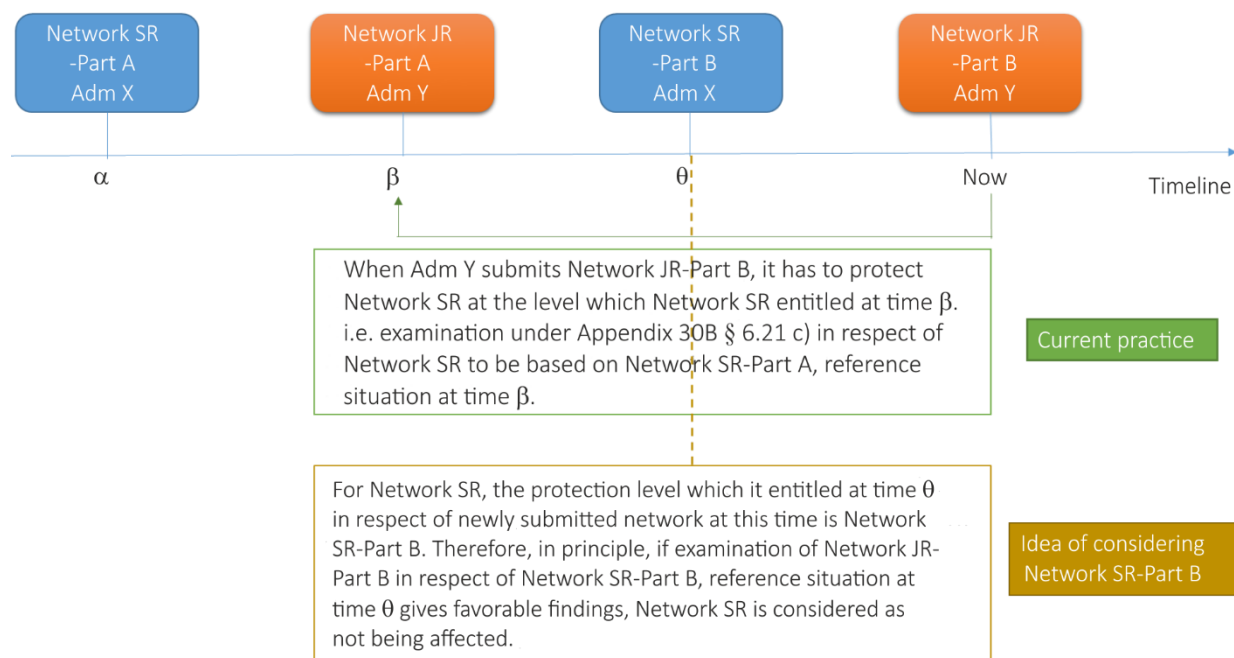
**Difficulties experienced by Adm Y:**  
Examination is unfavorable even though in reality, Network SR and Network JR can coexist and if examination in respect of Network SR is based on Network SR-Part B, examination result in respect of Network SR will become favourable.

Once an RR Appendix **30B** network (Network SR) is entered into the List and published under § 6.23 or § 6.25 (Network SR-Part B), the Network SR-Part A no longer exists in the Appendix **30B** databases from that Network SR-Part B publication. The protection level to which Network SR is entitled in respect of a newly submitted network (Network NEW) submitted after this point of time is based on Network SR-Part B.

Therefore, in principle, Network SR is considered as not being affected by Network JR-Part B if examination of Network JR-Part B in respect of Network SR-Part B using the method of Annex 4 gives favourable findings.

However, according to the current practice, the examination of Network JR-Part B is in respect of Network SR-Part A, which may lead to overprotection based on characteristics which are outdated and no longer valid.

FIGURE 3/7/11.3-2



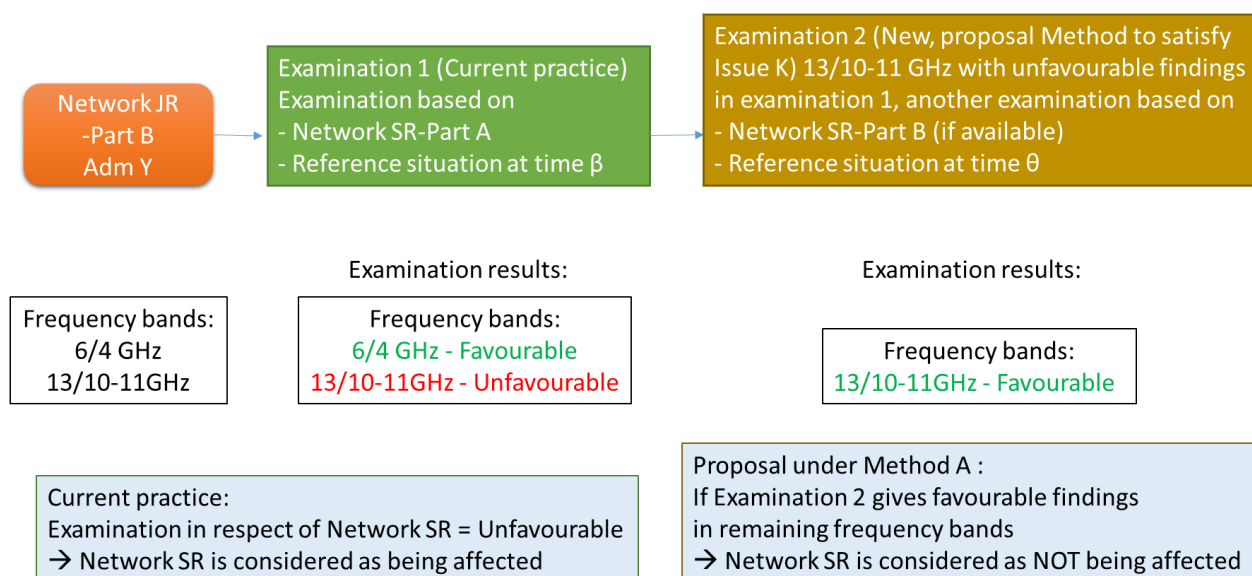
Impacts are considered if the current practice should be changed such that Network JR-Part B shall be examined with respect to Network SR-Part B instead of Network SR-Part A, if submitted (see Figure 3/7/11.3-2).

However, Network SR-Part B could potentially be more sensitive than Network SR-Part A in some area(s), in this case, the required protection level of Network SR-Part B could be higher than that of Network SR-Part A.

If the rule is changed in a way such that Network JR-Part B shall be examined with respect to Network SR-Part B instead of Network SR-Part A, if submitted, it is possible that Network JR-Part B is designed in a way which can coexist with Network SR-Part A and it can receive favourable findings in the examination under § 6.21 c) in respect of Network SR according to current practice. However, all of a sudden, the rule is changed and now Network SR requires more protection in some area(s) which caused the examination of Network JR-Part B to become unfavourable. This would lead to unintended consequences to the notifying administration (Adm Y), at the time the notifying administration is preparing its submission of Network JR-Part B, Network SR-Part B may not even be published and thus unknown to Adm Y, it is impossible for Adm Y to take into account and protect Network SR-Part B which is unknown to them.

To avoid the above-mentioned potential unintended consequences, one possible solution is to add one more examination under § 6.21 c) of RR Appendix 30B such that should any remaining affected networks (Network SR) whose assignments have been entered in the List before the submission of Network JR-Part B, the Bureau will further examine to see if Network SR-Part B remains affected. If further examination in respect of Network SR-Part B gives favourable findings, Network SR is considered as not being affected in examination under § 6.21 c). The diagram in Figure 3/7/11.3-3 illustrates the two-step examination approach proposed under the method for Issue K.

FIGURE 3/7/11.3-3



In this way, like the current practice today, if examination of Network JR-Part B in respect of Network SR-Part A is favourable, Network SR is considered as not being affected like today and no further examination will be conducted based on Network SR-Part B.

Meanwhile, it addresses the difficulties experienced by the notifying administration and allows its notice submitted under § 6.17 (Network JR-Part B) to receive favourable findings in respect of Network SR if Network SR-Part B is considered as not being affected in the further examination based on the method of Annex 4. This avoids overprotection of Network SR based on the characteristics which are outdated and no longer valid while ensuring Network SR is adequately protected.

### 3/7/11.4 Method to satisfy Issue K

This method adds one more examination under § 4.1.12 and § 4.2.16 of RR Appendices **30** and **30A** and § 6.21 c) of RR Appendix **30B** such that should any remaining affected networks whose assignments have been entered in the List before the submission under § 4.1.12 and § 4.2.16 of RR Appendices **30** and **30A** or § 6.17 of RR Appendix **30B**, the Bureau shall further examine if the remaining corresponding assignments in the List are still considered as being affected.

In this way, like the current practice today, if examination under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.21 c) of RR Appendix **30B** of Network JR-Part B in respect of Network SR-Part A is favourable, Network SR is considered as not being affected like today and no further examination will be conducted.

Meanwhile, it addresses the difficulties experienced by the notifying administration and allows its notice submitted under § 4.1.12 or § 4.2.16 of RR Appendices **30** and **30A** or § 6.17 of RR Appendix **30B** (Network JR-Part B) to receive favourable findings in respect of Network SR if Network SR-Part B is considered as not being affected in the further examination based on the method of Annex 1 (RR Appendix **30**), Annex 1 (RR Appendix **30A**) or Annex 4 (RR Appendix **30B**). This avoids overprotection of Network SR based on the characteristics which are outdated and no longer valid while ensuring Network SR is adequately protected.

**3/7/11.5 Regulatory and procedural considerations for Issue K**

**APPENDIX 30 (Rev.WRC-15)\***

**Provisions for all services and associated Plans and List<sup>1</sup> for  
the broadcasting-satellite service in the frequency bands  
11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1)  
and 12.2-12.7 GHz (in Region 2) (WRC-03)**

**ARTICLE 4 (REV.WRC-15)**

**Procedures for modifications to the Region 2 Plan or  
for additional uses in Regions 1 and 3<sup>3</sup>**

**4.1 Provisions applicable to Regions 1 and 3**

**MOD**

4.1.12<sup>XX</sup> If agreement has been reached with the administrations identified in the publication referred to under § 4.1.5 above, the administration proposing the new or modified assignment may continue with the appropriate procedure in Article 5, and shall so inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-19)

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<sup>XX</sup> Should any remaining affected networks whose assignments have been entered in the List before the notice received under § 4.1.12, the Bureau shall use the method of Annex 1 to further examine if the remaining corresponding assignments in the List are still considered as being affected. The examination in respect of those remaining affected networks is conducted independently using the Appendices **30** and **30A** master database corresponding to the Part B Special Section that was published under § 4.1.15. Resolution **548 (Rev.WRC-12)** applies. (WRC-19)

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 Plan or  
for additional uses in Regions 1 and 3<sup>3</sup>**

**4.2 Provisions applicable to Region 2**

**MOD**

4.2.16<sup>XX1</sup> If no comments have been received on the expiry of the periods specified in § 4.2.14, or if agreement has been reached with the administrations which have made comments and with which agreement is necessary, the administration proposing the modification may continue with the appropriate procedure in Article 5, and shall so inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-19)

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<sup>XX1</sup> Should any remaining affected networks whose assignments have been entered in the Plan before the notice received under § 4.2.16, the Bureau shall use the method of Annex 1 to further examine if the remaining corresponding assignments in the Plan are still considered as being affected. The examination in respect of those remaining affected networks is conducted independently using the Appendices **30** and **30A** master database corresponding to the Part B Special Section that was published under § 4.2.19. (WRC-19)

APPENDIX 30A (Rev.WRC-15)\*

**Provisions and associated Plans and List<sup>1</sup> for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz<sup>2</sup> and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-03)**

ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan or for additional uses in Regions 1 and 3**

**4.1 Provisions applicable to Regions 1 and 3**

**MOD**

4.1.12<sup>XX</sup> If agreement has been reached with the administrations identified in the publication referred to under § 4.1.5 above, the administration proposing the new or modified assignment may continue with the appropriate procedure in Article 5 and shall inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-19)

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<sup>XX</sup> Should any remaining affected networks whose assignments have been entered in the List before the notice received under § 4.1.12, the Bureau shall use the method of Annex 1 to further examine if the remaining corresponding assignments in the List are still considered as being affected. The examination in respect of those remaining affected networks is conducted independently using the Appendices 30 and 30A master database corresponding to the Part B Special Section that was published under § 4.1.15. Resolution 548 (Rev.WRC-12) applies. (WRC-19)



ARTICLE 4 (REV.WRC-15)

**Procedures for modifications to the Region 2 feeder-link Plan  
or for additional uses in Regions 1 and 3**

**4.2 Provisions applicable to Region 2**

**MOD**

4.2.16<sup>XX1</sup> If no comments have been received on the expiry of the periods specified in § 4.2.14, or if agreement has been reached with the administrations which have made comments and with which agreement is necessary, the administration proposing the modification may continue with the appropriate procedure in Article 5, and shall so inform the Bureau, indicating the final characteristics of the frequency assignment together with the names of the administrations with which agreement has been reached. (WRC-19)

APPENDIX 30B (Rev.WRC-15)

**Provisions and associated Plan for the fixed-satellite service  
in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz,  
10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz**

ARTICLE 6 (REV.WRC-15)

**Procedures for the conversion of an allotment into an assignment, for  
the introduction of an additional system or for the modification of  
an assignment in the List<sup>1,2</sup> (WRC-15)**

**MOD**

6.21 When the examination with respect to § 6.19 of an assignment received under § 6.17 leads to a favourable finding, the Bureau shall use the method of Annex 4 to examine if the affected administrations and the corresponding:

- a) allotments in the Plan;
- b) assignments which appear in the List at the date of receipt of the examined notice submitted under § 6.1;

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XX1 Should any remaining affected networks whose assignments have been entered in the Plan before the notice received under § 4.2.16, the Bureau shall use the method of Annex 1 to further examine if the remaining corresponding assignments in the Plan are still considered as being affected. The examination in respect of those remaining affected networks is conducted independently using the Appendices 30 and 30A master database corresponding to the Part B Special Section that was published under § 4.2.19. (WRC-19)

- c) assignments for which the Bureau has previously received complete information in accordance with § 6.1 and has conducted the examination under § 6.5 of this Article at the date of receipt of the examined notice submitted under § 6.1<sup>YY</sup>;

indicated in the Special Section published under § 6.7 and whose agreement has not been provided under § 6.17 are still considered as being affected by that assignment. (WRC-19)

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<sup>YY</sup> Should any remaining affected networks whose assignments have been entered in the List before the notice received under § 6.17, the Bureau shall use the method of Annex 4 to further examine if the remaining corresponding assignments in the List are still considered as being affected. The examination in respect of those remaining affected networks is conducted independently using the Appendix **30B** master database corresponding to the A6B Special Section that was published under § 6.23 or § 6.25. (WRC-19)

## Agenda item 7(L)

### **3/7/12 Issue L – Update to RR Appendix 4 data elements required for RR Article 22 epfd verification after revision of Recommendation ITU-R S.1503**

#### **3/7/12.1 Executive summary**

WRC-19 agenda item 7, Issue L, proposes revision to the data elements required for RR Article 22 epfd verification in consequence of the revision of Recommendation [ITU-R S.1503](#). At the meeting of Radiocommunication Study Group 4 held on 27 October 2017, Study Group 4 decided to seek adoption of revised Recommendation ITU-R S.1503-2 “Functional description to be used in developing software tools for determining conformity of non-geostationary-satellite orbit fixed-satellite system networks with limits contained in Article 22 of the Radio Regulations”. Revised Recommendation ITU-R S.1503-3 was then approved on 15 January 2018 after the procedure for simultaneous adoption and approval by correspondence.

The proposed changes to the data elements in consequence of this revision include:

- additional parameters, in particular the field “minimum satellite tracking duration in seconds”;
- additional degrees of flexibility in existing fields, such as the minimum elevation angle varying by both latitude and azimuth;
- ability to define sub-constellations with different sets of parameters per sub-constellation, e.g. minimum angle to the GSO arc that varies by orbit plane;
- ability to define different sets of system operating parameters by frequency band.

The new, extended, data elements are defined in addition to existing, further referred to as limited, fields to allow continuity during the transition of validation against the epfd limits in RR Article 22 using the methodology in Recommendation ITU-R S.1503-2 to that in Recommendation ITU-R S.1503-3.

In addition, there has been some clarification of terms to be consistent with their use in Recommendation ITU-R S.1503-3 and to avoid duplication.

#### **3/7/12.2 Background**

Recommendation ITU-R S.1503 defines an algorithm that can be used to determine whether a non-GSO FSS system or network meets the equivalent power flux-density (epfd) limits in RR Article 22. A revision to this Recommendation from versions ITU-R S.1503-2 to version ITU-R S.1503-3 was formally approved on 15 January 2018 after the procedure for simultaneous adoption and approval by correspondence.

The revised version introduced increased flexibility for non-GSO system operators to model their network while ensuring that the core algorithm to calculate epfd statistics was largely unchanged. This increased flexibility comes partly from new input parameters and partly from additional dimensions to existing input parameters. For example, the exclusion zone angle was assumed to be a single value in Recommendation ITU-R S.1503-2 but in the revision it can vary by latitude and frequency band.

The motivation for this work is to provide a better framework for GSO and non-GSO systems in frequency bands where there are epfd limits to protect the GSO in RR Article 22. Improvements in the detail and accuracy of the modelling of non-GSO systems can improve spectrum utilization,

increasing spectrum efficiency while maintaining the protection of the GSO. It can facilitate the introduction of new technologies and development of a wider range of non-GSO system types.

To realize these benefits it is necessary for the input data to be available, and to ensure this can occur they should be mandatory parameters defined in RR Appendix 4. Hence it is proposed to revise RR Appendix 4 to include these additional parameters.

### **3/7/12.3 Summary and analysis of the results of ITU-R studies**

Modifications to RR Appendix 4 in consequence of the revision of Recommendation ITU-R S.1503 were studied by the ITU-R and the tables below show an agreed set of changes.

### **3/7/12.4 Method to satisfy Issue L**

Under this method it is proposed to update RR Appendix 4 according to the changes shown in Section 3/7/12.5.

### **3/7/12.5 Regulatory and procedural considerations for Issue L**

## **APPENDIX 4 (REV.WRC-15)**

### **Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III**

## **ANNEX 2**

### **Characteristics of satellite networks, earth stations or radio astronomy stations<sup>2</sup> (Rev.WRC-12)**

#### **Footnotes to Tables A, B, C and D**

MOD

TABLE A  
GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,  
EARTH STATION OR RADIO ASTRONOMY STATION (Rev.WRC-19)

Items in Appendix	A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.4.b.4.g	the right ascension of the ascending node ( $\Omega_j$ ) for the $j$ -th orbital plane, measured counter-clockwise in the equatorial plane from the direction of the vernal equinox to the point where the satellite makes its South-to-North crossing of the equatorial plane ( $0^\circ \leq \Omega_j < 360^\circ$ ) Required only for space stations operating in a frequency band subject to the provisions of Nos. <b>9.11A</b> , <b>9.12</b> or <b>9.12A</b>					+					A.4.b.4.g	
A.4.b.4.h	the initial phase angle ( $\omega_i$ ) of the $i$ -th satellite in its orbital plane at reference time $t = 0$ , measured from the point of the ascending node ( $0^\circ \leq \omega_i < 360^\circ$ ) Required only for space stations operating in a frequency band subject to the provisions of Nos. <b>9.11A</b> , <b>9.12</b> or <b>9.12A</b>			+		+					A.4.b.4.h	
A.4.b.4.i	the argument of perigee ( $\omega_p$ ), measured in the orbital plane, in the direction of motion, from the ascending node to the perigee ( $0^\circ \leq \omega_p < 360^\circ$ ) Required only for space stations operating in a frequency band subject to the provisions of Nos. <b>9.11A</b> , <b>9.12</b> or <b>9.12A</b>			+		+					A.4.b.4.i	

Items in Appendix	<p align="center"><b>A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION</b></p>	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.4.b.4.j	<p>the longitude of the ascending node (<math>\theta_j</math>) for the <math>j</math>-th orbital plane, measured counter-clockwise in the equatorial plane from the Greenwich meridian to the point where the satellite orbit makes its South-to-North crossing of the equatorial plane (<math>0^\circ \leq \theta_j &lt; 360^\circ</math>)</p> <p>Required only for space stations operating in a frequency band subject to Nos. <b>22.5C</b>, <b>22.5D</b> or <b>22.5F</b> and for space stations operating in a frequency band not subject to the provisions of Nos. <b>9.11A</b>, <b>9.12</b> or <b>9.12A</b></p> <p><i>Note</i> - All satellites in the constellation must use the same reference time. If no reference time is provided in A.4.b.4.k and A.4.b.4.l, it is assumed to be <math>t=0</math>.</p>			+		+				A.4.b.4.j		
A.4.b.4.k	the date (day:month:year) at which the satellite is at the location defined by the longitude of the ascending node ( $\theta_j$ ), (see Note under A.4.b.4.j)			O		O				A.4.b.4.k		
A.4.b.4.l	the time (hours:minutes) at which the satellite is at the location defined by the longitude of the ascending node ( $\theta_j$ ), (see Note under A.4.b.4.j)			O		O				A.4.b.4.l		
A.4.b.5	<b>Not used</b>									A.4.b.5		
A.4.b.6	<b>For space stations operating in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F, additional data elements to characterize properly the orbital operation of the non-geostationary-satellite system:</b>									A.4.b.6		
A.4.b.6bis	<b>An indicator showing whether the set of operating parameters is provided in A.14.d (extended set of operating parameters) or provided in A.4.b.6.a and A.4.b.7 (limited set of operating parameters)</b>					X				A.4.b.6bis		
A.4.b.6.a	<b>For each range of latitudes:</b> the limited set of operating parameters									A.4.b.6.a		
A.4.b.6.a.1	the maximum number of non-geostationary satellites transmitting with overlapping frequencies to a given location					+				A.4.b.6.a.1		
A.4.b.6.a.2	the associated start of the latitude range					+				A.4.b.6.a.2		

Items in Appendix	A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.4.b.6.a.3	the associated end of the latitude range					+					A.4.b.6.a.3	
A.4.b.6.b	<b>Not used</b>										A.4.b.6.b	
A.4.b.6.c	an indicator showing whether the space station uses station-keeping to maintain a repeating ground track					X					A.4.b.6.c	
A.4.b.6.d	if the space station uses station-keeping to maintain a repeating ground track, the time in seconds that it takes for the constellation to return to its starting position, i.e. such that all satellites are in the same location with respect to the Earth and each other					+					A.4.b.6.d	
A.4.b.6.e	an indicator showing whether the space station should be modelled with a specific precession rate of the ascending node of the orbit instead of the $J_2$ term					X					A.4.b.6.e	
A.4.b.6.f	if the space station is to be modelled with a specific precession rate of the ascending node of the orbit instead of the $J_2$ term, the precession rate in degrees/day, measured counter-clockwise in the equatorial plane					+					A.4.b.6.f	
A.4.b.6.g	<b>Not used</b>										A.4.b.6.g	
A.4.b.6.h	<b>Not used</b>										A.4.b.6.h	
A.4.b.6.i	<b>Not used</b>										A.4.b.6.i	
A.4.b.6.j	the longitudinal tolerance of the longitude of the ascending node					X					A.4.b.6.j	
A.4.b.7	<b>For space stations operating in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F, the data elements to characterize properly the performance of the non-geostationary-satellite system: to be provided, if A.4.b.6bis indicates the limited set of operating parameters</b>										A.4.b.7	

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A.4.b.7.a	the maximum number of non-geostationary satellites receiving simultaneously with overlapping frequencies from the associated earth stations within a given cell					+					A.4.b.7.a	
A.4.b.7.b	the average number of associated earth stations with overlapping frequencies per square kilometre within a cell					+					A.4.b.7.b	
A.4.b.7.c	the average distance, in kilometres, between co-frequency cells					+					A.4.b.7.c	
A.4.b.7.cb is	the minimum elevation angle at which any associated earth station can transmit to or receive from a non-geostationary satellite					+					A.4.b.7.cbis	
A.4.b.7.d	For the exclusion zone about the geostationary-satellite orbit:										A.4.b.7.d	
A.4.b.7.d. 1	the type of zone (based on topocentric angle, satellite-based angle or other method for establishing the exclusion zone)					+					A.4.b.7.d.1	
A.4.b.7.d. 2	if the zone is based on a topocentric angle or a satellite-based angle, the width of the zone, in degrees					+					A.4.b.7.d.2	
A.4.b.7.d. 3	if an alternative method is used for establishing the exclusion zone, a detailed description of the avoidance mechanism					+					A.4.b.7.d.3	



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A.14	<b>FOR STATIONS OPERATING IN A FREQUENCY BAND SUBJECT TO Nos. 22.5C, 22.5D OR 22.5F: SPECTRUM MASKS</b>										A.14	
A.14.a	<b>For each e.i.r.p. mask used by the non-geostationary space station:</b>										A.14.a	
A.14.a.1	the mask identification code										A.14.a.1	
A.14.a.2	the lowest frequency for which the mask is valid										A.14.a.2	
A.14.a.3	the highest frequency for which the mask is valid										A.14.a.3	
A.14.a.4	the mask pattern defined in terms of the power in the reference bandwidth for a series of angles measured at the non-geostationary space station between the line to the sub-satellite point and the line to a point on the geostationary arc, together with the bandwidth used										A.14.a.4	
A.14.a.5	the reference bandwidth used for the mask pattern										A.14.a.5	
A.14.b	<b>For each associated earth station e.i.r.p. mask:</b>										A.14.b	
A.14.b.1	the mask identification code										A.14.b.1	
A.14.b.2	the lowest frequency for which the mask is valid										A.14.b.2	
A.14.b.3	the highest frequency for which the mask is valid										A.14.b.3	
A.14.b.4	<b>Not used</b>										A.14.b.4	
A.14.b.5	<b>Not used</b>										A.14.b.5	
A.14.b.6	the mask pattern defined in terms of the power in the reference bandwidth as a function of latitude and the off-axis angle between the non-geostationary earth station boresight line and the line from the non-geostationary earth station to a point on the GSO arc										A.14.b.6	

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A.14.b.7	the reference bandwidth used for the mask pattern					X					A.14.b.7	
A.14.c	<p><b>For each pfd mask used by the non-geostationary space station:</b></p> <p><i>Note</i> – The space station pfd mask is defined by the maximum power flux-density generated by any space station in the interfering non-geostationary-satellite system as seen from any point on the surface of the Earth</p>										A.14.c	
A.14.c.1	the mask identification code					X					A.14.c.1	
A.14.c.2	the lowest frequency for which the mask is valid					X					A.14.c.2	
A.14.c.3	the highest frequency for which the mask is valid					X					A.14.c.3	
A.14.c.4	the type of mask, among one of the following types: (Earth-based exclusion zone angle, difference in longitude, latitude), (satellite-based exclusion zone angle, difference in longitude, latitude) or (satellite azimuth, satellite elevation, latitude)					X					A.14.c.4	
A.14.c.5	the mask pattern of the power flux-density defined in three dimensions					X					A.14.c.5	
A.14.c.6	the reference bandwidth used for the mask pattern					X					A.14.c.6	
A.14.d	<p><b>For each set of non-geostationary satellite system operating parameters</b> to be provided, if A.4.b.6bis indicates the use of an extended set of operating parameters</p> <p><i>Note</i> – There could be different sets of parameters at different frequency bands, but only one set of operating parameters for any frequency band used by the non-geostationary system</p>					+					A.14.d	
A.14.d.1	the parameter set identification code					+					A.14.d.1	
A.14.d.2	the lowest frequency for which the mask is valid					+					A.14.d.2	
A.14.d.3	the highest frequency for which the mask is valid					+					A.14.d.3	

Items in Appendix	A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.14.d.4	minimum limit of the latitude range of non-geostationary earth station locations in degrees North					+					A.14.d.4	
A.14.d.5	maximum limit of the latitude range of non-geostationary earth station locations in degrees North					+					A.14.d.5	
A.14.d.6	the average number of associated earth stations, 1/km <sup>2</sup> , active at the same time					+					A.14.d.6	
A.14.d.7	the average distance, in kilometres, between co-frequency cell or beam footprint centre					+					A.14.d.7	
A.14.d.8	the minimum duration, in seconds, during which an earth station will track a non-geostationary satellite without handover for different ranges of latitude					+					A.14.d.8	
A.14.d.9	the maximum number of co-frequency tracked non-geostationary satellites for different ranges of latitude					+					A.14.d.9	
A.14.d.10	the exclusion zone angle (degrees), i.e. the minimum angle to the geostationary arc at the non-geostationary earth station at which it will operate defined at the earth station given latitude range <i>Note</i> – The exclusion zone angle could vary between non-geostationary system orbit planes. If identification code of orbital plane is not defined then it applies to all orbital planes					+					A.14.d.10	
A.14.d.11	the minimum elevation angle (degrees) of the non-geostationary earth station when it is receiving or transmitting within a given latitude (degrees North) and azimuth (degrees from North) range					+					A.14.d.11	

## Agenda item 7(M)

### **3/7/13 Issue M – Simplified regulatory regime for non-GSO satellite systems with short-duration missions**

#### **3/7/13.1 Executive summary**

The existing provisions of the RR for the advance publication and notification of satellites under Articles 9 and 11 do not take account of the short development cycle, the short lifetimes and the typical missions of non-GSO satellites with short-duration missions. Therefore, a simplified regulatory regime for the advance publication, notification and recording procedures for non-GSO satellite systems with short-duration missions is required. The successful and timely development and operation of non-GSO satellite systems with short-duration missions requires regulatory procedures that take account of the nature and timing for deployment of these systems.

Many of these non-GSO satellite systems are being developed by academic institutions, amateur satellite organizations, or by developing countries that are using these satellites to build their expertise in space capability. The current regulatory procedures for satellite networks and systems result in difficulties for non-GSO satellite systems with short-duration missions to be notified to the ITU. This can have adverse consequences in the management of interference as these satellite systems currently provide a range of services and are not confined to the amateur-satellite service, as was initially the case.

A draft new WRC Resolution, together with an associated regulatory regime for non-GSO satellite systems with short-duration missions, has been developed to address this issue.

#### **3/7/13.2 Background**

At WRC-15 a proposal for a new agenda item for WRC-19 “to consider modifications to the regulatory procedures for notifying satellite networks to accommodate nanosatellite and picosatellite missions” was submitted. WRC-15 decided not to include this as an item on the WRC-19 agenda, and concluded that this matter could best be dealt with by the ITU-R under the standing WRC agenda item 7.

Considering that the size of a satellite is independent of the nature of the service that it is intended to provide, a simplified regulatory regime has been developed for satellites with short-duration missions, independent of the size of the satellite.

Based on the above, ITU-R developed a method to address this issue that consists of modifications to the existing regulatory procedures for advanced publication and notification of satellite networks and systems that are not subject to Section II of RR Article 9 to facilitate the recording of non-GSO satellite systems with short-duration missions in the MIFR.

#### **3/7/13.3 Summary and analysis of the results of ITU-R studies**

Based on input contributions, ITU-R discussed and developed a simplified regulatory regime for non-GSO satellite systems with short-duration missions. This simplified regulatory regime would apply for such systems that are not subject to Section II of RR Article 9. The intent of the simplified regime is to accelerate the timing of the processing of submissions for such networks and systems in order to accommodate their rapid development and deployment cycle. It is understood that this simplified regulatory regime would not result in any special or additional rights for networks or systems using the simplified regime and that the resultant status and protection of networks and systems using the simplified regime would be the same as for any other network or system not subject to Section II of RR Article 9. This simplified regulatory regime is captured in a new WRC

Resolution together with an associated regulatory regime for non-GSO satellite systems with short-duration missions.

**3/7/13.4 Method to satisfy Issue M**

A new WRC Resolution, together with an associated regulatory regime for non-GSO satellite systems with short-duration missions, is proposed.

**3/7/13.5 Regulatory and procedural considerations for Issue M**

**MOD**

**ARTICLE 9**

**Procedure for effecting coordination with or obtaining agreement of other administrations<sup>1, 2, 3, MOD 4, 5, 6, 7, 8, 9</sup> (WRC-19)**

**MOD**

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<sup>4</sup> **A.9.4** Resolution **49 (Rev.WRC-15)**, Resolution **552 (Rev.WRC-15)** or draft new Resolution **[A7(M)-NGSO SHORT DURATION] (WRC-19)** as appropriate, shall also be applied with respect to those satellite networks and satellite systems that are subject to it. (WRC-19)

**MOD**

**ARTICLE 11**

**Notification and recording of frequency assignments<sup>1, MOD 2, 3, 4, 5, 6, 7, 8</sup> (WRC-19)**

**MOD**

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<sup>2</sup> **A.11.2** Resolution **49 (Rev.WRC-15)**, Resolution **552 (Rev.WRC-15)** or draft new Resolution **[A7(M)-NGSO SHORT DURATION] (WRC-19)** as appropriate, shall also be applied with respect to those satellite networks and satellite systems that are subject to it. (WRC-19)

**APPENDIX 4 (REV.WRC-15)**

**Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III**

## ANNEX 2

### **Characteristics of satellite networks, earth stations or radio astronomy stations<sup>2</sup>** (Rev.WRC-12)

#### **Footnotes to Tables A, B, C and D**

MOD

**TABLE A**  
**GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,  
EARTH STATION OR RADIO ASTRONOMY STATION** (Rev.WRC-19)

Items in Appendix	A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK, EARTH STATION OR RADIO ASTRONOMY STATION	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.2	<b>DATE OF BRINGING INTO USE</b>										A.2	
A.2.a	<p>the date (actual or foreseen, as appropriate) of bringing the frequency assignment (new or modified) into use</p> <p>For a frequency assignment to a GSO space station, including frequency assignments in Appendices <b>30</b>, <b>30A</b> and <b>30B</b>, the date of bringing into use is as defined in Nos. <b>11.44B</b> and <b>11.44.2</b></p> <p>For a frequency assignment to a non-GSO satellite system with a short-duration mission, the date of bringing into use is as defined in draft new Resolution [<b>A7(M)-NGSO SHORT DURATION</b>] (<b>WRC-19</b>)</p> <p>Whenever the assignment is changed in any of its basic characteristics (except in the case of a change under A.1.a, the date to be given shall be that of the latest change (actual or foreseen, as appropriate)</p> <p>Required only for notification</p>				+	+	+	+	+		A.2.a	

**ADD**

**DRAFT NEW RESOLUTION [A7(M)-NGSO SHORT DURATION] (WRC-19)**

**Simplified regulatory regime for non-GSO satellite systems  
with short-duration missions<sup>1</sup>**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that some non-GSO satellites with short-duration missions to date have been operating non-conforming assignments to the Radio Regulations on the condition not to cause harmful interference nor to claim protection (No. 4.4);
- b) that successful and timely development and operation of non-GSO satellites with short-duration missions may require regulatory procedures which take account of the short development cycle, the short lifetimes and the typical missions of such satellites, and therefore the application of certain provisions of Articles 9 and 11 of the Radio Regulations may need to be adapted to take account of the nature of these satellites;
- c) that these satellites typically have a short (one to two years) development time and are low cost, often using off-the-shelf components;
- d) that the operational lifetime of these satellites generally ranges from several weeks up to not more than three years;
- e) that non-GSO satellites with short-duration missions are being used for a wide variety of applications, including remote sensing, space weather research, upper atmosphere research, astronomy, communications, technology demonstration and education, and therefore may operate under various radiocommunication services;
- f) that advances in the field of satellite technology have resulted in non-GSO satellites with short-duration missions becoming a means for developing countries to become involved in space activities,

*considering further*

that the application of any simplified regulatory regime should have no impact on the regulatory sharing status of the allocations to services, both terrestrial and space, in frequency bands which may be used by non-GSO satellite systems with short-duration missions,

*recognizing*

- a) Resolution ITU-R 68, that seeks to improve awareness and increase knowledge on existing regulatory procedures for small satellites;
- b) that, even though satellite mass and size are not relevant from a frequency management perspective, the small mass and small dimensions of these satellites have been some of the major contributors to their success amongst new space-faring nations,

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<sup>1</sup> The definition of non-GSO satellite systems with short-duration missions is contained in *resolves* 4 and 5 of this Resolution.



*noting*

- a) Report ITU-R SA.2312 on “Characteristics, definitions and spectrum requirements of nanosatellites and picosatellites, as well as systems composed of such satellites”;
- b) Report ITU-R SA.2348 which contains descriptions of current regulatory practices relating to space network notification of such satellites,

*resolves*

- 1 that non-GSO satellite systems with short-duration missions operating under any space radiocommunication service not subject to the application of Section II of Article 9 shall be subject to the provisions of the Radio Regulations with the exceptions stipulated in the simplified regulatory regime contained in the Annex to this Resolution;
- 2 that the application of the simplified regulatory regime in the Annex to this Resolution shall have no impact, as compared to networks and systems not applying the simplified regulatory regime, on the regulatory sharing status of the allocations to services, both terrestrial and space, in frequency bands which may be used by non-GSO satellite systems with short-duration missions;
- 3 that non-GSO satellites with short-duration missions using spectrum allocated to the amateur-satellite service shall operate in accordance with the definition of the amateur-satellite service as contained in Article 25 of the Radio Regulations;
- 4 that the total number of satellites in a non-GSO satellite system with a short-duration mission shall not exceed *ten/TBD by WRC-19* satellites;
- 5 that the maximum period of operation and validity of frequency assignments of a non-GSO satellite system with a short-duration mission shall not exceed three years from the date of bringing into use of the frequency assignments (see the Annex to this Resolution for the definition of bringing into use for such systems), without any possibility of extension, after which the recorded assignments shall be cancelled;
- 6 that for the purpose of this Resolution, a non-GSO satellite system with a short-duration mission shall have a single launch date associated with the first launch (in the case of systems with multiple launches) and that launch date shall be defined as the date on which the first satellite of the non-GSO satellite system with a short-duration mission is placed into its notified orbital plane;
- 7 that non-GSO satellite systems with short-duration missions for which the regulatory regime in the Annex to this Resolution is applied will not accrue any special or additional rights under the Radio Regulations over those satellite networks or systems not applying the annexed regulatory regime,

*instructs the Director of the Radiocommunication Bureau*

- 1 to create, as soon as possible, a unique notice type associated with the application of this Resolution in order to facilitate the identification of non-GSO satellite systems with short-duration missions;
- 2 to expedite the online publication of such notices, in addition to the normal publication of notices;
- 3 to provide the necessary assistance to administrations in the implementation of this Resolution,

*invites administrations*

- 1 to cooperate in the application of the simplified regulatory regime in the Annex to this Resolution;

2 to exchange information associated with non-GSO satellite systems with short-duration missions and to make every possible effort to resolve interference that may be unacceptable to existing or planned satellite networks or systems, including those with short-duration missions;

3 to disseminate information on non-GSO satellite systems with short-duration missions in accordance with the provisions of Resolution ITU-R 68,

*invites the ITU-R Study Groups*

to continue to study the operation and regulatory regime of non-GSO satellites with short-duration missions.

## ANNEX TO DRAFT NEW RESOLUTION [A7(M)-NGSO SHORT DURATION] (WRC-19)

### **Simplified regulatory regime for non-GSO satellite systems with short-duration missions**

1 The general provisions of the Radio Regulations shall apply to non-GSO satellite systems with short-duration missions with the following exceptions/additions.

2 That when submitting advance publication information under No. **9.1**, administrations shall submit the best estimated orbital characteristics (Appendix 4 data item A.4.b.4) known at the early development time of the satellite project.

3 In the application of No. **9.1**, the notification information cannot be communicated to the Bureau at the same time, and can only be submitted after the first launch (in the case of systems with multiple launches) of the system.

4 In the application of No. **9.2B**, on receipt of the complete information sent under Nos. **9.1** and **9.2**, the Bureau shall publish it in a Special Section of its BR IFIC within two months.

5 In the application of No. **9.3**, if, upon receipt of the BR IFIC containing information published under No. **9.2B**, any administration believes that interference which may be unacceptable may be caused to its existing or planned satellite networks or systems, it shall within *two/TBD by WRC-19 but ≤ four* months of the date of publication of the International Frequency Information Circular (BR IFIC) communicate to the publishing administration, with copy to the Bureau, its comments on the particulars of the anticipated interference to its existing or planned systems.

6 In the application of No. **11.25**, notices relating to assignments for non-GSO satellite systems with short-duration missions shall be communicated to the Bureau only after the first launch of such systems (in the case of systems with multiple launches), and not later than two months after the date of bringing into use. Irrespective of the date of receipt of the notified characteristics of the non-GSO satellite system with a short-duration mission under this Resolution, the maximum period of validity of frequency assignments of this system shall not exceed the time limit in *resolves 5* of this Resolution. At the expiry date of period of validity, as described in *resolves 5* of this Resolution, the Bureau shall publish a suppression of the related Special Section. Administrations submitting notifications under No. **11.25** for non-GSO satellite systems with short-duration missions shall also submit a commitment to the Bureau stating that in case unacceptable interference is not resolved it shall undertake to eliminate the interference or reduce it to an acceptable level agreed by the affected administrations. This commitment shall be considered part of the complete information for the notice.

7 In the application of No. **11.28** the Bureau's publication of the notice is not required.

8 In the application of No. **11.31** the Bureau shall, within no more than three months from the date of receipt of complete and correct information under No. **11.28**, complete its examination of the submitted notice.

9 In addition to the application of No. **11.36** the Bureau shall publish the characteristics of the system together with the findings under No. **11.31** in the BR IFIC and on its website. This single publication shall replace the publications referred to in Article **11**.

10 In the application of No. **11.44**, the date of bringing into use of a non-GSO satellite system with a short-duration mission shall be considered automatically as the launch date of the system (see *resolves* 6 of this Resolution).

11 No. **11.47** shall not apply to non-GSO satellite systems with short-duration missions.

12 No. **11.49** shall not apply to non-GSO satellite systems with short-duration missions.

## Agenda item 9.1

9 to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:

9.1 on the activities of the Radiocommunication Sector since WRC-15;

NOTE: Nine issues have been identified by CPM19-1 under this agenda item.

### Agenda item 9.1(9.1.2)

#### **3/9.1.2 Resolution 761 (WRC-15)**

*Compatibility of International Mobile Telecommunications and broadcasting-satellite service (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3*

(WP 4A and WP 5D / (WP 6A))

#### **3/9.1.2/1 Executive summary**

Pursuant to Resolution **761 (WRC-15)**, the regulatory and technical studies between International Mobile Telecommunications (IMT) and the broadcasting-satellite service (sound) (BSS (sound)) in the frequency band 1 452-1 492 MHz in Regions 1 and 3 were conducted by ITU-R, taking into account IMT and BSS (sound) operational requirements.

The purpose of the studies is to respond to the *resolves to invite ITU-R* as contained in Resolution **761 (WRC-15)** in order to enable WRC-19 to decide on the matter, as appropriate.

Currently, RR No. **9.19**, *inter alia*, applies with respect to the coordination for potential interference from IMT systems into the BSS (sound) receivers across the border between different countries within the satellite network service area. At the same time, RR No. **9.11** applies currently with respect to the coordination for potential interference from a BSS (sound) space station into IMT receivers. In addition, associated Resolutions **33 (Rev.WRC-15)**, **507 (Rev.WRC-15)** and **528 (Rev.WRC-15)** apply. On this basis, the coordination and power flux-density limit solutions are currently in consideration, noting that maintaining the status quo (i.e. no changes to the Radio Regulations) is also a solution.

#### **3/9.1.2/2 Background**

The frequency band 1 452-1 492 MHz is allocated to the fixed service (FS), mobile service (MS), broadcasting service (BS) and broadcasting-satellite service (BSS). Based on the outcome of WRC-15, the frequency band 1 452-1 492 MHz is identified for use by Regions 1 and 3 administrations wishing to implement IMT in accordance with Resolution **223 (Rev.WRC-15)** and Resolution **761 (WRC-15)** (see RR Nos. **5.346** and **5.346A**). Pursuant to Resolution **528 (Rev.WRC-15)**, in the interim period, broadcasting-satellite systems may only be introduced within the upper 25 MHz of this frequency band in accordance with the procedures contained in Sections A to C of Resolution **33 (Rev.WRC-15)**, or in RR Articles **9** to **14**, as appropriate (see *resolves* 1 and 2 of Resolution **33 (Rev.WRC-15)**). The complementary terrestrial service may be introduced during this interim period subject to coordination with administrations whose services may be affected.

Based on the ITU BR database, there are many satellite network filings submitted for coordination in the frequency band 1 467-1 492 MHz in which the orbital positions of the space stations are distributed globally in the GSO. Some of these satellite networks are operational and their frequency assignments are already recorded in the Master International Frequency Register (MIFR).

To this effect, in order to avoid retroactive impact on the BSS (sound), necessary transitional measures are required to be decided by the conference, e.g. for networks in operation or for networks for which complete coordination information has been received by the Radiocommunication Bureau under RR Article 9 before the last day of WRC-19 or for networks which will be brought into use before the last day of WRC-19. When deciding on the appropriate date to be applied regarding the avoidance of a retroactive impact on the BSS (sound) and to properly manage avoidance of excessive and multiple submissions (warehousing of spectrum/orbital resources) before the date of application, WRC-19 could consider the timeline/process relating to satellite networks design stage for which complete RR Appendix 4 information for coordination has been received. Besides operational satellite systems, some other additional or succeeding BSS (sound) satellite systems are also planned to be deployed in the GSO. Currently, the coordination procedures in RR Nos. 9.11 and 9.19 are applied in order to reach the required sharing and compatibility conditions between the BSS and terrestrial services.

### **3/9.1.2/3 Summary and analysis of the results of ITU-R studies**

#### **3/9.1.2/3.1 Applicable ITU-R Recommendations and Reports**

Recommendations: [ITU-R BO.789](#), [ITU-R BO.1130](#), [ITU-R P.452](#), [ITU-R P.1546](#), [ITU-R P.2001](#), [ITU-R M.2101](#)

Reports: [ITU-R M.2292](#)

WDPDN Report ITU-R M.[IMT&BSS COMPATIBILITY]

ITU-R Handbook: [DSB Handbook – Terrestrial and satellite digital sound broadcasting to vehicular, portable and fixed receivers in the VHF/UHF bands](#)

Recommendation [ITU-R P.452](#) is a path specific interference prediction method which requires a terrain profile. Recommendation [ITU-R P.1546](#) is a path general terrestrial model derived from measurements over gently rolling terrain.

#### **3/9.1.2/3.2 BSS (sound) applications**

##### **3/9.1.2/3.2.1 Overview of BSS (sound) system characteristics**

BSS systems operating in the frequency band 1 452-1 492 MHz provide an essential capability that cannot efficiently or effectively be replicated by two-way terrestrial systems. They can provide seamless coverage over an entire nation, region or continent reaching billions of people with multiple channels of programming, using a fraction of the bandwidth required by two-way terrestrial systems for equivalent services. The programming, including educational content, emergency notifications, news and entertainment, can be provided in sound, data and video format to fixed-site and mobile terminals. In the event of a natural or man-made disaster, where terrestrial infrastructure might be damaged or destroyed, the broadcast satellite capability would not be affected.

While the broadcasting-satellite systems currently deployed in the frequency band 1 452-1 492 MHz provide mobile services mostly to cars, new, higher-powered satellites will leverage the propagation characteristics of the frequency band to reach small handheld terminals, computer tablets and other mobile devices. This capability is important to support government and general population requirements in rural and remote areas that would otherwise not be serviced by the broadcasting service, as well as in more densely populated areas where terrestrial mobile services are well developed. The ability of BSS applications to reach many customers is very important for the public service.

### **3/9.1.2/3.2.2 BSS (sound) high power requirement**

Satellites have proven themselves to be an important and effective broadcast technology, especially when covering very large regions. New BSS (sound) applications are planned for provision to smart phones and tablets (without an external antenna), which could be complementary to IMT services. However, reaching small terminals while supporting high quality of service and providing high capacity, requires very high satellite power<sup>26</sup>.

In particular, BSS handheld terminal receivers require the satellite signal to overcome body losses, multipath, shadowing and ill-defined antenna patterns, and therefore limiting power levels would preclude such services (see the details for this high power requirements in the relevant parts of the WDPDN Report ITU-R M.[IMT & BSS COMPATIBILITY]).

### **3/9.1.2/3.2.3 BSS (sound) terrestrial augmentations requirement**

Existing BSS systems that have been widely adopted rely on terrestrial augmentations to reach places unreachable by satellites, such as urban canyons or along highways with low-elevation look-angles to the satellite. In such systems, transmission from BSS and terrestrial augmentations are compatible, as they broadcast the same programmes and are operated by the same entity. Enabling technologies include: 1) buffering programming to enable seamless switching between the satellite and terrestrial augmentations and 2) combining satellite and terrestrial signals to improve the overall signal-to-noise ratio (SNR).

However, since these terrestrial augmentations are used in particular applications for which no typical characteristics are available, and because in general satellite reception is deemed to be more sensible to interference than augmentation systems, it has been agreed that terrestrial augmentations would not be taken into account in the compatibility studies.

### **3/9.1.2/3.2.4 BSS (sound) protection requirement**

From the viewpoint of avoiding interference, an exclusive use for the BSS (sound) may be preferred, in which complementary terrestrial sound broadcasting deployment is practical.

During the ITU-R studies, it was agreed that the  $I/N$  ratio of  $-12.2$  dB be used as the protection criteria for BSS (sound) receiver, and can be treated as the BSS (sound) receiver protection requirement from IMT single-entry interference across national borders.

## **3/9.1.2/3.3 IMT applications**

### **3/9.1.2/3.3.1 IMT system characteristics**

IMT systems operating in the frequency band 1 452-1 492 MHz would be able to deliver mobile broadband applications due to a good balance of capacity and coverage over relatively large areas including inside buildings. Therefore, various types of IMT deployments are expected in this frequency band in rural, urban and indoor environments using macro and small cells.

Furthermore, ITU-R is developing frequency arrangements in a revision of Recommendation [ITU-R M.1036](#). The frequency arrangements are based on i) frequency division duplex (FDD) with IMT base-station transmission only, ii) FDD using a paired arrangement with IMT base-station and mobile-station transmission and iii) time-division duplex (TDD) using an un-paired arrangement with IMT base-station and mobile-station transmission. Therefore, it was essential to consider protection of

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<sup>26</sup> See BSS (sound) satellite characteristics in Table 3-A of the WDPDN Report ITU-R M.[IMT & BSS COMPATIBILITY] Compatibility studies between IMT systems and BSS (sound) systems in the band 1 452-1 492 MHz in different countries in Regions 1 and 3.

both IMT base stations and mobile stations from BSS (sound) systems in the sharing and compatibility studies.

### **3/9.1.2/3.3.2 IMT protection requirement**

With respect to the characteristics of IMT systems to be used for sharing and compatibility studies, the parameters of IMT base stations and mobile stations are defined in the Report [ITU-R M.2292](#) in which the  $I/N$  of the protection criterion for IMT base stations and mobile stations is  $-6$  dB, respectively. In the sharing and compatibility studies, Recommendation [ITU-R M.2101](#) – *Modelling and simulation of IMT networks for use in sharing and compatibility studies* may be used.

### **3/9.1.2/3.4 Possible actions with respect to issue 9.1.2**

The following possible actions have been prepared with respect to WRC-19 agenda item 9.1, issue 9.1.2.

#### **3/9.1.2/3.4.1 Possible action 1: Maintain status quo (i.e. no changes to the Radio Regulations)**

This action is to maintain the status quo (i.e. no changes to the Radio Regulations) since the current regulations and technical conditions to ensure compatibility of IMT and BSS (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3 are sufficient and their change is not required.

#### **3/9.1.2/3.4.2 Possible action 2: Maintain status quo (i.e. no changes to the Radio Regulations) for those countries for which the frequency band is not identified for IMT**

This action is to maintain the status quo (i.e. no changes to the Radio Regulations) with respect to the countries for which the frequency band is not identified for IMT.

NOTE: With respect to the countries for which the frequency band is identified for IMT, other possible action may need to be applied.

#### **3/9.1.2/3.4.3 Possible action 3: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of BSS (sound) and stipulate pfd limits for the protection of IMT in Regions 1 and 3**

Under this action, maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of the BSS (sound). The protection of the BSS (sound) is achieved by the application of RR No. **9.19** currently in force.

On the other hand, for the protection of IMT, as indicated in *recognizing c*) in Resolution **761 (WRC-15)**, the application of RR No. **9.11** does not provide long-term stability for the operation of IMT due to the fact that only the IMT systems that would come into operation within the next three years would be protected if their coordination is agreed, and only for those three years. This situation implies that IMT systems may not be protected appropriately in those countries planning to deploy them in future, if the territory of those countries were covered by a satellite network service area provided by another country's BSS (sound) system(s). Therefore, this action is to specify pfd limit(s) at the Earth's surface produced by a space station in the BSS (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3. Then, RR No. 9.11 does not apply under this action. Three alternatives are available in this action. Alternatives 1 and 2 below stipulate the pfd limit(s) for Regions 1 and 3 in RR Table **21-4** under RR No. **21.16** taking into account the protection of IMT stations, and alternative 3 below stipulates the pfd limit(s) in a new footnote for Regions 1 and 3 taking into account the operational requirement of the BSS (sound) system pursuant to Resolution **761 (WRC-15)**. The alternative 1 is prepared for the downlink only

frequency arrangement and the alternative 2 is prepared for the FDD and TDD frequency arrangements.

**Alternative 1:**

–112.0 dB(W/m<sup>2</sup>) in 1 MHz for all angles of arrival above the horizontal plane, where this pfd limit is derived from the results of sharing and compatibility studies regarding protection of IMT mobile stations assuming 1 dB body loss.

**Alternative 2:**

- 131.3 dB(W/m<sup>2</sup>) in 1 MHz for angles of arrival ( $0^\circ \leq \delta \leq 5^\circ$ ) above the horizontal plane,
- 131.3 + 16/20( $\delta - 5$ ) dB(W/m<sup>2</sup>) in 1 MHz for angles of arrival ( $5^\circ \leq \delta \leq 25^\circ$ ) above the horizontal plane,
- 115.3 dB(W/m<sup>2</sup>) in 1 MHz for angles of arrival ( $25^\circ \leq \delta \leq 90^\circ$ ) above the horizontal plane,

where these pfd limits are derived from the results of sharing and compatibility studies regarding protection of both IMT base and mobile stations.

**Alternative 3:**

This alternative specifies pfd limitation by addition of the footnote RR No. **5.A912**, in which the operational requirement is appropriately considered as requested by Resolution **761 (WRC-15)**,

–91.5 dB(W/m<sup>2</sup>) in 4 MHz,

where this pfd limit is calculated from the e.i.r.p. value 70.8 dBW in this frequency band of a space station of BSS (sound); however, this pfd limit is not sufficient to protect IMT stations according to the results of sharing and compatibility studies. An example of a new footnote is as follows.

ARTICLE 5

**Frequency allocations**

**Section IV – Table of Frequency Allocations**

(See No. 2.1)

**MOD**

**1 300-1 525 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>1 452-1 492</b> FIXED MOBILE except aeronautical mobile 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B ADD 5.A912 5.341 5.342 5.345	<b>1 452-1 492</b> FIXED MOBILE 5.341B 5.343 5.346A BROADCASTING BROADCASTING-SATELLITE 5.208B ADD 5.A912  5.341 5.344 5.345	



**ADD**

**5.A912** Use of the frequency band 1 452-1 492 MHz in Regions 1 and 3 by the broadcasting-satellite service, and by the broadcasting service, is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (Rev.WRC-15)**. Before an administration brings into use a BSS (sound) satellite network in the frequency band 1 452-1 492 MHz, it shall ensure that the power flux-density (pfd) at the Earth’s surface produced by the space station does not exceed  $-91.5 \text{ dB(W/m}^2\text{)}$  in 4 MHz, unless otherwise agreed between the administrations concerned. (WRC-19)

**3/9.1.2/3.4.4 Possible action 4: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of IMT and stipulate pfd limits for the protection of BSS (sound) in Regions 1 and 3**

Under this action, maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of the IMT stations. The protection of IMT stations is therefore achieved by the application of RR No. **9.11** currently in force.

On the other hand, in order to ease the coordination under RR No. **9.19**, the mandatory action for the protection of BSS (sound) receivers shall be applied in which RR No. **21.2.1** shall also be considered. Then, RR No. **9.19** does not apply under this action. By modification of RR Nos. **5.346** and **5.346A**, this action stipulates the pfd limit across the borders between relevant countries, as follows.

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**1 300-1 525 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>1 452-1 492</b> FIXED MOBILE except aeronautical mobile MOD 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B 5.341 5.342 5.345	<b>1 452-1 492</b> FIXED MOBILE 5.341B 5.343 MOD 5.346A BROADCASTING BROADCASTING-SATELLITE 5.208B  5.341 5.344 5.345	

## MOD

**5.346** In Algeria, Angola, Saudi Arabia, Bahrain, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo (Rep. of the), Côte d'Ivoire, Djibouti, Egypt, United Arab Emirates, Gabon, Gambia, Ghana, Guinea, Iraq, Jordan, Kenya, Kuwait, Lesotho, Lebanon, Liberia, Madagascar, Malawi, Mali, Morocco, Mauritius, Mauritania, Mozambique, Namibia, Niger, Nigeria, Oman, Uganda, Palestine\*\*, Qatar, Dem. Rep. of the Congo, Rwanda, Senegal, Seychelles, Sudan, South Sudan, South Africa, Swaziland, Tanzania, Chad, Togo, Tunisia, Zambia, and Zimbabwe, the frequency band 1 452-1 492 MHz is identified for use by administrations listed above wishing to implement International Mobile Telecommunications (IMT) in accordance with Resolution **223 (Rev.WRC-15)**. This identification does not preclude the use of this frequency band by any other application of the services to which it is allocated and does not establish priority in the Radio Regulations. The use of this frequency band for the implementation of IMT is subject to agreement obtained under No. **9.21** with respect to the aeronautical mobile service used for aeronautical telemetry in accordance with No. **5.342**. See also Resolution **761 (WRC-15)**. Before an administration brings into use an IMT system in the frequency band 1 452-1 492 MHz, it shall ensure that the power flux-density (pfd) produced by any IMT transmitting station at 3 m above the ground of any point of the territory of any other administration which is within the service area of a satellite network in the broadcasting-satellite service in this frequency band does not exceed  $-159.4 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz))}$ , unless otherwise agreed between the administrations concerned. (WRC-19)

## MOD

**5.346A** The frequency band 1 452-1 492 MHz is identified for use by administrations in Region 3 wishing to implement International Mobile Telecommunications (IMT) in accordance with Resolution **223 (Rev.WRC-15)** and Resolution **761 (WRC-15)**. The use of this frequency band by the above administrations for the implementation of IMT is subject to agreement obtained under No. **9.21** from countries using stations of the aeronautical mobile service. This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Before an administration brings into use an IMT system in the frequency band 1 452-1 492 MHz, it shall ensure that the power flux-density (pfd) produced by any IMT transmitting station at 3 m above the ground of any point of the territory of any other administration which is within the service area of a satellite network in the broadcasting-satellite service in this frequency band does not exceed  $-159.4 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz))}$ , unless otherwise agreed between the administrations concerned. (WRC-19)

### **3/9.1.2/3.4.5 Possible action 5: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of BSS (sound) and stipulate a new coordination threshold for the protection of IMT in Regions 1 and 3**

Under this action, maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of the BSS (sound). The protection of the BSS (sound) receivers is achieved by the application of RR No. **9.19** currently in force.

Meanwhile, coordination under RR No. **9.11** is applied to address the interference from BSS (sound) into an IMT station where the pfd threshold is exceeded. Therefore, no pfd mandatory limitation is imposed under RR Article **21** to the BSS (sound) space station and no pfd mandatory limitation is set up across the borders in the 1 452-1 492 MHz frequency band. In addition, RR No. **21.2.1** should also be considered. Addition of relevant RR provisions is proposed accordingly.

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations

(See No. 2.1)

#### MOD

##### 1 300-1 525 MHz

Allocation to services		
Region 1	Region 2	Region 3
<b>1 452-1 492</b> FIXED MOBILE except aeronautical mobile 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B ADD 5.B912 5.341 5.342 5.345	<b>1 452-1 492</b> FIXED MOBILE 5.341B 5.343 5.346A BROADCASTING BROADCASTING-SATELLITE 5.208B ADD 5.B912 5.341 5.344 5.345	

#### ADD

**5.B912** Use of the frequency band 1 452-1 492 MHz in Regions 1 and 3 by the broadcasting-satellite service, and by the broadcasting service, is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (Rev.WRC-15)**. Before an administration brings into use a BSS (sound) satellite network in the frequency band 1 452-1 492 MHz, it should ensure that the power flux-density (pfd) at the Earth's surface produced by the space station does not exceed  $-106 \text{ dB(W/(m}^2 \cdot \text{MHz))}$ , unless otherwise agreed between the administrations concerned. Nos. **9.11** and **9.52C** still apply. (WRC-19)

NOTE: The pfd value  $-106 \text{ dB(W/(m}^2 \cdot \text{MHz))}$  is calculated from the e.i.r.p. value 70.8 dBW in 25 MHz of the space station of BSS (sound).

#### **3/9.1.2/3.4.6 Possible action 6: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of IMT and stipulate a new coordination threshold for the protection of BSS (sound) in Regions 1 and 3**

Under this action, maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of the IMT stations. The protection of IMT stations is achieved by the application of RR No. **9.11** currently in force.

Coordination under RR No. **9.19** is applied to address the interference from IMT system into a BSS (sound) earth station where the pfd threshold is exceeded. The BSS (sound) earth station receiver may receive aggregate interference from IMT transmissions which needs further studies.

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations

(See No. 2.1)

#### MOD

##### 1 300-1 525 MHz

Allocation to services		
Region 1	Region 2	Region 3
<b>1 452-1 492</b> FIXED MOBILE except aeronautical mobile MOD 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B 5.341 5.342 5.345	<b>1 452-1 492</b> FIXED MOBILE 5.341B 5.343 MOD 5.346A BROADCASTING BROADCASTING-SATELLITE 5.208B  5.341 5.344 5.345	

#### MOD

**5.346** In Algeria, Angola, Saudi Arabia, Bahrain, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo (Rep. of the), Côte d'Ivoire, Djibouti, Egypt, United Arab Emirates, Gabon, Gambia, Ghana, Guinea, Iraq, Jordan, Kenya, Kuwait, Lesotho, Lebanon, Liberia, Madagascar, Malawi, Mali, Morocco, Mauritius, Mauritania, Mozambique, Namibia, Niger, Nigeria, Oman, Uganda, Palestine\*\*, Qatar, Dem. Rep. of the Congo, Rwanda, Senegal, Seychelles, Sudan, South Sudan, South Africa, Swaziland, Tanzania, Chad, Togo, Tunisia, Zambia, and Zimbabwe, the frequency band 1 452-1 492 MHz is identified for use by administrations listed above wishing to implement International Mobile Telecommunications (IMT) in accordance with Resolution **223 (Rev.WRC-15)**. This identification does not preclude the use of this frequency band by any other application of the services to which it is allocated and does not establish priority in the Radio Regulations. The use of this frequency band for the implementation of IMT is subject to agreement obtained under No. **9.21** with respect to the aeronautical mobile service used for aeronautical telemetry in accordance with No. **5.342**. See also Resolution **761 (WRC-15)**. Before an administration brings into use an IMT system in the frequency band 1 452-1 492 MHz, it should ensure that the power flux-density (pfd) produced by any IMT transmitting station at 3 m above the ground of any point of the territory of any other administration which is within the service area of a satellite network in the broadcasting-satellite service in this frequency band does not exceed  $-159.4 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz))}$ , unless otherwise agreed between the administrations concerned. (WRC-19)

#### MOD

**5.346A** The frequency band 1 452-1 492 MHz is identified for use by administrations in Region 3 wishing to implement International Mobile Telecommunications (IMT) in accordance with Resolution **223 (Rev.WRC-15)** and Resolution **761 (WRC-15)**. The use of this frequency

band by the above administrations for the implementation of IMT is subject to agreement obtained under No. **9.21** from countries using stations of the aeronautical mobile service. This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Before an administration brings into use an IMT system in the frequency band 1 452-1 492 MHz, it should ensure that the power flux-density (pfd) produced by any IMT transmitting station at 3 m above the ground of any point of the territory of any other administration which is within the service area of a satellite network in the broadcasting-satellite service in this frequency band does not exceed  $-159.4 \text{ dB(W/(m}^2 \text{ 4 kHz))}$ , unless otherwise agreed between the administrations concerned. (WRC-19)

Note: Under this action, it is also proposed to keep the current application of RR Nos. **9.11** and **9.19**, and no mandatory pfd limitation set up under RR Article **21** to the BSS (sound) space station or across national borders in the 1 452-1 492 MHz frequency band. In addition, RR No. **21.2.1** should be considered.

#### **3/9.1.2/3.4.7 Possible action 7: Stipulate pfd limits for the protection of both IMT and BSS (sound) in Regions 1 and 3**

Under this action, stipulate pfd limits for the protection of both IMT and BSS (sound) in Regions 1 and 3.

The protection of IMT stations is the same as that in section 3/9.1.2/3.4.3. The protection of BSS (sound) receivers is the same as that in section 3/9.1.2/3.4.4.

#### **3/9.1.2/3.4.8 Possible action 8: Stipulate a new coordination threshold for the protection of both IMT and BSS (sound) in Regions 1 and 3**

Under this action, stipulate a new coordination threshold for the protection of both IMT and BSS (sound) in Regions 1 and 3.

The protection of IMT stations is the same as that in section 3/9.1.2/3.4.5. The protection of BSS (sound) receivers is the same as that in section 3/9.1.2/3.4.6.

### **3/9.1.2/4 Conclusions**

Based on the results of ITU-R studies as detailed in section 3/9.1.2/3.4 above, the following possible actions below were prepared in order to facilitate the long-term stability of IMT and BSS (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3.

#### **Possible action 1: Maintain status quo (i.e. no changes to the Radio Regulations)**

This action proposes to maintain the status quo (i.e. no changes to the Radio Regulations) since the current regulations and technical conditions to ensure compatibility of IMT and BSS (sound) in the frequency band 1 452-1 492 MHz in Regions 1 and 3 are sufficient and their change is not required.

#### **Possible action 2: Maintain status quo (i.e. no changes to the Radio Regulations) for those countries for which the frequency band is not identified for IMT**

This action proposes to maintain the status quo (i.e. no changes to the Radio Regulations) with respect to the countries for which the frequency band is not identified for IMT. With respect to the countries where IMT is identified the modifications to current provisions can be applied in the Radio Regulations appropriately.

**Possible action 3: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of BSS (sound) and stipulate pfd limits for the protection of IMT in Regions 1 and 3**

This action proposes to maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of the BSS (sound) receivers and to stipulate pfd limitation to BSS (sound) space stations for the protection of IMT. Alternatives 1 and 2 stipulate the pfd limit(s) in RR Table **21-4** under RR No. **21.16**, taking into account protection of IMT, pursuant to Resolution **761 (WRC-15)**.

In addition, alternative 3 stipulates the pfd limit(s) in a new footnote, taking into account the operational requirement of BSS (sound) system pursuant to Resolution **761 (WRC-15)**.

**Possible action 4: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of IMT and stipulate pfd limits for the protection of BSS (sound) in Regions 1 and 3**

This action proposes to maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of IMT stations and to stipulate pfd limitation to IMT for the protection of the BSS (sound) receivers by modification of RR Nos. **5.346** and **5.346A**.

**Possible action 5: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of BSS (sound) and stipulate a new coordination threshold for the protection of IMT in Regions 1 and 3**

This action proposes to maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of the BSS (sound) receivers, and to stipulate a coordination threshold for RR No. **9.11** based on new pfd values to reach coexistence.

**Possible action 6: Maintain status quo (i.e. no changes to the Radio Regulations) for the protection of IMT and stipulate a new coordination threshold for the protection of BSS (sound) in Regions 1 and 3**

This action proposes to maintain the status quo (i.e. no changes to the Radio Regulations) for the protection of IMT stations and to stipulate a coordination threshold for RR No. **9.19** based on new pfd values to reach coexistence for protection of BSS (sound) in Regions 1 and 3.

**Possible action 7: Stipulate pfd limits for the protection of both IMT and BSS (sound) in Regions 1 and 3**

The protection of IMT stations is the same as that in possible action 3. The protection of BSS (sound) receivers is the same as that in possible action 4.

**Possible action 8: Stipulate a new coordination threshold for the protection of both IMT and BSS (sound) in Regions 1 and 3**

The protection of IMT stations is the same as that in possible action 5. The protection of BSS (sound) receivers is the same as that in possible action 6.

The following Table 1 summarizes the possible actions as mentioned above with respect to WRC-19 agenda item 9.1, issue 9.1.2, in Regions 1 and 3.

TABLE 1

**Possible actions with respect to WRC-19 agenda item 9.1, issue 9.1.2, in Regions 1 and 3, pursuant to Resolution 761 (WRC-15)**

Possible action	Protection of IMT stations	Protection of BSS (sound) receivers
1	Maintain status quo (i.e. no changes to the Radio Regulations).	Maintain status quo (i.e. no changes to the Radio Regulations).
2	Maintain status quo (i.e. no changes to the Radio Regulations) for those countries for which the frequency band is not identified for IMT.	Maintain status quo (i.e. no changes to the Radio Regulations) for those countries for which the frequency band is not identified for IMT.
3	Stipulate pfd limit(s) for BSS (sound) space stations. Three alternatives are available in this action. <u>Alternative 1</u> : The pfd limit is stipulated in RR Table <b>21-4</b> under RR No. <b>21.16</b> taking into account protection of IMT mobile stations. <u>Alternative 2</u> : The pfd limit is stipulated in RR Table <b>21-4</b> under RR No. <b>21.16</b> taking into account protection of IMT base and mobile stations. <u>Alternative 3</u> : The pfd limit is stipulated in a new footnote taking into account the operational requirement of BSS (sound) system.	Maintain status quo (i.e. no changes to the Radio Regulations).
4	Maintain status quo (i.e. no changes to the Radio Regulations).	Stipulate pfd limit for IMT stations by modification of RR Nos. <b>5.346</b> and <b>5.346A</b> .
5	Stipulate a new coordination threshold for RR No. <b>9.11</b> based on pfd value. The pfd value is stipulated in a new footnote taking into account the e.i.r.p. value of 70.8 dBW for a space station of BSS (sound).	Maintain status quo (i.e. no changes to the Radio Regulations).
6	Maintain status quo (i.e. no changes to the Radio Regulations).	Stipulate a new coordination threshold for RR No. 9.19 based on pfd value to reach coexistence for protection of BSS (sound) receivers.
7	Stipulate pfd limit(s) for BSS (sound) space stations. Three alternatives are available in this action. <u>Alternative 1</u> : The pfd limit is stipulated in RR Table <b>21-4</b> under RR No. <b>21.16</b> taking into account protection of IMT mobile stations. <u>Alternative 2</u> : The pfd limit is stipulated in RR Table <b>21-4</b> under RR No. <b>21.16</b> taking into account protection of IMT base and mobile stations. <u>Alternative 3</u> : The pfd limit is stipulated in a new footnote taking into account the operational requirement of BSS (sound) system.	Stipulate pfd limit for IMT stations by modification of RR Nos. 5.346 and 5.346A.
8	Stipulate a new coordination threshold for RR No. <b>9.11</b> based on pfd value. The pfd value is stipulated in a new footnote taking into account the e.i.r.p. value of 70.8 dBW for a space station of BSS (sound).	Stipulate a new coordination threshold for RR No. 9.19 based on pfd value to reach coexistence for protection of BSS (sound) receivers.

Some of the possible actions described above could be included in a new WRC Resolution and Resolution **761 (WRC-15)** could then be suppressed. Alternatively, Resolution **761 (WRC-15)** could be revised.

## Agenda item 9.1(9.1.3)

### **3/9.1.3 Resolution 157 (WRC-15)**

*Study of technical and operational issues and regulatory provisions for new non-geostationary-satellite orbit systems in the 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz and 6 725-7 025 MHz frequency bands allocated to the fixed-satellite service.*

(WP 4A / WP 5A, WP 5C, (WP 3M))

#### **3/9.1.3/1 Executive summary**

Resolution **157 (WRC-15)** invites the ITU-R to study technical and operational issues and regulatory provisions for new non-geostationary-satellite orbit (non-GSO) systems in a number of frequency bands between 3 700 MHz and 7 025 MHz allocated to the fixed-satellite service, while ensuring that existing services are protected.

Specifically, in the frequency band 6 725-7 025 MHz, *resolves to invite the ITU Radiocommunication Sector d)* requests that the studies address the protection of feeder links for mobile-satellite service (MSS) systems operating in the space-to-Earth direction from unacceptable interference, pursuant to existing criteria, from co-frequency, non-GSO fixed-satellite service (FSS) system earth stations operating in the Earth-to-space direction.

In response to Resolution **157 (WRC-15)**, options have been developed to address issue 9.1.3 under WRC-19 agenda item 9.1.

#### **3/9.1.3/2 Background**

RR Article **21** contains provisions to ensure compatibility of non-GSO FSS operations with the fixed and mobile services. These provisions are in the form of pfd limits for non-GSO FSS systems. Similar to the sharing situations that led to the RR Article **22** epfd limits to protect GSO systems, the existing RR Article **21** pfd limits for 3 700-4 200 MHz were established based solely on sharing studies between highly-elliptical orbits (HEO) non-GSO systems and the fixed and mobile services. New non-GSO systems that seek to operate in these frequency bands may utilize different types of orbits.

Article **22** of the Radio Regulations contains provisions to ensure compatibility of non-GSO FSS operations with GSO networks. Among these provisions are uplink and downlink equivalent power flux-density (epfd $\uparrow$  and epfd $\downarrow$ ) limits to protect GSO networks from unacceptable interference. Regulatory provisions in RR Article **22** for sharing between non-GSO FSS systems and GSO FSS networks operating in the 6/4 GHz frequency bands were based on a particular type of HEO non-GSO system. The epfd $\downarrow$  limits in the 3 700-4 200 MHz (space-to-Earth) and epfd $\uparrow$  limits in the 5 925-6 725 MHz (Earth-to-space) frequency bands did not take into account circular orbit non-GSO systems and therefore are more stringent than in other FSS frequency bands that did consider circular orbit non-GSO systems.

RR Article **22** does not contain epfd $\downarrow$  and epfd $\uparrow$  limits for non-GSO systems in the frequency bands 4 500-4 800 MHz (space-to-Earth) and 6 725-7 025 MHz (Earth-to-space) allocated to the FSS, the use of which is subject to the provisions of RR Appendix **30B**.

At WRC-15, an issue was identified under WRC-19 agenda item 9.1 that called for the study of technical and operational issues and regulatory provisions for new non-GSO systems in frequency bands that included 6 725-7 025 MHz.



WRC-95 allocated the frequency band 6 700-7 075 MHz to FSS space-to-Earth feeder downlinks of non-GSO MSS systems on a primary basis. One worldwide, non-GSO MSS system, referred to as LEO-D in various ITU-R Recommendations has been in continuous operation in this frequency band since 1998. The potential for interference exists for co-frequency use for both of these applications between spacecraft and between earth stations if the earth stations are located in the same area. The frequency band 6 725-7 075 MHz is also used as uplink for RR Appendix **30B**. Article **22** of the Radio Regulations provides that the maximum aggregate power flux-density produced at the GSO and within  $\pm 5^\circ$  of inclination around the GSO by a non-GSO satellite system in the FSS shall not exceed  $-168$  dB (W/m<sup>2</sup>) in any 4 kHz band (see **RR No. 22.5A**).

RR Nos. **5.16** to **5.20** and **5.21** define the term tropical zone. In the tropical zone, the reliability of GSO systems in the 3 700-4 200 MHz and 5 925-6 425 MHz frequency bands is decisively undoubted. The characteristics of these frequency bands accommodate the rain attenuation issue that exists in the tropical zone. The existence of GSO satellites using the 3 700-4 200 MHz and 5 925-6 425 MHz frequency bands in developing countries especially located in the tropical zone is very important to support the economic growth of the countries through equitable distribution of ICT infrastructure, financial services, and government sector.

There is no calculation method on how to measure and/or calculate the amount of maximum aggregate power flux-density produced at the GSO and within  $\pm 5^\circ$  of inclination around the GSO by a non-GSO satellite system in the FSS. In fact, adding another category of service to those currently allocated to non-GSO systems would increase the doubt on how the receiving space station of the FSS in RR Appendix **30B** would be protected. In addition, at this stage there is no information on the new non-GSO satellite systems as referred to in the WRC-19 agenda item/issue. Therefore, there would be total uncertainty on how to measure and/or calculate the above-mentioned maximum aggregate power flux-density produced at the GSO and within  $\pm 5^\circ$  of inclination around the GSO by a non-GSO satellite system in the FSS.

Footnotes are contained in RR Article **5** to address protection of certain passive services as well as the radio astronomy service (see RR Nos. **5.458**, **5.458A** and **5.458B**).

### **3/9.1.3/3 Summary and analysis of the results of ITU-R studies**

#### **3/9.1.3/3.1 List of relevant ITU-R Recommendations, Reports and other relevant ITU-R publications**

In preparation for WRC-19, WDPDN Reports ITU-R S.[NGSO FSS 6/4 GHZ SHARING] and ITU-R S.[NGSO\_6/4-GHz] were developed, which provide studies and discussions related to WRC-19 agenda item 9.1, issue 9.1.3.

In addition, below is a non-exhaustive list of ITU-R publications whose latest version is relevant in respect of this issue:

Recommendations ITU-R S.465, ITU-R S.580, ITU-R S.672, ITU-R S.737, ITU-R S.738, ITU-R S.739, ITU-R S.740, ITU-R S.741, ITU-R S.1323, ITU-R S.1325, ITU-R S.1328, ITU-R S.1529 and ITU-R S.1781.

#### **3/9.1.3/3.2 Summary of the results of ITU-R studies**

According to Resolution **157 (WRC-15)**, sharing studies related to new non-GSO systems have been conducted.

a) *Sharing with GSO FSS in the frequency bands 3 700-4 200 MHz and 5 925-6 425 MHz*

Studies were carried out regarding sharing between circular orbit non-GSO systems and GSO networks under WRC-19 agenda item 9.1, issue 9.1.3. In the 6/4 GHz frequency band, there is minimal degradation due to propagation losses and thus the margin for protection is almost entirely dominated by the interference statistics. These studies considered the operation of a representative circular orbit non-GSO system intended to provide global broadband services. E<sub>pdf</sub> profiles were generated based on the collected statistics of this non-GSO system operation and compared against the protection criteria given in Recommendation ITU-R S.1323. The study shows that the operation of the circular orbit non-GSO system considered in the 6/4 GHz frequency bands results that FSS GSO systems are not protected (the exceedance of the protection criteria being as much as 40 dB). The application of mitigation techniques considered in the study does little to prevent the exceedance of the protection criteria.

b) *Sharing with GSO FSS in the frequency bands 4 500-4 800 MHz and 6 725-7 025 MHz*

It should be noted that according to RR No. **5.441**, the use of the frequency bands 4 500-4 800 MHz (space-to-Earth) and 6 725-7 025 MHz (Earth-to-space) by the FSS shall be in accordance with the provisions of RR Appendix **30B**, which is limited to GSO FSS networks.

Currently, sharing studies between non-GSO FSS systems and GSO FSS networks have not been conducted in these frequency bands.

c) *Sharing with HEO FSS in the frequency bands 3 700-4 200 MHz and 5 925-6 425 MHz*

One study was conducted to evaluate the probability of interference from circular orbit non-GSO FSS systems to a HEO FSS system operating in the bands frequency 3 700-3 900 MHz and 5 925-6 225 MHz. Under the relevant assumption for the characteristics and interference criteria, it shows that in the downlink scenario the *I/N* ratio could be exceeded during 0.015%-1.25% of time depending on the type of the affected earth station, configurations and parameters of the interfering LEO FSS constellation, and in the uplink scenario the LEO constellations with high inclinations may potentially exceed the long-term interference criteria and may cause interference to the HEO system, operating with earth station in the high latitudes. Considering that there are no coordination criteria and protection mitigation techniques between non-GSO FSS systems with highly elliptical and circular orbits, it is suggested to develop the regulatory approaches to ensure cooperation of non-GSO FSS HEO and LEO systems.

d) *Sharing with FSS (space-to-Earth) in the frequency band 6 700-7 025 MHz*

Two interference situations exist for bidirectional operation, i.e. spacecraft-to-spacecraft interference and earth station-to-earth station interference.

As included in the WDPDN Report ITU-R S.[NGSO FSS 6/4 GHz SHARING], spacecraft-to-spacecraft coordination may be possible, depending on specific spacecraft characteristics, such as antenna patterns, using existing coordination procedures. Earth station-to-earth station coordination will be possible using existing procedures for stations already established and filed with the ITU-R, but the case of new feeder-link stations for MSS systems could become problematic if the new non-GSO FSS earth stations are deployed on a ubiquitous or near-ubiquitous basis since large geographic areas could be blocked for the establishment of future feeder-link earth stations due to the strong likelihood of interference being caused to receiving feeder-link stations sharing frequencies with transmitting non-GSO FSS earth stations in the same geographic area.

- e) *Sharing with FS and MS in the frequency bands 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz and 6 725-7 025 MHz*

Sharing studies between new non-GSO FSS systems and the existing and planned systems in the fixed service and the mobile service have not been conducted at this stage.

### **3/9.1.3/4 Conclusions**

One study indicates that circular orbit non-GSO FSS operations in the 6/4 GHz frequency band could result in large exceedances (up to 40 dB) of the GSO protection criteria and concludes that it would be very difficult to operate a non-GSO circular orbit system for the purposes of a global broadband network in the 6/4 GHz frequency bands. Therefore, there is no need to review the values of the existing limits presented in RR Article **22** (epfd) and RR Article **21** (pfd) for the 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz, and 6 725-7 025 MHz frequency bands.

Another study suggested to establish a coordination procedure in the frequency bands 3 700-4 200 MHz and 5 925-6 425 MHz between non-GSO FSS systems under RR No. **9.12**. This study finds that there is no need to review the values of the existing limits presented in RR Article **22** (epfd) and RR Article **21** (pfd) for the 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz, and 6 725-7 025 MHz frequency bands.

## Agenda item 9.1(9.1.9)

### **3/9.1.9 Resolution 162 (WRC-15)**

*Studies relating to spectrum needs and possible allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space)*

**(WP 4A / WP 4B, WP 5A, WP 5C, WP 5D, WP 7C, WP 7D, (WP 3M))**

#### **3/9.1.9/1 Executive summary**

Resolution **162 (WRC-15)** resolves to invite ITU-R to conduct studies considering additional spectrum needs for development of the fixed-satellite service (FSS) and conduct sharing and compatibility studies with existing services to determine the suitability of new primary allocations to the FSS in the frequency band 51.4-52.4 GHz (Earth-to-space) limited to FSS gateway links for geostationary orbit use, and the possible associated regulatory actions.

ITU-R has conducted studies required by Resolution **162 (WRC-15)**. The results of analysis of additional spectrum needs are contained in DN Report ITU-R S.[SPECTRUM\_NEEDS]. The results of sharing and compatibility studies with incumbent services including the fixed service (FS), mobile service (MS), Earth exploration-satellite service (EESS) (passive), radio astronomy service (RAS), and sharing with potential IMT-2020 applications are contained in PDN Report ITU-R S.[SPECTRUM\_SHARING].

The spectrum needs were analysed and it was concluded that the additional allocation to the FSS being considered is beneficial to make broadband connections accessible to communities as achieved by high throughput satellite (HTS) systems.

The conducted studies between FSS (Earth-to-space) and incumbent services in the 51.4-52.4 GHz frequency band and in adjacent frequency bands have demonstrated the possibility of sharing and compatibility by the means of separation distances between the stations as well as by limiting the unwanted emissions falling in the passive frequency band 52.6-54.25 GHz. It was concluded that the coexistence between the FSS and FS can be achieved through separation distances between FSS earth stations and FS stations. Regarding the MS, ITU-R has confirmed that there are no ITU-R Recommendations or Reports that include system characteristics and/or protection requirements for systems in MS operating at the frequency band 51.4-52.4 GHz. However, this statement does not preclude any existing or future use of the frequency band by the MS. In addition, the frequency band 51.4-52.4 GHz is being considered for IMT-2020 identification; therefore, sharing studies with this application have been conducted. Sharing through separation distances between FSS earth stations and IMT-2020 stations is feasible under the two services.

Based on the results of studies and in order to ensure protection of the currently allocated EESS (passive) and space research service (SRS) (passive) systems in the 52.6-54.25 GHz frequency band, it is proposed to apply unwanted emission power limits on FSS earth stations, depending on the elevation angle of the FSS earth station antenna. To address the possible allocation to FSS limited to gateway links, a minimum earth station antenna size is also being considered. Regarding the protection of future GSO EESS (passive) sensors, a minimum orbital separation in the GSO arc between the FSS and EESS space stations would be required.

#### **3/9.1.9/2 Background**

Satellite systems are increasingly being used to deliver broadband services with high data rates to accommodate user demand and service expectations worldwide. Next-generation satellite networks are expected to provide data rate services from 100 Mbit/s to greater than 1 Gbit/s on a single

channel to all users regardless of location. Satellite systems enable the immediate connection of many subscribers, irrespective of their location, to broadband and Internet backbone networks with just one launch, compared to a point-by-point roll-out. By implementing advanced technologies such as spot-beam antennas and high frequency reuse factors, HTS reach many times the throughput of traditional satellites using the same amount of allocated spectrum, which leads to the reduction of Gigabits per second (Gbit/s) costs.

The limiting factor of HTS satellite networks is the amount of spectrum allocated to the forward link in the Earth-to-space segment (gateway-to-satellite link).

Current HTS systems are mainly operated in Ka-band and use the Earth-to-space allocations for both user links and gateway links, which leads to the scarcity of spectral resources in this frequency band. In order to achieve higher data rates and improve the services provided to end-users, it is proposed to use the allocation to FSS (Earth-to-space) in the 50/40 GHz frequency bands for the gateway uplink (from gateway to space station) and Ka-band allocations to FSS (Earth-to-space) for the user uplink (from user terminals to space station). Therefore, the consideration of new primary allocations to the FSS in the frequency band 51.4-52.4 GHz (Earth-to-space) limited to FSS gateway links is required.

The current frequency range of primary allocations to FSS (Earth-to-space) in the frequency bands 40/50 GHz in Regions 1, 2 and 3 is 42.5-43.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz. The two FSS Earth-to-space allocations in the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz are almost contiguous, making these 4 GHz allocations suitable for operation of wideband carriers. The additional allocation of FSS (Earth-to-space) in the 51.4-52.4 GHz frequency band will allow access to 5 GHz of almost contiguous spectrum for the uplink communications; in addition, the 42.5-43.5 GHz allocation would enable a total of 6 GHz of spectrum for Earth-to-space communications. This situation will make it more suitable for the operation of FSS systems providing high data rate services worldwide with satisfactory availabilities.

### **3/9.1.9/3 Summary and analysis of the results of ITU-R studies**

#### **3/9.1.9/3.1 Studies on spectrum needs**

Next-generation FSS satellite systems can leverage innovative technologies to provide a wide range of broadband services for residential, commercial, institutional, and professional users worldwide irrespective of their location. This can be achieved through frequency reuse by covering a given geographical area with a number of spot beams instead of using traditional wide beams. In order to meet the requirements for frequency bands used for uplink gateways, it is proposed to migrate the gateway uplinks to higher frequency bands in particular the 50/40 GHz frequency bands.

In DN Report ITU-R S.[SPECTRUM\_NEEDS], spectrum needs for development of the FSS and justification of the additional 1 GHz FSS allocation (Earth-to-space) in the 51.4-52.4 GHz frequency band are analysed. Those studies have been conducted taking into account several aspects including:

- a) the need to contribute to providing connectivity to the world's population that currently does not have access to the Internet;
- b) advances in satellite technology such as spot-beam antennas and high frequency reuse factors that are crucial to deliver broadband services everywhere, including rural and isolated areas;
- c) current allocations to the FSS in the 50/40 GHz frequency bands and the technical simplifications of satellite payloads in these frequency bands if the new allocation is granted to the FSS;

- d) improvement of the availability levels that can be reached by FSS networks operating in these frequency bands that are subject to significant propagation impairments.

The consideration of all these aspects indicate that the additional allocation to the FSS being considered would be beneficial to make reliable broadband connections more accessible to communities through satellite communication regardless of their geographical location, as achieved by HTS.

### **3/9.1.9/3.2 Relevant ITU-R Recommendations and Reports**

ITU-R Recommendations, relevant for sharing and compatibility studies under WRC-19 agenda item 9.1, issue 9.1.9, are:

- ITU-R S.1328, ITU-R S.1557, ITU-R S.465, ITU-R F.758, ITU-R F.1495, ITU-R F.1496, ITU-R F.1565, ITU-R F.1606, ITU-R F.2086, ITU-R P.452, ITU-R P.525, ITU-R P.676, ITU-R P.840, ITU-R RA.517, ITU-R RA.611, ITU-R RA.769, ITU-R RA.1031, ITU-R SM.1542, ITU-R SM.1633, ITU-R RS.1861, ITU-R M.2101, ITU-R RS.2017

ITU-R Reports, relevant for the studies under WRC-19 agenda item 9.1, issue 9.1.9, are:

- ITU-R S.2361, ITU-R RA.2131, ITU-R RA.2126, ITU-R RA.2188, ITU-R SM.2091

New ITU-R Reports developed for this issue are:

- DN Report ITU-R S.[SPECTRUM\_NEEDS], PDN Report ITU-R S.[SPECTRUM\_SHARING]

### **3/9.1.9/3.3 Compatibility and sharing studies**

In PDN Report ITU-R S.[SPECTRUM\_SHARING], sharing and compatibility studies between the potential new FSS and the FS, MS (including the potential IMT-2020 applications), RAS and the EESS (passive) were addressed to the extent that up-to-date information permitted.

Sharing studies between the FSS (Earth-to-space) and FS were conducted. To protect FS stations, separation distances up to 33 km are required when assuming FSS earth station transmission e.i.r.p. spectral density level of  $-47$  dBW/MHz and minimum antenna diameter of 4.5 m. The calculation was based on flat terrain, which means that the distance can be reduced when real terrain is taken into consideration. Studies also concluded that FSS space stations will not receive harmful interference from FS stations.

Regarding sharing with the MS, the relevant ITU-R expert group has confirmed that there are no ITU-R Recommendations or Reports that include such characteristics of land mobile service in the 51.4-52.4 GHz frequency band; the relevant ITU-R expert group has also confirmed that currently there are no maritime or aeronautical mobile systems identified in the frequency band 51.4-52.4 GHz, and therefore no ITU-R operational requirements nor technical characteristics are available. However, such confirmation does not exclude the operation of the MS nor does it exclude the future use of the frequency band by the MS.

Sharing studies between the FSS and the possible IMT-2020 applications of the MS have indicated that the required separation distances between FSS earth stations and IMT base station and IMT user equipment are 260 and 330 metres, respectively. These values may be further reduced by consideration of propagation losses other than free space, the pointing of the IMT-2020 antennas in directions other than that of the FSS earth station, and the high likelihood that the antenna pattern of the FSS earth station is more directive than the  $29-25 \log \theta$  pattern assumed in the analysis.

Regarding the RAS, RR No. **5.556** indicates that radio astronomy observations may be carried out in the frequency band 51.4-54.25 GHz under national arrangements. Compatibility studies

performed concluded that separation distances are needed to protect radio astronomy observation from FSS interference. However, it could be feasible, under certain circumstances, for GSO FSS operators to protect the radio astronomy stations operating in this frequency band in their own and neighbouring countries by choosing appropriate sites for earth stations while planning the deployments of FSS earth stations (ES).

Several compatibility studies were conducted to determine unwanted emission power limits for the protection of EESS (passive) in the frequency band 52.6-54.25 GHz.

**Study 1** was an interference analysis examining the four EESS (passive) sensors contained in Recommendation ITU-R RS.1861-0 over nine different measurement areas across the world. This study determined that the worst-case interference received in this analysis was in measurement area I (Equatorial South America), and exceeded the protection criteria by 49.12 dB using an unwanted emission power from FSS ES of 0 dBW/100 MHz falling in the passive frequency band. However, an unwanted emission power limit of  $-34.35$  dBW/100 MHz could be considered for earth stations with elevation angles below 75 degrees, without considering apportionment of the EESS protection criterion.

**Study 2** indicated that the EESS (passive) protection criterion when apportionment among services is considered, can be satisfied when the unwanted emissions from each FSS ES falling in the passive frequency band are limited to  $-39$  dBW/100 MHz for FSS earth stations with elevation angles equal or lower than  $78^\circ$ . For FSS ES with higher elevation angles, the unwanted emissions in the passive frequency band should be limited to  $-52$  dBW/100 MHz. In addition, the protection of a GSO EESS sensor identified as sensor A<sup>27</sup> would require a minimum angular separation in the GSO arc between the FSS satellite and the EESS satellite; such orbital separation varies between  $0.5^\circ$  and  $2^\circ$ , depending on the unwanted emission limits considered for the FSS ES.

**Study 3** indicated that the EESS (passive) protection criteria when apportionment among services is considered, can be satisfied when the unwanted emissions from each FSS ES falling in the passive frequency band are limited to  $-37$  dBW/100 MHz for FSS earth stations with elevation angles equal or lower than  $74^\circ$ . For FSS ES with higher elevation angles, the unwanted emissions in the passive frequency band should be limited to  $-52$  dBW/100 MHz.

**Study 4** indicates that for non-GSO conical scan sensors, different orbital altitudes may cause different interference level from FSS earth stations. In order to protect EESS (passive) sensor J2 (Recommendation ITU-R RS.1861-0), the unwanted emissions from each FSS ES should be limited to  $-64.6$  dBW/100 MHz. In order to protect EESS (passive) JX sensor<sup>28</sup>, the unwanted emissions from each FSS ES should be limited to  $-61.8$  dBW/100 MHz. The orbit separation between GSO FSS satellite and GSO EESS (passive) satellite should be not less than  $0.9^\circ$  to protect GSO EESS (passive) systems when the unwanted emissions from each FSS ES are limited to  $-45$  dBW/100 MHz.

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<sup>27</sup> Information for sensor A is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J10).

<sup>28</sup> Information for JX sensor is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J8).

**Study 5** analysed the protection of EESS (passive) sensor Meteor-M<sup>29</sup> assuming an apportionment factor of 3 dB for the EESS protection criterion and an unwanted emission power of –19.7 dBW/100 MHz of the FSS ES. The static analysis indicated that for the worst-case single-entry main-to-main beam scenario, the threshold of interference will be exceeded by 72.1 dB. A static analysis determined that there will also be a deficit of 7.4 dB when Meteor-M satellite falls within the main lobe of the transmitting FSS ES located outside the passive sensor Instantaneous Field of View (IFOV).

According to results of dynamic interference analysis the threshold interference level of –172 dBW/100 MHz (apportionment of 3 dB is applied) is exceeded by 17 dB for more than 10% of the time (corresponding to Meteor-M passive sensor data unavailability per pixel) for a single FSS earth station with 13.5 m antenna diameter (unwanted emission power in the passive frequency band of –19.7 dBW/100 MHz) and by 22 dB for 4.5 m antenna (unwanted emission power in the passive frequency band of –10.2 dBW/100 MHz). Limitations on unwanted emissions of –36.7 dBW/100 MHz within 52.6-54.25 GHz frequency band will be required for transmitting FSS ES, operating in the frequency band below 52.4 GHz to protect the Meteor-M passive sensor.

The following table summarizes the results from the five compatibility studies conducted between FSS and EESS (passive):

Study	EESS protection criteria apportionment	Protection of non-GSO EESS (passive) in Rec. ITU-R RS.1861-0: FSS ES unwanted emission limit and elevation angle	Protection of other non-GSO EESS (passive) sensors: FSS ES unwanted emission limit	Protection of GSO EESS (passive) sensor A <sup>1</sup> : FSS ES unwanted emission limit, separation angle between FSS and EESS satellites
1	No	–34 dBW/100 MHz, <75° –49 dBW/100 MHz, ≥75°		
2	3 dB	–39 dBW/100 MHz, <78° –52 dBW/100 MHz, ≥78°	Sensor JX <sup>2</sup> : –25 dBW/100 MHz	–39 dBW/100 MHz, 1.8° –52 dBW/100 MHz, 0.5°
3	3 dB	–37 dBW/100 MHz, <74° –52 dBW/100 MHz, ≥74°		
4	No	–64.6 dBW/100 MHz	Sensor JX <sup>2</sup> : –61.8 dBW/100 MHz	–45 dBW/100 MHz, 0.9°
5	3 dB		Sensor Meteor-M <sup>3</sup> : –36.7 dBW/ 100 MHz	
<sup>1</sup> Information for sensor A is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J10). <sup>2</sup> Information for JX sensor is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J8). <sup>3</sup> Information for Meteor-M sensor is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J4 (Updated)).				

<sup>29</sup> Information for Meteor-M sensor is included in preliminary draft revision of Recommendation ITU-R RS.1861 (see section 6.11, sensor J4 (Updated)).



### 3/9.1.9/4 Conclusions

In response to Resolution **162 (WRC-15)**, ITU-R developed two Reports; one on spectrum needs for development of the FSS and the second one on sharing and compatibility between FSS and existing services.

It is considered to make an allocation of the frequency band 51.4-52.4 GHz to the FSS (Earth-to-space), limited to FSS gateway links for geostationary orbit use while protecting currently allocated services in the same frequency band and in adjacent frequency bands as follows:

To protect FS stations, separation distances up to 33 km are required when assuming flat terrain, which means that the distance can be reduced when real terrain is taken into consideration. Regarding the possible IMT-2020 applications of the MS in the same frequency band, the required separation distances between FSS earth stations and IMT base station and IMT user equipment are 260 and 330 metres, respectively.

The protection of non-GSO EESS (passive) sensors operating in the frequency band 52.6-54.25 GHz can be achieved by limiting the FSS earth station unwanted emissions falling in the passive frequency band as follows:

#### Option 1A:

(-39 to -34) dBW in any 100 MHz of the EESS (passive) frequency band for FSS ES with antenna elevation angles lower than (74° to 78°)

(-52 to -49) dBW in any 100 MHz of the EESS (passive) frequency band for FSS ES with antenna elevation angles equal or higher than (74° to 78°)

#### Option 2A:

(-64 to -37) dBW in any 100 MHz of the EESS (passive) frequency band for FSS ES.

Regarding the protection of future GSO EESS (passive) sensors, it was found that angular separations between GSO FSS and GSO EESS (passive) satellites in the order of 0.5-1.8 degrees would be necessary for unwanted emission levels of the FSS earth stations falling in the passive frequency bands of -52 dBW/100 MHz and -39 dBW/100 MHz respectively. One of the following procedures (or alternatives to them) could be implemented to address this issue. In the regulatory implementation of Example 1, none of these options are yet proposed. The following description would be used as guidance for regulatory proposals to be submitted during CPM19-2.

#### Option 1B:

Ensuring a minimum angular separation in the GSO arc between the FSS and the EESS (passive) space stations. The orbital separation would vary between 0.5 and 1.8 degrees, depending on the FSS ES unwanted emission levels falling in the passive frequency band. The regulatory implementation of this procedure could be that the BR identifies the GSO EESS (passive) satellites operating at  $\pm 1.8$  degrees from the nominal orbital position of the FSS space station and includes them among the coordination requirements of the FSS network.

#### Option 2B:

To give priority to a limited number of orbital positions in the GSO arc for the operation of GSO EESS (passive) sensors. The GSO FSS networks with space stations located at less than 2 degrees separation of such positions should adjust the FSS ES emissions or ensure a maximum pfd level at the EESS satellite so as to protect the EESS (passive) sensors on board the GSO satellite. Some administrations have expressed interest to include at least the following orbital positions for protection of EESS (passive) sensors

on board GSO satellites: 0°, 3.5°E, 9.5°E, 41.5°E, 76°E, 79°E, 86.5°E, 99.5°E, 105°E, 112°E, 123.5°E, 133°E, 165.8°E, 3.2°W, 14.5°W, 75°W, and 137°W. This list of orbital positions is characteristic of expected GSO EESS (passive) locations but is not to be considered exhaustive of possible GSO EESS (passive) sensor orbital positions.

In line with *resolves* 2 of Resolution **162 (WRC-15)** involving “*the possible associated regulatory actions*”, relevant regulatory considerations are put forward as follows, including modifications to Article 5, Article 21, Appendix 7, and Resolution 750 (Rev.WRC-15) of the Radio Regulations.

Examples of possible regulatory solutions are shown below.

**Example 1:**

In this example a new primary allocation would be made to the FSS in the frequency band 51.4-52.4 GHz (Earth-to-space) in RR limited to FSS gateway links for geostationary orbit use.

ARTICLE 5

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**51.4-55.78 GHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>51.4-52.4</b>	FIXED FIXED-SATELLITE (Earth-to-space) ADD 5.A919 MOBILE 5.547 5.556 MOD 5.338A	
<b>52.4-52.6</b>	FIXED MOD 5.338A MOBILE 5.547 5.556	

**Reasons:** Allocation to the FSS (Earth-to-space).

**MOD**

**5.338A** In the frequency bands 1 350-1 400 MHz, 1 427-1 452 MHz, 22.55-23.55 GHz, 30-31.3 GHz, 49.7-50.2 GHz, 50.4-50.9 GHz, 51.4-52.4 GHz, 52.4-52.6 GHz, 81-86 GHz and 92-94 GHz, Resolution **750 (Rev.WRC-19)** applies. (WRC-19)

**Reasons:** Application of the limits for FSS ES unwanted emissions as contained in the proposed revision to Resolution **750 (Rev.WRC-15)**.

**ADD**

**5.A919** The use of the frequency band 51.4-52.4 GHz by the fixed-satellite service (Earth-to-space) is limited to geostationary satellite networks and restricted to gateway links with a minimum antenna diameter of 4.5 metres. (WRC-19)

**Reasons:** To limit the new allocation to gateways operating in FSS GSO networks.

ARTICLE 21

**Terrestrial and space services sharing frequency bands above 1 GHz**

**Section II – Power limits for terrestrial stations**

**MOD**

TABLE 21-2 (Rev.WRC-19)

Frequency band	Service	Limit as specified in Nos.
...	...	...
10.7-11.7 GHz <sup>5</sup> (Region 1) 12.5-12.75 GHz <sup>5</sup> (Nos. <b>5.494</b> and <b>5.496</b> ) 12.7-12.75 GHz <sup>5</sup> (Region 2) 12.75-13.25 GHz 13.75-14 GHz (Nos. <b>5.499</b> and <b>5.500</b> ) 14.0-14.25 GHz (No. <b>5.505</b> ) 14.25-14.3 GHz (Nos. <b>5.505</b> and <b>5.508</b> ) 14.3-14.4 GHz <sup>5</sup> (Regions 1 and 3) 14.4-14.5 GHz 14.5-14.8 GHz 51.4-52.4 GHz	Fixed-satellite	<b>21.2, 21.3 and 21.5</b>
...	...	...

**Reasons:** Inclusion of the frequency band proposed for the new allocation to FSS (Earth-to-space) for applicability of the limits in RR Nos. **21.2, 21.3 and 21.5.**

**Section III – Power limits for earth stations**

**MOD**

**TABLE 21-3** (Rev.WRC-19)

Frequency band		Services
...	...	...
14.3-14.4 GHz <sup>6</sup>	(for Regions 1 and 3)	
14.4-14.8 GHz		
17.7-18.1 GHz		Fixed-satellite
22.55-23.15 GHz		Earth exploration-satellite
27.0-27.5 GHz <sup>6</sup>	(for Regions 2 and 3)	Mobile-satellite
27.5-29.5 GHz		Space research
31.0-31.3 GHz	(for the countries listed in No. <b>5.545</b> )	
34.2-35.2 GHz	(for the countries listed in No. <b>5.550</b> with respect to the countries listed in No. <b>5.549</b> )	
51.4-52.4 GHz		Fixed-satellite

**Reasons:** Inclusion of the frequency band proposed for the new allocation to FSS (Earth-to-space) for applicability of the limits in RR No. **21.8**.

APPENDIX 7 (REV.WRC-15)

**Methods for the determination of the coordination area around an earth station in frequency bands between 100 MHz and 105 GHz**

ANNEX 7

**System parameters and predetermined coordination distances for determination of the coordination area around an earth station**

MOD

TABLE 7c (Rev.WRC-19)

**Parameters required for the determination of coordination distance for a transmitting earth station**

Transmitting space radiocommunication service designation		Fixed-satellite	Fixed-satellite <sup>2</sup>	Fixed-satellite <sup>3</sup>	Space research	Earth exploration-satellite, space research	Fixed-satellite, mobile-satellite, radionavigation-satellite	Fixed-satellite	Fixed-satellite <sup>2</sup>
Frequency bands (GHz)		24.65-25.25 27.0-29.5	28.6-29.1	29.1-29.5	34.2-34.7	40.0-40.5	42.5-47 47.2-50.2 50.4-51.4	51.4-52.4	47.2-50.2
Receiving terrestrial service designations		Fixed, mobile	Fixed, mobile	Fixed, mobile	Fixed, mobile, radiolocation	Fixed, mobile	Fixed, mobile, radionavigation	Fixed, mobile	Fixed, mobile
Method to be used		§ 2.1	§ 2.2	§ 2.2		§ 2.1, § 2.2	§ 2.1, § 2.2	§ 2.1	§ 2.2
Modulation at terrestrial station <sup>1</sup>		N	N	N		N	N	N	N
Terrestrial station interference parameters and criteria	$p_0$ (%)	0.005	0.005	0.005		0.005	0.005	0.005	0.001
	$n$	1	2	1		1	1	1	1
	$p$ (%)	0.005	0.0025	0.005		0.005	0.005	0.005	0.001
	$N_L$ (dB)	0	0	0		0	0	0	0
	$M_s$ (dB)	25	25	25		25	25	25	25
Terrestrial station parameters	$G_x$ (dBi) <sup>4</sup>	50	50	50		42	42	42	46
	$T_e$ (K)	2 000	2 000	2 000		2 600	2 600	2 600	2 000
Reference bandwidth	$B$ (Hz)	$10^6$	$10^6$	$10^6$		$10^6$	$10^6$	$10^6$	$10^6$
Permissible interference power	$P_r(p)$ (dBW) in $B$	-111	-111	-111		-110	-110	-110	-111

<sup>1</sup> A: analogue modulation; N: digital modulation.

<sup>2</sup> Non-geostationary satellites in the fixed-satellite service.

<sup>3</sup> Feeder links to non-geostationary-satellite systems in the mobile-satellite service.

<sup>4</sup> Feeder losses are not included.

**MOD**

**RESOLUTION 750 (REV.WRC-19)**

**Compatibility between the Earth exploration-satellite service (passive) and relevant active services**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

...

*noting*

- a) that the compatibility studies between relevant active and passive services operating in adjacent and nearby frequency bands are documented in Report ITU-R SM.2092 and in PDN Report ITU-R S.[SPECTRUM\_SHARING];
- b) that the compatibility studies between IMT systems in the frequency bands 1 375-1 400 MHz and 1 427-1 452 MHz and EESS (passive) systems in the frequency band 1 400-1 427 MHz are documented in Report ITU-R RS.2336;
- c) that Report ITU-R F.2239 provides the results of studies covering various scenarios between the fixed service, operating in the frequency band 81-86 GHz and/or 92-94 GHz, and the Earth exploration-satellite service (passive), operating in the frequency band 86-92 GHz;
- d) that Recommendation ITU-R RS.2017 provides the interference criteria for satellite passive remote sensing,

...

TABLE 1-1

EESS (passive) band	Active service band	Active service	Limits of unwanted emission power from active service stations in a specified bandwidth within the EESS (passive) band <sup>1</sup>
...	...	...	...
52.6-54.25 GHz	51.4-52.6 GHz	Fixed	For stations brought into use after the date of entry into force of the Final Acts of WRC-07: -33 dBW in any 100 MHz of the EESS (passive) band
52.6-54.25 GHz	51.4-52.4 GHz	Fixed-satellite (E-to-s)	For earth stations brought into use after the date of entry into force of the Final Acts of WRC-19: <b>Option 1A:</b> (-39 to -34) dBW in any 100 MHz of the EESS (passive) band for earth stations with antenna elevation angles lower than (74° to 78°) (-52 to -49) dBW in any 100 MHz of the EESS (passive) band for earth stations with antenna elevation angles equal or higher than (74° to 78°) <b>Option 2A:</b> (-64 to -37) dBW in any 100 MHz of the EESS (passive) band for earth stations.

**Reasons:** To limit the unwanted emissions from the FSS Earth stations falling in the frequency band 52.6-54.25 GHz to protect the EESS (passive) according to their elevation angle.

**Example 2:**

**NOC**

**ARTICLES**

**NOC**

**APPENDICES**

**NOC**

**RESOLUTIONS**

**Reasons:** No new allocation in the frequency band 51.4-52.4 GHz to the fixed-satellite service if the protection of existing services including EESS (**passive**) in adjacent frequency band is not ensured by technical, operational and regulatory considerations.





## CHAPTER 4

### Science services

(Agenda items 1.2, 1.3, 1.7)

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## Agenda item 1.2

(WP 7B / WP 4C, WP 5A, (WP 3M), (WP 7C), (WP 7D))

*1.2 to consider in-band power limits for earth stations operating in the mobile-satellite service, meteorological-satellite service and Earth exploration-satellite service in the frequency bands 401-403 MHz and 399.9-400.05 MHz, in accordance with Resolution 765 (WRC-15);*

*Resolution 765 (WRC-15) - Establishment of in-band power limits for earth stations operating in mobile-satellite service, the meteorological-satellite service and the Earth exploration-satellite service in the frequency bands 401-403 MHz and 399.9-400.05 MHz.*

### **4/1.2/1 Executive summary**

Taking into account the results of ITU-R studies, the objective of WRC-19 agenda item 1.2 is to consider establishing, within the Radio Regulation, in-band power limits applicable to earth stations transmissions in the frequency bands 399.9-400.05 MHz and 401-403 MHz in order to ensure the operation of existing and future systems that usually implement low or moderate output powers for mobile-satellite service (MSS), Earth exploration-satellite service (EESS) and meteorological satellite service (MetSat) systems.

PDN Report ITU-R SA.[400MHz-LIMITS] compiles elements related to background on WRC-19 agenda item 1.2 as well as technical considerations on MSS, EEES and MetSat and associated space operation functions according to RR No. 1.23 in the frequency ranges of 399.9-400.05 MHz and 401-403 MHz bands. This Report includes an analysis section providing a guidance to derive the possible e.i.r.p. (equivalent isotropically radiated power) and e.i.r.p. density limits under this agenda item while recognizing that some current and planned systems using space operation functions according to RR No. 1.23 in these bands will not be able to comply with a given set of limits.

For the band 399.9-400.05 MHz, three different methods are proposed.

For the band 401-403 MHz, two different methods are proposed.

### **4/1.2/2 Background**

Two frequency bands: 399.9-400.05 MHz for MSS (Earth-to-space), 401-403 MHz for EEES (Earth-to-space) and MetSat (Earth-to-space) are under the scope of this agenda item. These bands are mainly for data collection systems (DCS) and data collection platform systems (DCP), and may be used as associated space operation functions in accordance with RR No. 1.23. EEES, MetSat, and MSS systems in these frequency bands are currently used or planned for use by DCS that implement moderate/low power levels. In these bands, earth stations, also called platforms, are deployed and send specific information to dedicated satellites which collect the corresponding data when the platforms are in the satellite footprint. Most of these platforms are active all the time. It is to be noted that very often, customers tend to use very low powers to ensure extended lifetime of the platforms.

In addition, the bands are used as associated space operation functions as described in the PDN Report ITU-R SA.[400MHz-LIMITS] providing characteristics of some links in each of these bands. This agenda item was created as a result of the significant recent increase in use of the frequency bands 401-403 MHz and 399.9-400.05 MHz for telecommand purposes. This increase is largely attributable to increased interest by educational institutions and some commercial entities seeking to operate large fleets and constellations of satellites. A large number of these satellite networks are already filed in both bands and as can be seen from filed parameters in the ITU-R database (i.e. large uplink transmit gains for example), plan to use the frequency bands 401-403 MHz and 399.9-400.05 MHz for telecommand (see RR No. 1.135) (Earth-to-space) purposes under the EEES,

MetSat, or MSS allocations as associated space operation functions in accordance with RR No. **1.23**.

The proliferation of such telecommand usage could impact usage by the large number of existing lower power DCS stations communicating to sensitive receivers on GSO and non-GSO satellites. The output power levels of some of the earth stations referred to these telecommand links (Earth-to-space) transmitting higher data rates can be much higher than the power levels used for the operation of DCS in these frequency bands. In view of such differences in the power levels, mitigation measures would be necessary to ensure protection of the DCS platforms. Such mitigation measures require study in detail to provide guidance to the operators of telecommand links for their implementation. It should also be noted that the number of such deployed telecommand earth stations is limited and telecommand earth stations will in general operate with directive transmitting antennas affording isolation when pointing in directions separated in space from DCS satellite systems.

In the 401-403 MHz band, currently over tens of thousands of DCS stations communicating with GSO and non-GSO are deployed worldwide for the purpose of collecting essential weather and climate data. The DCP gather information activity related to the Earth, the environment and scientific application, weather, environment observation: meteorological and oceanographic, seismic observation, volcanology, geodesy and geodynamics, fishing vessel monitoring, wildlife tracking, homeland security, law enforcement, test/evaluation, monitoring shipments of dangerous goods, humanitarian applications, managing water resources or tsunami warning system, etc. The data which are collected by DCP, are sent and received by satellites in visibility of these platforms, that retransmit the retrieved information to dedicated earth stations.

In the 399.9-400.05 MHz band, several large constellations under development are planning to operate under the MSS allocation which in some cases may also include operation of associated space operation functions according to RR No. **1.23**.

### **4/1.2/3 Summary and analysis of the results of ITU-R studies**

#### **4/1.2/3.1 Relevant ITU-R recommendations and reports**

Relevant ITU-R Recommendations: ITU-R SA.2044-0, ITU-R SA.1163-2, ITU-R SA.1164-2, ITU-R SA.1627-0, ITU-R SA.1159-4, ITU-R SA.2045-0 and ITU-R M.2046-0.

PDN ITU-R Report: ITU-R SA.[400MHZ-LIMITS].

#### **4/1.2/3.2 Studies regarding the power limits**

In the frequency band 401-403 MHz, according to on-going ITU-R studies, in practice, for non-GSO satellite networks, the values of output power range from  $-3$  dBW (bandwidth of 800 Hz) up to 7 dBW (bandwidth of 6 400 Hz). In some applications, the power may decrease down to  $-25$  dBW using specific techniques such as spread spectrum multiple access. For specific bands within 401-403 MHz satellite uplink e.i.r.p. for DCS low-Earth orbiting (LEO) systems could reach 12 dBW for existing non-GSO MetSat system (i.e. Meteor-3M). The maximum value of the corresponding antenna gain is below 3 dBi, and in practice the antenna gain does not exceed 0 dBi. The antennas are most of time omnidirectional and whip antennas are used. Thus, any additional use, other than for DCS, of this limited and unique spectrum resource for DCS systems would have to blend in with appropriate power levels such that the reception of signals from data collection platforms at the satellite receivers is not interfered.

For GSO networks, it can be noted that the international data collection system (IDCS) of the DCP is based on the usage of GSO satellites, and the e.i.r.p. at the antenna output shall not exceed 22 dBW under any combination of operational conditions. The transmitted radio frequency shall use

the 11 IDCS channels (with centre frequencies spaced 3 kHz apart) from 402.034-402.067 MHz regardless of the GSO spacecraft. Other GSO channels are reserved for DCP, and there are various types of DCP transmitters in operation generally ranging from 5 W, 10 W, and 20 W output power with a directional antenna, or 40 W or even higher output power with an omnidirectional antenna. The resulting uplink e.i.r.p. is between 6 to 22 dBW. Highly elliptical orbit (HEO) DCS systems are based on the orbits with apogee of 40 000 km, which makes their characteristics similar to characteristic of the GSO DCP. For DCPs operating with HEO satellites (ARCTICA-M), uplink e.i.r.p. would not exceed 16-18 dBW.

Given the significant difference in the power level ranges of non-GSO data collection platforms compared to platforms communicating to GSO MetSat and EESS satellites, as outlined above, the establishment of e.i.r.p. limits will have to differentiate between non-GSO (LEO and medium-Earth orbit (MEO)) and GSO/HEO DCS in the 401-403 MHz frequency band.

In this respect, the establishment of an appropriate set of in-band e.i.r.p. limits in the 401-403 MHz band will have to take into account the framework set forth by the general partitioning in Recommendation ITU-R SA.2045-0 to ensure the protection of existing and future use of meteorological operations (MetSat and EESS (Earth-to-space)) in the 401-403 MHz frequency band for both non-GSO (LEO and MEO) and GSO/HEO DCS systems.

PDN Report ITU-R SA.[400 MHz-LIMITS] contains the technical characteristics and results of current ITU-R studies for in-band power limits applicable to the earth stations in the MSS in the frequency band 399.9-400.05 MHz and the MetSat and the EESS in the frequency band 401-403 MHz. The Report shows that the power limits for the earth stations operating in the EESS and MetSat in the frequency band 401-403 MHz are based on two categories: GSO/HEO and non-GSO (LEO and MEO). Regarding the MSS in the frequency band 399.9-400.05 MHz, since this band is limited to non-GSO, only one set of limits for DCS is necessary, noting that these limits will not support associated space operation functions.

The conclusion of PDN Report ITU-R SA.[400MHz-LIMITS] (see Tables 4/1.2/3-1 and 4/1.2/3-2 below) are that the earth station maximum e.i.r.p. for non-GSO DCS systems in the MSS in the frequency band 399.9-400.05 MHz, and both GSO and non-GSO DCS systems in the MetSat and the EESS in the frequency band 401-403 MHz, shall comply with the following conditions:

TABLE 4/1.2/3-1

Frequency band	Maximum e.i.r.p. of the earth stations
399.9-400.05 MHz	5 dBW

TABLE 4/1.2/3-2

Frequency band	Maximum e.i.r.p. of the earth stations	
401-403 MHz	GSO/HEO	22 dBW
	non-GSO (MEO and LEO)	7 dBW <sup>(1)</sup>

<sup>(1)</sup> The maximum e.i.r.p. for existing non-GSO MetSat system in the 401.898-402.522 MHz can be increased up to 12 dBW.

The telecommand earth station maximum e.i.r.p. for associated space operation functions in the frequency band 399.9-400.05 MHz is 18 dBW under normal mode of operation, but this value may

be exceeded by up to 14 dB under emergency mode, for short periods only, during emergency situations.

#### 4/1.2/3.3 Studies regarding the e.i.r.p. density limits

PDN Report ITU-R SA.[400MHZ-LIMITS] contains the technical characteristics and results of current ITU-R studies for in-band power limits applicable to the MetSat and the EESS in the frequency band 401-403 MHz and associated telecommand links in these bands.

One study indicated that the associated e.i.r.p. density for the GSO systems deployed in 401-403 MHz frequency band could be used, however, it is important to take into account the requirement for coexistence of different types of carriers operating within these frequencies, including telecommand operations, while ensuring protection of DCS systems through use of various methods including mitigation measures. Mitigation methods could be further developed and captured in ITU-R Recommendations, as appropriate. Table 4/1.2/3-3 provides the limits that may be imposed on different types of operations in the band of interest to ensure efficient and proper use of this band and fall within the range of e.i.r.p. density used by current systems. It has to be noted that these values are only consistent with the telecommand links.

TABLE 4/1.2/3-3

Frequency band	Maximum e.i.r.p. density of the earth stations	
401-403 MHz	GSO/HEO DCS	2 dBW/Hz
	non-GSO (MEO and LEO) DCS	-27 dBW/Hz <sup>(1)</sup>

<sup>(1)</sup> The maximum e.i.r.p. density for existing non-GSO MetSat system in the 401.898-402.522 MHz can be increased up to -20 dBW/Hz.

Regarding the non-GSO space operation service (SOS), the maximum e.i.r.p. density of the earth stations is -5 dBW/Hz.

This study indicated that the associated e.i.r.p. density for the GSO systems deployed in the 401-403 MHz frequency band could be between -25.8 to 2 dBW/Hz, suggesting a range of 28 dB (e.i.r.p. range of 5 to 22 dBW). This wide range is indicative of the earth stations deployed in this band use of links based on wide range of e.i.r.p. and/or bandwidth parameters. Furthermore, for non-GSO satellite DCS systems in this band, the values of typical earth stations e.i.r.p. densities range between -35 to -20 dBW/Hz or an e.i.r.p. range of -3 to 13 dBW (excluding ICARUS system). For the telecommand links described in the PDN Report ITU-R SA.[400MHZ-LIMITS], the peak e.i.r.p. density ranges from -17.8 to -6.4 dBW/Hz or an e.i.r.p. range of 27 to 39 dBW. Given the larger differences in the e.i.r.p. density level ranges of non-GSO data collection platforms compared to platforms communicating to GSO MetSat and EESS satellites, as outline above, the establishment of e.i.r.p. density limits will have to differentiate between non-GSO (LEO/MEO) and GSO/HEO DCS in the 401-403 MHz frequency band.

It should be noted that these e.i.r.p. density figures were derived assuming a uniform spectrum shape of carriers.

On the basis of this analysis, this study proposes the following e.i.r.p. density limits to be considered under this agenda item:

TABLE 4/1.2/3-4

GSO/HEO DCS	2 dBW/Hz
non-GSO SOS	2 dBW/Hz
non-GSO (MEO and LEO) DCS	-27 dBW/Hz

It should be noted that using these e.i.r.p. densities for DCS and SOS applications, the resulting e.i.r.p. figures would be much larger for SOS applications, due to their large bandwidth. The above proposal was not supported by sharing analysis to confirm that they would allow protection of DCS systems.

#### **4/1.2/3.4 Compatibility studies between DCS and SOS**

##### **4/1.2/3.4.1 399.9-400.05 MHz frequency band**

Two studies were performed to assess the effect of telecommand signals from a non-GSO MSS earth station (Earth-to-space) into the non-GSO DCS satellite receiver. The analyses show that the levels of interference from non-GSO MSS earth station uplink telecommand signals into the non-GSO DCS satellite receiver could significantly exceed the relevant ITU-R interference criteria.

##### **4/1.2/3.4.2 401-403 MHz frequency band**

Three studies were performed to assess the effect of telecommand signals from a non-GSO satellite earth station (E-s) into the GSO DCS and non-GSO DCS satellite receivers. All analyses show that the levels of interference from the telecommand signals of non-GSO earth stations (Earth-to-space) into the GSO DCS and/or non-GSO DCS satellite receivers could significantly exceed the relevant ITU-R interference criteria. The use of mitigation techniques may reduce the interference to GSO DCS and non-GSO DCS satellite receiver uplink operations. One study, using a certain type of highly directional antenna that are not covered by Recommendation ITU-R F.699-8, shows that the telecommand signals non-GSO earth station may comply with the up-to-date GSO DCS interference criteria by introducing the avoidance angle measured from TT&C non-GSO earth station antenna pointing direction towards GSO DCS satellites. This study analyses the case of GRUS satellite systems. This “avoidance angle” GSO DCS interference mitigation requires a more comprehensive analysis of other types of system characteristics, such as the antenna pattern and the number of non-GSO telecommand systems operating in the same frequency.

##### **4/1.2/3.4.3 Summary of all compatibility studies**

The results of the studies show that the non-GSO telecommand operations are not compatible with the low power operations of MSS, EESS, and MetSat systems in the 399.9-400.05 MHz and 401-403 MHz frequency bands. The proliferation of telecommand usage may have a significant impact upon the large number of existing lower power DCP stations communicating to sensitive receivers on GSO and non-GSO satellites.

Apart from a possible band segmentation in the band 399.9-400.05 MHz, no other measure has been found to solve the compatibility issue between DCS and telecommand operations.

In addition, necessary measures are required in both bands to permit the continued operation of frequency assignments to networks and systems for which the confirmed date of bringing into use is prior to WRC-19 and whose operations exceed the proposed e.i.r.p. or e.i.r.p. density limits, as appropriate (see section 4/1.2/3).

## **4/1.2/4 Methods to satisfy the agenda item**

### **4/1.2/4.1 For the band 399.9-400.05 MHz**

#### **4/1.2/4.1.1 Method A NOC**

##### **4/1.2/4.1.2 Method B**

To include in RR the relevant e.i.r.p. limits given in section 4/1.2/3.2 by adding a new footnote in the bands 399.9-400.03 MHz in the Table of Frequency Allocations in RR Article 5, leaving the band 400.03-400.05 MHz without e.i.r.p. limits. This method proposes a grandfathering period up to 22 November 2024.

#### **Advantages:**

- Would ensure the operation of existing and future systems that usually implement low or moderate output powers for MSS systems, whilst also accommodating the higher power systems for MSS and telecommand.
- Accommodate a transitional phase for high power telecommand systems.
- Provide long-term security and assurance of the global network for the protection of stations of the data collection system of MSS services.
- Retains the quality of MSS data supporting safety-of-life services including public weather warnings and alerts, operational decision support for dams, locks and maritime operations on coasts and within inland waterways, emergency response and management for flood scenarios, relay of wildfire weather conditions for wildfire firefighters and other critical uses, and the possibility of disaster risk reduction, but in a reduced bandwidth.

#### **Disadvantages:**

- Part of the MSS band (20 kHz) may be used by high power telecommand links and this part of the band may not be usable by data collection systems, that would imply a reduction of the frequency band dedicated to data collection.

#### **4/1.2/4.1.3 Method C**

The proposed method is to include in RR the relevant e.i.r.p. limits given in section 4/1.2/3.2 by adding a new footnote in the bands 399.9-400.05 MHz in the Table of Frequency Allocations in RR Article 5. This method does not leave any band without e.i.r.p. limits but proposes a grandfathering period up to 22 November 2024.

#### **Advantages:**

- Would ensure the operation of existing and future systems that usually implement low or moderate output powers for MSS systems.
- Accommodate a transitional phase for high power telecommand systems for MSS, EESS and MetSat.
- Provide long-term security and assurance of the global network for the protection of stations of the data collection system of MSS services.
- Retains the quality of MSS data supporting safety-of-life services including public weather warnings and alerts, operational decision support for dams, locks and maritime operations on coasts and within inland waterways, emergency response and management for flood scenarios, relay of wildfire weather conditions for wildfire firefighters and other critical uses, and the possibility of disaster risk reduction.

**Disadvantages:**

- May not allow telecommand operations for non-GSO MSS satellite systems to close communication links.
- Telecommand operation for MSS would be prevented after 22 November 2024.

**4/1.2/4.1.4 Method D**

The proposed method is to include in RR the relevant e.i.r.p. limits given in section 4/1.2/3.2 by adding a new footnote in the bands 399.9-400.03 MHz in the Table of Frequency Allocations in RR Article 5, leaving the band 400.03-400.05 MHz without e.i.r.p. limits. This method proposes a grandfathering period up to 22 November 2029.

**Advantages:**

- Would ensure the operation of existing and future systems that usually implement low or moderate output powers for MSS systems, whilst also accommodating the higher power systems for MSS and telecommand.
- Accommodate a transitional phase for high power telecommand systems.
- Provide long-term security and assurance of the global network for the protection of stations of the data collection system of MSS services.
- Retains the quality of MSS data supporting safety-of-life services including public weather warnings and alerts, operational decision support for dams, locks and maritime operations on coasts and within inland waterways, emergency response and management for flood scenarios, relay of wildfire weather conditions for wildfire firefighters and other critical uses, and the possibility of disaster risk reduction, but in a reduced bandwidth.

**Disadvantages:**

- Part of the MSS band (20 kHz) may be used by high power telecommand links and this part of the band may not be usable by data collection systems, that would imply a reduction of the frequency band dedicated to data collection.

**4/1.2/4.2 For the bands 401-403 MHz**

**4/1.2/4.2.1 Method E**

The proposed method is to include in RR the relevant e.i.r.p. limits given in section 4/1.2/3.2 by adding a new footnote in the bands 401-403 MHz in the Table of Frequency Allocations in RR Article 5.

**Advantages:**

- The in-band power limits applicable to earth stations would ensure the operation of existing and future systems that usually implement low or moderate output powers for EESS, and MetSat systems, whilst also accommodating the higher power systems for MSS and telecommand.
- Accommodate a transitional phase for high power telecommand systems.
- Provide long-term security and assurance of the global network for the protection of stations of the data collection system of EESS, and MetSat services.
- Retains the quality of meteorological and environmental data supporting safety-of-life services including public weather warnings and alerts, operational decision support for dams, locks and maritime operations on coasts and within inland waterways, emergency



response and management for flood scenarios, relay of wildfire weather conditions for wildfire firefighters and other critical uses, and the possibility of disaster risk reduction.

**Disadvantages:**

- Telecommand operation for EESS and MetSat would be prevented after 1 January 2029.

**4/1.2/4.2.2 Method F**

The proposed method is to include in RR the relevant e.i.r.p. limits and e.i.r.p. densities given in section 4/1.2/3.2 and 4/1.2/3.3 in different bands by adding a new footnote in the bands 401-403 MHz in the Table of Frequency Allocations in RR Article 5. This method proposes specific requests for operations for Telecommand to ensure protection of EESS and MetSat.

**Advantages:**

- Allows continuation of existing and future telecommand operations in the EESS and MetSat frequency bands.

**Disadvantages:**

- The in-band power limits applicable to earth stations would prevent the operation of existing and future systems that usually implement low or moderate output powers for EESS, and MetSat systems.
- Does not provide long-term security and assurance of the global network for the protection of stations of the data collection system of EESS, and MetSat services.
- Does not retain the quality of meteorological and environmental data supporting safety-of-life services including public weather warnings and alerts, operational decision support for dams, locks and maritime operations on coasts and within inland waterways, emergency response and management for flood scenarios, relay of wildfire weather conditions for wildfire firefighters and other critical uses, and the possibility of disaster risk reduction.
- Does not protect data collection systems in the EESS and MetSat frequency bands.

**4/1.2/5 Regulatory and procedural considerations**

**4/1.2/5.1 For the band 399.9-400.05 MHz**

**4/1.2/5.1.1 Method A**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**NOC**

**335.4-410 MHz**

#### 4/1.2/5.1.2 Method B

##### MOD

##### 335.4-410 MHz

Allocation to services		
Region 1	Region 2	Region 3
399.9-400.05	MOBILE-SATELLITE (Earth-to-space) 5.209 5.220 ADD 5.A12	

##### ADD

**5.A12** In the frequency band 399.9-400.03 MHz, the maximum e.i.r.p. of earth stations in the mobile-satellite service shall not exceed 5 dBW. Until 22 November 2024, this limit shall not apply to satellite systems for which complete notification information has been received by the Radiocommunication Bureau by 22 November 2019 and that have been brought into use by that date. Administrations are encouraged to make all practicable efforts to comply with the limits in the frequency band 399.9-400.03 MHz prior to 22 November 2024. (WRC-19)

#### 4/1.2/5.1.3 Method C

##### MOD

##### 335.4-410 MHz

Allocation to services		
Region 1	Region 2	Region 3
399.9-400.05	MOBILE-SATELLITE (Earth-to-space) 5.209 5.220 ADD 5.B12	

##### ADD

**5.B12** In the frequency band 399.9-400.05 MHz, the maximum e.i.r.p. of earth stations in the mobile-satellite service shall not exceed 5 dBW. Until 22 November 2024, this limit shall not apply to satellite systems for which complete notification information has been received by the Radiocommunication Bureau by 22 November 2019 and that have been brought into use by that date. Administrations are encouraged to make all practicable efforts to comply with the limits in the frequency band 399.9-400.05 MHz prior to 22 November 2024. (WRC-19)

#### 4/1.2/5.1.4 Method D

##### MOD

##### 335.4-410 MHz

Allocation to services		
Region 1	Region 2	Region 3
399.9-400.05	MOBILE-SATELLITE (Earth-to-space) 5.209 5.220 ADD 5.C12	

**ADD**

**5.C12** In the frequency band 399.9-400.03 MHz, the maximum e.i.r.p. of earth stations in the mobile-satellite service shall not exceed 5 dBW. Until 22 November 2029, this limit shall not apply to satellite systems for which complete notification information has been received by the Radiocommunication Bureau by 22 November 2019 and that have been brought into use by that date. Administrations are encouraged to make all practicable efforts to comply with the limits in the frequency band 399.9-400.03 MHz prior to 22 November 2029. (WRC-19)

**4/1.2/5.2 For the bands 401-403 MHz**

**4/1.2/5.2.1 Method E**

**MOD**

**335.4-410 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>401-402</b>	METEOROLOGICAL AIDS SPACE OPERATION (space-to-Earth) EARTH EXPLORATION-SATELLITE (Earth-to-space) ADD 5.D12 METEOROLOGICAL-SATELLITE (Earth-to-space) ADD 5.D12 Fixed Mobile except aeronautical mobile	
<b>402-403</b>	METEOROLOGICAL AIDS EARTH EXPLORATION-SATELLITE (Earth-to-space) ADD 5.D12 METEOROLOGICAL-SATELLITE (Earth-to-space) ADD 5.D12 Fixed Mobile except aeronautical mobile	

**ADD**

**5.D12** In the frequency band 401-403 MHz, the maximum e.i.r.p. of earth stations in the meteorological-satellite service and the Earth exploration-satellite service shall not exceed 22 dBW for geostationary systems and non-geostationary systems with an orbit of apogee equal or greater than 35 786 km and 7 dBW for non-geostationary systems with an orbit of apogee lower than 35 786 km.

These provisions shall not apply to all systems in the meteorological-satellite service and the Earth exploration-satellite service in this frequency band for which complete notification information has been received by the Radiocommunication Bureau before 22 November 2019 and brought into use before 22 November 2019.

After 1 January 2029, these limits will apply to all systems in the meteorological-satellite service and the Earth exploration-satellite service operating in this frequency band.

In the frequency band 401.898-402.522 MHz, the maximum e.i.r.p. of earth stations for the METEOR-3M satellite system for which complete notification information was received by the Radiocommunication Bureau by 28 April 2007, can be increased to 12 dBW. (WRC-19)

#### 4/1.2/5.2.2 Method F

### MOD

#### 335.4-410 MHz

Allocation to services		
Region 1	Region 2	Region 3
<b>401-402</b>	METEOROLOGICAL AIDS SPACE OPERATION (space-to-Earth) EARTH EXPLORATION-SATELLITE (Earth-to-space) ADD 5.E12 ADD 5.F12 METEOROLOGICAL-SATELLITE (Earth-to-space) ADD 5.E12 ADD 5.F12 Fixed Mobile except aeronautical mobile	
<b>402-403</b>	METEOROLOGICAL AIDS EARTH EXPLORATION-SATELLITE (Earth-to-space) ADD 5.E12 ADD 5.F12 METEOROLOGICAL-SATELLITE (Earth-to-space) ADD 5.E12 ADD 5.F12 Fixed Mobile except aeronautical mobile	

### ADD

**5.E12** In the frequency band 401.7-402.850 MHz, the maximum e.i.r.p. density of earth stations in the meteorological-satellite service and the Earth exploration-satellite service shall not exceed 2 dBW/Hz for geostationary systems and non-geostationary systems used for telecommand operations. The e.i.r.p. density shall not exceed -27 dBW/Hz for non-geostationary systems not used for telecommand operations. These limits do not apply to systems for which the Advance Publication Information (API) has been received by the Radiocommunication Bureau prior to 22 November 2019.

In the frequency band 401-401.7 MHz and 402.850-403 MHz, the maximum e.i.r.p. of earth stations in the meteorological-satellite service and the Earth exploration-satellite service shall not exceed 22 dBW for geostationary systems and non-geostationary systems with an orbit of apogee equal or greater than 35 786 km and 7 dBW for non-geostationary systems with an orbit of apogee lower than 35 786 km.

These provisions shall not apply to systems in the meteorological-satellite service and the Earth exploration-satellite service in this frequency band for which complete notification information has been received by the Radiocommunication Bureau before 22 November 2019 and brought into use before 22 November 2019.

As of the 1 January 2029, these limits will apply to all systems in the meteorological-satellite service and the Earth exploration-satellite service operating in this frequency band. (WRC-19)

### ADD

**5.F12** Operations for telecommand of the space stations in the band 401-403 MHz (under No. 1.23) need to take into account the operation of stations in the Earth exploration-satellite service and the meteorological-satellite service in accordance with the Radio Regulations. (WRC-19)

Notes:

In considering the Methods, some administrations are of the view that proposed Method F contradicts to objectives of Resolution **765 (WRC-15)**, since proposed e.i.r.p. density limits, which are not justified by technical studies, would not ensure protection and future operation of DCS systems, therefore this Method should be deleted.

Some other administrations are of the view that the proposed Method F could satisfy the objectives of Resolution **765 (WRC-15)**, protecting data collection services, with deployment of proper mitigation techniques.

**4/1.2/5.3 For all Methods A, B, C, D, E, F**

**SUP**

## RESOLUTION 765 (WRC-15)

**Establishment of in-band power limits for earth stations operating in mobile-satellite service, the meteorological-satellite service and the Earth exploration-satellite service in the frequency bands 401-403 MHz and 399.9-400.05 MHz**

## Agenda item 1.3

(WP 7B / WP 5A, WP 5C, WP 5D, WP 6A, (WP 3M))

*1.3 to consider possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a possible primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz, in accordance with Resolution 766 (WRC-15);*

*Resolution 766 (WRC-15) – Consideration of possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz.*

### 4/1.3/1 Executive summary

This agenda item aims at determining the possibility of upgrading the secondary meteorological-satellite service (MetSat) (space-to-Earth) allocation to primary status and adding a primary Earth exploration satellite-service (EESS) (space-to-Earth) allocation in the frequency band 460-470 MHz.

This has to be performed while providing protection and not imposing any additional constraints on existing primary services to which the frequency band is already allocated and to services in the adjacent frequency bands, and maintaining the conditions contained in RR No. 5.289. In addition, the resultant power flux-density (pfd) mask will be no less restrictive than  $-152$  dBW/m<sup>2</sup>/4 kHz.

The PDN Report ITU-R SA.[460 MHz METSAT-EESS] provides the studies and compiles elements related to background on WRC-19 agenda item 1.3. This Report also includes initial technical considerations on EESS and MetSat in the 460-470 MHz band and other services allocated in this band and adjacent bands, namely the mobile, maritime mobile, mobile-satellite, fixed and broadcasting services.

The studies resulted in the development of pfd limits for non-GSO satellites and separate pfd limits for GSO satellites that would protect the incumbent in-band and adjacent channel service operations.

The single Method proposes Radio Regulations (RR) changes that upgrade the MetSat and EESS allocations to primary in the frequency band 460-470 MHz.

### 4/1.3/2 Background

The use of the frequency band 460-470 MHz is already established due to the existence of a secondary allocation to MetSat. Meteorological satellites already transmit in this band to control and configure data collection platforms.

Data collection systems (DCS) operate on geostationary and non-geostationary orbits in the MetSat and the EESS (Earth-to-space) systems in the frequency band 401-403 MHz (uplink) and 460-470 MHz (downlink). DCS are essential for monitoring and predicting climate change, monitoring ocean, and water resources, weather forecasting and assisting in protecting biodiversity, as well as improving maritime security.

DCS have been operating globally under a secondary allocation and on a primary basis in some countries under RR No. 5.290, but this use is constrained by coordination under RR No. 9.21. This has led to differing limitations and protection criteria and has posed a barrier to implementation of essential DCS components on a global basis.

According to RR No. **5.289**, “Earth exploration-satellite service applications, other than the meteorological-satellite service, may also be used in the bands 460-470 MHz and 1 690-1 710 MHz for space-to-Earth transmissions subject to not causing harmful interference to stations operating in accordance with the Table”.

One of the EESS/MetSat usages comprises the data collection platforms gathering information activity related to the Earth, the environment and scientific application, weather and environment observation. The data, which are collected by ground platforms, are sent to the corresponding satellites that retransmit the retrieved information to dedicated earth stations. DCS are particularly useful for the collection of data from remote and inhospitable locations where it may provide the only possibility for data relay. Even so, the system has very many uses in areas with a highly developed infrastructure. The installations required for relay of the data tend to be inexpensive, unobtrusive, and normally blend easily into the local environment.

Amongst others, this band is currently used by the advanced data collection system also called ARGOS which is a unique worldwide location and DCS dedicated to studying oceans and atmospheric conditions, preserving and monitoring wildlife, volcanoes, fishing fleets, shipments of dangerous goods, humanitarian applications, and managing water resources.

DCS help the scientific community to better monitor and understand our environment, but also help industry to comply with environmental protection regulations implemented by various governments. This positioning capability also permits applications such as monitoring drifting ocean buoys and studying wildlife migration paths.

A primary allocation to the MetSat and EESS (space-to-Earth) in the frequency band 460-470 MHz would provide confidence to space and meteorological agencies deeply involved in satellite data collection programs and the public sectors funding the development and operation of such systems. These space programs have been representing a long-term effort and investment for decades between the time when the program is officially decided, the development, the launch phase, and the time when the various satellites are in operation, keeping in mind that usually many satellites are deployed in order to provide a continuous service. Space and meteorological agencies are also investing in the continuity of these programs providing subsequent satellites and payloads, and an allocation upgrade in the frequency band 460-470 MHz would provide the necessary long-term continuity for these programs of public interest. In addition, the power flux-density (pfd) limits will provide reliable protection to incumbent terrestrial services without imposing constraints.

#### **4/1.3/3 Summary and analysis of the results of ITU-R studies**

The PDN Report ITU-R SA.[460 MHZ METSAT-EESS] provides the studies related to WRC-19 agenda item 1.3. This Report is based on the most restrictive results for the pfd levels required to protect MS and FS systems from MetSat/EESS satellite downlinks.

The results of the static analyses presented four cases where the pfd limit was more stringent than  $-152 \text{ dBW/m}^2/4 \text{ kHz}$ . Dynamic analysis was performed where the static analysis resulted in a pfd limit more restrictive than  $-152 \text{ dBW/m}^2/\text{MHz}$  and time constraints for the radio frequency interference (RFI) were known. This was the case for the FS point-to-point (P-P), point-to-multipoint (P-MP), and radio frequency mesh network central alarm (RF CSA) systems as well as all applications under the mobile service. Static analysis were also done to address the protection of BS and radio astronomy in adjacent bands.

The studies determined that the pfd limits for the downlink emission of non-GSO and GSO satellites as a function of the angle of arrival ( $\alpha$ ) are:

For non-GSO satellites:

$$\text{pfd (dBW/(m}^2 \cdot 4 \text{ kHz))} = \begin{cases} -157 & 0^\circ \leq \alpha < 5^\circ \\ -157 + 0.5(\alpha - 5) & 5^\circ \leq \alpha < 15^\circ \\ -152 & 15^\circ \leq \alpha \leq 90^\circ \end{cases}$$

For GSO satellites:

Option 1:

$$\text{pfd (dBW/(m}^2 \cdot 4 \text{ kHz))} = \begin{cases} -162 & 0^\circ \leq \alpha \leq 15^\circ \\ -162 + 0.5(\alpha - 15) & 15^\circ < \alpha < 35^\circ \\ -152 & 35^\circ \leq \alpha \leq 90^\circ \end{cases}$$

Option 2:

$$\text{pfd (dBW/(m}^2 \cdot 4 \text{ kHz))} = -156 + 0.033 \times \alpha \quad 0^\circ \leq \alpha \leq 90^\circ$$

Further studies are needed to address the pfd limits for GSO satellites and conclude on a single mask.

The frequency band 460-470 MHz has been utilized by several satellite systems, some of which do not meet the above pfd limit masks. An appropriate arrangement is necessary to ensure that the existing satellite systems, including those for which complete notification information or coordination request was received by the Radiocommunication Bureau prior to the end of WRC-19 can continue their operation in compliance with the provisions adopted at WRC-19.

#### **4/1.3/4 Methods to satisfy the agenda item**

##### **4/1.3/4.1 Method A NOC**

##### **4/1.3/4.2 Method B**

An upgrade of the MetSat (space-to-Earth) allocation from secondary to primary status and a primary EESS (space-to-Earth) allocation could be added in the frequency band 460-470 MHz provided that the priority of MetSat over EESS, as currently contained in the Radio Regulations, is retained and that the protection of primary services in the frequency band and in adjacent frequency bands is ensured.

In order to protect terrestrial services, pfd limits are proposed for both non-GSO and GSO MetSat/EESS satellites.

In addition, RR No. **5.290** is proposed to be suppressed since MetSat and EESS are primary services in the frequency band.

Finally, a new Resolution is proposed to provide the transitional measures for the existing MetSat/EESS frequency assignments.



## 4/1.3/5 Regulatory and procedural considerations

### 4/1.3/5.1 Method A

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations (See No. 2.1)

NOC

460-890 MHz

SUP

#### RESOLUTION 766 (WRC-15)

**Consideration of possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz**

### 4/1.3/5.2 Method B

MOD

460-890 MHz

Allocation to services		
Region 1	Region 2	Region 3
460-470	EARTH EXPLORATION-SATELLITE (space-to-Earth) ADD 5.C13 FIXED METEOROLOGICAL-SATELLITE (space-to-Earth) MOBILE 5.286AA  5.287 5.288 ADD 5.A13 ADD 5.B13	

MOD

**5.289** Earth exploration-satellite service applications, other than the meteorological-satellite service, may also be used in the band 1 690-1 710 MHz for space-to-Earth transmissions subject to not causing harmful interference to stations operating in accordance with the Table. (WRC-19)

**Reasons:** Inclusion in the Table, a primary EESS (space-to-Earth) allocation in the frequency band 460-470 MHz.

**SUP**

**5.290** *Different category of service:* in Afghanistan, Azerbaijan, Belarus, China, the Russian Federation, Japan, Kyrgyzstan, Tajikistan and Turkmenistan, the allocation of the band 460-470 MHz to the meteorological-satellite service (space-to-Earth) is on a primary basis (see No. **5.33**), subject to agreement obtained under No. **9.21**. (WRC-12)

**Reasons:** Consequential change.

**ADD**

**5.A13** In the frequency band 460-470 MHz, earth stations in the meteorological-satellite service (space-to-Earth) and Earth exploration-satellite service (space-to-Earth) shall not cause harmful interference to nor claim protection from stations of the fixed and mobile services. (WRC-19)

**ADD**

**5.B13** In the frequency band 460-470 MHz, space stations in the meteorological-satellite (space-to-Earth) and Earth exploration-satellite (space-to-Earth) services shall comply with the following power flux-density limits.

For non-GSO space stations:

$$\text{pfd (dBW/(m}^2 \cdot 4 \text{ kHz))} = \begin{cases} -157 & 0^\circ \leq \alpha < 5^\circ \\ -157 + 0.5(\alpha - 5) & 5^\circ \leq \alpha < 15^\circ \\ -152 & 15^\circ \leq \alpha \leq 90^\circ \end{cases}$$

and for GSO space stations:

Option 1:

$$\text{pfd (dBW/(m}^2 \cdot 4 \text{ kHz))} = \begin{cases} -162 & 0^\circ \leq \alpha \leq 15^\circ \\ -162 + 0.5(\alpha - 15) & 15^\circ < \alpha < 35^\circ \\ -152 & 35^\circ \leq \alpha \leq 90^\circ \end{cases}$$

Option 2:

$$\text{pfd (dBW/(m}^2 \cdot 4 \text{ kHz))} = -156 + 0.033 \times \alpha \quad 0^\circ \leq \alpha \leq 90^\circ$$

where  $\alpha$  is the angle of arrival above the horizontal plane, in degrees.

These limits apply to all space stations in the meteorological-satellite service and Earth exploration-satellite service in this frequency band for which a complete notification information or coordination request was received by the Radiocommunication Bureau after the end of WRC-19. Resolution [A13] (WRC-19) shall apply. (WRC-19)

**ADD**

**5.C13** In the frequency band 460-470 MHz stations in the Earth exploration-satellite service (space-to-Earth) shall not cause harmful interference to nor claim protection from stations in the meteorological-satellite service (space-to-Earth). (WRC-19)

**APPENDIX 7 (REV.WRC-15)**

**Methods for the determination of the coordination area around an earth station in frequency bands between 100 MHz and 105 GHz**

**ANNEX 7**

**System parameters and predetermined coordination distances for determination of the coordination area around an earth station**

**3 Horizon antenna gain for a receiving earth station with respect to a transmitting earth station**

MOD

TABLE 8a (Rev.WRC-19)

Parameters required for the determination of coordination distance for a receiving earth station

Receiving space radiocommunication service designation	Space operation, space research	Meteorological-satellite, mobile-satellite	Space research	Space research, space operation	Space operation	Mobile-satellite	Meteorological-satellite	Mobile-satellite	Space research	Space operation		Broad-casting-satellite	Mobile-satellite	Broadcasting-satellite (DAB)	Mobile-satellite, land-mobile satellite, maritime mobile-satellite
Frequency bands (MHz)	137-138	137-138	143.6-143.65	174-184	163-167 272-273 <sup>5</sup>	335.4-399.9	400.15-401	400.15-401	400.15-401	401-402		620-790	856-890	1 452-1 492	1 518-1 530 1 555-1 559 2 160-2 200 <sup>1</sup>
Transmitting terrestrial service designations	Fixed, mobile	Fixed, mobile	Fixed, mobile, radio-location	Fixed, mobile, broadcasting	Fixed, mobile	Fixed, mobile	Meteorological aids	Meteorological aids	Meteorological aids	Meteorological aids, fixed, mobile		Fixed, mobile, broadcasting	Fixed, mobile, broadcasting	Fixed, mobile, broadcasting	Fixed, mobile
Method to be used	§ 2.1	§ 2.1	§ 2.1	§ 2.1	§ 2.1	§ 1.4.6	§ 1.4.6	§ 1.4.6	–	§ 2.1		§ 1.4.5	§ 1.4.6	§ 1.4.5	§ 1.4.6
Modulation at earth station <sup>2</sup>	N		N		N				N	N				N	N
Earth station interference parameters and criteria	$p_0$ (%)	0.1	0.1	0.1	1.0		0.012		0.1	0.1					10
	$n$	2		2	1		1		2	2					1
	$p$ (%)	0.05		0.05	1.0		0.012		0.05	0.05					10
	$N_L$ (dB)	0		0	0		0		0	0					0
	$M_s$ (dB)	1		1	1		4.3		1	1					1
	$W$ (dB)	0		0	0		0		0	0					0
Terrestrial station parameters	$E$ (dBW) in $B$ <sup>3</sup>	A	–	–	15		–	–	–	–				38	37 <sup>4</sup>
		N	–	–	15		–	–	–	–				38	37
	$P_t$ (dBW) in $B$	A	–	–	–1		–	–	–	–				3	0
		N	–	–	–1		–	–	–	–				3	0
	$G_x$ (dBi)	–	–	–	16		–	–	–	–				35	37
Reference bandwidth	$B$ (Hz)	1	1	1	$10^3$		$177.5 \times 10^3$		1	1				$25 \times 10^3$	$4 \times 10^3$
Permissible interference power	$P_r(p)$ (dBW) in $B$	–199	–199	–199	–173		–148		–208	–208					–176

<sup>1</sup> In the band 2 160-2 200 MHz, the terrestrial station parameters of line-of-sight radio-relay systems have been used. If an administration believes that, in this band transhorizon systems need to be considered, the parameters associated with the frequency band 2 500-2 690 MHz may be used to determine the coordination area.

<sup>2</sup> A: analogue modulation; N: digital modulation.

<sup>3</sup>  $E$  is defined as the equivalent isotropically radiated power of the interfering terrestrial station in the reference bandwidth.

<sup>4</sup> This value is reduced from the nominal value of 50 dBW for the purposes of determination of coordination area, recognizing the low probability of high power emissions falling fully within the relatively narrow bandwidth of the earth station.

<sup>5</sup> The fixed-service parameters provided in the column for 163-167 MHz and 272-273 MHz are only applicable to the band 163-167 MHz.

**SUP**

**RESOLUTION 766 (WRC-15)**

**Consideration of possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz**

(Note to CPM/19-2: Due to the time constraint it was not possible to carefully review the text of this Resolution in particular areas containing the status of assignment which normally should be included in the Table of Allocations and associated Footnotes, there is a need to carefully review this Resolution and transfer the status of assignment to corresponding Footnotes and alignment of the text to be clearly understood by the readers.)

(Note to CPM/19-2: the intention of this resolution is to guarantee that 1) current networks notified under RR No. **5.290** on a primary basis or coordinated under RR No. **9.21** will continue to have the same rights, including those obtained under RR No. **9.21** agreements and 2) that current networks notified under the secondary EESS allocations (see RR No. **5.289**) that are not compliant with the pfd limits could have similar rights vis-à-vis EESS networks under the new primary EESS allocation (similar issue for MetSat systems). Views from the Bureau would be needed to ensure that the proposed provisions (“*resolves*” and “*instructs the Director of the Bureau*”) below duly reach those goals.)

**ADD**

**DRAFT NEW RESOLUTION [A13] (WRC-19)**

**Transitional measures for existing satellite networks and systems of the meteorological-satellite service (space-to-Earth) and the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a)* that data collection systems (DCS) operate on geostationary and non-geostationary orbits in the meteorological-satellite service (MetSat) and the Earth exploration-satellite service (EESS) (Earth-to-space) systems in the frequency band 401-403 MHz;
- b)* that DCS are essential for monitoring and predicting climate change, monitoring oceans, and water resources, weather forecasting and assisting in protecting biodiversity and improving maritime security;
- c)* that most of these DCS have implemented satellite downlinks (space-to-Earth) in the frequency band 460-470 MHz which bring significant improvements to the operation of satellite

DCS, such as the transmission of information to optimize the usage of the terrestrial data collection platforms;

- d) that the frequency band 460-470 MHz is also used for the downlink of mission and telemetry data for meteorological and Earth exploration purposes;
- e) that the frequency band 460-470 MHz is allocated to the fixed and mobile services on a primary basis and is widely used by these services;
- f) that the World Radiocommunication Conference 2019 (WRC-19) has upgraded the secondary allocation of the MetSat (space-to-Earth) to primary status and added a primary allocation to the EESS (space-to-Earth) in the frequency band 460-470 MHz, and established the power flux-density (pfd) masks in the provision of No. **5.B13** to provide protection of existing terrestrial services to which the frequency band is already allocated and in the adjacent frequency bands;
- g) that WRC-19 has deleted No. **5.290** and the relevant parameters in Table 8a of Appendix 7, which identified some administrations that already had a primary allocation to the MetSat (space-to-Earth), subject to agreement obtained under No. **9.21**, in the light of the upgrade mentioned in *considering f*) above, and that it is necessary to provide some measures for the satellite systems which was in accordance with No. **5.290** to retain their regulatory status as of the end of WRC-19,

*noting*

- a) that several EESS and MetSat satellite networks and systems in the frequency band 460-470 MHz were notified and brought into use;
- b) that some of these EESS and MetSat satellite networks and systems above may not meet the pfd masks in *considering f*), but there is a need to authorize them to continue their operation,

*resolves*

- 1 that the satellite networks and systems in the meteorological-satellite (space-to-Earth) and Earth exploration-satellite (space-to-Earth) services in the frequency band 460-470 MHz for which a complete coordination request or notification information has been received by the Radiocommunication Bureau prior to the end of WRC-19 are allowed to continue to operate with the same parameters under Appendix 4 submitted for coordination or notification;
- 2 that the frequency assignment of MetSat (space-to-Earth) and EESS (space-to-Earth) satellite network in the frequency band 460-470 MHz for which complete notification information or coordination request was received by the Radiocommunication Bureau prior to the end of WRC-19 and which space stations do not meet the pfd limits given in No. **5.B13** shall be used on a secondary basis with respect to the fixed and mobile service stations;
- 3 that the satellite systems in the meteorological-satellite service (space-to-Earth) referred to in *considering g*) for which complete coordination information related to No. **9.21** has been received by the Radiocommunication Bureau prior to the end of WRC-19 can operate on a primary basis, and that, for those systems, the relevant provisions of Articles 9 and 11 continue to apply, and the relevant agreements obtained under No. **9.21** remain in force after the end of WRC-19,

*instructs the Director of the Radiocommunication Bureau*

for the frequency assignment of MetSat (space-to-Earth) and EESS (space-to-Earth) satellite network for which complete notification information or coordination request was received by the Radiocommunication Bureau prior to the end of WRC-19, the Bureau shall review the finding under No. **11.50** without proposal to the administration that it submit a new assignment to replace

the previous one. The date of such assignment original recording in the Master International Frequency Register (MIFR) shall be kept.

## Agenda item 1.7

**(WP 7B / WP 4A, WP 4C, WP 5A, WP 5B, WP 5C, WP 6A, WP 7C, WP 7D,  
(WP 1A), (WP 3M), (WP 4B))**

*1.7 to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution 659 (WRC-15);*

**Resolution 659 (WRC-15)** – *Studies to accommodate requirements in the space operation service for non-geostationary satellites with short duration missions.*

### **4/1.7/1 Executive summary**

In accordance with Resolution 659 (WRC-15), ITU-R has performed studies on spectrum needs for telemetry, tracking and command (TT&C) in the space operation service (SOS) for non-GSO satellites with short duration (non-GSO SD) missions, to assess the suitability of existing allocations to the SOS and, if necessary, to consider possible new allocations.

Typical non-GSO SD TT&C technical parameters were developed for use in the studies.

The studies show that the amount of spectrum required for non-GSO SD systems is 0.682 MHz to 0.938 MHz for non-GSO SD earth station uplink (depends on scenario) and 0.625 MHz to 2.5 MHz for non-GSO SD satellite downlink (depends on scenario).

Furthermore, technical and regulatory studies including sharing studies were carried out.

Four methods and associated regulatory texts were developed to satisfy this agenda item. Methods B1 and B2 propose a new allocation (see Resolution 659 (WRC-15) *invites* 3) and Method C proposes to use existing allocations (see Resolution 659 (WRC-15) *invites* 2):

- Method A proposes no change to the Radio Regulations;
- Method B1 proposes a new SOS (Earth-to-space) allocation for non-GSO SD systems in the frequency range 403-404 MHz;
- Method B2 proposes a new SOS (Earth-to-space) allocation for non-GSO SD systems in the frequency range 404-405 MHz;
- Method C proposes to use the SOS allocation in the frequency band 137-138 MHz for downlink and the band 148-149.9 MHz for uplink and to provide appropriate associated regulatory provisions in the Radio Regulations for telecommand links of non-GSO SD missions.

### **4/1.7/2 Background**

WRC-19 agenda item 1.7 invites studies to accommodate spectrum requirements for TT&C in the SOS for non-GSO SD missions. These types of missions provide an affordable means to access orbital resources (spectrum and orbit) for new entrants into the use of space-based applications. The mass and dimensions of these satellites have significantly contributed to their successful adoption among newly spacefaring nations. Thus, the demand for suitable allocations (in particular to the SOS) will likely increase. However, it is important to ensure that any satellite radio-frequency operation avoids harmful interference to incumbent and authorized systems and services. The two frequency bands below 1 GHz under consideration for new or upgraded allocation (150.05-174 MHz and 400.15-420 MHz) are used for a wide variety of terrestrial and space applications,



and some are heavily used on a consistent basis. Nevertheless, new allocations to the SOS in these frequency bands should not put undue constraints on any incumbent services.

The term “short duration mission” used in Resolution **659 (WRC-15)** refers to a mission having a limited period of validity of “not more than typically three years”. Therefore, the term “short duration mission” is directly tied to the lifetime of the spacecraft. For example, a single spacecraft with a lifetime of less than typically three years, where the operator does not launch replenishment or replacement spacecraft, is a short duration mission. However the case of one (or multiple) spacecraft with a lifetime of less than typically three years, where the operator launches a (or multiple) replenishment or replacement spacecraft such that the operator has persistent frequency assignments longer than typically three years, is not a short duration mission.

#### **4/1.7/2.1 The mobile satellite service in the frequency band 406-406.1 MHz**

The frequency band 406-406.1 MHz, allocated exclusively to the MSS, is within the studied frequency range of 400.15-420 MHz in *invites ITU-R 3* of Resolution **659 (WRC-15)**. Resolution **659 (WRC-15)** recognizes the regulatory provisions contained in RR No. **5.266**, RR No. **5.267** and Resolution **205 (Rev.WRC-15)**. This band is used by the COSPAS-SARSAT system for safety of life purposes, and therefore the 406-406.1 MHz band should not be considered for an allocation to the SOS. Protection of safety-of-life systems operating in this frequency band is further described in Article **31** and Appendix **15** of the Radio Regulations. Since the frequency bands 400.15-406 MHz and 406.1-420 MHz are under consideration for an SOS allocation, adjacent band interference to COSPAS-SARSAT has been studied and is addressed in section 4/1.7/3.3.3.3.1.

#### **4/1.7/3 Summary and analysis of the results of ITU-R studies**

##### **4/1.7/3.1 Relevant ITU-R Recommendations and Reports**

Relevant ITU-R Recommendations: [SA.363-5](#), [P.452-16](#), [SA.514-3](#), [SA.609-2](#), [F.699-8](#), [F.758-6](#), [RA.769-2](#), PDR [SA.1163-3](#), PDR [SA.1164-3](#), PDR [RS.1165-3](#), PDR [RS.1263-2](#), [F.1336-4](#), [M.1478-3](#), [M.1808-0](#), [SA.2044-0](#), [M.2046-0](#), [SA.2045-0](#), [P.2108-0](#).

Relevant ITU-R Reports: DN Report SA.[SHORT DURATION NGSO – REQUIREMENTS], DN Report SA.[SHORT DURATION NGSO – CHARACTERISTICS] and PDN Report SA.[SHORT DURATION NGSO – SHARING STUDIES].

##### **4/1.7/3.2 Results of the study of spectrum needs**

DN Report ITU-R SA.[SHORT DURATION NGSO – REQUIREMENTS] contains studies to determine the amount of TT&C spectrum required for non-GSO SD missions, based on the protection criteria as outlined in Recommendation ITU-R SA.363-5.

The studies in DN Report ITU-R SA.[SHORT DURATION NGSO – REQUIREMENTS] show that the protection criteria could be exceeded for many of the various satellite-earth station pair scenarios considered, but not always. Therefore, in practice, some inter-operator coordination may be necessary. Furthermore, such coordination may be necessary to account for changes in the satellite population. Lastly, it is expected that some of the 300 satellite-earth station combinations will be in centrally-controlled multi-satellite (and earth station) systems, in which spectrum use is coordinated and thus efficiencies may be gained. This Report indicates that the spectrum needs for non-GSO SD systems are in the range from 0.625 MHz to 2.5 MHz in the space-to-Earth direction and in the range from 0.682 MHz to 0.938 MHz in the Earth-to-space direction, depending on the operational scenario.

#### **4/1.7/3.3 Results of sharing or compatibility studies**

The DN Report ITU-R SA.[SHORT DURATION NGSO – CHARACTERISTICS] which studies typical non-GSO SD TT&C parameters was developed to perform sharing/compatibility studies with incumbent services; the results of these sharing/compatibility studies are contained in PDN Report ITU-R SA.[SHORT DURATION NGSO – SHARING STUDIES].

##### **4/1.7/3.3.1 Suitability of existing allocations to the space operation service in the frequency range below 1 GHz**

In the Earth-to-space direction there is currently no spectrum allocated to the SOS below 1 GHz which is not subject to RR No. **9.21**. As indicated in *recognizing a*) of Resolution **659 (WRC-15)**, SOS allocations where No. **9.21** applies are not suitable for non-GSO SD missions. However, if the application of RR No. **9.21** is removed in the frequency band 148-149.9 MHz, this band would become a good candidate to accommodate short duration mission requirements. The impact of removing RR No. **9.21** is still to be investigated.

An examination of the telemetry downlink (space-to-Earth) summary shows that currently there are three frequency bands below 1 GHz that are allocated to the SOS on a primary basis: 137-138 MHz, 272-273 MHz and 401-402 MHz. However the frequency bands 272-273 MHz and 401-402 MHz are heavily used by existing systems. The spectrum needs for short duration missions could therefore be most suitably met in the 137-138 MHz SOS (space-to-Earth) allocation. Consideration of this band for short duration missions may need further regulatory and technical studies.

##### **4/1.7/3.3.2 Results of sharing and compatibility studies within the frequency range 150.05-174 MHz**

All studies conducted in the frequency range 150.05-174 MHz show that sharing between non-GSO SD systems (Earth-to-space and space-to-Earth) and the existing incumbent services in this frequency band is not feasible as indicated below.

###### **4/1.7/3.3.2.1 150.05-153 MHz band - radio astronomy service (RAS)**

A study performed on the in-band sharing scenario between the RAS and non-GSO SD satellites in both Earth-to-space and space-to-Earth directions show that co-channel, co-existence is not feasible in this band. For the Earth-to-space direction a separation distance of 697 km is required between a RAS station and an earth station operating to the non-GSO SD satellites. For the space-to-Earth direction the interference thresholds for the RAS bands are exceeded with a margin of up to 72 dB.

The results show that a guardband of 1.5 MHz from each edge of the 150.05-153 MHz frequency range is required for both uplink and downlink directions with an associated separation distance of up to 4 km for transmitting earth stations. However, if the separation distance is more than 4 km the guardband will be less than 1.5 MHz.

###### **4/1.7/3.3.2.2 150.05-174 MHz band (land mobile service)**

Sharing studies with land-mobile systems in the frequency band 150.05-174 MHz show:

- 1 sharing between non-GSO SD satellites and land-mobile stations is not feasible;
- 2 sharing between non-GSO SD earth stations and land-mobile stations is not feasible.

###### **4/1.7/3.3.2.3 154-156 MHz band (space surveillance radars)**

Space surveillance radars operating in the frequency band 154-156 MHz can cause unacceptable interference to SOS systems in the Earth-to-space direction for command of non-GSO SD satellites. Unacceptable interference could result in satellite control loss. It was also shown that the space surveillance radars operating in this frequency band can suffer unacceptable interference from such

systems in the space-to-Earth direction. Therefore, sharing of SOS systems (Earth-to-space and space-to-Earth) with the radiolocation systems in this frequency band is not feasible.

#### **4/1.7/3.3.2.4 156-162.0375 MHz band (GMDSS)**

SOS non-GSO SD space and earth stations can cause interference to GMDSS receiving stations in the following scenarios:

- 1 interference to ship stations is caused by SOS non-GSO SD space and earth stations on the frequencies 156.3 MHz, 156.525 MHz, 156.650 MHz, 156.8 MHz, 161.975 MHz and 162.025 MHz;
- 2 interference to coast stations is caused by SOS non-GSO SD space and earth stations on the frequencies 156.3 MHz, 156.525 MHz, 156.650 MHz, 156.8 MHz, 161.975 MHz and 162.025 MHz;
- 3 interference to space stations is caused by SOS non-GSO SD space and earth stations on the frequencies 161.975 MHz and 162.025 MHz;
- 4 interference to aircraft stations is caused by SOS non-GSO SD space and earth stations on the frequencies 156.3 MHz, 156.525 MHz, 156.8 MHz, 161.975 MHz and 162.025 MHz;
- 5 it is noted that for each frequency given above, the channel bandwidth is the centre frequency  $\pm 12.5$  kHz.

#### **4/1.7/3.3.3 Results of sharing and compatibility studies within the frequency range 400.15-420 MHz**

##### **4/1.7/3.3.3.1 Results of sharing and compatibility studies within the frequency range 400.15-403 MHz**

All studies conducted in the frequency range 400.15-403 MHz show that sharing is not feasible between non-GSO SD systems and the existing incumbent services as indicated below.

##### **4/1.7/3.3.3.1.1 400.15-401 MHz band (SRS/MetSat)**

The simulation studies indicate that the levels of mutual interference between SRS (space-to-Earth) transmissions and SOS (space-to-Earth) transmissions in the frequency band 400.15-401 MHz would exceed the relevant ITU-R protection criteria thresholds by large amounts for single-entry cases. Aggregate interference would increase the exceedance. Therefore, co-frequency sharing between non-GSO SD and incumbent systems in the SOS and SRS in this band is not feasible.

Sharing studies between MetSat (space-to-Earth) transmissions and SOS (space-to-Earth) non-GSO SD satellite transmissions in the 400.15-401 MHz frequency band show that relevant ITU-R interference criteria thresholds are exceeded when considering co-frequency operation. Therefore, the results of the studies show that an upgrade of the SOS (space-to-Earth) allocation from secondary to primary as per *invites* 3 of Resolution **659 (WRC-15)** is not feasible.

##### **4/1.7/3.3.3.1.2 401-402 MHz band (MetSat/EESS)**

##### **4/1.7/3.3.3.1.2.1 401-402 MHz band - MetSat/EESS (non-GSO SD satellite space-to-Earth direction)**

Studies show that non-GSO SD satellite operations in the space-to-Earth direction would cause harmful interference to the GSO and non-GSO data collection systems (DCS) spacecraft receivers. Therefore, the non-GSO SD satellites (space-to-Earth) systems are not compatible with GSO DCS

and non-GSO DCS spacecraft receivers in the 401-402 MHz frequency band when considering co-frequency operation.

#### **4/1.7/3.3.3.1.2.2 401-402 MHz band - MetSat/EESS (non-GSO SD satellite Earth-to-space direction)**

Studies show that the levels of interference from non-GSO SD Earth-to-space transmissions into the GSO DCS and non-GSO DCS receivers would exceed the interference protection criteria thresholds; therefore the non-GSO SD (Earth-to-space) systems are not compatible with GSO DCS and non-GSO DCS spacecraft receivers when considering co-frequency operation.

#### **4/1.7/3.3.3.1.2.3 402-403 MHz (MetSat/EESS)**

Based on the studies conducted in the 401-402 MHz frequency band on the compatibility between non-GSO SD satellites and MetSat/EESS systems, the same conclusions should be applied to the 402-403 MHz frequency band due to the similar operations. Therefore, co-frequency sharing between non-GSO short duration satellites and MetSat/EESS systems in this frequency band is not compatible in both directions.

#### **4/1.7/3.3.3.1.2.4 400.15-403 MHz band - MetAids (non-GSO SD satellite space-to-Earth and Earth-to-space directions)**

Sharing and compatibility studies between non-GSO SD satellite space-to-Earth and Earth-to-space operations and meteorological aids service (MetAids) systems (radiosondes, dropsondes and rocketsondes) were performed.

Study results show that when non-GSO-SD satellite and MetAids systems are operated co-channel within the 400.15-403 MHz frequency band that both the long-term and the short-term protection criteria for MetAids (radiosondes, dropsondes and rocketsondes) are exceeded.

Therefore, co-channel sharing between non-GSO SD satellite and MetAids systems operating in the 400.15-403 MHz frequency band is not feasible.

#### **4/1.7/3.3.3.1.2.5 402-403 MHz (MetSat/EESS) - Out-of-Band transmissions from non-GSO SD operations in 403-404 MHz**

Results of a study show that there is interference to non-GSO DCS receivers in 402.85-403 MHz from potential SOS non-GSO SD satellite operations in the 403-404 MHz frequency band. Therefore, use of 403-404 MHz by non-GSO SD systems will not be compatible if a guardband is not applied.

#### **4/1.7/3.3.3.2 Results of sharing and compatibility studies within the frequency range 403-406 MHz**

Sharing and compatibility studies between non-GSO SD satellite space-to-Earth and Earth-to-space operations and MetAids systems (radiosondes, dropsondes and rocketsondes) were performed.

The studies show varying conclusions regarding the feasibility of sharing between potential new allocations for the non-GSO SD systems and the existing services in the 403-406 MHz range as indicated below.

A) Three studies show that when non-GSO-SD satellite and MetAids systems are operated co-channel within the 400.15-406 MHz frequency band that both the long-term and the short-term protection criteria for MetAids (radiosondes, dropsondes and rocketsondes) are exceeded. Therefore these three studies concluded that co-channel sharing between non-GSO SD satellite and MetAids systems operating in the 400.15-406 MHz frequency band is not feasible. These studies therefore suggest that any allocation to SOS in a portion of the 403-406 MHz band (e.g. 403-404 MHz)

would *de facto* lead to band segmentation, excluding MetAids operations use from this band, as well as from adjacent bands. As stipulated in the ITU/WMO Handbook on Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction the entire 400.15-406 MHz band is required for MetAids operation for the foreseeable future.

**B)** One study indicated that coexistence between the SOS (Earth-to-space) and MetAids in the 403-406 MHz band is feasible and therefore a new allocation may be made to the SOS within the band 403-405 MHz in support of non-GSO SD missions. This study did not consider dropsondes or rocketsondes. This study used a specific situation (e.g. number of radiosonde stations, detailed terrain and land use data, 6 kHz receiver bandwidth, earth station antenna height) instead of a more generic situation that would ensure protection of radiosonde receivers from non-GSO SD on a global basis.

**C)** One other study also indicated that coexistence between the SOS (Earth-to-space) and MetAids in the 403-406 MHz band is feasible and therefore a new allocation may be made to the SOS within the band 403-405 MHz in support of non-GSO SD missions. This study considered a scenario with a single earth station and satellite and furthermore various mitigation techniques (e.g. reduced e.i.r.p., pointing avoidance) were considered.

A comparative analysis of the use of different ITU-R Recommendations dealing with propagation models showed that this did not account for the difference in results between the studies in A) above and the studies in B) and C) above.

A study performed to determine interference from radiosondes to SD non-GSO satellite receivers in the Earth-to-space direction concludes that co-frequency sharing with radiosondes is feasible. One study indicated that sharing with radiosondes is not feasible because interference could occur to SD non-GSO satellite receivers in some circumstances.

#### **4/1.7/3.3.3.3 Results of sharing and compatibility studies within the frequency range 406-420 MHz**

All studies conducted in the frequency range 406-420 MHz show that sharing is not feasible between non-GSO SD systems and the existing services as indicated below.

##### **4/1.7/3.3.3.3.1 406-406.1 MHz band (mobile satellite service - COSPAS-SARSAT)**

As noted in section 4/1.7/2.1 the frequency band 406-406.1 MHz should not be considered for an allocation to the SOS. The protection provided by RR No. **5.267** (any emission capable of causing harmful interference to the authorized uses of the band 406-406.1 MHz is prohibited) also includes protection from out-of-band emissions from services which might operate in frequencies adjacent to 406-406.1 MHz.

Analysis of proposed non-GSO SD satellite systems operating in frequencies adjacent to 406-406.1 MHz concluded that transmissions would exceed the emergency position indicating radio beacon (EPIRB) maximum permissible level of interference. However, the implementation of 100 kHz guardbands above 406.1 MHz and below 406 MHz would protect the spaceborne COSPAS-SARSAT receivers operating in the 406-406.1 MHz frequency band from non-GSO SD space-to-Earth transmissions. Additionally, the implementation of a 1 MHz guardband below 406 MHz and 900 kHz above 406.1 MHz applied to the non-GSO SD satellite earth stations would protect the spaceborne COSPAS-SARSAT receivers.

##### **4/1.7/3.3.3.3.2 406.1-410 MHz band (LMS, FS, RAS)**

Analysis of sharing between non-GSO SD satellites and land-mobile and fixed stations in the 406.1-410 MHz frequency band showed that sharing is not feasible. The analysis also showed that

sharing between non-GSO SD earth stations and land-mobile and fixed stations in the 406.1-410 MHz frequency band is not feasible when considering co-frequency operation.

A study performed on the in-band sharing scenario between the RAS and non-GSO SD missions in both Earth-to-space and space-to-Earth directions showed that co-channel co-existence is not feasible in this band. For the Earth-to-space direction a separation distance of 560 km is required between a RAS station and an earth station operating to the non-GSO satellites. For the space-to-Earth direction the interference thresholds for the RAS bands are exceeded with a margin of up to 68 dB.

The results show that a guardband of 1.5 MHz from each edge of the 406.1-410 MHz frequency range is required for both uplink and downlink directions with an associated separation distance of up to four km for transmitting earth stations. However, if the separation distance is more than four km the guardband will be less than 1.5 MHz.

#### **4/1.7/3.3.3.3 410-420 MHz band (SRS, LMS, FS)**

Eight scenarios were studied for the compatibility of SOS non-GSO SD satellites and the Space-to-Space Communication System (SSCS) in the SRS from the International Space Station in the frequencies 414.2 MHz (primary frequency) and 417.1 MHz (backup frequency). The results from the eight different scenarios indicate that sharing is not feasible when considering co-frequency operation.

Analysis of sharing between non-GSO SD satellites and land-mobile and fixed stations in the 410-420 MHz frequency band showed that sharing is not feasible when considering co-frequency operation. The analysis also showed that sharing between non-GSO SD earth stations and land-mobile and fixed stations in the 410-420 MHz frequency band is not feasible when considering co-frequency operation.

#### **4/1.7/3.3.4 Summary of Studies**

Study results are summarized below; more details of all the studies can be found in DN Report ITU-R SA.[SHORT DURATION NGSO – REQUIREMENTS] and PDN Report ITU-R SA.[SHORT DURATION NGSO – SHARING STUDIES].

#### **Summary of the study on the spectrum needs for non-GSO SD systems**

The requirements report indicates that the spectrum needs for non-GSO SD systems are in the range from 0.625 MHz to 2.5 MHz in the space-to-Earth direction and in the range from 0.682 MHz to 0.938 MHz in the Earth-to-space direction, depending on the operational scenario.

#### **Summary of studies on the suitability of existing SOS allocations below 1 GHz**

Studies show that in the Earth-to-space direction all frequency allocations to the SOS below 1 GHz are subject to RR No. **9.21**.

Some studies proposed that if the application of RR No. **9.21** is removed in the frequency band 148-149.9 MHz in the Earth-to-space direction, this band would become a good candidate to accommodate short duration mission requirements. The impact of removing RR No. **9.21** is still to be investigated.

Some studies found that spectrum needs for short duration missions could be most suitably met in the existing 137-138 MHz SOS (space-to-Earth) allocation. Consideration of this band for short duration missions may need further regulatory and technical studies.

### **Summary of studies on the potential upgrade of existing SOS allocations below 1 GHz**

A study in the frequency band 400.15-401 MHz concluded that an upgrade to the SOS (space-to-Earth) allocation for non-GSO SD missions is not feasible because MetSat and SRS protection criteria would be exceeded.

### **Summary of studies of potential new SOS allocations in the frequency range 150.05-174 MHz**

All studies conducted in the frequency range show that sharing between non-GSO SD systems (Earth-to-space and space-to-Earth) and the existing incumbent services in this frequency band is not feasible.

### **Summary of studies of potential new SOS allocations in the frequency range 400.15-420 MHz**

All studies conducted in the frequency range 400.15-403 MHz show that sharing between non-GSO SD systems (Earth-to-space and space-to-Earth) and the existing incumbent services in this frequency band is not feasible.

Studies conducted in the frequency range 403-406 MHz show varying conclusions regarding the feasibility of sharing between new allocations for non-GSO SD systems and the MetAids as indicated in section 4/1.7/3.3.3.2. Further studies may be required.

All studies conducted in the frequency range 406-420 MHz show that sharing between non-GSO SD systems (Earth-to-space and space-to-Earth) and the existing incumbent services in this frequency band is not feasible.

### **Summary of studies regarding the protection of systems operating in the MSS in the band 406-406.1 MHz**

A study has shown that because of the impact of interference that no new allocation should be established in the 406-406.1 MHz band. In the frequency bands 405-406 MHz and 406.1-407 MHz, a study has shown that a possible new SOS allocation for non-GSO SD missions in both directions, (space-to-Earth) and (Earth-to-space) should not be made because out-of-band emissions would exceed COSPAS-SARSAT protection criteria in the adjacent 406-406.1 MHz band.

## **4/1.7/4 Methods to satisfy the agenda item**

### **4/1.7/4.1 Method A NOC**

### **4/1.7/4.2 Method B**

An allocation of 1 MHz to the SOS in the Earth-space direction, limited to non-GSO SD satellite systems, in either 403-404 MHz (see method B1) or 404-405 MHz (see method B2) as indicated in section 4/1.7/3.3.3.2 and below, which is not subject to coordination under Section II of Article 9 of the Radio Regulations.

#### **Advantages:**

- An allocation to the SOS in the Earth-to-space direction would provide a regulatory compliant alternative to the current and foreseen use of the bands under consideration under WRC-19 agenda item 1.2 for telemetry, tracking and command in the Earth-to-space direction, for which WRC-19 agenda item 1.2 is trying to establish e.i.r.p. limits.

**Disadvantages:**

- Several studies show that co-channel sharing with MetAids is not feasible in the 403-406 MHz band and hence that current and future usage of the 403-406 MHz frequency band for MetAids will not be fulfilled.
- This method is not proposing a downlink band associated with this uplink band.

**4/1.7/4.3 Method C**

This method (refer section 4/1.7/3.3.1) proposes to use the existing SOS allocation in the frequency band 137-138 MHz for downlink and the 148-149.9 MHz band for uplink and to provide appropriate associated regulatory provisions in the Radio Regulations for telecommand links of non-GSO SD satellites.

In the frequency band 148-149.9 MHz, in order to comply with the requirement of non-GSO SD missions for an allocation which is not subject to coordination under section II of Article 9 of the Radio Regulations, it is proposed to remove the reference to RR No. 9.21 in RR No. 5.218.

In the frequency band 137-138 MHz, Method C would apply to stations of the SOS (space-to-Earth) the same coordination threshold with terrestrial services as those for space stations of the MSS (space-to-Earth) (see sections 1.1.1 and 1.1.2 of Annex 1 of Appendix 5 of the RR).

**Advantages:**

- To use efficiently the existing allocation to the SOS in this band.
- To recognize the specificity of non-GSO SD with an appropriate identification in the Radio Regulations.
- The definition of a pfd limit for coordination in 137-138 MHz will ensure more protection to terrestrial services than the current situation.
- The design of associated equipment will be improved as the same antenna will be used for both transmission and reception.

**Disadvantages:**

- The impact of removal of RR No. 9.21 (in particular for non-GSO SD missions) is still to be studied.
- Consideration of the 137-138 MHz frequency band for non-GSO SD may need further regulatory and technical studies.



**4/1.7/5 Regulatory and procedural considerations**

**4/1.7/5.1 Method A**

**ARTICLE 5**

**Frequency allocations**

**NOC**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**SUP**

**RESOLUTION 659 (WRC-15)**

**Studies to accommodate requirements in the space operation service for  
non-geostationary satellites with short duration missions**

**4/1.7/5.2 Method B1**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**335.4-410 MHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>403-404 METEOROLOGICAL AIDS</b>		
SPACE OPERATION (Earth-to-space) ADD 5.A17		
Fixed		
Mobile except aeronautical mobile		
5.265		

<b>404-406 METEOROLOGICAL AIDS</b>
Fixed
Mobile except aeronautical mobile
5.265

**ADD**

**5.A17** The use of the band 403-404 MHz by the space operation service (Earth-to-space) is limited to non-GSO satellites with short duration missions having a limited period of validity of not more than three years (refer to Resolution 4 (Rev.WRC-03)). (WRC-19)

Note: Studies carried out in support of this Method includes elements such as separation distances and guardbands which need to be respected. Consequently, such missing information should be duly included in the regulatory parts.

**4/1.7/5.3 Method B2**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**

(See No. 2.1)

**MOD**

**335.4-410 MHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>403-404 METEOROLOGICAL AIDS</b>		
Fixed		
Mobile except aeronautical mobile		
5.265		
<b>404-405 METEOROLOGICAL AIDS</b>		
SPACE OPERATION (Earth-to-space) ADD 5.B17		
Fixed		
Mobile except aeronautical mobile		
5.265		
<b>405-406 METEOROLOGICAL AIDS</b>		
Fixed		
Mobile except aeronautical mobile		
5.265		

**ADD**

**5.B17** The use of the band 404-405 MHz by the space operation service (Earth-to-space) is limited to non-GSO satellites with short duration missions having a limited period of validity of not more than three years (refer to Resolution 4 (Rev.WRC-03)). (WRC-19)

Note: Studies carried out in support of this Method includes elements such as separation distances and guardbands which need to be respected. Consequently, such missing information should be duly included in the regulatory parts.

**SUP**

**RESOLUTION 659 (WRC-15)**

**Studies to accommodate requirements in the space operation service for non-geostationary satellites with short duration missions**

**4/1.7/5.4 Method C**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**75.2-137.175 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>137-137.025</b>	SPACE OPERATION (space-to-Earth) ADD 5.C17 METEOROLOGICAL-SATELLITE (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) 5.208A 5.208B 5.209 SPACE RESEARCH (space-to-Earth) Fixed Mobile except aeronautical mobile (R) 5.204 5.205 5.206 5.207 5.208	
<b>137.025-137.175</b>	SPACE OPERATION (space-to-Earth) ADD 5.C17 METEOROLOGICAL-SATELLITE (space-to-Earth) SPACE RESEARCH (space-to-Earth) Fixed Mobile except aeronautical mobile (R) Mobile-satellite (space-to-Earth) 5.208A 5.208B 5.209 5.204 5.205 5.206 5.207 5.208	

**ADD**

**5.C17** The frequency bands 137-138 MHz and 148-149.9 MHz are identified for use by administrations wishing to implement telemetry, tracking and command links for non-GSO satellites with short duration missions. Resolution [A17-METHOD-C] (WRC-19) applies. This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. (WRC-19)

**MOD**

**137.175-148 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>137.175-137.825</b>	SPACE OPERATION (space-to-Earth) ADD 5.C17 METEOROLOGICAL-SATELLITE (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) 5.208A 5.208B 5.209 SPACE RESEARCH (space-to-Earth) Fixed Mobile except aeronautical mobile (R) 5.204 5.205 5.206 5.207 5.208	
<b>137.825-138</b>	SPACE OPERATION (space-to-Earth) ADD 5.C17 METEOROLOGICAL-SATELLITE (space-to-Earth) SPACE RESEARCH (space-to-Earth) Fixed Mobile except aeronautical mobile (R) Mobile-satellite (space-to-Earth) 5.208A 5.208B 5.209 5.204 5.205 5.206 5.207 5.208	

**MOD**

**148-161.9375 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>148-149.9</b> FIXED MOBILE except aeronautical mobile (R) MOBILE-SATELLITE (Earth-to-space) 5.209 MOD 5.218 5.219 5.221 ADD 5.C17	<b>148-149.9</b> FIXED MOBILE MOBILE-SATELLITE (Earth-to-space) 5.209  MOD 5.218 5.219 5.221 ADD 5.C17	

## MOD

**5.218** *Additional allocation:* the band 148-149.9 MHz is also allocated to the space operation service (Earth-to-space) on a primary basis. The bandwidth of any individual transmission shall not exceed  $\pm 25$  kHz. (WRC-19)

## ADD

### DRAFT NEW RESOLUTION [A17-METHOD-C] (WRC-19)

#### **Frequency bands identified for telemetry, tracking and command of non-GSO satellites with short duration missions**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that the term “short duration mission” used in this Resolution refers to a mission having a limited period of validity of not more than three years;
- b) that telemetry, tracking and command links for non-GSO satellites with short duration missions falls under the space operation service;
- c) that these satellites are constrained in terms of low on-board power and low antenna gain;
- d) that No. **5.C17** identifies the bands 137-138 MHz (space-to-Earth) and 148-149.9 MHz (Earth-to-space) for such applications;
- e) that ITU-R studies have indicated that frequency bands other than those mentioned in *considering d)* allocated to the space operation service below 1 GHz are not suitable for such applications,

*resolves*

- 1 that administrations wishing to implement telemetry, tracking and command of non-GSO satellites with short duration missions use the bands referred to in *considering d)* above;
- 2 that in the band 137-138 MHz, coordination of space stations of the space operation service (SOS) (space-to-Earth) with respect to terrestrial services (except aeronautical mobile (OR) service networks operated by the administrations listed in Nos. **5.204** and **5.206**) is required only if the pfd produced by this space station exceeds  $-125$  dB(W/(m<sup>2</sup> · 4 kHz)) at the Earth’s surface;
- 3 that, in the band 137-138 MHz, coordination of a space station of the SOS (space-to-Earth) with respect to the aeronautical mobile (OR) service is required if the pfd produced by this space station at the Earth’s surface exceeds  $-140$  dB(W/(m<sup>2</sup> · 4 kHz)) for the administrations referred to in *resolves 2*,

*further resolves*

that the use of the bands in *considering d)* for non-GSO satellites in the space operation service with short duration missions does not establish priority in the Radio Regulations and does not preclude the use of the band for any application of the services to which they are allocated.

Notes:

- 1 *resolves* 1 would need to be included in the relevant footnotes.
- 2 Appropriate mechanisms to be used for application of *resolves* 2 and 3 are required.

**SUP**

RESOLUTION 659 (WRC-15)

**Studies to accommodate requirements in the space operation service for  
non-geostationary satellites with short duration missions**

## CHAPTER 5

### **Maritime, aeronautical and amateur services** (Agenda items 1.1, 1.8, 1.9.1, 1.9.2, 1.10, 9.1 (issue 9.1.4))

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## Agenda item 1.1

(WP 5A / WP 5B, WP 5C, WP 6A, (WP 1A), (WP 3K), (WP 3M))

*1.1 to consider an allocation of the frequency band 50-54 MHz to the amateur service in Region 1, in accordance with Resolution 658 (WRC-15);*

*Resolution 658 (WRC-15) – Allocation of the frequency band 50-54 MHz to the amateur service in Region 1*

### 5/1.1/1 Executive summary

This agenda item addresses a possible new Region 1 allocation to the amateur service in the frequency band 50-54 MHz by full or partial worldwide harmonization with the existing 4 MHz primary allocations in Regions 2 and 3.

The spectrum needs for the amateur service has been quantified in two studies using an application-based approach. One of them indicates that 4 MHz of spectrum is required while the other indicates that 1.75 MHz is required.

Administrations in parts of Region 1 are party to the ST61<sup>30</sup> and GE89<sup>31</sup> Regional Agreements which remain in force in the band 50-54 MHz.

Studies have been undertaken to assess the possibility of sharing with the incumbent broadcasting, land mobile and radiolocation services. The studies have demonstrated that large separation distances are required for sharing with incumbent services. Furthermore, regulatory provisions will need to be implemented. Depending upon the incumbent service to be protected, the different protection distances and some measures can be found in Report ITU-R M.[AMATEUR\_50\_MHz].

Four methods are provided to satisfy the agenda item including the No Change method:

- **Method A:** An allocation to the amateur service on a primary basis in Region 1 in the band 50-54 MHz, or part thereof;
- **Method B:** An allocation to the amateur service on a secondary basis in Region 1 in the band 50-54 MHz, or part thereof (**Method B1**), or in the band 50 MHz–51.75 MHz (**Method B2**);
- **Method C:** An allocation to the amateur service in Region 1 on a partly primary and partly secondary basis in all or part of the frequency band 50-54 MHz;
- **Method D:** No changes in the frequency band 50-54 MHz.

Regulatory text is also provided for implementation of the proposed methods.

### 5/1.1/2 Background

In ITU Region 1, the frequency band 50-54 MHz is allocated to the broadcasting service on a primary basis, with additional or alternative allocations to the amateur, fixed, mobile, and/or radiolocation limited to wind profiler radars (WPR) services in some countries.

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<sup>30</sup> Final Acts of the European Broadcasting Conference (Stockholm, 1961 as revised in Geneva, 2006) (“ST61”) in the European Broadcasting Area.

<sup>31</sup> Final Acts of the African Broadcasting Conference (Geneva, 1989 as revised in Geneva, 2006) (“GE89”) in the African Broadcasting Area and neighbouring countries.

The frequency band 47-68 MHz in most of Region 1 is governed by the ST61 and GE89 Regional Agreements, which remain in force. Noting that several countries in Region 1 were not party to the original agreements.

Noting that the frequency band 50-54 MHz is allocated to the amateur service on a primary basis in ITU Regions 2 and 3, full or partial worldwide harmonization of the allocation to the amateur service in the frequency band 50-54 MHz would enhance radio amateurs' global efforts to fulfil the purposes of the amateur service, which include self-training, technical investigations and intercommunication for a variety of purposes including communication in support of disaster relief.

### **5/1.1/3 Summary and analysis of the results of ITU-R studies**

#### **5/1.1/3.1 Spectrum needs**

In considering the need for spectrum harmonization across the three regions, the required amount of spectrum for existing and future amateur applications needs to be calculated, taking into account the principles contained in Recommendation **34 (Rev.WRC-12)**.

An application-based approach, based on current usage of the 50-54 MHz frequency band in Regions 2 and 3, has been developed and agreed for calculating the spectrum needs for current and envisaged amateur applications in the 50-54 MHz frequency band. The results given by this application-based approach are strongly dependent upon the input parameters used. The parameters obtained through the spectrum occupancy analysis and contest log data are used in one study, while the parameters for another study are based on estimations.

Both studies considered the following applications: point-to-point single sideband (SSB) and frequency modulated (FM) voice transmission, FM voice repeater systems, wideband digital modes and infrastructure applications using a variety of transmission protocols.

In one study, the spectrum needs have been calculated for two different spectrum use situations: an average spectrum use occurring in about 98% of time (average day) and an exceptional intensive spectrum use (e.g., contest) occurring in about 2% of time.

Different parameters used for the spectrum needs calculations for each use case are derived through spectrum monitoring data analysis (only eight days in April 2018) as well as through the amateur contest data analysis (during June 2017 50 MHz contest of International Amateur Radio Union - IARU ). The obtained results are representative for European countries with the average amateur population density of 0.117 stations/km<sup>2</sup>. Table 5/1.1-1 summarizes the spectrum needs calculation results of that study.

TABLE 5/1.1-1

**Spectrum needs for different combination of amateur applications and use cases based on spectrum occupancy measurements and log-data analysis**

<b>Required spectrum (kHz)</b>		
<b>Applications</b>	<b>Average use + 300% margin (98% of time)</b>	<b>Intensive use (2% of time)</b>
SSB, FM, wideband	540	765
SSB, FM, wideband, repeaters	740	1 865**
SSB, FM, wideband, repeaters, infrastructure	1 240	4 865** 1 465*
* Infrastructure and repeaters are only considered in average cases.		
** The spectrum needs calculation regarding infrastructure and repeaters in the intensive use case assumes the same value for the fraction of active amateur stations using SSB; however, such a situation is unlikely to occur in practice and may need to be ignored.		

Another study uses the same applications-based approach, but using only estimated parameters based on long-term band usage patterns for SSB, FM, repeater and propagation beacon applications and extrapolated for future wideband applications (+) gives the spectrum needs shown in Table 5/1.1-2.

Using the parameters typical for the countries of European Conference of Postal and Telecommunications (CEPT), with an average population density of amateur licensees (0.07 stations/km<sup>2</sup>), the required spectrum is calculated to be slightly in excess of 4 MHz. Table 5/1.1-2 shows the estimated spectrum required for each of the applications.

TABLE 5/1.1-2

**Spectrum needs for different amateur applications based on parameter estimation**

<b>Required spectrum (kHz)</b>	
<b>Applications</b>	<b>Average use (100% of time)</b>
SSB	87
FM	25
Wideband modes <sup>++</sup>	500
Repeaters (FM)	950
Infrastructure <sup>++</sup>	2 500
Propagation beacons	100
<b>Total for all applications</b>	<b>4 162</b>

**5/1.1/3.2 Sharing with the broadcasting service in Region 1**

The transition to digital television broadcasting has significantly reduced the occupancy of the 50-54 MHz frequency band by the broadcasting service in ITU Region 1. However, the regional plans ST61 and GE89 still contain many frequency assignments in the frequency band 50-54 MHz and the Master International Frequency Register (MIFR) contains hundreds of records for broadcasting service transmitters in ITU Region 1.

Studies have shown that for protection of the broadcasting service from harmful interference, a field strength from an amateur station at the edge of the service area of a broadcasting transmitter shall not exceed 6 dB( $\mu$ V/m) for 10% of the time at a height of 10 m above ground. Typical separation distances between amateur service systems and broadcasting service stations would range from 70 to 175 km.

### **5/1.1/3.3 Sharing between the amateur service and the land mobile service in Region 1**

For an interference protection ratio of  $I/N = -6$  dB, studies have shown that for protection of the land mobile service from harmful interference, a separation distance in the range of 170 km to more than 500 km in average terrain is needed. In mountainous regions, the separation distances are in about the same range. Dependent on the amateur service application, interference from a single amateur station may simultaneously interfere with more than 25 mobile channels in a range of up to 170 km. Given the mobile nature of governmental communication systems, new and existing amateur service applications (fixed, mobile or portable) using the frequency band of 50-54 MHz, make sharing difficult.

One study has shown that some amateur service applications, such as repeaters (in high activity situations) and new infrastructure will generate harmful interference into the mobile service if operated in the frequency band 50-54 MHz. However, some other amateur service applications, such as SSB, FM, wideband modes and repeaters (in low activity situations), could share the band 50-54 MHz with the mobile service under specific operational conditions. It was further calculated that the spectrum needs for SSB, FM, wideband modes and repeaters in the band 50-54 MHz could be satisfied within 1.75 MHz. Therefore, in view of *invites* 1 and 2 of Resolution **658 (WRC-15)**, this study concludes that any spectrum allocation within the band 50-54 MHz for the amateur service should be limited to 1.75 MHz.

Monte-Carlo simulations conducted with no mitigation techniques have shown that the probability of interference is highly dependent on the usage density of the band by amateurs. For the SSB mode, it has been shown that the probability of harmful interference ranges between 8 and 86% given the number of active amateur channels considered in the simulation radius. For the FM mode, it is about 28%. For the wideband digital mode, the probability of interference is around 93% for the in-band case (affecting up to 20 land mobile channels) and decreases for the out-of-band emissions.

Interference mitigation measures such as coordination between services in adjacent countries, operational limitation on amateur stations; listen-before-talk operation and technical means such as spread spectrum techniques have not been studied as part of this agenda item.

### **5/1.1/3.4 Sharing between the amateur service and the radiolocation service (wind profiler radars)**

Radio Regulations (RR) No. **5.162A** provides an additional allocation to the radiolocation service on a secondary basis in a number of countries, limited to the operation of wind profiler radars (WPR).

Studies show that typical separation distances between amateur service systems and wind profiler radars would range from 29 km to distances above 300 km, confirming the need for specific protection measures.

Taking into account the limited numbers of systems in or immediately adjacent to the frequency band 50-54 MHz range (and probably the expected low number of amateur systems in the vicinity of WPR installations), sharing could probably be considered on a case-by-case basis e.g. coordination zones established in affected geographical areas.

It has to be noted that this approach, currently, could only be possible and efficient if appropriate regulatory measures in the Radio Regulations ensure that amateur and radiolocation services are of equal status within the 50-54 MHz band.

#### **5/1.1/3.5 Relevant ITU-R Recommendations**

Recommendations ITU-R [M.1634-0](#), [M.1651-0](#), [M.1732-2](#), [M.1825-0](#), [P.526-14](#), [P.1546-5](#), [P.2001-2](#), [SM.851-1](#), [SM.1055-0](#), [BT.1368-13](#), [BT.2033-1](#).

#### **5/1.1/3.6 Relevant ITU-R Reports**

WDPDN Report ITU-R M.[AMATEUR\_50\_MHz], Report ITU-R [BT.2387-0](#).

#### **5/1.1/4 Methods to satisfy the agenda item**

Four methods are proposed to satisfy the agenda item and all of them involve suppression of Resolution **658 (WRC-15)**.

*[Note: CPM19-2 is invited to consider whether to maintain the advantages and disadvantages for each method, taking into account that those might not be present in the draft CPM text for other agenda items.]*

##### **5/1.1/4.1 Method A**

An allocation to the amateur service on a primary basis in all the band 50-54 MHz, or part thereof, with appropriate footnotes to provide protection to services which already have an allocation in the band.

##### **Advantages:**

- The requirement of the amateur service to have an allocation in the frequency band 50-54 MHz in Region 1 would be partly or fully satisfied.
- Partial or full harmonization of spectrum throughout the three ITU regions would be achieved for the amateur service, thus the principles outlined in Recommendation **34 (Rev.WRC-12)** would be respected.

##### **Disadvantages:**

- Administrations may need to adopt specific measures or develop multilateral agreements to ensure harmful interference is not caused to stations of incumbent services operated within their territory or in neighbouring territories.
- The amateur service could cause harmful interference to incumbent services which may be difficult to resolve.
- Regarding the radiolocation service, the sharing approach proposed may not be fulfilled.
- May affect current and future usage of the band.

##### **5/1.1/4.2 Method B1**

An allocation to the amateur service on a secondary basis in all or part of the frequency band 50-54 MHz, with appropriate footnotes or appropriate regulatory text to provide protection to services which already have an allocation in the band.

##### **Advantages:**

- The requirement of the amateur service to have an allocation in the frequency band 50-54 MHz in Region 1 would be fully or partly satisfied.

- Full or partial harmonization of spectrum throughout the three RR Regions would be achieved, thus the principles outlined in Recommendation **34 (Rev.WRC-12)** would be respected.
- Incumbent services with a primary allocation remain protected and does not place constraints on the secondary incumbent services.

**Disadvantages:**

- Full harmonization of spectrum for the amateur service throughout the three RR Regions would not be achieved in terms of service status.
- If the amateur service has secondary status, future introduction of new primary services into the band or modification to RR Article **5** covering all or part of the 50-54 MHz frequency band may adversely impact the amateur service.

**5/1.1/4.3 Method B2**

An allocation to the amateur service on a secondary basis in the frequency band 50-51.75 MHz, with appropriate footnotes to provide protection to services which already have an allocation in the band.

**Advantages:**

- The spectrum needs of the amateur service in the frequency band 50-54 MHz in Region 1 would be satisfied according to one study.
- Partial harmonization of spectrum throughout the three RR Regions would be achieved, thus the principles outlined in Recommendation **34 (Rev.WRC-12)** would be respected.
- Incumbent services with a primary allocation remain protected and does not place constraints on the secondary incumbent services.

**Disadvantages:**

- The spectrum needs of the amateur service in the frequency band 50-54 MHz in Region 1 would be only partly satisfied according to another study.
- Full harmonization of spectrum for the amateur service throughout the three RR Regions would not be achieved in terms of service status.
- If the amateur service has secondary status, future introduction of new primary services into the band or modification to RR Article **5** covering all or part of the 50-54 MHz frequency band may adversely impact the amateur service.

**5/1.1/4.4 Method C**

An allocation to the amateur service on a partly primary and partly secondary basis in all or part of the frequency band 50-54 MHz, with appropriate footnotes to provide protection to services which already have an allocation in the band.

**Advantages:**

- The requirement of the amateur service to have an allocation in the frequency band 50-54 MHz in Region 1 would be fully or partially satisfied.
- Partial harmonization of spectrum throughout the three ITU regions would be achieved, thus the principles outlined in Recommendation **34 (Rev.WRC-12)** would be fully or partially respected.
- The use of RR No. **4.4** for implementing spectrum allocations on a national or multinational basis may be avoided.

**Disadvantages:**

- The needs of the amateur service in the frequency band 50-54 MHz in Region 1 for spectrum and spectrum harmonization may only be partly satisfied.
- Administrations may need to adopt specific measures, or develop multilateral agreements to ensure harmful interference is not caused to stations of incumbent services (which may be difficult to resolve) operating within their territory or in neighbouring territories.
- Regarding the radiolocation service, the sharing approach proposed may not be fulfilled.
- May affect current and future usage of the band.

**5/1.1/4.5 Method D**

Method D is to not make any changes (No Change) in the frequency band 50-54 MHz.

**Advantage:**

- Avoid additional restrictions on the operations of broadcasting, radiolocation, land mobile and fixed services stations and avoid possible interference from the amateur service.

**Disadvantage:**

- Does not satisfy the requirements of the amateur service.

**5/1.1/5 Regulatory and procedural considerations**

**5/1.1/5.1 For all Methods A, B1, B2, C, and D, suppression of Resolution 658 (WRC-15)**

**SUP**

**RESOLUTION 658 (WRC-15)**

**Allocation of the frequency band 50-54 MHz to the amateur service in Region 1**

**5/1.1/5.2 For Method A**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**47-75.2 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>47-50</b> BROADCASTING  5.162A 5.163 5.164 5.165	<b>47-50</b> FIXED MOBILE	<b>47-50</b> FIXED MOBILE BROADCASTING  5.162A
<b>50-5[x]</b> AMATEUR BROADCASTING 5.162A 5.164 5.165 5.169 ADD 5.A11 ADD 5.B11	<b>50-54</b> AMATEUR  5.162A 5.167 5.167A 5.168 5.170	
<b>5[x]-68</b> BROADCASTING  5.162A 5.163 5.164 5.165 [5.169] 5.171	<b>54-68</b> BROADCASTING Fixed Mobile  5.172	<b>54-68</b> FIXED MOBILE BROADCASTING  5.162A

**ADD**

**5.A11** In Region 1 in the frequency band 50-5[x] MHz, with the exception of those countries listed in No. **5.169**, stations of the amateur service shall not cause harmful interference to, or claim protection from, stations of the broadcasting service. The administrations of neighbouring countries in Region 1 shall ensure that the field strength emitted by an amateur station does not exceed a calculated value of +6 dB(µV/m) at a height of 10 m above ground at the service area boundary of operational broadcasting stations for more than 10% of time, unless otherwise agreed between affected administrations. (WRC-19)



**ADD**

**5.B11** In Region 1 in the frequency band 50-5[x] MHz with the exception of those countries listed in No. **5.169**, stations of the amateur service shall not cause harmful interference to, or claim protection from, stations of the mobile service and wind profiler radars operating in the radiolocation service. (See Resolution [A11-WPR] (WRC-19).) (WRC-19)

*[Note: The draft new Resolution [A11-WPR] (WRC-19) has not been developed yet and contributions to CPM19-2 are invited.]*

**5/1.1/5.3 For Method B1**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**47-75.2 MHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>47-50</b> BROADCASTING  5.162A 5.163 5.164 5.165	<b>47-50</b> FIXED MOBILE	<b>47-50</b> FIXED MOBILE BROADCASTING  5.162A
<b>50-5[x]</b> BROADCASTING Amateur 5.162A 5.164 5.165 5.169 ADD 5.C11 ADD 5.D11	<b>50-54</b> AMATEUR  5.162A 5.167 5.167A 5.168 5.170	
<b>5[x]-68</b> BROADCASTING  5.162A 5.163 5.164 5.165 [5.169] 5.171	<b>54-68</b> BROADCASTING Fixed Mobile  5.172	<b>54-68</b> FIXED MOBILE BROADCASTING  5.162A

**ADD**

**5.C11** Amateur stations in the band 50-5[x] MHz, with the exception of those countries listed in No. **5.169**, shall not cause harmful interference to, or claim protection from, existing or planned, broadcasting, mobile, fixed or wind profiler radars operating in the radiolocation service. (WRC-19)

**ADD**

**5.D11** The use of frequencies within the frequency band 50-5[x] MHz by amateur stations with the exception of those countries listed in No. **5.169**, is subject to getting prior special authorization from the administration concerned, together with the agreement of other administrations, whose broadcasting service may be affected. To identify potentially affected administrations in Region 1 the field-strength value must be set to 6 dB(µV/m) at a height of 10 m above the ground for 10% of the time at the border of the territory of this administration. (WRC-19)

**5/1.1/5.4 For Method B2**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**

(See No. 2.1)

**MOD**

**47-75.2 MHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>47-50</b> BROADCASTING  5.162A 5.163 5.164 5.165	<b>47-50</b> FIXED MOBILE	<b>47-50</b> FIXED MOBILE BROADCASTING  5.162A
<b>50-51.75</b> BROADCASTING Amateur ADD 5.E11 5.162A 5.164 5.165 5.169	<b>50-54</b> AMATEUR    5.162A 5.167 5.167A 5.168 5.170	
<b>51.75-54</b> BROADCASTING 5.162A 5.164 5.165 5.169		

<b>54-68</b> BROADCASTING  5.162A 5.163 5.164 5.165 5.171	<b>54-68</b> BROADCASTING Fixed Mobile  5.172	<b>54-68</b> FIXED MOBILE BROADCASTING  5.162A
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**ADD**

**5.E11** *Additional allocations:* in countries not listed in No. **5.169** stations in the amateur service shall not cause harmful interference to other services to which this band is allocated. The operation of stations in the amateur service shall be subject to agreement obtained under No. **9.21** with respect to the broadcasting service. For identification of potentially affected administrations in Region 1 the field-strength value of 6 dB( $\mu$ V/m) for 10% of the time produced at 10 m above ground level at the border of the territory of any other administration shall be used. (WRC-19)

**5/1.1/5.5 For Method C**

ARTICLE 5

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

47-75.2 MHz

Allocation to services		
Region 1	Region 2	Region 3
<b>47-50</b> BROADCASTING  5.162A 5.163 5.164 5.165	<b>47-50</b> FIXED MOBILE	<b>47-50</b> FIXED MOBILE BROADCASTING  5.162A
<b>50-[xx]</b> AMATEUR BROADCASTING 5.162A 5.164 5.165 5.169 ADD 5.F11 ADD 5.G11	<b>50-54</b> AMATEUR	

<p>[xx]-[&lt;54] BROADCASTING Amateur 5.162A 5.164 5.165 5.169 ADD 5.H11</p>	<p>5.162A 5.167 5.167A 5.168 5.170</p>	
<p>[&lt;54]-68 BROADCASTING  5.162A 5.163 5.164 5.165 [5.169] 5.171</p>	<p><b>54-68</b> BROADCASTING Fixed Mobile  5.172</p>	<p><b>54-68</b> FIXED MOBILE BROADCASTING  5.162A</p>

**ADD**

**5.F11** In Region 1, in the frequency band 50-[xx] MHz, with the exception of those countries listed in No. **5.169**, stations in the amateur service shall not cause harmful interference to, or claim protection from, stations in the broadcasting service. The administrations of neighbouring countries in Region 1 shall ensure that the field strength emitted by an amateur station does not exceed a calculated value of +6 dB( $\mu$ V/m) at a height of 10 m above ground at the service area boundary of operational broadcasting stations for more than 10% of time, unless otherwise agreed between affected administrations. (WRC-19)

**ADD**

**5.G11** In Region 1, in the frequency band 50-[xx] MHz, with the exception of those countries listed in No. **5.169**, stations in the amateur service shall not cause harmful interference to, or claim protection from, stations in the mobile service and wind profiler radars operating in the radiolocation service. (See Resolution **[B11-WPR]** (WRC-19).) (WRC-19)

*[Note: The draft new Resolution **[B11-WPR]** (WRC-19) has not been developed yet and contributions to CPM19-2 are invited.]*

**ADD**

**5.H11** *Additional allocations:* frequencies in the frequency band [xx-< 54] MHz may be used by amateur service stations as a secondary allocation. The use of frequencies by amateur stations is subject to getting prior special permission from the appropriate authority, together with the agreement of other administrations, whose radio service may be affected. To identify potentially affected administrations in Region 1 the field-strength value must be set to 6 dB( $\mu$ V/m) for 10% of the time at the border of the territory of any other administration. (WRC-19)

**5/1.1/5.6 For Method D**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**NOC**

**47-75.2 MHz**

## Agenda item 1.8

*1.8 to consider possible regulatory actions to support Global Maritime Distress Safety System (GMDSS) modernization and to support the introduction of additional satellite systems into the GMDSS, in accordance with Resolution 359 (Rev.WRC-15);*

*Resolution 359 (Rev.WRC-15) – Consideration of regulatory provisions for updating and modernization of the Global Maritime Distress and Safety System*

### **5/1.8/1 Executive summary**

WRC-19 agenda item 1.8 encompasses two separate items. The first is global maritime distress and safety system (GMDSS) modernization addressed under *resolves to invite ITU-R 1* of Resolution 359 (Rev.WRC-15). In this chapter GMDSS modernization is referred to as “Issue A.” The second is the introduction of additional satellite systems into the GMDSS, covered under *resolves to invite ITU-R 2* of Resolution 359 (Rev.WRC-15). The introduction of an additional satellite system into the GMDSS is referred to as “Issue B.”

#### **5/1.8/1.1 Resolution 359 (Rev.WRC-15), invites the 2019 World Radiocommunication Conference 1**

To satisfy Issue A under WRC-19 agenda item 1.8, two methods are presented below to be reflected in the Radio Regulations. The first method is no change; the second method includes frequencies to be used for medium frequency (MF) and high frequency (HF) navigational data (NAVDAT) systems, in support of GMDSS modernization.

#### **5/1.8/1.2 Resolution 359 (Rev.WRC-15), invites the 2019 World Radiocommunication Conference 2**

To satisfy Issue B under WRC-19 agenda item 1.8, several methods are presented below to reflect in the Radio Regulations the frequencies used by a non-GSO GMDSS satellite system, noting that WRC-19 is invited to take into consideration the activities of International Maritime Organization (IMO).

### **5/1.8/2 Background**

Agenda item 1.8 (Resolution 359 (Rev.WRC-15)), concerns GMDSS. *Resolves 1* addresses the modernization of the GMDSS while *resolves 2* addresses the introduction of additional satellite providers into the GMDSS.

#### **5/1.8/2.1 Issue A: Global maritime distress and safety system modernization**

The GMDSS was adopted as part of the 1988 amendments to the International Convention for the Safety of Life at Sea, 1974 (SOLAS). It was fully implemented in 1999. It has served the mariner and the maritime industry well since its inception, but some of the GMDSS technologies used have not reached their full potential, and some GMDSS functions could be performed by more modern technologies.

IMO has adopted a modernization plan for the GMDSS containing a high-level review and a detailed review. The detailed review and the plan show that the use of some existing services is declining. Meanwhile, some new technologies are considered to be possibly introduced in the modernized GMDSS, such as VHF data exchange system (VDES) and the NAVDAT system. The VDES has been already covered by WRC-15 for the terrestrial component and agenda item 1.9.2 covers the satellite component, therefore no action is requested for the VDES under agenda item 1.8.

Navigational text (NAVTEX) was incorporated into the regulations for the GMDSS for disseminating maritime safety information, which was introduced in a transitional phase from 1992 to 1999, after which it became mandatory under Chapter V of the SOLAS regulations.

In March 2012, ITU-R approved Recommendation ITU-R M.2010 “*Characteristics of a digital system, named Navigational Data for broadcasting maritime safety and security related information from shore-to-ship in the 500 kHz band*”. Later on, in April 2014, the other Recommendation ITU-R M.2058 “*Characteristics of a digital system, named navigational data for broadcasting maritime safety and security related information from shore-to-ship in the maritime HF frequency band*” was also approved. NAVDAT is counted as an enhancement of existing NAVTEX and could be considered as a potential entity in next generation of GMDSS.

WRC-12 addressed the allocation of the 495-505 kHz frequency band for the maritime mobile service. This band is regarded as the most suitable for MF NAVDAT application. However, regulatory provisions are still needed for both MF and HF NAVDAT applications.

#### **5/1.8/2.2 Issue B: Introduction of additional satellite systems into the Global Maritime Distress and Safety System (*resolves to invite ITU-R 2*)**

To date, only one satellite system has been incorporated by the IMO in the GMDSS “system of systems”. Noting *recognizing d*) of Resolution **359 (Rev.WRC-15)**, WRC-19 is invited to consider the ITU-R studies that may be undertaken as part of this agenda item (see section 5/1.8/1.2 above).

A compilation of related ITU-R Recommendations and Reports is given below.

#### **5/1.8/3 Summary and analysis of the results of ITU-R studies**

Existing relevant Recommendations and Report for Issue A:

Recommendations [ITU-R M.2010](#), [ITU-R M.2058](#), [ITU-R M.1798](#), [ITU-R P.368](#), Report [ITU-R M.2201](#).

Existing relevant Recommendations and Reports for Issue B:

Recommendations [ITU-R M.1184-2](#), [ITU-R M.1188-1](#), [ITU-R M.1583-1](#), [ITU-R RA.1631-0](#), Report [ITU-R M.2369-0](#), WDPDN Report ITU-R M.[GMDSS-SATREG], WDPDN Report ITU-R M.[RAS-COMPAT].

#### **5/1.8/3.1 Issue A: Global maritime distress and safety system modernization (*resolves to invite ITU-R 1*)**

IMO will approve the revision of SOLAS Chapters III and IV in 2022. For this reason, it will be important to keep on the agenda for WRC-23 the modernization of the GMDSS. However, some actions could be considered and taken for the WRC-19. The regulatory recognition of the frequencies for the MF and HF NAVDAT could facilitate the work during WRC-23. It will also help the administrations, given sufficient time, to make available those frequencies for the MF and HF NAVDAT.

NAVDAT is a kind of digital system for broadcasting maritime safety and security-related information from shore-to-ship. NAVDAT uses a time-slot allocation similar to the NAVTEX system which could be coordinated by IMO in the same manner. NAVDAT could operate in both MF and HF frequency bands. A 10 kHz channel is the necessary bandwidth for each system. The system uses OFDM which is a modulation technology for digital transmissions, and every subcarrier is modulated either in 64-QAM, 16-QAM or 4-QAM.

As the 500 kHz frequency band provides good coverage as shown in Recommendation ITU-R P.368-9, the frequency band 415-526.5 kHz of the maritime mobile service would be used for MF NAVDAT as described in Recommendation ITU-R M.2010.

The detailed review of GMDSS shows that the uses of HF narrowband direct printing (NBDP) for follow-up communications is declining greatly, and HF MSI could also be accomplished by means other than NBDP, such as HF NAVDAT. Six channels respectively in 4 MHz, 6 MHz, 8 MHz, 12 MHz, 16 MHz and 22 MHz frequency bands listed in RR Appendix 17 would be used for HF NAVDAT, as described in Recommendation ITU-R M.2058.

NAVDAT has the function of broadcasting message of safety of navigation, security, piracy, search and rescue, meteorological messages and piloting or harbour messages etc. There is a need to establish international harmonized standards, including technical and operational characteristics in detail, such as priority identification, protocol, message classification and data structure, etc. and necessary coordination schemes by IMO, and harmonized frequency band explicitly identified by the Radio Regulations. This will ensure the implementation of global NAVDAT application. This is very similar to the implementation of international NAVTEX service transmitting English language messages operating on 518 kHz.

On the other hand, as the high affectivity and efficiency, the NAVDAT system could also be used by national authorities for transmitting safety and security-related information in national languages or for some specific functions. This kind of national NAVDAT application might not operate in globally harmonized standards, for example, in different data structures, or in different frequency bands. The national NAVDAT systems will or need not meet the coordination schemes by IMO, depending on the frequency bands they use. This is very similar to NAVTEX transmitting local language messages operating on 490 kHz or other frequency bands specified by national authorities in accordance with the NAVTEX Manual.

### **Analyses on medium-frequency band**

So far, NAVDAT is one of the most important potential elements involved both in GMDSS modernization and e-navigation. However, there is not any frequency band used for the application in the Radio Regulations. With respect to the frequency band 415-526.5 kHz, only the 495-505 kHz band is exclusively allocated in the maritime mobile service globally. Thus, this band would be the best choice for the international NAVDAT broadcasting.

Technically, the other parts of the frequency band 415-526.5 kHz are also suitable for the NAVDAT application. However, the use of these bands by the maritime mobile service is restricted for only radiotelegraphy according to RR No. 5.79. Practically, except the NAVTEX services, radiotelegraphy has been greatly declined to disuse in many countries. Allowing national NAVDAT systems using these bands for the maritime mobile service might be feasible. Some appropriate regulatory approach would give administrations an opportunity to promote the development and deployment of this kind of new advanced technology.

The further protection approaches will be considered during the implementation of GMDSS modernization as NAVDAT recognized in GMDSS, and the coordination scheme developed. This is planned to be done in the study cycle of WRC-23, according to the progress of activities of IMO.

### **Analyses on high-frequency band**

WRC-12 designed some frequency bands in RR Appendix 17 for digitally modulated emissions in the maritime mobile service (e.g. as described in the most recent version of Recommendation ITU-R M.1798) from 1 January 2017 by footnote *p*). ITU-R issued Recommendation ITU-R M.2058-0 in February 2014. Six channels respectively within 4 MHz, 6 MHz, 8 MHz, 12 MHz, 16 MHz and 22 MHz frequency bands with footnote *p*) are recommended to be used for HF



NAVDAT. It is feasible technically. However, there are needs to take appropriate actions to give NAVDAT application regulatory status to operate in these bands. Furthermore, just as the same as the MF NAVDAT, the further protection approaches on HF bands need to be considered during the implementation of GMDSS modernization depending on the situation related to NAVDAT recognized in GMDSS, and the related coordination scheme developed. This is also planned to be done in the study cycle of WRC-23, according to the progress of activities of IMO.

Analysis of the Master International Frequency Register showed that the frequency bands suggested for implementation of the HF NAVDAT system were used by a large number of transmitting coastal stations in the maritime mobile service subject to existing spectrum allocations. Those stations could cause harmful interference to the operation of HF NAVDAT system ship receivers on a significant portion of the World Ocean. Therefore, effective implementation of HF NAVDAT systems would require appropriate development of regulatory and technical measures providing its compatibility with currently existing maritime mobile stations. Currently the NAVDAT system does not refer to internationally coordinated systems, adopted by IMO. Therefore, incorporation of HF NAVDAT system frequency bands into RR Appendix 15 seems inappropriate.

### **5.1.8/3.2 Issue B: Introduction of additional satellite systems into the Global Maritime Distress and Safety System (*resolves to invite ITU-R 2*)**

There is currently one operating non-GSO MSS system being considered by the IMO which could provide worldwide operation of GMDSS within MSS allocations in the frequency range 1 616-1 626.5 MHz, including to Arctic and Antarctic areas.

This system was first published under special section RES46/C/40, BR IFIC 2081, and notified in BR IFIC 2418. The allocation used by this system is also used by other non-GSO and GSO MSS systems.

MSS satellite systems in the band 1 610-1 626.5 MHz are subject to frequency coordination under RR Article 9 as indicated in RR No. 5.364. Specifically RR No. 9.11A, together with the associated Rules of Procedure (RoP), calls for coordination between geostationary and non-geostationary satellite networks alike, and with other services having equal rights. The above-mentioned system's service links within this band (both uplink and downlink) having been coordinated under RR No. 9.11A with those services with equal status, notified and recorded under RR Article 11 in the Master International Frequency Register (MIFR). It is emphasized that today, apart from frequency overlap check, there is no established criteria to trigger coordination with other satellite networks. However, many coordinations have taken place and are taking place on the basis of frequency overlap. Consequently, successful application of RR No. 9.11A should not be construed as successful coordination similar to those foreseen under RR No. 9.7. It is also to be noted that the MSS downlinks are recorded as having secondary status.

Within the band 1 616-1 626.5 MHz the satellite system under consideration by IMO operates using the same frequency for both uplink and downlink, to each mobile earth station. A full description of this operation can be found in Report ITU-R M.2369.

Under the authorization issued by the notifying administration, the space stations of the satellite system are authorized to operate in the 1 618.725-1 626.5 MHz band, and on a shared basis with another non-GSO network under the responsibility of the same notifying administration in the 1 617.775-1 618.725 MHz band.

On this subject, two views were expressed:

- View 1: expressed that, because these assignments are operated using time division duplex (TDD), in which the subscriber units and satellites transmit and receive in the same frequency band, the secondary downlinks are effectively protected by the primary

uplink communication links and in practice enjoy the same rights in the 1 618.725-1 626.5 MHz band. There is no other operational MSS system which is co-frequency with the HIBLEO-2 system. From the practical perspective of the assignments and their protection, the unique operation of the HIBLEO-2 satellite uplink and downlink in the same frequency band (“time division duplex”), the date priority enjoyed by the HIBLEO-2 filing, and the primary allocation status of the uplink provide suitable protection for use of the frequencies in both directions.

- View 2: expressed that since synchronization and the channel assignments mentioned above are managed by the satellite, it is vital for the function of this system that the downlink can be received without interruption, something that cannot be ensured with a secondary allocation. Moreover, the operation of this satellite system downlink has a status of “non-interference, non-protection” vis-à-vis any primary service within the same band and in adjacent bands, and since there is currently no reliable coordination criteria, apart from frequency overlap which is one among other interference criteria, to accomplish coordination, the allocation should not be a candidate to provide a safety-of-life aspect as required by the GMDSS.

#### **5/1.8/3.2.1 Allocations and other regulatory provisions to be taken into account**

Various portions of the band 1 610.0-1 626.5 MHz are also allocated to the following services:

- aeronautical mobile-satellite (route) service (AMS(R)S),
- aeronautical radionavigation service (ARNS),
- fixed service (FS),
- radio astronomy service (RAS), and
- radiodetermination-satellite service (RDSS).

##### **5/1.8/3.2.1.1 Allocations and associated matters**

The services listed above and their current operational status are further discussed below.

- Pursuant to RR No. **5.367**, AMS(R)S is allocated on a primary basis in the band 1 610-1 626.5 MHz in both uplink and downlink directions, subject to agreement to be obtained under RR No. **9.21**.

Two views were expressed:

- View 1: It should be noted that, based on this allocation, the International Civil Aviation Organization (ICAO) has adopted Standards and Recommended Practices (SARPs) in relation to communications of different categories of AMS(R)S safety messages over the satellite system being considered by the IMO for provision of GMDSS.
  - View 2: There is no need to talk about SARPs and ICAO Standards, for inclusion in CPM text. Irrespective of actions taken under this agenda item, ICAO continues to apply the standards with respect to AMS(R)S. Moreover, it is not within the mandate nor the competence of ITU-R Study Groups to confirm or otherwise the compliance of operation of any system with ICAO standards.
- ARNS is allocated in the band 1 610-1 626.5 MHz. There are no known planned or operational ARNS systems in this band.
  - Radio astronomy service (RAS) operates in the 1 610.6-1 613.8 MHz frequency band on a primary basis. Resolution **359 (Rev.WRC-15)** invites WRC-19 to consider the

impact on the protection of the RAS, in accordance with RR No. **5.372**. In this connection some administrations operating RAS in the frequency band above have reported that, since 1998, harmful interference has been experienced from the downlink operations of this MSS system. This was reported to the ITU<sup>32</sup> and to the responsible administration for the satellite system<sup>33</sup>. The responsible administration described measures<sup>34</sup> it is taking that will, in its view, resolve the interference. (See also working document towards a PDN Report ITU-R M.[RAS.COMPAT].)

- Pursuant to RR No. **5.359**, FS is allocated in the band 1 610-1 626.5 MHz. It is noted that RR No. **5.359** (adopted before WARC-92) states: “*Administrations are urged to make all practicable efforts to avoid the implementation of new fixed-service stations in these frequency bands*”.
- The RDSS is allocated in the band 1 610-1 626.5 MHz on a primary basis in Region 2, and on a secondary basis in Regions 1 and 3 and under RR No. **5.364** is subject to coordination under RR No. **9.11A**. In addition, RR No. **5.369** provides for the RDSS (Earth-to-space) in the 1 610-1 626.5 MHz band on a primary basis for some countries in Regions 1 and 3 identified in the footnote, subject to agreement under RR No. **9.21** from countries not listed in this provision.

Two views were expressed:

- View 1: In the 1 613.8-1 626.5 MHz band, a downlink using a MSS secondary allocation (space-to-Earth) cannot claim protection from harmful interference from the uplink of satellite networks using the primary allocation (Earth-to-space), operating in accordance with the Radio Regulations.
- View 2: In the 1 613.8-1 626.5 MHz band, stations using the secondary MSS (space-to-Earth) allocation cannot claim protection from harmful interference from stations using the primary RDSS (Earth-to-space) allocation. However, in Regions 1 and 3, outside of the twenty administrations listed in RR No **5.369**, the RDSS (Earth-to-space) allocation is secondary in the remaining 138 Region 1 and Region 3 administrations. Consequently, both the RDSS (Earth-to-space) allocation and the MSS (space-to-Earth) allocation are of secondary allocation status. Regardless of the situation described above, before consideration of the secondary MSS (space-to-Earth) allocation vis-à-vis the primary RDSS (Earth-to-space) allocation, the operator of the primary RDSS (Earth-to-space) allocation must first effect successful coordination with the operator of the primary MSS (Earth-to-space) allocation. In the case of the MSS system that is under consideration by the IMO, and is at the basis of *resolves 2*, that MSS system would have date priority over any RDSS system filed subsequently. In this situation, successful coordination of MSS and RDSS uplinks on the basis of frequency overlap in the same geographical area may prove difficult. Furthermore, coordination with the primary MSS (Earth-to-space) allocation on the same satellite system would be also required by any primary RDSS (Earth-to-space) system notified subsequently. The above requirements in practice ensure protection of MSS secondary (space-to-Earth) assignments on the MSS system being considered by the IMO.

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<sup>32</sup> See ITU-R RRB 17.1 Document [2].

<sup>33</sup> See Attachments 4, 6, 7, 8, 9, 10 and 11 of RRB 17.1 Document [2].

<sup>34</sup> See ITU-R RRB 17.1 Document [5].

- The adjacent frequency band 1 626.5-1 660.5 MHz is allocated to the MSS (Earth-to-space).

Two views were expressed:

- View 1: Several MSS networks and systems use bands adjacent to, both above and below, those proposed for GMDSS operation for uplinks from mobile earth stations (MESs). It is important that non-GSO MESs planned to be used for GMDSS services be designed and installed in such a manner as to mitigate the effect of, and be resilient to, the potential interference from existing non-GSO and GSO terminals, including Global Mobile Personal Communications by Satellite (GMPCS), operating in those adjacent bands and remain within the purpose and objectives of the GMDSS. It is important for administrations to take this issue into account when deciding on the matter.
- View 2: MSS MESs to be used for GMDSS services within the frequency band 1 616-1 626.5 MHz should be designed and installed on ships in such a manner as to mitigate the effect of, and be resilient to, potential interference from other existing MSS terminals operating in the adjacent band. In this regard, the expert U.N. agency for maritime safety communications, the International Maritime Organization (IMO) provides performance standards for ship earth stations for use in the GMDSS<sup>35</sup>. Furthermore, it is important to note that management of communication devices that may operate on board ships is an on-going exercise carried out by the national licensing authorities.

#### **5/1.8/3.2.1.2 Other regulatory provisions**

- RR No. **1.59**, which defines a safety service.
- RR No. **5.368**, which references RR No. **4.10** and its applicability (if any) to the MSS and RDSS.
- RR No. **9.52C** including reference to RR No. **9.47** and RR No. **9.48** which describes the nature of coordination.
- RR Appendix **15** contains all frequencies and frequency bands used by the GMDSS.
- Paragraph 2.3 of RoP relating to RR No. **9.11A** which describes the need to coordinate.
- Paragraph 5 of RoP relating to RR No. **11.50** which explains the role of the BR resulting from the upgrade of an existing service.

#### **5/1.8/4 Methods to satisfy the agenda item**

Two methods are proposed to satisfy Issue A, while 5 methods are proposed to satisfy Issue B.

##### **5/1.8/4.1 Issue A: Modernization of the global maritime distress and safety system (*resolves to invite ITU-R 1*)**

###### **5/1.8/4.1.1 Method A1**

No change to the Radio Regulations.

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<sup>35</sup> See, IMO Resolution MSC.434(98), “*Performance Standards for a Ship Earth Station for use in the GMDSS*” (June 2017).

#### **5/1.8/4.1.2 Method A2**

##### **MF NAVDAT**

The frequency band 495-505 kHz is intended to be used for international MF NAVDAT.

The limitation on the use of the bands 415-495 kHz and 505-526.5 kHz (505-510 kHz in Region 2) in the maritime mobile service only by radiotelegraphy should be removed. And the possibility of using these bands by national MF NAVDAT could be given.

##### **HF NAVDAT**

It is needed to modify RR Appendix **17** to allow the frequency bands described in the most recent version of Recommendation ITU-R M.2058 to be used for the HF NAVDAT system. Therewith, proper regulatory provisions should be developed to ensure compatibility of HF NAVDAT systems with digital maritime mobile systems operating the frequency bands concerned subject to relevant existing allocations.

WRC-23 will consider the modernization of the GMDSS after IMO has concluded its work on this topic. Therefore, at that time it will be possible to consider a possible revision of RR Appendix **15**.

#### **5/1.8/4.2 Issue B: Introduction of additional satellite systems into global maritime distress and safety systems (*resolves to invite ITU-R 2*)**

The methods described below were presented but were not discussed nor analysed. These methods, therefore, reflect the respective views of their proponents and do not reflect the consensus of ITU-R.

##### **5/1.8/4.2.1 Method B1**

Due to limited antenna discrimination provided by MSS earth stations, MSS frequency band segmentation is a well-established coordination approach amongst coordinating MSS satellite systems. In the case of MSS frequencies used in both uplink and downlink directions by the same user terminal of the satellite system, upon coordinating such frequency use in one direction, other satellite networks are in effect prevented access to those frequencies in the same geographical area. Non-presence of emissions from other satellite systems within the coordinated geographical area would ensure protection of using same frequencies in the other direction of transmission by the satellite system operating bidirectionally on the same frequencies.

The GMDSS-candidate non-GSO MSS system has been operating in a stable spectrum environment for twenty years and GMDSS carriage does not result in technical or operational changes to the system. No new allocations or associated studies are required. However, from a regulatory perspective, in order to implement the “recognition” by IMO of the system under consideration as a satellite provider for the GMDSS in the frequency band 1 616-1 626.5 MHz, regulatory modifications would be necessary to the Radio Regulations including:

- a) A footnote in the MSS allocations to identify their use in the GMDSS;
- b) Modification of provisions RR Nos. **5.364** and **5.368** in order to avoid any inconsistency and ambiguity about the regulatory status of the maritime mobile-satellite service in the band 1 616-1 626.5 MHz when used for GMDSS.
- c) The addition of the band 1 616-1 626.5 MHz to Table 15-2 of RR Appendix **15**, as well as provisions RR No. **33.50** and RR No. **33.53** of RR Article **33**.

Further, although Radio Regulations provisions regarding safety services are not linked to a particular allocation status, in introducing this frequency band in RR Appendix **15**, to avoid that the secondary allocation for the downlink could be seen as a precedent and due to the unique nature of

the Iridium system where MSS frequencies are used in both the uplink and downlink directions within the same frequency band, a note could be associated with this band, which reads:

*“In addition to its availability for routine non-safety purposes, the band 1 616-1 626.5 MHz is used for distress and safety purposes in the Earth-to-space and space-to-Earth directions in the maritime mobile-satellite service solely by satellite networks using the same channel in both directions.”*

#### **5/1.8/4.2.2 Method B2**

This method addresses the regulatory status of the band 1 616-1 626.5 MHz with respect to MSS operations in the adjacent frequency band 1 626.5-1 660.5 MHz. The adjacent band is used by transmitting MESs in GSO MSS networks, including ship earth stations used in the GMDSS.

The current allocation to MSS (space-to-Earth) in the band 1 616-1 626.5 MHz is secondary, while the MSS (Earth-to-space) allocation in the band 1 626.5-1 660.5 MHz is primary.

Some methods (e.g. B1 and B5) would effectively change the regulatory status of the allocation to the MSS (space-to-Earth) in the band 1 616-1 626.5 MHz, effectively or directly raising that MSS allocation status to primary when used for GMDSS. This could lead to new constraints being placed on GSO MSS operations in the adjacent frequency band. Method B2 supplements these methods with additional regulatory text that would maintain the current regulatory status with respect to GSO MSS operations in the adjacent band.

The method would apply an additional regulatory provision in a footnote in Article 5 of the Radio Regulations, stating that mobile earth stations receiving in the band 1 616-1 626.5 MHz shall not claim protection from mobile earth stations transmitting in the adjacent band 1 626.5-1 660.5 MHz.

#### **5/1.8/4.2.3 Method B3**

As Method B1, but identifying only the MSS allocation in the 1 616-1 626.5 MHz (Earth-to-space) direction for GMDSS.

#### **5/1.8/4.2.4 Method B4**

With Method B4 a NOC is proposed due to the fact that a number of issues, including the regulatory status of the non-GSO system, and any potential adverse impact of any change to the regulatory status of in-band and adjacent systems or the apparent inconsistency and potential constraint of RR No. 5.368 have not been studied. Further, the compatibility issues related to the protection of the radio astronomy have not been solved.

#### **5/1.8/4.2.5 Method B5**

##### **5/1.8/4.2.5.1 Method B5(a)**

From a regulatory perspective, in order to implement the “recognition” by IMO of the system under consideration as a satellite provider for the GMDSS, regulatory modifications would be necessary to the Radio Regulations. One regulatory difficulty for the satellite network, which utilizes the band 1 613.8-1 626.5 MHz with TDD mode, is that it has a primary allocation for the uplink and solely a secondary allocation for the downlink.

A secondary allocation is not compatible with a safety service like the GMDSS; therefore it is proposed to upgrade the status from secondary to primary but solely for the frequency band 1 621.35-1 626.5 MHz. The reason is that in this frequency band the considered satellite network is the only one to operate and is not sharing with other satellite networks. This 5 MHz is fully sufficient to operate the GMDSS.

Nevertheless, the upgrade of the allocation shall not be interpreted as a relaxation of the obligation for Iridium to protect the radio astronomy. In this respect, it is noted that the secondary status of Iridium did not prevent interference to radio astronomy due to the fact that there are no regulatory limits protecting effectively the radio astronomy services. Therefore, it is proposed to define in the Radio Regulations the unwanted emission limits ensuring the protection of radio astronomy. A regulatory limit is considered as much more protective than the existing secondary status of MSS downlink in this frequency band.

This method will both satisfy the maritime community and improve the protection of radio astronomy.

The regulatory proposal for this method is as follows:

- Upgrade the status of the band 1 621.35-1 626.5 MHz from a secondary to a primary allocation to the MSS (space-to-Earth).
- Identify this band 1 621.35-1 626.5 MHz in RR Appendix **15** for GMDSS purpose with a note like “In addition to its availability for routine non-safety purposes, the band 1 621.35-1 626.5 MHz is used for distress and safety purposes in the Earth-to-space and space-to-Earth directions in the maritime mobile-satellite service. GMDSS distress, urgency and safety communications have priority in this band.”
- Modification of RR Nos. **5.364** and **5.368** in order to remove any ambiguity due to the upgrade of the status for the downlink segment.
- The band 1 613.8-1 621.35 MHz will remain secondary for MSS (space-to-Earth).
- A modification of RR No. **5.372** is proposed introducing the maximum value of *epfd* and *pfd* defined in Resolution **739 (Rev.WRC-15)**, in order to make mandatory and quantify the protection of the radio astronomy.
- Adjustment of RR No. **5.208B** and of Resolution **739 (Rev.WRC-15)** in order not to refer any more to the band 1 613.8-1 626.5 MHz. The Resolution gives just a threshold of “best effort” which is less effective than a regulatory limit. In any case the RR No. **5.208B** could be suppressed for the band 1 613.8-1 626.5 MHz due to the modification of RR No. **5.372**.
- Consequential modifications in RR Article **33** are proposed.
- Suppression of Resolution **359 (Rev.WRC-15)** with regard to *resolves 2*.

#### **5/1.8/4.2.5.2 Method B5(b)**

As Method B5(a), but limiting modification of the allocation to the maritime mobile-satellite service as follows:

- upgrade the status of the band 1 621.35-1 626.5 MHz from a secondary to a primary allocation to the MMSS (space-to-Earth);
- the band 1 613.8-1 626.35 MHz will remain secondary for MSS (space-to-Earth).

## **5/1.8/5 Regulatory and procedural considerations**

### **5/1.8/5.1 For Issue A**

#### **5/1.8/5.1.1 For Method A1**

**NOC**

## **ARTICLES**

**NOC**

## **APPENDICES**

**NOC**

## **RESOLUTIONS**

**NOC**

## **RECOMMENDATIONS**

### **5/1.8/5.1.2 For Method A2**

#### **MF NAVDAT**

The possible modifications to the provisions of RR are considered as following:

### **ARTICLE 5**

#### **Frequency allocations**

##### **Section IV – Table of Frequency Allocations**

(See No. 2.1)

#### **MOD**

**5.79** The use of the allocations to the maritime mobile service in the frequency bands 415-495 kHz and 505-526.5 kHz (505-510 kHz in Region 2) is limited to radiotelegraphy. In addition, these bands as well as 495-505 kHz may also be used for the NAVDAT system as described in the most recent version of Recommendation ITU-R M.2010, subject to special arrangements between interested and affected administrations. (WRC-19)

**Reasons:** These two bands are used currently by the NAVTEX system. They could be used in the future by the NAVDAT system and will need time-slot allocation between interested administrations.



**MOD**

**495-1 800 kHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>495-505</b>	MARITIME MOBILE ADD 5.A18	

**ADD**

**5.A18** The band 495-505 kHz is exclusively used for the international NAVDAT system as described in the most recent version of Recommendation ITU-R M.2010. (WRC-19)

**HF NAVDAT**

The possible modifications to the provisions of RR are considered as follows:

**MOD**

**APPENDIX 17 (REV.WRC-19)**

**Frequencies and channelling arrangements in the  
high-frequency bands for the maritime mobile service**

(See Article 52)

...

ANNEX 1\* (REV.WRC-19)

**Frequencies and channelling arrangements in the high-frequency bands for the maritime mobile service, in force until 31 December 2016** (WRC-12)

**MOD**

**PART A – Table of subdivided bands** (WRC-19)

...

**Table of frequencies (kHz) to be used in the band between 4 000 kHz and 27 500 kHz allocated exclusively to the maritime mobile service** (continued)

<b>Band (MHz)</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>12</b>	<b>16</b>	<b>18/19</b>	<b>22</b>	<b>25/26</b>
...	...	...	...	...	...	...	...	...
Limits (kHz)	4 221	6 332.5	8 438	12 658.5	16 904.5	19 705	22 445.5	26 122.5
Frequencies assignable for wideband systems, facsimile, special and data transmission systems and direct-printing telegraphy systems <i>m) p) pp) s)</i>								
Limits (kHz)	4 351	6 501	8 707	13 077	17 242	19 755	22 696	26 145

...

*p)* These sub-bands, except the frequencies referred to in Notes *j)*, *n)* and *o)*, may be used for the initial testing and the possible future introduction within the maritime mobile service of new digital technologies. Stations using these sub-bands for this purpose shall not cause harmful interference to, and shall not claim protection from, other stations operating in accordance with Article 5.

*pp)* These sub-bands are also designated for the NAVDAT system as described in the most recent version of Recommendation ITU-R M.2058.

**SUP**

**RESOLUTION 359 (REV.WRC-15)**

**Consideration of regulatory provisions for updating and modernization of the Global Maritime Distress and Safety System**

\* *Note by the Secretariat:* Annex 1 contains the entire text of Appendix 17 (REV.WRC-07)

**5/1.8/5.2 For Issue B**

**5/1.8/5.2.1 For Method B1**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**

(See No. 2.1)

**MOD**

**5.364** The use of the band 1 610-1 626.5 MHz by the mobile-satellite service (Earth-to-space) and by the radiodetermination-satellite service (Earth-to-space) is subject to coordination under No. 9.11A. A mobile earth station operating in either of the services in this band shall not produce a peak e.i.r.p. density in excess of  $-15$  dB(W/4 kHz) in the part of the band used by systems operating in accordance with the provisions of No. 5.366 (to which No. 4.10 applies), unless otherwise agreed by the affected administrations. In the part of the band where such systems are not operating, the mean e.i.r.p. density of a mobile earth station shall not exceed  $-3$  dB(W/4 kHz). Except when used for distress and safety purposes in the band 1 616-1 626.5 MHz by satellite networks in the maritime mobile-satellite service using the same channel in the Earth-to-space and space-to-Earth directions, stations of the mobile-satellite service, operating in any direction of transmission, shall not claim protection from stations in the aeronautical radionavigation service, stations operating in accordance with the provisions of No. 5.366 and stations in the fixed service operating in accordance with the provisions of No. 5.359. Administrations responsible for the coordination of mobile-satellite networks shall make all practicable efforts to ensure protection of stations operating in accordance with the provisions of No. 5.366. (WRC-19)

**Reasons:** To recognize the safety service aspects of GMDSS operations within the band 1 616-1 626.5 MHz.

**MOD**

**5.368** With respect to the radiodetermination-satellite and mobile-satellite services the provisions of No. 4.10 do not apply in the band 1 610-1 616 MHz, with the exception of the aeronautical radionavigation-satellite service. (WRC-19)

**Reasons:** To recognize that the band 1 616-1 626.5 MHz is used for safety services. Consequently, RR No. 4.10 applies.

The following addition of RR No. 5.GMDSS-B1 to RR Article 5 could be either a standalone footnote or combined with another footnote:

**ADD**

**5.GMDSS-B1** The band 1 616-1 626.5 MHz may also be used in the Earth-to-space and space-to-Earth directions for the provision of distress, urgency, and safety communications of the Global Maritime Distress and Safety System (GMDSS). See Appendix 15, Table 15-2, No. 33.50 and No. 33.53. (WRC-19)

**Reasons:** To identify the band 1 616-1 626.5 MHz as being available for the provision of GMDSS by mobile-satellite service systems.

**MOD**

**APPENDIX 15 (REV.WRC-19)**

**Frequencies for distress and safety communications for the Global Maritime Distress and Safety System (GMDSS)**

(See Article 31)

The frequencies for distress and safety communications for the GMDSS are given in Tables 15-1 and 15-2 for frequencies below and above 30 MHz, respectively.

**NOC**

TABLE 15-1 (WRC-07)  
**Frequencies below 30 MHz**

**MOD**

TABLE 15-2 (WRC-19)  
**Frequencies above 30 MHz (VHF/UHF)**

<b>Frequency (MHz)</b>	<b>Description of usage</b>	<b>Notes</b>
...	...	...
*1 544-1 545	D&S-OPS	Use of the band 1 544-1 545 MHz (space-to-Earth) is limited to distress and safety operations (see No. <b>5.356</b> ), including feeder links of satellites needed to relay the emissions of satellite emergency position-indicating radio beacons to earth stations and narrow-band (space-to-Earth) links from space stations to mobile stations.
1 616-1 626.5	SAT-COM	In addition to its availability for routine non-safety purposes, the band 1 616-1 626.5 MHz is used for distress and safety purposes in the Earth-to-space and space-to-Earth directions in the maritime mobile-satellite service solely by satellite networks using the same channel in both directions. GMDSS distress, urgency and safety communications have priority in this band over non-safety communications within the same satellite system. (WRC-19)
1 626.5-1 645.5	SAT-COM	In addition to its availability for routine non-safety purposes, the band 1 626.5-1 645.5 MHz is used for distress and safety purposes in the Earth-to-space direction in the maritime mobile-satellite service. GMDSS distress, urgency and safety communications have priority in this band (see No. <b>5.353A</b> ).
...	...	...

**Legend:**

...

**Reasons:** To add the band 1 616-1 626.5 MHz as being available for distress and safety communications for the Global Maritime Distress and Safety System (GMDSS).

## ARTICLE 33

### **Operational procedures for urgency and safety communications in the global maritime distress and safety system (GMDSS)**

#### **Section V – Transmission of maritime safety information<sup>2</sup>**

**33.49** *E – Maritime safety information via satellite*

#### **MOD**

**33.50** § 26 Maritime safety information may be transmitted via satellite in the maritime mobile-satellite service using the bands 1 530-1 545 MHz and 1 616-1 626.5 MHz (see Appendix 15). (WRC-19)

**Reasons:** To include the 1 616-1 626.5 MHz band as being available for transmitting maritime safety information via satellite.

#### **Section VII – Use of other frequencies for safety** (WRC-07)

#### **MOD**

**33.53** § 28 Radiocommunications for safety purposes concerning ship reporting communications, communications relating to the navigation, movements and needs of ships and weather observation messages may be conducted on any appropriate communications frequency, including those used for public correspondence. In terrestrial systems, the bands 415-535 kHz (see Article 52), 1 606.5-4 000 kHz (see Article 52), 4 000-27 500 kHz (see Appendix 17), and 156-174 MHz (see Appendix 18) are used for this function. In the maritime mobile-satellite service, frequencies in the bands 1 530-1 544 MHz, 1 616-1 626.5 MHz and 1 626.5-1 6+45.5 MHz are used for this function as well as for distress alerting purposes (see No. 32.2). (WRC-19)

**Reasons:** To apply RR No. 33.53 to the 1 610-1 626.5 MHz band for use by mobile-satellite service systems approved by the International Maritime Organization to participate in the Global Maritime Safety and Distress System.

#### **5/1.8/5.2.2 For Method B2**

As Methods B1 or B5, but with the following addition to RR Article 5, either as a standalone footnote or combined with another footnote:

#### **ADD**

**5.GMDSS-B2** Mobile earth stations receiving in the band 1 616-1 626.5 MHz shall not claim protection from mobile earth stations transmitting in the band 1 626.5-1 660.5 MHz. (WRC-19)

**Reasons:** To maintain the current regulatory status with respect to MSS operations in the band 1 626.5-1 660.5 MHz.

#### **5/1.8/5.2.3 For Method B3**

As Method B1, except:

## MOD

**5.364** The use of the band 1 610-1 626.5 MHz by the mobile-satellite service (Earth-to-space) and by the radiodetermination-satellite service (Earth-to-space) is subject to coordination under No. **9.11A**. A mobile earth station operating in either of the services in this band shall not produce a peak e.i.r.p. density in excess of  $-15$  dB(W/4 kHz) in the part of the band used by systems operating in accordance with the provisions of No. **5.366** (to which No. **4.10** applies), unless otherwise agreed by the affected administrations. In the part of the band where such systems are not operating, the mean e.i.r.p. density of a mobile earth station shall not exceed  $-3$  dB(W/4 kHz). Except when used for distress and safety purposes in the band 1 616-1 626.5 MHz by satellite networks in the maritime mobile-satellite service in the Earth-to-space direction, stations of the mobile-satellite service shall not claim protection from stations in the aeronautical radionavigation service, stations operating in accordance with the provisions of No. **5.366** and stations in the fixed service operating in accordance with the provisions of No. **5.359**. Administrations responsible for the coordination of mobile-satellite networks shall make all practicable efforts to ensure protection of stations operating in accordance with the provisions of No. **5.366**. (WRC-19)

## MOD

**5.368** With respect to the radiodetermination-satellite and mobile-satellite services the provisions of No. **4.10** do not apply in the band 1 610-1 626.5 MHz, with the exception of the aeronautical radionavigation-satellite service and of the maritime mobile-satellite service in the band 1 616-1 626.5 MHz (Earth-to-space) solely when used for GMDSS by satellite networks in the Earth-to-space direction for distress and safety purposes. (WRC-19)

**Reasons:** To recognize that in the band 1 616-1 626.5 MHz (Earth-to-space) the maritime mobile-satellite service is used for the provision of maritime safety services. Consequently, RR No. **4.10** should apply.

The following addition of RR No. **5.GMDSS-B3** to RR Article **5** could be either a standalone footnote or combined with another footnote:

## ADD

**5.GMDSS-B3** The band 1 616-1 626.5 MHz may also be used in the Earth-to-space direction for the provision of distress, urgency, and safety communications of the Global Maritime Distress and Safety System (GMDSS). See Appendix **15**, Table 15-2, No. **33.50** and No. **33.53**. (WRC-19)

**Reasons:** To identify the band 1 616-1 626.5 MHz (Earth-to-space) as being available for the provision of GMDSS by mobile-satellite service systems.

## MOD

### APPENDIX 15 (REV.WRC-19)

#### Frequencies for distress and safety communications for the Global Maritime Distress and Safety System (GMDSS)

(See Article **31**)

The frequencies for distress and safety communications for the GMDSS are given in Tables 15-1 and 15-2 for frequencies below and above 30 MHz, respectively.

**NOC**

TABLE 15-1 (WRC-07)  
**Frequencies below 30 MHz**

**MOD**

TABLE 15-2 (WRC-19)  
**Frequencies above 30 MHz (VHF/UHF)**

Frequency (MHz)	Description of usage	Notes
...	...	...
*1 544-1 545	D&S-OPS	Use of the band 1 544-1 545 MHz (space-to-Earth) is limited to distress and safety operations (see No. <b>5.356</b> ), including feeder links of satellites needed to relay the emissions of satellite emergency position-indicating radio beacons to earth stations and narrow-band (space-to-Earth) links from space stations to mobile stations.
1 616-1 626.5	SAT-COM	In addition to its availability for routine non-safety purposes, the band 1 616-1 626.5 MHz (Earth-to-space) is used for distress and safety purposes in the Earth-to-space direction in the maritime mobile-satellite service solely by satellite networks using the same channel in both directions. GMDSS distress, urgency and safety communications have priority in this band over non-safety communications within a satellite system. (WRC-19)
1 626.5-1 645.5	SAT-COM	In addition to its availability for routine non-safety purposes, the band 1 626.5-1 645.5 MHz is used for distress and safety purposes in the Earth-to-space direction in the maritime mobile-satellite service. GMDSS distress, urgency and safety communications have priority in this band (see No. <b>5.353A</b> ).
...	...	...

**Reasons:** To add the band 1 616-1 626.5 MHz as being available for distress and safety communications for the Global Maritime Distress and Safety System (GMDSS).

## ARTICLE 33

### **Operational procedures for urgency and safety communications in the global maritime distress and safety system (GMDSS)**

#### **Section VII – Use of other frequencies for safety (WRC-07)**

**MOD**

**33.53** § 28 Radiocommunications for safety purposes concerning ship reporting communications, communications relating to the navigation, movements and needs of ships and weather observation messages may be conducted on any appropriate communications frequency, including those used for public correspondence. In terrestrial systems, the bands 415-535 kHz

(see Article **52**), 1 606.5-4 000 kHz (see Article **52**), 4 000-27 500 kHz (see Appendix **17**), and 156-174 MHz (see Appendix **18**) are used for this function. In the maritime mobile-satellite service, frequencies in the bands 1 530-1 544 MHz, 1 616-1 626.5 MHz (Earth-to-space) and 1 626.5-1 645.5 MHz are used for this function as well as for distress alerting purposes (see No. **32.2**). (WRC-19)

**Reasons:** To apply RR No. **33.53** to the 1 610-1 626.5 MHz band for use by mobile-satellite service systems approved by the International Maritime Organization to participate in the Global Maritime Safety and Distress System.

#### **5/1.8/5.2.4 For Method B4**

**NOC**

### **ARTICLES**

**NOC**

### **APPENDICES**

**NOC**

### **RESOLUTIONS**

**NOC**

### **RECOMMENDATIONS**

**Reasons:** In order to introduce an additional satellite system into the GMDSS, the frequency band to be used by this system must be entered into RR Appendix **15**. Regarding the frequency band 1 613.8-1 626.5 MHz, the secondary MSS allocation in the space-to-Earth direction cannot be considered for GMDSS.

A satellite system, the downlink of which:

- 1) has a status of “non-interference, non-protection” vis-à-vis any primary service within the same band and in adjacent bands; and
- 2) has currently no reliable coordination criteria, apart from frequency overlap which is one among other interference criteria to accomplish coordination, should not be a candidate to provide safety-of-life aspects as required by the GMDSS.

Moreover according to paragraph 2.3 of the Rules of Procedure relating to application of RR No. **9.11A** (“*While recognizing the difficulties of harmonizing the text of the footnotes to Article 5 introduced by WARC-92, WRC-95 and WRC-97 on the one hand and the text of the provision of No. **9.11A** (including Nos. **9.12** to **9.16**) and **9.17A**, as appropriate with respect to the services to which this provision is applicable, on the other hand, the Board concluded that the procedure is applicable to all other space and terrestrial services with respect to those satellite services having allocations with equal rights and mentioned in the specific footnotes to which this provision applies. The frequency bands are those to which, in a footnote, reference is made to this provision in the Table of Frequency Allocations (see Tables 9.11A-1 and 9.11A-2 below). In these Tables, there is an indication of those other space services (in addition to the MSS and radiodetermination-satellite*



*service as well as non-GSO MSS feeder links and non-GSO FSS included in the footnotes) to which this coordination procedure shall also apply”).*

The downlink of the HIBLEO-2 using the band 1 613.8-1 626.5 MHz was not required to coordinate with any space or terrestrial service of primary status. Consequently, should a primary status (on a provisional basis) be granted to this allocation, it is fundamental for the downlink assignments of HIBLEO-2 to carry out the required coordination with all space and terrestrial services submitted to the Bureau until a decision can be made to identify it for GDMSS. Finally the consequences of such action must be analysed.

In addition to the lack of reliable criteria for application of RR No. **9.11A**, pursuant to RR No. **9.52C** (“For coordination requests under Nos. **9.11** to **9.14** and **9.21**, an administration not responding under No. **9.52** within the same four-month period shall be regarded as unaffected and, in the cases of Nos. **9.11** to **9.14**, the provisions of Nos. **9.48** and **9.49** shall apply.”) unlike RR No. **9.7** the coordination procedure is of an implicit type, i.e., those administrations which failed to reply to request for coordination were considered as not affected even though in reality they were affected.

On account of any attempt to upgrade the status of this allocation from secondary to primary to fulfil this agenda item, the following studies are needed to be carried out:

- a) the amount of bandwidth required for GMDSS while the allocated MSS band is also used for routine non-safety purposes;
- b) the sharing and compatibility of the MSS system in the considered frequency band with incumbent services in the same and in adjacent bands;
- c) the potential impact of possible modifications to the provisions of the Radio Regulations on sharing and compatibility with other services and systems in the frequency band and adjacent frequency bands.

The issues listed above have not been studied or resolved. The inconsistency and potential constraint of RR Nos. **5.364** and **5.368** have not been studied. The harmful interference from the MSS space-to-Earth operations continues to exist in the radio astronomy frequency band 1 610.6-1 613.8 MHz and several administrations are having ongoing communications with the ITU-R RRB on this interference issue. The frequency band 1 613.8-1 626.5 MHz, or any part thereof, is therefore to be considered not suitable for use in GMDSS as long as these studies have not been carried out.

**5/1.8/5.2.5 For Method B5**

**5/1.8/5.2.5.1 For Method B5(a)**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**1 610-1 660 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<p><b>1 613.8-1 621.35</b> MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION Mobile-satellite (space-to-Earth)</p> <p>5.341 5.355 5.359 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.369 5.371 MOD 5.372</p>	<p><b>1 613.8-1 621.35</b> MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION RADIODETERMINATION- SATELLITE (Earth-to-space) Mobile-satellite (space-to-Earth)</p> <p>5.341 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.370 MOD 5.372</p>	<p><b>1 613.8-1 621.35</b> MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION Mobile-satellite (space-to-Earth)</p> <p>Radiodetermination-satellite (Earth-to-space)</p> <p>5.341 5.355 5.359 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.369 MOD 5.372</p>
<p><b>1 621.35-1 626.5</b> MOBILE-SATELLITE (space-to-Earth) MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION</p> <p>5.341 5.355 5.359 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.369 5.371 MOD 5.372</p>	<p><b>1 621.35-1 626.5</b> MOBILE-SATELLITE (space-to-Earth) MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION RADIODETERMINATION- SATELLITE (Earth-to-space)</p> <p>5.341 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.370 MOD 5.372</p>	<p><b>1 621.35-1 626.5</b> MOBILE-SATELLITE (space-to-Earth) MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION Radiodetermination-satellite (Earth-to-space)</p> <p>5.341 5.355 5.359 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.369 MOD 5.372</p>
<p><b>1 626.5-1 660</b></p>	<p>MOBILE-SATELLITE (Earth-to-space) 5.351A 5.341 5.351 5.353A 5.354 5.355 5.357A 5.359 5.362A 5.374 5.375 5.376</p>	

## MOD

**5.208B\*** In the frequency bands:

137-138 MHz,  
387-390 MHz,  
400.15-401 MHz,  
1 452-1 492 MHz,  
1 525-1 610 MHz  
2 655-2 690 MHz,  
21.4-22 GHz,

Resolution **739 (Rev.WRC-15)** applies. (WRC-19)

## MOD

**5.364** The use of the band 1 610-1 626.5 MHz by the mobile-satellite service (Earth-to-space) and by the radiodetermination-satellite service (Earth-to-space) is subject to coordination under No. **9.11A**. A mobile earth station operating in either of the services in this band shall not produce a peak e.i.r.p. density in excess of  $-15$  dB(W/4 kHz) in the part of the band used by systems operating in accordance with the provisions of No. **5.366** (to which No. **4.10** applies), unless otherwise agreed by the affected administrations. In the part of the band where such systems are not operating, the mean e.i.r.p. density of a mobile earth station shall not exceed  $-3$  dB(W/4 kHz). Except when used for distress and safety purposes in the band 1 621.35-1 626.5 MHz (see Appendix **15**), stations of the mobile-satellite service shall not claim protection from stations in the aeronautical radionavigation service, stations operating in accordance with the provisions of No. **5.366** and stations in the fixed service operating in accordance with the provisions of No. **5.359**. Administrations responsible for the coordination of mobile-satellite networks shall make all practicable efforts to ensure protection of stations operating in accordance with the provisions of No. **5.366**. (WRC-19)

## MOD

**5.368** With respect to the radiodetermination-satellite and mobile-satellite services the provisions of No. **4.10** do not apply in the band 1 610-1 626.5 MHz, with the exception of the aeronautical radionavigation-satellite service and of the mobile-satellite service in the band 1 621.35-1 626.5 MHz when used for GMDSS. (WRC-19)

## MOD

**5.372** Harmful interference shall not be caused to stations of the radio astronomy service using the band 1 610.6-1 613.8 MHz by stations of the radiodetermination-satellite and mobile-satellite services (No. **29.13** applies). Non-GSO satellite systems operating in the band 1 613.8-1 626.5 MHz shall not exceed an efd of  $-258$  dBW/m<sup>2</sup>/20 kHz in the band 1 610.6-1 613.8 MHz unless the data loss resulting from exceeding this limit is less than 2%, and GSO satellite networks operating in the band 1 613.8-1 626.5 MHz shall not exceed a pfd of  $-194$  dBW/m<sup>2</sup>/20 kHz in the band 1 610.6-1 613.8 MHz, at any radio astronomy station performing observations in this band. The verification of the compliance with the efd threshold for non-GSO systems shall be done using Recommendation ITU-R M.1583-1 and the antenna pattern and the maximum antenna gain given in Recommendation ITU-R RA.1631-0. (WRC-19)

## ARTICLE 33

### **Operational procedures for urgency and safety communications in the global maritime distress and safety system (GMDSS)**

#### **Section V – Transmission of maritime safety information<sup>2</sup>**

**33.49** *E – Maritime safety information via satellite*

**MOD**

**33.50** § 26 Maritime safety information may be transmitted via satellite in the maritime mobile-satellite service using the bands 1 530-1 545 MHz and 1 621.35-1 626.5 MHz (see Appendix 15). (WRC-19)

**MOD**

#### **Section VII – Use of other frequencies for safety** (Rev.WRC-19)

**MOD**

**33.53** § 28 Radiocommunications for safety purposes concerning ship reporting communications, communications relating to the navigation, movements and needs of ships and weather observation messages may be conducted on any appropriate communications frequency, including those used for public correspondence. In terrestrial systems, the bands 415-535 kHz (see Article 52), 1 606.5-4 000 kHz (see Article 52), 4 000-27 500 kHz (see Appendix 17), and 156-174 MHz (see Appendix 18) are used for this function. In the maritime mobile-satellite service, frequencies in the bands 1 530-1 544 MHz, 1 621.35-1 626.5 MHz and 1 626.5-1 645.5 MHz are used for this function as well as for distress alerting purposes (see No. 32.2). (WRC-19)

**MOD**

## APPENDIX 15 (REV.WRC-19)

### **Frequencies for distress and safety communications for the Global Maritime Distress and Safety System (GMDSS)**

(See Article 31)

The frequencies for distress and safety communications for the GMDSS are given in Tables 15-1 and 15-2 for frequencies below and above 30 MHz, respectively.

**MOD**

TABLE 15-2 (*end*) (WRC-19)

<b>Frequency (MHz)</b>	<b>Description of usage</b>	<b>Notes</b>
...	...	...
1 621.35-1 626.5	SAT-COM	In addition to its availability for routine non-safety purposes, the band 1 621.35-1 626.5 MHz is used for distress and safety purposes in the Earth-to-space and space-to-Earth directions in the mobile-satellite service. GMDSS distress, urgency and safety communications have priority in this band.
...	...	...

**MOD**

**RESOLUTION 739 (REV.WRC-19)**

**Compatibility between the radio astronomy service and the active space services in certain adjacent and nearby frequency bands**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

...

**ANNEX 1 TO RESOLUTION 739 (REV.WRC-19)**

...

TABLE 1-1  
pfd thresholds for unwanted emissions from any geostationary space station  
at a radio astronomy station

Space service	Space service frequency band	Radio astronomy frequency band	Single dish, continuum observations		Single dish, spectral line observations		VLBI		Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of:
			pfd <sup>(1)</sup>	Reference bandwidth	pfd <sup>(1)</sup>	Reference bandwidth	pfd <sup>(1)</sup>	Reference bandwidth	
			(dB(W/m <sup>2</sup> ))	(MHz)	(dB(W/m <sup>2</sup> ))	(kHz)	(dB(W/m <sup>2</sup> ))	(kHz)	
MSS (space-to-Earth)	387-390	322-328.6	-189	6.6	-204	10	-177	10	WRC-07
BSS MSS (space-to-Earth)	1 452-1 492 1 525-1 559	1 400-1 427	-180	27	-196	20	-166	20	WRC-03
MSS (space-to-Earth)	1 525-1 559	1 610.6-1 613.8	NA	NA	-194	20	-166	20	WRC-03
RNSS (space-to-Earth)	1 559-1 610	1 610.6-1 613.8	NA	NA	-194	20	-166	20	WRC-07
BSS FSS (space-to-Earth)	2 655-2 670	2 690-2 700	-177	10	NA	NA	-161	20	WRC-03
FSS (space-to-Earth)	2 670-2 690	2 690-2 700 (in Regions 1 and 3)	-177	10	NA	NA	-161	20	WRC-03
	<b>(GHz)</b>	<b>(GHz)</b>	-	-	-	-	-	-	
BSS	21.4-22.0	22.21-22.5	-146	290	-162	250	-128	250	WRC-03 for VLBI, and WRC-07 for other types of observation

NA: Not applicable, measurements of this type are not made in this frequency band.

<sup>(1)</sup> Integrated over the reference bandwidth with an integration time of 2 000 s.

TABLE 1-2  
epfd thresholds<sup>(1)</sup> for unwanted emissions from all space stations of a non-GSO satellite system  
at a radio astronomy station

Space service	Space service frequency band	Radio astronomy frequency band	Single dish, continuum observations		Single dish, spectral line observations		VLBI		Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of:
			epfd <sup>(2)</sup>	Reference bandwidth	epfd <sup>(2)</sup>	Reference bandwidth	epfd <sup>(2)</sup>	Reference bandwidth	
			(MHz)	(MHz)	(dB(W/m <sup>2</sup> ))	(MHz)	(dB(W/m <sup>2</sup> ))	(kHz)	
MSS (space-to-Earth)	137-138	150.05-153	-238	2.95	NA	NA	NA	NA	WRC-07
MSS (space-to-Earth)	387-390	322-328.6	-240	6.6	-255	10	-228	10	WRC-07
MSS (space-to-Earth)	400.15-401	406.1-410	-242	3.9	NA	NA	NA	NA	WRC-07
MSS (space-to-Earth)	1 525-1 559	1 400-1 427	-243	27	-259	20	-229	20	WRC-07
RNSS (space-to-Earth) <sup>(3)</sup>	1 559-1 610	1 610.6-1 613.8	NA	NA	-258	20	-230	20	WRC-07
MSS (space-to-Earth)	1 525-1 559	1 610.6-1 613.8	NA	NA	-258	20	-230	20	WRC-07

NA: Not applicable, measurements of this type are not made in this frequency band.

<sup>(1)</sup> These epfd thresholds should not be exceeded for more than 2% of time.

<sup>(2)</sup> Integrated over the reference bandwidth with an integration time of 2 000 s.

<sup>(3)</sup> This Resolution does not apply to current and future assignments of the radionavigation-satellite system GLONASS/GLONASS-M in the frequency band 1 559-1 610 MHz, irrespective of the date of reception of the related coordination or notification information, as appropriate. The protection of the radio astronomy service in the frequency band 1 610.6-1 613.8 MHz is ensured and will continue to be in accordance with the bilateral agreement between the Russian Federation, the notifying administration of the GLONASS/GLONASS-M system, and IUCAF, and subsequent bilateral agreements with other administrations.

**SUP**

**RESOLUTION 359 (REV.WRC-15)**

**Consideration of regulatory provisions for updating and modernization of the  
Global Maritime Distress and Safety System**

**5/1.8/5.2.5.2 For Method B5(b)**

As Method B5(a) except as follows:

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations  
(See No. 2.1)**

**MOD**

**1 610-1 660 MHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>1 613.8-1 621.35</b> MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION Mobile-satellite (space-to-Earth)	<b>1 613.8-1 621.35</b> MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION RADIODETERMINATION- SATELLITE (Earth-to-space) Mobile-satellite (space-to-Earth)	<b>1 613.8-1 621.35</b> MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION Mobile-satellite (space-to-Earth)  Radiodetermination-satellite (Earth-to-space)
5.341 5.355 5.359 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.369 5.371 MOD 5.372	5.341 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.370 MOD 5.372	5.341 5.355 5.359 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.369 MOD 5.372



<p><b>1 621.35-1 626.5</b> MARITIME MOBILE-SATELLITE (space-to-Earth) MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION Mobile-satellite (space-to-Earth) except maritime mobile-satellite (space-to-Earth)</p> <p>5.341 5.355 5.359 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.369 5.371 MOD 5.372</p>	<p><b>1 621.35-1 626.5</b> MARITIME MOBILE-SATELLITE (space-to-Earth) MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION RADIODETERMINATION-SATELLITE (Earth-to-space) Mobile-satellite (space-to-Earth) except maritime mobile-satellite (space-to-Earth)</p> <p>5.341 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.370 MOD 5.372</p>	<p><b>1 621.35-1 626.5</b> MARITIME MOBILE-SATELLITE (space-to-Earth) MOBILE-SATELLITE (Earth-to-space) 5.351A AERONAUTICAL RADIONAVIGATION Mobile-satellite (space-to-Earth) except maritime mobile-satellite (space-to-Earth) Radiodetermination-satellite (Earth-to-space)</p> <p>5.341 5.355 5.359 MOD 5.364 5.365 5.366 5.367 MOD 5.368 5.369 MOD 5.372</p>
<p><b>1 626.5-1 660</b> MOBILE-SATELLITE (Earth-to-space) 5.351A 5.341 5.351 5.353A 5.354 5.355 5.357A 5.359 5.362A 5.374 5.375 5.376</p>		

**MOD**

**5.368** With respect to the radiodetermination-satellite and mobile-satellite services the provisions of No. **4.10** do not apply in the band 1 610-1 626.5 MHz, with the exception of the aeronautical radionavigation-satellite service and of the maritime mobile-satellite service in the band 1 621.35-1 626.5 MHz when used for GMDSS. (WRC-19)

**MOD**

APPENDIX 15 (REV.WRC-19)

**Frequencies for distress and safety communications for the Global Maritime Distress and Safety System (GMDSS)**

(See Article 31)

The frequencies for distress and safety communications for the GMDSS are given in Tables 15-1 and 15-2 for frequencies below and above 30 MHz, respectively.

**MOD**

TABLE 15-2 (end) (WRC-19)

Frequency (MHz)	Description of usage	Notes
...	...	...

1 621.35-1 626.5	SAT-COM	In addition to its availability for routine non-safety purposes, the band 1 621.35-1 626.5 MHz is used for distress and safety purposes in the Earth-to-space and space-to-Earth directions in the maritime mobile-satellite service. GMDSS distress, urgency and safety communications have priority in this band.
...	...	...

## Agenda item 1.9.1

(WP 5B / WP 4C, WP 5A, WP 5C, (WP 1B), (WP 3M), (WP 7D))

1.9 *to consider, based on the results of ITU-R studies:*

1.9.1 *regulatory actions within the frequency band 156-162.05 MHz for autonomous maritime radio devices to protect the GMDSS and automatic identifications system (AIS), in accordance with Resolution 362 (WRC-15);*

Resolution 362 (WRC-15) – *Autonomous maritime radio devices operating in the frequency band 156-162.05 MHz*

### 5/1.9.1/1 Executive summary

The aim of this agenda item is to prevent unregulated operation of autonomous maritime radio devices (AMRD) in order to enhance safety of navigation and to ensure the integrity of the global maritime distress and safety system (GMDSS) which is the only system for distress, urgency, safety and routine communication for general shipping. Furthermore, the integrity of the collision avoidance system, automatic identification system (AIS), including the AIS VHF data link needs to be ensured.

Four methods to satisfy this agenda item were developed. It is noted that according to Resolution ITU-R 2-7 Annex 2 Section 4 “methods of no change is always a possible method and normally should not be included amongst the methods”.

One method considers amendments to the footnote *f*) in RR Appendix 18 to allow AMRD Group A to operate on certain channels.

Three methods consider the harmonization of the spectrum use for AMRD Group B. One method aims to use channel 2006 as listed in RR Appendix 18 for AIS technology. The second method aims to use channels 2078, 2019 and 2079 as listed in RR Appendix 18 for non-AIS technology. The third method aims to use the frequency band 161.4375-161.4875 MHz, which is not part of RR Appendix 18, for non-AIS technology.

### 5/1.9.1/2 Background

Studies on this WRC-19 agenda item are based on the following definition of AMRD:

An AMRD is a *mobile station*; operating at sea and transmitting independently of a *ship station* or a *coast station*. Two groups of AMRD are identified:

- Group A: AMRD that enhance the safety of navigation;
- Group B: AMRD that do not enhance the safety of navigation (AMRD which deliver signals or information which do not concern the vessel can distract or mislead the navigator and degrade the safety of navigation).

*Considering a*) of Resolution 362 (WRC-15) introduces the need to “enhance safety of navigation”. The relevant term is derived from the International Convention for the Safety of Life at Sea (SOLAS), as amended. Within SOLAS, Chapter V is titled “Safety of navigation” and contains all relevant regulations. Consequently, the criterion for distinguishing the two categories of AMRD is the influence on the safety of navigation. Any signal or information originated by an AMRD, which reaches the navigator, may influence the safety of navigation. This includes AIS (symbols to be shown on radar and on the electronic chart display and information system (ECDIS), if equipped) and VHF (working channels, Ch. 16 and Ch. 70). In any case, the navigator has to decide how to

proceed. In a positive case, the safety of navigation will be enhanced. But in other cases, AMRD which deliver signals or information which do not concern the vessel can distract or mislead the navigator and degrade the safety of navigation.

Although the term “safety of navigation” is used in SOLAS and other International Maritime Organization (IMO) documents, there is no formal existing definition. The regulations listed in SOLAS Chapter V are relevant to achieve safety of navigation. WDPDN Report ITU-R M.[AMRD] explains how “safety of navigation” has to be understood to evaluate the categories of AMRD.

Consequently, in distinguishing the two groups of AMRD, the following question has to be answered: is safety of navigation enhanced or rather degraded?

AMRD that enhance the safety of navigation may be subject to IMO SOLAS regulations for the presentation of information to the navigators on board vessels. AMRD categorized as “Group A” are contained in Recommendation ITU-R M.[AMRD] in a dedicated list of applications, in consultation with IMO. The other not listed AMRD have to be considered as Group B AMRD.

Sharing and compatibility studies between AMRD in the mobile service and other existing services, including land mobile service, would be required to ensure compatibility with incumbent services if AMRD were to use frequencies not listed in RR Appendix 18.

### **5/1.9.1/3 Summary and analysis of the results of ITU-R studies**

#### **5/1.9.1/3.1 Applications with autonomous maritime radio devices**

To distinguish the two categories of AMRD, a two-step approach was used.

The first step was a compilation of the existing applications of AMRD which could be found on the market worldwide. To get a clear overview on these devices, to compile and to categorize the existing AMRD in the different countries, Circular Letter 5/LCCE/64 was sent to ITU Member States with a questionnaire to request information of such devices. Responses were received from 16 member administrations and one non-governmental organization member.

The responses are summarized in the WDPDN Report ITU-R M.[AMRD].

The information was consolidated to give a general description of the applications. Applications described in the responses to the questionnaire included diver emergency and Danbuoy/lifebuoy uses and these have been included in a man overboard (MOB) category as the function appears the same: A separate category for routine diver functions has been created.

The result shows that some devices are using AIS channels in the maritime mobile service frequency bands. Different transmitting power and intervals, message formats and unregulated maritime mobile service identities (MMSIs) are used by these AMRD.

Fishnet indicators have been divided into two categories; one to identify and locate a hazard; one for net recovery only.

General categories of “Tracking an object which is not a hazard to navigation” and possible future “Mobile aid to navigation (mobile AtoN) for an object which is a hazard to navigation” have been created. A racing mark and an oceanographic meteorological buoy could be in either category.

Emergency position-indicating radiobeacon (EPIRB) and AIS-search and rescue transmitter (SART) are components in the GMDSS and therefore not considered to be AMRD.

Two respondents indicated that future mobile AtoN might include virtual and physical types.

One respondent also reported devices operating on industrial, scientific and medical (ISM) frequencies.

The second step was listing the technical details of the various AMRD and its applications. Various technologies, such as AIS, digital selective calling, synthetic voice, or the combination of the technologies have been observed. In addition to channels 6/16/70, AIS 1, AIS 2 and other frequency bands outside the maritime mobile service, some AMRD are wrongly using 121.5 MHz and/or 406 MHz. Other AMRD use identities in the maritime mobile service such as MMSI.

The operation of AMRD is also various. Some AMRD are deployed at sea, others are carried by divers and used in the vessel and the vicinity. So, AMRD could be used at sea including the coastal areas, and AMRD may be brought into land or may be washed ashore by accident.

It could be concluded from the studies that the application of AMRD lacks harmonized technical standards and frequency bands. The operation of AMRD is also varied, and AMRD could be used in areas where they cause interferences to the land mobile service if AMRD and the land mobile service use the same frequency bands. The technical standards on AMRD are necessary in order to conduct sharing and compatibility studies, and these standards should cover the transmitting power and intervals, technologies used, message formats and so on. Meanwhile, it is necessary to find proper frequency bands for the application of AMRD, whether within or without the maritime mobile service frequency bands, without causing any interference to the existing services.

#### **5/1.9.1/3.2 Existing relevant Recommendations and Reports are listed as follows:**

Recommendations [ITU-R M.493-14](#), [ITU-R M.585-7](#), [ITU-R M.1371-5](#), WDPDN Report ITU-R M.[AMRD], WDPDN Report ITU-R M.[NEW\_MARNUM] and WDPDN Recommendation ITU-R M.[AMRD].

#### **5/1.9.1/3.3 Analyses on spectrum requirements**

AMRD specified as Group A intended to be operated on frequencies of the current Radio Regulations (RR) Appendix 18. So, no additional spectrum requirement for this category of devices has been identified. However, this group will be restricted by the list of applications in new Recommendation ITU-R M.[AMRD].

For AMRD specified as Group B, the following spectrum requirements have been considered:

- Only one AIS channel is required to support AMRD applications. There is a low antenna height and the transmission power will be restricted to 1 W. A huge amount of AMRD in a certain area cannot be expected. It is unlikely to overload this 25 kHz channel;
- AMRD applications using other technologies require three 25 kHz channels. There is a low antenna height and the transmission power will be restricted to 1 W. If needed, channel sharing is necessary.

#### **5/1.9.1/3.4 Appropriate frequency bands**

Group A, AMRD that enhance the safety of navigation, are intended to use the frequencies of the current RR Appendix 18. These frequencies have been allocated for the operation of vessels.

Group B, AMRD that do not enhance the safety of navigation, but do operate in the maritime environment, should not be permitted to use the frequencies which cause any constraints on the existing mobile services. The signals or information originated by this group of AMRD do not concern the operation of vessels.

The part of the frequency range 156-162.05 MHz which is not channelized by RR Appendix 18 is already allocated to the fixed and mobile services, and these sub-bands are widely used by land mobile service in many countries. Especially, in some countries, these sub-bands are being used by public protection and disaster relief.

In RR Appendix **18**, the frequency 160.900 MHz (Ch. 2006) is already reserved for experimental use for future applications (see footnote *r*). This frequency is intended to be used solely by AIS-technology for AMRD Group B.

AMRD Group B using other technologies may be operated on the frequencies 161.525 MHz (Channel 2078), 161.550 MHz (Channel 2019) and 161.575 MHz (Channel 2079).

#### **5/1.9.1/3.5 Analyses on device identification requirements**

AMRD that are noted as Group A should use the numbering scheme given in Recommendation [ITU-R M.585-7](#) and the symbols given in Recommendation [ITU-R M.1371-5](#). Revisions of the recommendations might be necessary to display special AMRD on the ECDIS.

AMRD noted as Group B should use a new numbering system which is under development (WDPDN Report ITU-R M.[NEW\_MARNUM]).

#### **5/1.9.1/4 Methods to satisfy the agenda item**

##### **5/1.9.1/4.1 Autonomous maritime radio devices Group A**

###### **5/1.9.1/4.1.1 Method A**

For the operation of AMRD Group A, it is proposed to amend footnote *f*) of RR Appendix **18** to allow AMRD Group A to operate on frequency channels 156.525 MHz (channel 70), 161.975 MHz (AIS 1) and 162.025 MHz (AIS 2).

##### **5/1.9.1/4.2 Autonomous maritime radio devices Group B**

In order to accommodate the variety of Group B AMRD technologies, the following methods are proposed:

###### **5/1.9.1/4.2.1 Method B1**

For operation of AMRD using AIS-technology, the frequency 160.900 MHz (Ch. 2006) (new AMRD AIS) is suggested to be used. This requires amendment to RR Appendix **18** footnote *r*) as appropriate. Such use should be in accordance with the latest version of Recommendation ITU-R M.[AMRD].

###### **5/1.9.1/4.2.2 Method B2**

AMRD Group B using other technologies than AIS technology may be operated on the frequencies 161.525 MHz (Channel 2078), 161.550 MHz (Channel 2019) and 161.575MHz (Channel 2079). This requires amendment to RR Appendix **18** footnote *mm*) as appropriate. Such use should be in accordance with the latest version of Recommendation ITU-R M.[AMRD].

###### **5/1.9.1/4.2.3 Method B3**

For AMRD Group B using non-AIS technology, this method proposes to modify the Radio Regulations to allow use of the frequency band 161.4375-161.4875 MHz, subject to causing no harmful interference to the existing services. Such use should be in accordance with the latest version of Recommendation ITU-R M.[AMRD].

## **5/1.9.1/5 Regulatory and procedural considerations**

### **5/1.9.1/5.1 For Method A**

#### **MOD**

### APPENDIX 18 (REV.WRC-19)

#### **Table of transmitting frequencies in the VHF maritime mobile band**

(See Article 52)

...

#### **Notes referring to the Table**

...

#### *Specific notes*

...

- f) The frequencies 156.300 MHz (channel 06), 156.525 MHz (channel 70), 156.800 MHz (channel 16), 161.975 MHz (AIS 1) and 162.025 MHz (AIS 2) may also be used by aircraft stations for the purpose of search and rescue operations and other safety-related communication. The frequencies 156.525 MHz (channel 70), 161.975 MHz (AIS 1) and 162.025 MHz (AIS 2) may also be used by autonomous maritime radio devices Group A for digital selective calling respectively AIS-technology. Such use should be in accordance with the most recent version of Recommendation ITU-R M.[AMRD]. (WRC-19)

### **5/1.9.1/5.2 For Method B1**

#### **MOD**

### APPENDIX 18 (REV.WRC-19)

#### **Table of transmitting frequencies in the VHF maritime mobile band**

(See Article 52)

...

#### **Notes referring to the Table**

...

#### *Specific notes*

...

- r) In the maritime mobile service, this frequency is reserved for usage of autonomous maritime radio devices Group B using AIS technology. Such use should be in accordance with the latest version of Recommendation ITU-R M.[AMRD]. (WRC-19)

### 5/1.9.1/5.3 For Method B2

**MOD**

## APPENDIX 18 (REV.WRC-19)

### Table of transmitting frequencies in the VHF maritime mobile band

(See Article 52)

...

#### Notes referring to the Table

...

*Specific notes*

...

*mm*) Transmission on these channels is limited to coast stations. If permitted by administrations and specified by national regulations, these channels may be used by ship stations for transmission. All precautions should be taken to avoid harmful interference to channels AIS 1, AIS 2, 2027\* and 2028\*.

In addition channels 2078, 2019 and 2079 may also be used for AMRD Group B for non-AIS technologies as described in the most recent version of Recommendation ITU-R M.[AMRD], subject to coordination with affected administrations. (WRC-19)

\* From 1 January 2019, channel 2027 will be designated ASM 1 and channel 2028 will be designated ASM 2.

### 5/1.9.1/5.4 For Method B3

The possible modifications to the provisions of RR to satisfy the frequency need for AMRD are considered as follows:

## ARTICLE 5

### Frequency allocations

#### Section IV – Table of Frequency Allocations

(See No. 2.1)

**MOD**

**148-161.9375 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>156.8375-161.9375</b> FIXED MOBILE except aeronautical mobile 5.226 ADD 5.A191	<b>156.8375-161.9375</b> FIXED MOBILE 5.226 ADD 5.A191	



**ADD**

**5.A191** The frequency band 161.4375-161.4875 MHz can be used by Group B autonomous maritime radio devices using non-AIS technologies as described in the most recent version of Recommendation ITU-R M.[AMRD], subject to not causing harmful interference to the existing services. (WRC-19)

## Agenda item 1.9.2

(WP 5B / WP 4C, WP 5A, WP 5C, (WP 1A), (WP 3M))

1.9 to consider, based on the results of ITU-R studies:

1.9.2 modifications of the Radio Regulations, including new spectrum allocations to the maritime mobile-satellite service (Earth-to-space and space-to-Earth), preferably within the frequency bands 156.0125-157.4375 MHz and 160.6125-162.0375 MHz of Appendix 18, to enable a new VHF data exchange system (VDES) satellite component, while ensuring that this component will not degrade the current terrestrial VDES components, applications specific messages (ASM) and AIS operations and not impose any additional constraints on existing services in these and adjacent frequency bands as stated in recognizing d) and e) of Resolution 360 (Rev.WRC-15);

Resolution 360 (Rev.WRC-15) – Consideration of regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication

### 5/1.9.2/1 Executive summary

In accordance with Resolution 360 (Rev.WRC-15), the ITU-R has undertaken studies for possible new allocation to the maritime mobile-satellite service (MMSS) (Earth-to-space and space-to-Earth), preferably within the frequency bands 156.0125-157.4375 MHz and 160.6125-162.0375 MHz of Radio Regulations (RR) Appendix 18.

The results of the sharing studies are contained in Recommendation ITU-R M.2092-0 which has been developed during the last study cycle and WDPDN Report ITU-R M.[VDES-SAT].

Based on the results of the studies, six methods have been developed to satisfy WRC-19 agenda item 1.9.2.

#### Method A

NOC to the Radio Regulations except suppression of Resolution 360 (Rev.WRC-15). This implies no allocation for the VHF data exchange (VDE) satellite component of the VHF data exchange system (VDES).

#### Method B

This method proposes new primary allocations for the MMSS (Earth-to-space and space-to-Earth), details for coordination of the VDES space stations with respect to terrestrial services are described below in the method section.

#### Method C

This method uses the same frequency plan as Method B but with new secondary allocation for the MMSS (Earth-to-space) and (space-to-Earth).

Due to the secondary allocation status for the VDES-SAT, there is no coordination between MMSS and terrestrial services and therefore there is no need to introduce a specific power flux-density (pfd) mask in the RR.

#### Method D

Same as Method C except with the addition of a pfd limit in RR Article 5 in order to protect the terrestrial service. The description of the pfd mask is given in the WDPND Report ITU-R M.[VDES-SAT]

## **Method E**

This method is a variant of Method B but using a pfd mask different from that contained in Recommendation ITU-R M.2092. The description of the pfd mask is given in Appendix 2 of the WDPND Report ITU-R M.[VDES-SAT].

## **Method F**

Similar to Method B with a different regulatory procedure (different frequency selection for satellite and terrestrial components of the VDES).

### **5/1.9.2/2 Background**

The studies associated with WRC-15 agenda item 1.16 resulted in elaboration of a concept for the VDES reflected in Recommendation ITU-R M.2092-0. The system combines the current automatic identification system (AIS), applications specific messages (ASM) as well as data exchange terrestrial and satellite components.

During WRC-15, no allocations were made to VDES satellite component since the compatibility studies with the incumbent services in the frequency bands assumed for operation of VDES satellite component and in the adjacent frequency bands were incomplete.

To this effect, Resolution **360 (WRC-12)** was revised and updated to invite the WRC-19 to consider, based on the results of ITU-R studies, modifications of the Radio Regulations, including new spectrum allocations to the MMSS (Earth-to-space and space-to-Earth), preferably within the frequency bands 156.0125-157.4375 MHz and 160.6125-162.0375 MHz of RR Appendix **18**, to enable a new VDES satellite component, while ensuring that this component will not degrade the current terrestrial VDES components, ASM and AIS operations and not impose any additional constraints on existing services in these and adjacent frequency bands as stated in *recognizing d*) and *e*) of Resolution **360 (Rev. WRC-15)**.

### **5/1.9.2/3 Summary and analysis of the results of ITU-R studies**

#### **5/1.9.2/3.1 Discussion on compatibility with incumbent services**

Compatibility studies between satellite component of VDES and incumbent services have been performed. These studies are contained in the WDPND Report ITU-R M.[VDES-SAT], together with a summary of why a VDES satellite component is required, identification of the spectrum requirements and a technical description of the satellite component of VDES.

The compatibility between the downlink of the satellite component of VDES and mobile, as well as fixed, services has been evaluated by two study methodologies.

One methodology uses carrier-to-interference analysis to evaluate if the pfd mask contained in Recommendation ITU-R M.2092 provides protection for incumbent services. The interference analysis for fixed services uses bit-error ratio performance as specified in Recommendation ITU-R F.758 and  $C/(N+I)$  threshold for that bit-error ratio performance provided in Recommendation ITU-R F.1101. The interference analysis for mobile services uses signal-to-noise and distortion ratio (SINAD) threshold and bit-error ratio performance as specified in Recommendation ITU-R M.1808.

The other methodology uses interference-to-noise analysis based on a protection criteria of  $I/N = -6$  dB, specified in Recommendation ITU-R M.1808 and Recommendation ITU-R F.758.

The two study methodologies lead to different pfd masks, as they are based on different assumptions as mentioned above, that provide compatibility with incumbent fixed and mobile services.

One study on compatibility between the VDE-SAT uplink and the land mobile service indicates that VDES satellite receiver can suffer interference caused by stations in the terrestrial services. Another study, which is supported by measurements, indicate compatibility between the VDE-SAT uplink and the land mobile service when using the most robust waveform.

### **5/1.9.2/3.2 Frequency plans**

The following three frequency plans are being studied in working document towards a PDN Report ITU-R M.[VDES-SAT]. The proposed methods refer only to frequency plan alternatives 2 and 3.

#### **5/1.9.2/3.2.1 Frequency plan alternative 1**

Frequency plan alternative 1 allows for utilization of the channels 24, 84, 25, 85, 26 and 86 of RR Appendix 18 in a shared manner between VDE-TER and VDE-SAT.

- Four channels 1024, 1084, 1025 and 1085 are shared between ship-to-shore and ship-to-satellite (VDE-SAT uplink) services.
- Two channels 1026 and 1086 are exclusively reserved for ship-to-satellite (VDE-SAT uplink) services.
- Four channels 2024, 2084, 2025 and 2085 are shared among shore-to-ship, ship-to-ship and satellite-to-ship (VDE-SAT downlink) services.
- Two channels 2026 and 2086 are exclusively reserved for satellite-to-ship (VDE-SAT downlink) services.

#### **5/1.9.2/3.2.2 Frequency plan alternative 2**

Frequency plan alternative 2 allows for utilization of channels 24, 84, 25 and 85 primarily for VHF data exchange terrestrial (VDE-TER), while channels 26 and 86 are, within the context of VDES, exclusively reserved for VHF data exchange satellite (VDE-SAT) uplink. VDE-SAT uplink is also possible in channels 24, 84, 25 and 85, but the VDE-SAT uplink in these channels do not impose constraints on VDE-TER. Frequencies are, within the context of VDES, exclusively reserved for VDE-SAT downlink within the frequency range 160.9625 MHz to 161.4875 MHz, which is not channelized in RR Appendix 18.

- Four channels 1024, 1084, 1025 and 1085 are reserved for ship-to-shore services, but ship-to-satellite (VDE-SAT uplink) services are possible without imposing constraints on ship-to-shore services.
- Four channels 2024, 2084, 2025 and 2085 are reserved for shore-to-ship and ship-to-ship services, but ship-to-satellite (VDE-SAT uplink) services are possible without imposing constraints on shore-to-ship and ship-to-ship services.
- Four channels 1026, 1086, 2026 and 2086 are exclusively reserved for ship-to-satellite (VDE-SAT uplink) services.
- Frequencies are exclusively reserved for satellite-to-ship (VDE-SAT downlink) services within the frequency range 160.9625 MHz to 161.4875 MHz, which is not channelized in RR Appendix 18.

### 5/1.9.2/3.2.3 Frequency plan alternative 3

Frequency plan alternative 3 allows for utilization of the channels 24, 84, 25 and 85 in a shared manner between VDE-TER and VDE-SAT, while channels 26 and 86 exclusively reserved for VDE-SAT.

- Four channels 1024, 1084, 1025 and 1085 are shared between ship-to-shore, ship-to-ship, shore-to-ship and ship-to-satellite (VDE-SAT uplink) services.
- Two channels 1026 and 1086 are exclusively reserved for ship-to-satellite (VDE-SAT uplink) services.
- Four channels 2024, 2084, 2025 and 2085 are primarily for the satellite-to-ship (VDE-SAT downlink) service, while shore-to-ship services are possible without imposing constraints on satellite-to-ship services.
- Two channels 2026 and 2086 are exclusively reserved for satellite-to-ship (VDE-SAT downlink) services.

### 5/1.9.2/3.3 Existing relevant Recommendations and Reports are listed as follows:

Recommendations [ITU-R F.758](#), [ITU-R F.1101](#), [ITU-R M.1084](#), [ITU-R M.1808](#), [ITU-R M.1842](#), [ITU-R M.2092](#), WDPDN Report ITU-R M.[VDES-SAT].

### 5/1.9.2/4 Methods to satisfy the agenda item

#### 5/1.9.2/4.1 Method A

Due to the sharing difficulties of the VDES satellite component uplink and downlink with the systems in the land mobile service, it is proposed to make no changes in the Radio Regulations except suppression of Resolution **360 (Rev.WRC-15)**.

#### 5/1.9.2/4.2 Method B

This method is based on frequency plan alternative 2 and proposes a new primary allocation for the MMSS (Earth-to-space) in the frequency band 157.1875-157.3375 MHz (channels 1024, 1084, 1025, 1085, 1026 and 1086) and the frequency band 161.7875-161.9375 (channels 2026 and 2086). The channels 1026, 1086, 2026 and 2086 are exclusively reserved for ship-to-satellite (VDE-SAT uplink) services. The channels 1024, 1084, 1025 and 1085 are reserved for ship-to-shore services, but ship-to-satellite (VDE-SAT uplink) services are possible without imposing constraints on ship-to-shore services.

The method proposes a new primary allocation for the MMSS (space-to-Earth) for frequency band 160.9625-161.4875 MHz, for improved VDE communication capacity and coverage.

Coordination of VDE space stations of the MMSS (space-to-Earth) with respect to terrestrial services is described in modification of RR Appendix **5**, taking into account the pfd mask defined at the last study cycle in Recommendation ITU-R M.2092-0.

It is proposed also to clarify that the coordination between MMSS and terrestrial services is subject to the application of the provisions of RR No. **9.14**.

The method proposes to modify provisions RR Nos. **5.208A** and **5.208B** in order to ensure the protection of the radio astronomy service (RAS) in the nearest frequency band.

In order to protect the RAS, Annex 1 to Resolution **739 (Rev.WRC-07)** is revised to include MMSS in the frequency band 160.9625-161.4875 MHz.

### 5/1.9.2/4.3 Method C

This method is based on frequency plan alternative 2 and proposes a new secondary allocation for the MMSS (Earth-to-space) in the frequency band 157.1875-157.3375 MHz (channels 1024, 1084, 1025, 1085, 1026 and 1086) and the frequency band 161.7875-161.9375 (channels 2024, 2084, 2025, 2085, 2026 and 2086). The channels 1026, 1086, 2026 and 2086 are exclusively reserved for ship-to-satellite (VDE-SAT uplink) services. The channels 1024, 1084, 1025 and 1085 are reserved for ship-to-shore services, but ship-to-satellite (VDE-SAT uplink) services are possible without imposing constraints on ship-to-shore services.

The method proposes a new secondary allocation for the MMSS (space-to-Earth) in the frequency band 160.9625-161.4875 MHz, for improved VDE communication capacity and coverage.

The method proposes to modify provisions RR Nos. **5.208A** and **5.208B** in order to ensure the protection of the RAS in the nearest frequency band.

In order to protect the RAS, Annex 1 to Resolution **739 (Rev.WRC-07)** is revised to include MMSS in the frequency band 160.9625-161.4875 MHz.

Due to the proposed secondary allocation status for the VDES-SAT, there is no coordination between MMSS and terrestrial services and therefore there is no need to introduce a specific pfd mask in the RR.

### 5/1.9.2/4.4 Method D

This method is based on frequency plan alternative 2 and proposes, in addition to regulatory changes in method C, to introduce pfd limits for VDE-SAT downlink which are based on *I/N* protection criteria.

### 5/1.9.2/4.5 Method E

This method is based on frequency plan alternative 2 and proposes a variant of Method B but using a pfd mask different from that contained in ITU-R M.2092. The description of the pfd mask is given in Appendix 2 of WDPDN Report ITU-R M.[VDES-SAT].

### 5/1.9.2/4.6 Method F

This method is based on frequency plan alternative 3 and proposes a new primary allocation for the MMSS (Earth-to-space) in the frequency band 157.1875-157.3375 MHz (channels 1024, 1084, 1025, 1085, 1026 and 1086 of RR Appendix **18**).

The method proposes a new primary allocation for the MMSS (space-to-Earth) in the frequency band 161.7875-161.9375 MHz (channels 2024, 2084, 2025, 2085, 2026 and 2086 of RR Appendix **18**), for improved VDE communication capacity and coverage.

To avoid complexity in sharing between VDES satellite downlink and VDES terrestrial communication, when introducing VDES satellite component, the method proposes to change the frequency plan of VDES terrestrial communication as follows.

- RR Appendix **18** lower legs (channels 1024, 1084, 1025, 1085) are for ship-to-shore, shore-to-ship and ship-to-ship VDE.
- RR Appendix **18** upper legs (channels 2024, 2084, 2025, 2085) are for shore-to-ship VDE when satellite downlink is not available.

The method proposes to modify provisions of RR Nos. **5.208A** and No. **5.208B** in order to ensure the protection of the RAS in the nearest frequency band. In order to protect the RAS, Annex 1 to Resolution **739 (Rev.WRC-15)** would be revised to include MMSS in the frequency band 161.7875-161.9375 MHz.

The method proposes to add provision RR No. **5.226B** in order to ensure the coordination of terrestrial services in the same frequency band. Coordination of VDE space stations of the MMSS (space-to-Earth) with respect to terrestrial services is described in modification of RR Appendix 5, proposing a pfd mask.

### **5/1.9.2/5 Regulatory and procedural considerations**

#### **5/1.9.2/5.1 For Method A**

## **ARTICLE 5**

### **Frequency allocations**

#### **Section IV – Table of Frequency Allocations (See No. 2.1)**

#### **NOC**

**148–161.9375 MHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>156.8375-161.9375</b> FIXED MOBILE except aeronautical mobile 5.226	<b>156.8375-161.9375</b> FIXED MOBILE  5.226	

#### **SUP**

### **RESOLUTION 360 (REV.WRC-15)**

#### **Consideration of regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication**

**Reasons:** It is proposed to suppress Resolution **360 (Rev.WRC-15)** since it will become superfluous after the studies are completed.

#### **5/1.9.2/5.2 For Methods B and E**

## **ARTICLE 5**

### **Frequency allocations**

#### **Section IV – Table of Frequency Allocations (See No. 2.1)**

**MOD**

**148-161.9375 MHz**

<b>Allocation to services</b>		
<b>Region 1</b>	<b>Region 2</b>	<b>Region 3</b>
<b>156.8375-157.1875</b> FIXED MOBILE except aeronautical mobile 5.226	<b>156.8375-157.1875</b> FIXED MOBILE 5.226	
<b>157.1875-157.3375</b> FIXED MOBILE except aeronautical mobile MARITIME MOBILE-SATELLITE (Earth-to-space) 5.226 ADD 5.226A	<b>157.1875-157.3375</b> FIXED MOBILE MARITIME MOBILE-SATELLITE (Earth-to-space) 5.226 ADD 5.226A	
<b>157.3375-160.9625</b> FIXED MOBILE except aeronautical mobile 5.226	<b>157.3375-160.9625</b> FIXED MOBILE 5.226	
<b>160.9625- 161.4875</b> FIXED MOBILE except aeronautical mobile MARITIME MOBILE-SATELLITE (space-to-Earth) MOD 5.208A MOD 5.208B 5.226 ADD 5.226B	<b>160.9625-161.4875</b> FIXED MOBILE MARITIME MOBILE-SATELLITE (space-to-Earth) MOD 5.208A MOD 5.208B 5.226 ADD 5.226B	
<b>161.4875-161.7875</b> FIXED MOBILE except aeronautical mobile 5.226	<b>161.4875-161.7875</b> FIXED MOBILE 5.226	
<b>161.7875-161.9375</b> FIXED MOBILE except aeronautical mobile MARITIME MOBILE-SATELLITE (Earth-to-space) 5.226 ADD 5.226A	<b>161.7875-161.9375</b> FIXED MOBILE MARITIME MOBILE-SATELLITE (Earth-to-space) 5.226 ADD 5.226A	

**ADD**

**5.226A** The use of the frequency bands 157.1875-157.3375 MHz and 161.7875-161.9375 MHz by the maritime mobile-satellite (Earth-to-space) service is limited to the systems which operate in accordance with Appendix **18**. (WRC-19)



## ADD

**5.226B** The use of the frequency band 160.9625-161.4875 MHz by the maritime mobile-satellite (space-to-Earth) service is limited to the systems which operate in accordance with Appendix 18. Such use is subject to the application of the provisions of No. 9.14 for coordination with stations of terrestrial services. (WRC-19)

**Reasons:** The above modifications of RR Article 5 identify a MMSS allocation uplink and downlink for the VHF Data Exchange System which is described in the WDPDN Report ITU-R M.[VDES-SAT]. It is also clarified, in the footnote RR No. 5.226B, that the coordination between MMSS and terrestrial services is subject to the application of the provision of RR No. 9.14.

## MOD

**5.208A** In making assignments to space stations in the mobile-satellite service in the bands 137-138 MHz, 387-390 MHz, 400.15-401 MHz and in the maritime-mobile satellite service (space-to-Earth) in the band 160.9625-161.4875 MHz, administrations shall take all practicable steps to protect the radio astronomy service in the bands 150.05-153 MHz, 322-328.6 MHz, 406.1-410 MHz and 608-614 MHz from harmful interference from unwanted emissions. The threshold levels of interference detrimental to the radio astronomy service are shown in the relevant ITU-R Recommendation. (WRC-19)

## MOD

**5.208B\*** In the frequency bands:  
137-138 MHz,  
160.9625-161.4875 MHz,  
387-390 MHz,  
400.15-401 MHz,  
1 452-1 492 MHz,  
1 525-1 610 MHz,  
1 613.8-1 626.5 MHz,  
2 655-2 690 MHz,  
21.4-22 GHz,

Resolution 739 (Rev.WRC-19) applies. (WRC-19)

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\* This provision was previously numbered as No. 5.347A. It was renumbered to preserve the sequential order.

**MOD**

**APPENDIX 18 (REV.WRC-19)**

**Table of transmitting frequencies in the  
VHF maritime mobile band**

(See Article 52)

...

Channel designator	Notes	Transmitting frequencies (MHz)		Inter-ship	Port operations and ship movement		Public correspondence
		From ship stations	From coast stations		Single frequency	Two frequency	
24	w), ww), x), xx)	157.200	161.800		x	x	x
1024	w), ww), x), xx), AAA)	157.200					
2024	w), ww), x), xx), AAA)	161.800	161.800	x (digital only)			
84	w), ww), x), xx)	157.225	161.825		x	x	x
1084	w), ww), x), xx), AAA)	157.225					
2084	w), ww), x), xx), AAA)	161.825	161.825	x (digital only)			
25	w), ww), x), xx)	157.250	161.850		x	x	x
1025	w), ww), x), xx), AAA)	157.250					
2025	w), ww), x), xx), AAA)	161.850	161.850	x (digital only)			
85	w), ww), x), xx)	157.275	161.875		x	x	x
1085	w), ww), x), xx), AAA)	157.275					
2085	w), ww), x), xx), AAA)	161.875	161.875	x (digital only)			
26	w), ww), x)	157.300	161.900		x	x	x
1026	w), ww), x), AAA)	157.300					
2026	w), ww), x), AAA)		161.900				
86	w), ww), x)	157.325	161.925		x	x	x

Channel designator	Notes	Transmitting frequencies (MHz)		Inter-ship	Port operations and ship movement		Public correspondence
		From ship stations	From coast stations		Single frequency	Two frequency	
1086	w), ww), x), AAA)	157.325					
2086	w), ww), x), AAA)		161.925				
27	z), zx)	157.350	161.950			x	x
1027	z), zz)	157.350	157.350		x		
ASM 1	z)	161.950	161.950				
87	z), zz)	157.375	157.375		x		
28	z), zx)	157.400	162.000			x	x
1028	z), zz)	157.400	157.400		x		
ASM 2	z)	162.000	162.000				
88	z), zz)	157.425	157.425		x		
AIS 1	f), l), p)	161.975	161.975				
AIS 2	f), l), p)	162.025	162.025				

**Notes referring to the Table**

...

*Specific notes*

...

w) In Regions 1 and 3:

The frequency bands 157.200-157.325 MHz and 161.800-161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are identified for the utilization of the VHF Data Exchange System (VDES) described in the most recent version of Recommendation ITU-R M.2092. These frequency bands may also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not causing harmful interference to, or claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-19)

wa) In Regions 1 and 3:

The frequency bands 157.025-157.100 MHz and 161.625-161.700 MHz (corresponding to channels: 80, 21, 81 and 22) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using multiple 25 kHz contiguous channels.

The frequency bands 157.150-157.175 MHz and 161.750-161.775 MHz (corresponding to channels: 23 and 83) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using two 25 kHz contiguous channels. From 1 January 2017, the frequencies 157.125 MHz and 161.725 MHz (corresponding to channel: 82) are identified for the utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842.

The frequency bands 157.025-157.175 MHz and 161.625-161.775 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23 and 83) can also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-19)

...

xx) The channels 24, 84, 25 and 85 may be merged in order to form unique channels with a bandwidth of 100 kHz in order to operate the VDES terrestrial component described in the most recent version of Recommendation ITU-R M.2092. (WRC-19)

...

z) These channels are each split into two simplex channels. The channels 2027 and 2028 designated as ASM 1 and ASM 2 are used for application specific messages (ASM) as described in the most recent version of Recommendation ITU-R M.2092. (WRC-19)

...

zz) The channels 1027, 1028, 87 and 88 are used as single-frequency analogue channels for port operation and ship movement. (WRC-19)

AAA) These channels which are also allocated to the maritime mobile-satellite service (Earth-to-space), shall be used for the reception of VDES messages from ships as described in the most recent version of Recommendation ITU-R M.2092 in the following way:

- The channels 1024, 1084, 1025 and 1085 are reserved for ship-to-shore services, but ship-to-satellite (VDE-SAT uplink) services are possible without imposing constraints on ship-to-shore services.
- The channels 2024, 2084, 2025 and 2085 are reserved for shore-to-ship and ship-to-ship services, but ship-to-satellite (VDE-SAT uplink) services are possible without imposing constraints on shore-to-ship and ship-to-ship services.
- The channels 1026, 1086, 2026 and 2086 are exclusively reserved for ship-to-satellite (VDE-SAT uplink) services. (WRC-19)

**Reasons:** The channels are identified for the satellite uplink of the VDES.

MOD

RESOLUTION 739 (REV.WRC-19)

**Compatibility between the radio astronomy service and the active space services in certain adjacent and nearby frequency bands**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

...

ANNEX 1 TO RESOLUTION 739 (REV.WRC-19)

**Unwanted emission threshold levels**

TABLE 1-2

**epfd thresholds<sup>(1)</sup> for unwanted emissions from all space stations of a non-GSO satellite system at a radio astronomy station**

Space service	Space service band	Radio astronomy band	Single dish, continuum observations		Single dish, spectral line observations		VLBI		Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of:
			epfd <sup>(2)</sup>	Reference bandwidth	epfd <sup>(2)</sup>	Reference bandwidth	epfd <sup>(2)</sup>	Reference bandwidth	
			(MHz)	(MHz)	(dB(W/m <sup>2</sup> ))	(MHz)	(dB(W/m <sup>2</sup> ))	(kHz)	
MSS (space-to-Earth)	137-138	150.05-153	-238	2.95	NA	NA	NA	NA	WRC-07
MMSS (space-to-Earth)	160.9625-161.4875	150.05-153	-238	2.95	NA	NA	NA	NA	WRC-19
MSS (space-to-Earth)	387-390	322-328.6	-240	6.6	-255	10	-228	10	WRC-07
MSS (space-to-Earth)	400.15-401	406.1-410	-242	3.9	NA	NA	NA	NA	WRC-07
MSS (space-to-Earth)	1 525-1 559	1 400-1 427	-243	27	-259	20	-229	20	WRC-07
RNSS (space-to-Earth) <sup>(3)</sup>	1 559-1 610	1 610.6-1 613.8	NA	NA	-258	20	-230	20	WRC-07
MSS (space-to-Earth)	1 525-1 559	1 610.6-1 613.8	NA	NA	-258	20	-230	20	WRC-07
MSS (space-to-Earth)	1 613.8-1 626.5	1 610.6-1 613.8	NA	NA	-258	20	-230	20	WRC-03

**SUP**

**RESOLUTION 360 (REV.WRC-15)**

**Consideration of regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication**

**Reasons:** It is proposed to suppress Resolution **360 (Rev.WRC-15)** since it will become superfluous after the studies are completed and the identification of frequencies in order to enhance maritime radiocommunications has been made by WRC-19.

**5/1.9.2/5.2.1 For Method B**

**MOD**

**APPENDIX 5 (REV.WRC-19)**

**Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9**

**ANNEX 1**

**MOD**

**1 Coordination thresholds for sharing between MSS (space-to-Earth) and terrestrial services in the same frequency bands and between non-GSO MSS feeder links (space-to-Earth) and terrestrial services in the same frequency bands and between RDSS (space-to-Earth) and terrestrial services in the same frequency bands (WRC-19)**

**MOD**

**1.1 Below 1 GHz\***

...

1.1.4 In the band 160.9625-161.4875 MHz, coordination of a space station of the maritime mobile-satellite service (space-to-Earth) with respect to terrestrial services is required only if the power spectral and flux-density produced by this space station exceeds the following mask in dB(W/(m<sup>2</sup> · 4 kHz)) at the Earth's surface:

---

\* These provisions apply only to the MSS.

$$PFD(\theta^{\circ})_{((dBW/m^2 \cdot 4 \text{ kHz}))} = \begin{cases} -149 + 0.16 * \theta^{\circ} & 0^{\circ} \leq \theta < 45^{\circ}; \\ -142 + 0.53 * (\theta^{\circ} - 45^{\circ}) & 45^{\circ} \leq \theta < 60^{\circ}; \\ -134 + 0.1 * (\theta^{\circ} - 60^{\circ}) & 60^{\circ} \leq \theta \leq 90^{\circ}. \end{cases}$$

where  $\theta$  is the angle of arrival of the incident wave above the horizontal plane (degrees).

**Reasons:** It is proposed to extend the coordination threshold defined in Annex 1 of RR Appendix 5 for the VDES using the frequency band 160.9625-161.4875 MHz by using the pfd mask defined in the Recommendation ITU-R M.2092-0.

#### 5/1.9.2/5.2.2 For Method E

MOD

### APPENDIX 5 (REV.WRC-19)

#### Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

### ANNEX 1

MOD

#### 1 Coordination thresholds for sharing between MSS (space-to-Earth) and terrestrial services in the same frequency bands and between non-GSO MSS feeder links (space-to-Earth) and terrestrial services in the same frequency bands and between RDSS (space-to-Earth) and terrestrial services in the same frequency bands (WRC-19)

MOD

##### 1.1 Below 1 GHz\*

...

1.1.4 In the band 160.9625-161.4875 MHz, coordination of a space station of the maritime mobile-satellite service (space-to-Earth) with respect to terrestrial services is required only if the power spectral and flux-density produced by this space station exceeds the following mask in dB(W/(m<sup>2</sup> · 4 kHz)) at the Earth's surface:

---

\* These provisions apply only to the MSS.

$$pfd(\theta^\circ)_{(dBW/(m^2 * 4 \text{ kHz}))} = \begin{cases} -141.72 - 8.15 + 12 \left( \frac{\theta}{16.47} \right)^2 & 0^\circ \leq \theta < 8.5^\circ \\ -149 + 0.16 * \theta^\circ & 8.5^\circ \leq \theta < 45^\circ \\ -142 + 0.53 * (\theta^\circ - 45^\circ) & 45^\circ \leq \theta < 58.5^\circ \\ -141.72 + 6.85 - 10 \log_{10} \left( \left( \frac{\theta}{16.47} \right)^{-1.5} + k \right) & 58.5^\circ \leq \theta \leq 90^\circ \end{cases}$$

where  $\theta$  is the angle of arrival of the incident wave above the horizontal plane (degrees).

**5/1.9.2/5.3 For Methods C and D**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**

(See No. 2.1)

**MOD**

**148-161.9375 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>156.8375-157.1875</b> FIXED MOBILE except aeronautical mobile 5.226	<b>156.8375-157.1875</b> FIXED MOBILE 5.226	
<b>157.1875-157.3375</b> FIXED MOBILE except aeronautical mobile Maritime mobile-satellite (Earth-to-space) ADD 5.226A 5.226	<b>157.1875-157.3375</b> FIXED MOBILE Maritime mobile-satellite (Earth-to-space) ADD 5.226A 5.226	
<b>157.3375-160.9625</b> FIXED MOBILE except aeronautical mobile 5.226	<b>157.3375-160.9625</b> FIXED MOBILE 5.226	
<b>160.9625-161.4875</b> FIXED MOBILE except aeronautical mobile Maritime mobile-satellite (space-to-Earth) MOD 5.208A MOD 5.208B ADD 5.226B 5.226	<b>160.9625-161.4875</b> FIXED MOBILE Maritime mobile-satellite (space-to-Earth) MOD 5.208A MOD 5.208B ADD 5.226B 5.226	



<b>161.4875-161.7875</b> FIXED MOBILE except aeronautical mobile 5.226	<b>161.4875-161.7875</b> FIXED MOBILE 5.226
<b>161.7875-161.9375</b> FIXED MOBILE except aeronautical mobile Maritime mobile-satellite (Earth-to-space) ADD 5.226A 5.226	<b>161.7875-161.9375</b> FIXED MOBILE Maritime mobile-satellite (Earth-to-space) ADD 5.226A 5.226

## ADD

**5.226A** The use of the frequency bands 157.1875-157.3375 MHz and 161.7875-161.9375 MHz by the maritime mobile-satellite (Earth-to-space) service is limited to non-GSO systems which operate in accordance with Appendix **18**. (WRC-19)

**Reasons:** The above modification of RR Article **5** specify that the MMSS allocation (Earth-to-space) for the VDES satellite component as described in the WDPDN Report ITU-R M.[VDES-SAT] should operate in accordance with RR Appendix **18**.

## MOD

**5.208A** In making assignments to space stations in the mobile-satellite service in the bands 137-138 MHz, 387-390 MHz, 400.15-401 MHz and in the maritime-mobile satellite service (space-to-Earth) in the band 160.9625-161.4875 MHz, administrations shall take all practicable steps to protect the radio astronomy service in the bands 150.05-153 MHz, 322-328.6 MHz, 406.1-410 MHz and 608-614 MHz from harmful interference from unwanted emissions. The threshold levels of interference detrimental to the radio astronomy service are shown in the relevant ITU-R Recommendation. (WRC-19)

**Reasons:** The above modification is proposed to ensure the protection of the radio astronomy service (RAS).

## MOD

**5.208B\*** In the frequency bands:  
 137-138 MHz,  
 160.9625-161.4875 MHz,  
 387-390 MHz,  
 400.15-401 MHz,  
 1 452-1 492 MHz,  
 1 525-1 610 MHz,  
 1 613.8-1 626.5 MHz,  
 2 655-2 690 MHz,  
 21.4-22 GHz,

Resolution **739 (Rev.WRC-19)** applies. (WRC-19)

---

\* This provision was previously numbered as No. **5.347A**. It was renumbered to preserve the sequential order.

**Reasons:** The above modification is proposed to ensure the protection of the radio astronomy service (RAS).

**MOD**

APPENDIX 18 (REV.WRC-19)

**Table of transmitting frequencies in the  
VHF maritime mobile band**

(See Article 52)

...

Channel designator	Notes	Transmitting frequencies (MHz)		Inter-ship	Port operations and ship movement		Public correspondence
		From ship stations	From coast stations		Single frequency	Two frequency	
24	w), ww), x), xx)	157.200	161.800		x	x	x
1024	w), ww), x), xx), AAA)	157.200					
2024	w), ww), x), xx), AAA)	161.800	161.800	x (digital only)			
84	w), ww), x), xx)	157.225	161.825		x	x	x
1084	w), ww), x), xx), AAA)	157.225					
2084	w), ww), x), xx), AAA)	161.825	161.825	x (digital only)			
25	w), ww), x), xx)	157.250	161.850		x	x	x
1025	w), ww), x), xx), AAA)	157.250					
2025	w), ww), x), xx), AAA)	161.850	161.850	x (digital only)			
85	w), ww), x), xx)	157.275	161.875		x	x	x
1085	w), ww), x), xx), AAA)	157.275					
2085	w), ww), x), xx), AAA)	161.875	161.875	x (digital only)			
26	w), ww), x)	157.300	161.900		x	x	x
1026	w), ww), x), AAA)	157.300					
2026	w), ww), x), AAA)		161.900				
86	w), ww), x)	157.325	161.925		x	x	x

Channel designator	Notes	Transmitting frequencies (MHz)		Inter-ship	Port operations and ship movement		Public correspondence
		From ship stations	From coast stations		Single frequency	Two frequency	
1086	w), ww), x), AAA)	157.325					
2086	w), ww), x), AAA)		161.925				
27	z), zx)	157.350	161.950			x	x
1027	z), zz)	157.350	157.350		x		
ASM 1	z)	161.950	161.950				
87	z), zz)	157.375	157.375		x		
28	z), zx)	157.400	162.000			x	x
1028	z), zz)	157.400	157.400		x		
ASM 2	z)	162.000	162.000				
88	z), zz)	157.425	157.425		x		
AIS 1	f), l), p)	161.975	161.975				
AIS 2	f), l), p)	162.025	162.025				

#### Notes referring to the Table

...

#### Specific notes

...

m) These channels may be operated as single frequency channels, subject to coordination with affected administrations. The following conditions apply for single frequency usage:

- The lower frequency portion of these channels may be operated as single frequency channels by ship and coast stations.
- Transmission using the upper frequency portion of these channels is limited to coast stations.
- If permitted by administrations and specified by national regulations, the upper frequency portion of these channels may be used by ship stations for transmission. All precautions should be taken to avoid harmful interference to channels AIS 1, AIS 2, ASM 1 and ASM 2. (WRC-19)

mm) Transmission on these channels is limited to coast stations. If permitted by administrations and specified by national regulations, these channels may be used by ship stations for transmission. All precautions should be taken to avoid harmful interference to channels AIS 1, AIS 2, ASM 1 and ASM 2. (WRC-19)

...

w) In Regions 1 and 3:

The frequency bands 157.200-157.325 MHz and 161.800-161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are identified for the utilization of the VHF Data Exchange System (VDES) described in the most recent version of Recommendation ITU-R M.2092. These frequency bands may also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not causing harmful interference to, or claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-19)

wa) In Regions 1 and 3:

The frequency bands 157.025-157.100 MHz and 161.625-161.700 MHz (corresponding to channels: 80, 21, 81 and 22) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using multiple 25 kHz contiguous channels.

The frequency bands 157.150-157.175 MHz and 161.750-161.775 MHz (corresponding to channels: 23 and 83) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using two 25 kHz contiguous channels. From 1 January 2017, the frequencies 157.125 MHz and 161.725 MHz (corresponding to channel: 82) are identified for the utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842.

The frequency bands 157.025-157.175 MHz and 161.625-161.775 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23 and 83) can also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-19)

...

xx) The channels 24, 84, 25 and 85 may be merged in order to form unique channels with a bandwidth of 100 kHz in order to operate the VDES terrestrial component described in the most recent version of Recommendation ITU-R M.2092. (WRC-19)

...

z) These channels are each split into two simplex channels. The channels 2027 and 2028 designated as ASM 1 and ASM 2 are used for application specific messages (ASM) as described in the most recent version of Recommendation ITU-R M.2092. (WRC-19)

...

zz) The channels 1027, 1028, 87 and 88 are used as single-frequency analogue channels for port operation and ship movement. (WRC-19)

AAA) These channels may be used in the maritime mobile-satellite service (Earth-to-space) by the VDES satellite component in the following way:

- The channels 1024, 1084, 1025 and 1085 are reserved for ship-to-shore services, but ship-to-satellite (VDE-SAT uplink) services are possible without imposing constraints on ship-to-shore services.
- The channels 2024, 2084, 2025 and 2085 are reserved for shore-to-ship and ship-to-ship services, but ship-to-satellite (VDE-SAT uplink) services are possible without imposing constraints on shore-to-ship and ship-to-ship services.
- The channels 1026, 1086, 2026 and 2086 are exclusively reserved for ship-to-satellite (VDE-SAT uplink) services. (WRC-19)

**Reasons:** To update the Radio Regulations.

MOD

RESOLUTION 739 (REV.WRC-19)

**Compatibility between the radio astronomy service and the active space services in certain adjacent and nearby frequency bands**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

ANNEX 1 TO RESOLUTION 739 (REV.WRC-19)

**Unwanted emission threshold levels**

TABLE 1-2

**epfd thresholds<sup>(1)</sup> for unwanted emissions from all space stations of a non-GSO satellite system at a radio astronomy station**

Space service	Space service band	Radio astronomy band	Single dish, continuum observations		Single dish, spectral line observations		VLBI		Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of:
			epfd <sup>(2)</sup>	Reference bandwidth	epfd <sup>(2)</sup>	Reference bandwidth	epfd <sup>(2)</sup>	Reference bandwidth	
			(MHz)	(MHz)	(dB(W/m <sup>2</sup> ))	(MHz)	(dB(W/m <sup>2</sup> ))	(kHz)	
MSS (space-to-Earth)	137-138	150.05-153	-238	2.95	NA	NA	NA	NA	WRC-07
MMSS (space-to-Earth)	160.9625-161.4875	150.05-153	-238	2.95	NA	NA	NA	NA	WRC-19
MSS (space-to-Earth)	387-390	322-328.6	-240	6.6	-255	10	-228	10	WRC-07
MSS (space-to-Earth)	400.15-401	406.1-410	-242	3.9	NA	NA	NA	NA	WRC-07
MSS (space-to-Earth)	1 525-1 559	1 400-1 427	-243	27	-259	20	-229	20	WRC-07
RNSS (space-to-Earth) <sup>(3)</sup>	1 559-1 610	1 610.6-1 613.8	NA	NA	-258	20	-230	20	WRC-07
MSS (space-to-Earth)	1 525-1 559	1 610.6-1 613.8	NA	NA	-258	20	-230	20	WRC-07
MSS (space-to-Earth)	1 613.8-1 626.5	1 610.6-1 613.8	NA	NA	-258	20	-230	20	WRC-03

SUP

## RESOLUTION 360 (REV.WRC-15)

### **Consideration of regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication**

**Reasons:** It is proposed to suppress Resolution **360 (Rev.WRC-15)** since it will become superfluous after the studies are completed and the identification of frequencies in order to enhance maritime radiocommunications has been made by WRC-19.

#### **5/1.9.2/5.3.1 For Method C**

##### **ADD**

**5.226B** The use of the frequency band 160.9625-161.4875 MHz by the maritime mobile-satellite (space-to-Earth) service is limited to non-GSO systems. (WRC-19)

**Reasons:** The above modification of RR Article **5** specify that the MMSS allocation (space-to-Earth) for the VDES satellite component as described in the WDPDN Report ITU-R M.[VDES-SAT] should be limited to non-GSO systems.

#### **5/1.9.2/5.3.2 For Method D**

##### **ADD**

**5.226B** The use of the frequency band 160.9625-161.4875 MHz by the maritime mobile-satellite (space-to-Earth) service is limited to the non-GSO systems. In that band, the power flux-density at the surface of the Earth produced by emissions from transmitting stations of the maritime mobile-satellite (space-to-Earth) service shall not exceed  $-172.3 \text{ dB(W/m}^2\text{)}$  for  $0^\circ \leq \theta < 5^\circ$ ,  $-172.3 + 0.45 (\theta - 5) \text{ dB(W/m}^2\text{)}$  for  $5^\circ \leq \theta < 25^\circ$  and  $-163.3 \text{ dB(W/m}^2\text{)}$  for  $25^\circ \leq \theta \leq 90^\circ$ , where  $\theta$  is the angle of arrival of the radio-frequency wave and the reference bandwidth is 4 kHz. (WRC-19)

**5/1.9.2/5.4 For Method F**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**148-161.9375 MHz**

Allocation to services		
Region 1	Region 2	Region 3
<b>156.8375-157.1875</b> FIXED MOBILE except aeronautical mobile 5.226	<b>156.8375-157.1875</b> FIXED MOBILE 5.226	
<b>157.1875-157.3375</b> FIXED MOBILE except aeronautical mobile MARITIME MOBILE-SATELLITE (Earth-to-space) 5.226 ADD 5.226A	<b>157.1875-157.3375</b> FIXED MOBILE MARITIME MOBILE-SATELLITE (Earth-to-space) 5.226 ADD 5.226A	
<b>157.3375-161.7875</b> FIXED MOBILE except aeronautical mobile 5.226	<b>157.3375-161.7875</b> FIXED MOBILE 5.226	
<b>161.7875-161.9375</b> FIXED MOBILE except aeronautical mobile MARITIME MOBILE-SATELLITE (space-to-Earth) MOD 5.208A MOD 5.208B 5.226 ADD 5.226B	<b>161.7875-161.9375</b> FIXED MOBILE MARITIME MOBILE-SATELLITE (space-to-Earth) MOD 5.208A MOD 5.208B 5.226 ADD 5.226B	

**Reasons:** The above modifications of RR Article 5 identify a MMSS allocation uplink and downlink for the VHF Data Exchange System which is described in Recommendation ITU-R M.2092-0.

**MOD**

**5.208A** In making assignments to space stations in the mobile-satellite service in the bands 137-138 MHz, 387-390 MHz, 400.15-401 MHz and in the maritime-mobile-satellite service (space-to-Earth) in the band 161.7875-161.9375 MHz, administrations shall take all practicable steps to protect the radio astronomy service in the bands 150.05-153 MHz, 322-328.6 MHz, 406.1-410 MHz

and 608-614 MHz from harmful interference from unwanted emissions. The threshold levels of interference detrimental to the radio astronomy service are shown in the relevant ITU-R Recommendation. (WRC-19)

**Reasons:** The frequency range 161.7875-161.9375 MHz is a new allocation to the maritime mobile-satellite service (space-to-Earth). To ensure protection of the RAS this frequency range has to be added to RR No. **5.208A**.

## MOD

**5.208B\*** In the frequency bands:  
137-138 MHz,  
161.7875-161.9375 MHz,  
387-390 MHz,  
400.15-401 MHz,  
1 452-1 492 MHz,  
1 525-1 610 MHz,  
1 613.8-1 626.5 MHz,  
2 655-2 690 MHz,  
21.4-22 GHz,

Resolution **739 (Rev.WRC-19)** applies. (WRC-19)

**Reasons:** The frequency range 161.7875-161.9375 MHz is a new allocation to the maritime mobile-satellite service (space-to-Earth). To ensure protection of the RAS this frequency range has to be added to RR No. **5.208B**.

## ADD

**5.226A** The use of the frequency band 157.1875-157.3375 MHz by the maritime mobile-satellite service (Earth-to-space) is limited to the systems which operate in accordance with Appendix **18**. (WRC-19)

**Reasons:** Identify a MMSS allocation uplink for the VHF Data Exchange System which is described in Recommendation ITU-R M.2092-0.

## ADD

**5.226B** The use of the frequency band 161.7875-161.9375 MHz by the maritime mobile-satellite service (space-to-Earth) is limited to the systems which operate in accordance with Appendix **18**. Such use is subject to the application of the provisions of No. **9.14** for coordination with stations of terrestrial services. (WRC-19)

**Reasons:** Identify a MMSS allocation downlink for the VHF Data Exchange System which is described in Recommendation ITU-R M.2092-0. It is also clarified, in the footnote RR No. **5.226B**, that the coordination between MMSS and terrestrial services is subject to the application of the provision of RR No. **9.14**.

---

\* This provision was previously numbered as RR No. **5.347A**. It was renumbered to preserve the sequential order.



MOD

## APPENDIX 5 (REV.WRC-19)

### Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

#### ANNEX 1

MOD

### 1 Coordination thresholds for sharing between MSS (space-to-Earth) and terrestrial services in the same frequency bands and between non-GSO MSS feeder links (space-to-Earth) and terrestrial services in the same frequency bands and between RDSS (space-to-Earth) and terrestrial services in the same frequency bands (WRC-19)

MOD

#### 1.1 Below 1 GHz\*

...

1.1.4 In the band 161.7875-161.9375 MHz, coordination of a space station of the maritime mobile-satellite service (space-to-Earth) with respect to terrestrial services is required only if the power spectral and flux-density produced by this space station exceeds the following mask in dB(W/(m<sup>2</sup> · 4 kHz)) at the Earth's surface:

$$PF D(\theta^{\circ})_{((\text{dBW}/\text{m}^2 \cdot 4 \text{ kHz}))} = \begin{cases} -149 + 0.16 * \theta^{\circ} & 0^{\circ} \leq \theta < 45^{\circ}; \\ -142 + 0.53 * (\theta^{\circ} - 45^{\circ}) & 45^{\circ} \leq \theta < 60^{\circ}; \\ -134 + 0.1 * (\theta^{\circ} - 60^{\circ}) & 60^{\circ} \leq \theta \leq 90^{\circ}. \end{cases}$$

where  $\theta$  is the angle of arrival of the incident wave above the horizontal plane (degrees).

**Reasons:** It is proposed to extend the coordination threshold defined in Annex 1 of RR Appendix 5 for the VDES using the frequency band 161.7875-161.9375 MHz by using the pfd mask defined in Recommendation ITU-R M.2092-0.

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\* These provisions apply only to the MSS.

**MOD****APPENDIX 18 (REV.WRC-19)****Table of transmitting frequencies in the  
VHF maritime mobile band**

(See Article 52)

Channel designator	Notes	Transmitting frequencies (MHz)		Inter-ship	Port operations and ship movement		Public correspondence
		From ship stations	From coast stations		Single frequency	Two frequency	
24	w), ww), x), xx)	157.200	161.800		x	x	x
1024	w), ww), x), xx), AAA)	157.200	157.200	x (digital only)			
2024	w), ww), x), xx), BBB)		161.800				
84	w), ww), x), xx)	157.225	161.825		x	x	x
1084	w), ww), x), xx), AAA)	157.225	157.225	x (digital only)			
2084	w), ww), x), xx), BBB)		161.825				
25	w), ww), x), xx)	157.250	161.850		x	x	x
1025	w), ww), x), xx), AAA)	157.250	157.250	x (digital only)			
2025	w), ww), x), xx), BBB)		161.850				
85	w), ww), x), xx)	157.275	161.875		x	x	x
1085	w), ww), x), xx), AAA)	157.275	157.275	x (digital only)			
2085	w), ww), x), xx), BBB)		161.875				
26	w), ww), x)	157.300	161.900		x	x	x
1026	w), ww), x), AAA)	157.300					
2026	w), ww), x), BBB)		161.900				
86	w), ww), x)	157.325	161.925		x	x	x
1086	w), ww), x), AAA)	157.325					
2086	w), ww), x), BBB)		161.925				
27	z), zx)	157.350	161.950			x	x
1027	z), zz)	157.350	157.350		x		
ASM 1	z)	161.950	161.950				

Channel designator	Notes	Transmitting frequencies (MHz)		Inter-ship	Port operations and ship movement		Public correspondence
		From ship stations	From coast stations		Single frequency	Two frequency	
87	<i>z), zz)</i>	157.375	157.375		x		
28	<i>z), zx)</i>	157.400	162.000			x	x
1028	<i>z), zz)</i>	157.400	157.400		x		
ASM 2	<i>z)</i>	162.000	162.000				
88	<i>z), zz)</i>	157.425	157.425		x		
AIS 1	<i>f), l), p)</i>	161.975	161.975				
AIS 2	<i>f), l), p)</i>	162.025	162.025				

...

w) In Regions 1 and 3:

The frequency bands 157.200-157.325 MHz and 161.800-161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are identified for the utilization of the VHF Data Exchange System (VDES) described in the most recent version of Recommendation ITU-R M.2092. These frequency bands may also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not causing harmful interference to, or claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-19)

wa) In Regions 1 and 3:

The frequency bands 157.025-157.100 MHz and 161.625-161.700 MHz (corresponding to channels: 80, 21, 81 and 22) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using multiple 25 kHz contiguous channels.

The frequency bands 157.150-157.175 MHz and 161.750-161.775 MHz (corresponding to channels: 23 and 83) are identified for utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842 using two 25 kHz contiguous channels. From 1 January 2017, the frequencies 157.125 MHz and 161.725 MHz (corresponding to channel: 82) are identified for the utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842.

The frequency bands 157.025-157.175 MHz and 161.625-161.775 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23 and 83) can also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-19)

...

xx) The channels 24, 84, 25 and 85 may be merged in order to form unique channels with a bandwidth of 100 kHz in order to operate the VDES terrestrial component described in the most recent version of Recommendation ITU-R M.2092. (WRC-19)

...

z) These channels are each split into two simplex channels. The channels 2027 and 2028 designated as ASM 1 and ASM 2 are used for application specific messages (ASM) as described in the most recent version of Recommendation ITU-R M.2092. (WRC-19)

...

zz) The channels 1027, 1028, 87 and 88 are used as single-frequency analogue channels for port operation and ship movement. (WRC-19)

*AAA)* The combination of the channels 1024, 1084, 1025, 1085, 1026 and 1086, which are also allocated to the maritime mobile-satellite service (Earth-to-space), shall be used for the reception of VDES messages from ships as described in the most recent version of Recommendation ITU-R M.2092. (WRC-19)

*BBB)* The combination of the channels 2024, 2084, 2025, 2085, 2026 and 2086, which are also allocated to the maritime mobile-satellite service (space-to-Earth), shall be used for the reception of VDES messages from satellites as described in the most recent version of Recommendation ITU-R M.2092. (WRC-19)

**Reasons:** The above modifications of RR Appendix **18** identify a MMSS allocation uplink and downlink for the VHF Data Exchange System which is described in Recommendation ITU-R M.2092-0. The channels are identified for the satellite downlink of the VDES.

MOD

RESOLUTION 739 (REV.WRC-19)

**Compatibility between the radio astronomy service and the active space services in certain adjacent and nearby frequency bands**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

ANNEX 1 TO RESOLUTION 739 (REV.WRC-19)

**Unwanted emission threshold levels**

TABLE 1-2

**epfd thresholds<sup>(1)</sup> for unwanted emissions from all space stations of a non-GSO satellite system at a radio astronomy station**

Space service	Space service frequency band	Radio astronomy frequency band	Single dish, continuum observations		Single dish, spectral line observations		VLBI		Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of:
			epfd <sup>(2)</sup>	Reference bandwidth	epfd <sup>(2)</sup>	Reference bandwidth	epfd <sup>(2)</sup>	Reference bandwidth	
			(dB(W/m <sup>2</sup> ))	(MHz)	(dB(W/m <sup>2</sup> ))	(kHz)	(dB(W/m <sup>2</sup> ))	(kHz)	
MSS (space-to-Earth)	137-138	150.05-153	-238	2.95	NA	NA	NA	NA	WRC-07
MMSS (space-to-Earth)	161.7875-161.9375	150.05-153	-238	2.95	NA	NA	NA	NA	WRC-19
MSS (space-to-Earth)	387-390	322-328.6	-240	6.6	-255	10	-228	10	WRC-07
MSS (space-to-Earth)	400.15-401	406.1-410	-242	3.9	NA	NA	NA	NA	WRC-07
MSS (space-to-Earth)	1 525-1 559	1 400-1 427	-243	27	-259	20	-229	20	WRC-07
RNSS (space-to-Earth) <sup>(3)</sup>	1 559-1 610	1 610.6-1 613.8	NA	NA	-258	20	-230	20	WRC-07

MSS (space-to-Earth)	1 525-1 559	1 610.6-1 613.8	NA	NA	-258	20	-230	20	WRC-07
MSS (space-to-Earth)	1 613.8-1 626.5	1 610.6-1 613.8	NA	NA	-258	20	-230	20	WRC-03

NA: Not applicable, measurements of this type are not made in this frequency band.

- (1) These epfd thresholds should not be exceeded for more than 2% of time.
- (2) Integrated over the reference bandwidth with an integration time of 2 000 s.
- (3) This Resolution does not apply to current and future assignments of the radionavigation-satellite system GLONASS/GLONASS-M in the frequency band 1 559-1 610 MHz, irrespective of the date of reception of the related coordination or notification information, as appropriate. The protection of the radio astronomy service in the frequency band 1 610.6-1 613.8 MHz is ensured and will continue to be in accordance with the bilateral agreement between the Russian Federation, the notifying administration of the GLONASS/GLONASS-M system, and IUCAF, and subsequent bilateral agreements with other administrations.

**Reasons:** The frequency range 161.7875-161.9375 MHz is a new allocation to the maritime mobile-satellite service (space-to-Earth). To ensure protection of the RAS this frequency range has to be added to Annex 1 to Resolution **739 (Rev.WRC-15)**.

**SUP**

**RESOLUTION 360 (REV.WRC-15)**

**Consideration of regulatory provisions and spectrum allocations to the maritime mobile-satellite service to enable the satellite component of the VHF Data Exchange System and enhanced maritime radiocommunication**

**Reasons:** It is proposed to suppress Resolution **360 (Rev.WRC-15)** since it will become superfluous after the studies are completed and the identification of frequencies in order to enhance maritime radiocommunication has been made by WRC-19.

## Agenda item 1.10

**(WP 5B / WP 4A, WP 4B, WP 4C, WP 5A, WP 5C, WP 5D, WP 6A, WP 7D,  
(WP 3M), (WP 7B), (WP 7C))**

*1.10 to consider spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System (GADSS), in accordance with Resolution 426 (WRC-15);*

*Resolution 426 (WRC-15): Studies on spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System*

### **5/1.10/1 Executive summary**

In accordance with Resolution 426 (WRC-15), ITU-R considered spectrum needs and regulatory provisions for the introduction and the use of the global aeronautical distress and safety system (GADSS).

Two methods were developed, both of which state that no changes to Radio Regulations (RR) Article 5 are required in addition to suppression of Resolution 426 (WRC-15).

In Method A, modification to RR Article 30 and a new RR Article 34A to recognize GADSS in the RR are suggested.

In Method B, by comparison, different modifications to RR Article 30, a different new RR Article 34A, and a Resolution requiring the development of ITU-R Recommendations to list the frequency bands of the systems contributing to GADSS, and their technical characteristics and protection criteria are suggested. Method B also states that, for all GADSS functions, only frequency bands that already have been allocated on a primary basis and for safety purposes be used.

### **5/1.10/2 Background**

The International Civil Aviation Organization (ICAO) has developed a concept of operations (ConOps) to support the future development of GADSS.

The ConOps<sup>36</sup> describes in particular the following functions:

- Aircraft tracking
  - Typically uses existing technologies to assist in the timely identification and location of aircraft.
  - Provides an automated reporting function every 15 mins or less.
  - Aircraft tracking may be accomplished by multiple different systems over the duration of a flight.
- Autonomous distress tracking
  - An automated method of position reporting at intervals of one minute or less to support search and rescue (SAR), triggered by indications that an aircraft is in distress which may result in an accident.

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<sup>36</sup> Version 6.0. In 2017 the ICAO Air Navigation Commission agreed to use Version 6.0 to guide the further development of ICAO performance-based standards in order to support the implementation of the ConOps.



- Distress tracking aims to establish the location of a potential accident site within a six nautical mile (11.11 km) radius.
- Post-flight localization and recovery
  - A combination of both the immediate need to locate and rescue possible survivors after an air accident using emergency location beacons and other methods to an accuracy of <1 nautical mile (<1.85 km), and the timely collection of aircraft components and data that will assist in the accident investigation.
- Procedures and information management
  - The method of data collection and notification of flight tracking data to the relevant SAR, and rescue coordination centres.

The ConOps provides the guidelines for the development of ICAO performance-based standards, outlining specific technical and operational requirements that an aircraft shall meet. It does not identify specific systems proposed to contribute to GADSS. ICAO intends to use systems operating under existing allocations in accordance with the provisions of the RR, including the use of emergency position-indicating radio beacons (termed as emergency locator transmitters in ICAO) operating in the 406-406.1 MHz frequency band<sup>37</sup>.

### **5/1.10/3 Summary and analysis of the results of ITU-R studies**

ICAO has concluded the GADSS requirements can be satisfied using systems operating within existing aeronautical frequency allocations or distress spectrum, (e.g. the 406-406.1 MHz frequency band) and for WRC-19 no additional spectrum allocations are required. Therefore, no changes are required to RR Article 5.

Possible changes to other portions of RR have been identified to facilitate GADSS implementation<sup>38</sup>.

#### **5/1.10/3.1 Relevant ITU-R Recommendations and Reports**

Working document towards a preliminary draft new Report ITU-R M.[GADSS].

### **5/1.10/4 Methods to satisfy the agenda item**

Two methods are proposed to satisfy the agenda item and both involve suppression of Resolution **426 (WRC-15)**.

#### **5/1.10/4.1 Method A**

Regarding *invites ITU-R 2* of Resolution **426 (WRC-15)**, in order to facilitate its introduction, modification of the RR are proposed to include GADSS as a distress and safety communications system in RR Chapter VII – Distress and safety communications.

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<sup>37</sup> The 406-406.1 MHz frequency band is already identified for the use of emergency position-indicating radiobeacons in the provisions of RR No. **5.266**.

<sup>38</sup> It was noted that some RR provisions outside the scope of WRC-19 agenda item 1.10 may not reflect the current/future plans for aeronautical use. No related WRC-19 action is proposed regarding those provisions.

The modifications of RR proposed under Method A specify:

- that the details of the GADSS elements are contained in Annexes to the ICAO Convention;
- that the type of radiocommunication service used depends on the requirements of the specific GADSS function;
- that operation of GADSS elements under RR No. 4.4 is precluded.

#### **5/1.10/4.2 Method B**

Regarding *invites ITU-R 2* of Resolution **426 (WRC-15)**, in order to facilitate its introduction, modification of the RR are proposed to include GADSS as a distress and safety communications system in RR Chapter VII – Distress and safety communications. In addition, the frequency bands used for GADSS, its systems, their technical characteristics and protection criteria shall be reflected in the relevant ITU-R Recommendations. Therefore, a new Resolution [**A110-GADSS**] (**WRC-19**) calling ICAO to provide to ITU-R the information in relation to the frequency bands and systems included in GADSS and also the information about the technical characteristics of such systems and inviting ITU-R to develop appropriate Recommendations shall be developed.

The modifications of the RR proposed under Method B specify:

- that the details of the GADSS elements are contained in Annexes to the ICAO Convention;
- that GADSS shall only operate using primary service allocations;
- that the GADSS must operate in accordance with the terms of new Resolution [**A110-GADSS**] (**WRC-19**), resolving:
  - that systems composing the GADSS shall only operate in frequency bands that have already been provided for safety purposes;
  - that ITU-R shall develop ITU-R Recommendations detailing the system elements of the GADSS including their operating frequency bands and technical characteristics;
  - that if constituent elements of GADSS are changed, those changes should be reflected in the relevant ITU-R Recommendation.

### **5/1.10/5 Regulatory and procedural considerations**

#### **5/1.10/5.1 Method A**

**NOC**

## **ARTICLE 5**

### **Frequency allocations**

## CHAPTER VII

### Distress and safety communications<sup>1</sup>

#### ARTICLE 30

##### General provisions

##### Section I – Introduction

##### MOD

**30.1** § 1 Nos. **30.4-30.13**, and Articles **31, 32, 33** and **34** of this Chapter contain the provisions for the operational use of the global maritime distress and safety system (GMDSS), whose functional requirements, system elements and equipment carriage requirements are set forth in the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended. These Nos. and Articles also contain provisions for initiating distress, urgency and safety communications by means of radiotelephony on the frequency 156.8 MHz (VHF channel 16). (WRC-19)

##### ADD

**30.1A** Article **34A** of this Chapter contains the provisions for the global aeronautical distress and safety system (GADSS), whose functional requirements are set forth in the Annexes to the Convention on International Civil Aviation, as amended. (WRC-19)

##### ADD

#### ARTICLE 34A

##### Global aeronautical distress and safety system

##### ADD

**34A.1** The global aeronautical distress and safety system (GADSS) determines performance requirements for the radiocommunication systems utilized for conducting functions such as aircraft tracking, autonomous distress tracking, and post-flight localization and recovery. (WRC-19)

##### ADD

**34A.2** The type of radiocommunication service(s) to be used by systems contributing to the GADSS depend(s) on the requirements of the specific GADSS function. Systems contributing to the GADSS shall not be operated under the provisions of No. **4.4**. (WRC-19)

**SUP**

**RESOLUTION 426 (WRC-15)**

**Studies on spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System**

**5/1.10/5.2 Method B**

**NOC**

**ARTICLE 5**

**Frequency allocations**

**CHAPTER VII**

**Distress and safety communications<sup>1</sup>**

**ARTICLE 30**

**General provisions**

**Section I – Introduction**

**MOD**

**30.1** § 1 Nos. **30.4-30.13**, and Articles **31, 32, 33** and **34** of this Chapter contain the provisions for the operational use of the global maritime distress and safety system (GMDSS), whose functional requirements, system elements and equipment carriage requirements are set forth in the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended. These Nos. and Articles also contain provisions for initiating distress, urgency and safety communications by means of radiotelephony on the frequency 156.8 MHz (VHF channel 16). Article **34A** of this Chapter contains provisions for the global aeronautical distress and safety system (GADSS), whose functional requirements, system elements and equipment carriage requirements are set forth in the Annexes to the Convention on International Civil Aviation, as amended. (WRC-19)

**ADD**

## ARTICLE 34A

### **Global aeronautical distress and safety system**

**ADD**

**34A.1** The GADSS determines performance requirements for the radiocommunication systems utilized for conducting several functions, such as aircraft tracking, autonomous distress tracking, and post-flight localization and recovery.

Resolution [A110-GADSS] (WRC-19) is applied for operation of GADSS. (WRC-19)

**ADD**

**34A.2** The performance requirements, system elements and equipment carriage requirements of GADSS are set forth in ICAO standards and recommended practices, guidance material and manuals. (WRC-19)

**ADD**

**34A.3** The radiocommunication systems meeting the GADSS performance requirements may operate in the radiocommunication services having an appropriate allocation in Article 5. The choice of a primary type of radiocommunication service to be used depends on the requirements of the specific GADSS function. (WRC-19)

**ADD**

## DRAFT NEW RESOLUTION [A110-GADSS] (WRC-19)

### **Implementation and operation of global aeronautical distress and safety system**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

- a) that the International Civil Aviation Organization (ICAO) has developed the concept of operations for the global aeronautical distress and safety system (GADSS);
- b) that GADSS is intended to provide for the timely identification and location of an aircraft during all phases of flight including distress and emergency situations, which will also support search and rescue (SAR) and flight data recorder recovery;
- c) that the GADSS at its current development phase can be introduced within existing primary aeronautical frequency allocations, and may not need any new systems or applications for such introduction;

d) that the full GADSS concept can be realized in an evolutionary manner, and some applications may be developed after 2019,

*recognizing*

a) that SAR operations of aircraft passengers and crew survived in an aircraft accident have the highest priority;

b) that retrieval of flight recorder data is required to prevent aircraft accidents in future;

c) that interference-free operation of systems included in GADSS and protection of the GADSS frequencies included in the Radio Regulations, should be ensured;

d) that there are provisions in the Radio Regulations, including frequency band allocations, related to aeronautical services that support distress and safety systems;

e) that Annex 10 to the Convention on International Civil Aviation is a part of international standards and recommended practices for aeronautical telecommunication systems used by international civil aviation,

*resolves*

1 that GADSS elements shall use frequency bands which have already been provided for safety purposes;

2 that the frequency bands used by GADSS, its system elements and their technical characteristics to be contained in ITU-R Recommendation(s) as appropriate;

3 that in case of changes of the frequency bands, system elements included in GADSS or their technical and operational characteristics, these changes to be contained in ITU-R Recommendation(s) as appropriate,

*invites ITU-R*

based on the information to be provided by ICAO, to develop the relevant ITU-R Recommendation(s) and to ensure their timely update,

*instructs the Secretary-General*

to bring this Resolution to the attention of the Secretary-General of ICAO,

*invites the International Civil Aviation Organization*

to provide to ITU-R the information in relation to GADSS elements, their technical and operational characteristics and operational frequency bands for development of the relevant ITU-R Recommendations and timely update this information in case of change of GADSS elements, their technical characteristics and operational frequency bands.

**SUP**

## RESOLUTION 426 (WRC-15)

### **Studies on spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System**

## Agenda item 9.1

9 *to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:*

9.1 *on the activities of the Radiocommunication Sector since WRC-15;*

Resolution **763 (WRC-15)** – *Stations on board sub-orbital vehicles*

Note: Nine issues have been identified by CPM19-1 under this agenda item.

### Agenda item 9.1(9.1.4)

#### **5/9.1.4 Resolution 763 (WRC-15)**

*Stations on board sub-orbital vehicles.*

**(WP 5B / WP 4A, WP 4C, WP 7B)**

##### **5/9.1.4/1 Executive summary**

ITU-R is studying the impact of the future deployments of sub-orbital vehicles on radiocommunication regulations and some aspects would require further consideration. Thus, there is no identification of any change to the Radio Regulations at WRC-19.

##### **5/9.1.4/2 Background**

WRC-15 adopted Resolution **763 (WRC-15)** to consider stations on board sub-orbital vehicles. It has been resolved to conduct studies during the WRC-19 study cycle:

- to identify any required technical and operational measures, in relation to stations on board sub-orbital vehicles, that could assist in avoiding harmful interference between radiocommunication services;
- to determine spectrum requirements and, based on the outcome of those studies, to consider a possible future agenda item for WRC-23.

It is also noted that ITU-R in 2015 formulated Question ITU-R [259/5](#).

Sub-orbital vehicles, including space planes, have been developed to reach altitudes much higher than conventional aircraft. Some of them aim to reach space. Sub-orbital vehicles may perform various missions (e.g. deploying a space vehicle, conducting scientific research, carrying passengers) and then return to the Earth's surface.

Sub-orbital vehicles must safely share airspace used by conventional aircraft during certain phases of flight. There is a need to track and to be able to communicate and send commands to the sub-orbital vehicles for the entire duration of the flight. It is expected to use existing allocations, in particular, for systems and applications related to aviation safety and standardized by ICAO for harmonization and interoperability.

ICAO has begun efforts to change some existing aviation equipment standards to support possible use of that equipment by craft flying at altitudes and speeds greater than those reached by conventional aircraft.

##### **5/9.1.4/3 Summary and analysis of the results of ITU-R studies**

The ITU-R initiated regulatory, technical and operational studies on sub-orbital vehicles.

### 5/9.1.4/3.1 Regulatory issues

The definitions of sub-orbital vehicle and sub-orbital flight still need to be agreed taking into account that other international organizations are also dealing with this topic. Indeed, there is no internationally agreed boundary between the Earth's atmosphere and the space domain<sup>39</sup>. Consequently, there is not a defined delimitation between terrestrial services and space services as described in Article 1 of the Radio Regulations.

One view is to categorize sub-orbital vehicles in regards to their mission type. For an aeronautical usage such as transportation of passengers and cargo it may be considered that all the aeronautical services could be relevant, and used during all phases of the mission.

Another view is to consider a distinction between operations in the Earth's atmosphere and operations in space, as described in the following two sections.

### 5/9.1.4/3.2 Operations in the Earth's atmosphere

When operating in airspace controlled by an air navigation service provider, sub-orbital vehicles and space planes may be required to be equipped with the aeronautical systems operating under the same ICAO standards as the other aircraft operating in that airspace. Due to their high speed relative to conventional aircraft, the same equipment could be required in order to anticipate trajectories passing through portions of controlled airspace.

Sub-orbital vehicles would be expected to use the existing aeronautical allocations in accordance with the Radio Regulations. No regulatory changes are anticipated for stations on board sub-orbital vehicles operating in the Earth's atmosphere.

### 5/9.1.4/3.3 Operations in space

Some sub-orbital vehicles are intended to reach such altitudes and ensure space missions that define them as spacecraft within the Radio Regulations. However, some radiocommunication equipment on board sub-orbital vehicles may expect to use frequency bands that are not included in the space radiocommunication service allocation, such as the ones operated under terrestrial allocations and interoperable with ICAO standardized systems.

One view is that a sub-orbital vehicle may be regarded as a space station and therefore any radiocommunications with the sub-orbital vehicle may also be regarded as space radiocommunications in accordance with the definitions of Article 1 of the Radio Regulations. The stations on board a sub-orbital vehicle, when in space, may not be considered as an earth station, nor terrestrial station. Sub-orbital vehicles may not be allowed to use terrestrial services nor satellite services, in particular those used by international civil aviation, such as the mobile-satellite services or the aeronautical mobile (R) service. A regulatory provision then would have to be issued.

Another view is that stations on board sub-orbital vehicles may be able to communicate with mobile satellite-service satellites throughout all phases of flight and such operations are consistent with the definition of the mobile-satellite service contained in RR No. 1.25. Consideration should be given to direction of use (space-to-space, space-to-Earth, and Earth-to-space). However, in this case regulatory provisions may be necessary to be able to continue to operate terrestrial aeronautical services.

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<sup>39</sup> *Considering b*) of WRC-15 Resolution 763 (WRC-15) states that the boundary between the Earth's atmosphere and space is usually assumed to be 100 kilometres above the Earth's surface.



#### **5/9.1.4/3.4 Technical studies including link analyses, Doppler shift, and frequency planning**

Preliminary draft new Report ITU-R M.[SUBORBITAL VEHICLES] contains the studies utilized for this agenda item. Study 1 is contained in Annex 3 of the preliminary draft new Report ITU-R M.[SUBORBITAL VEHICLES], Study 2 is contained in Annex 4 of the preliminary draft new Report ITU-R M.[SUBORBITAL VEHICLES].

Study 1 contains the link budget analyses for sub-orbital vehicles using avionics systems for communications, navigation, and surveillance have been studied and show that the performance required for radiocommunications may be fulfilled when there is no radiocommunications blackout. Study 2 indicates that to avoid a communications blackout, additional communications system(s) may be required to provide continuous coverage throughout the entire mission. Indeed, during some types of re-entry, there may be a loss of radiocommunications, and certain frequencies may be more susceptible to the loss of link, while frequency bands higher than 23 GHz may help mitigate or eliminate this problem.

Study 1 also provides the Doppler shift analyses for sub-orbital vehicles using avionics systems for communications navigation and surveillance and show that the performance required for radiocommunications may be fulfilled. The same study shows there may be impact on terrestrial frequency planning but the study does not take into account such impact on other services. In Study 2, Doppler shift and rate of change were also analysed for an example mission of a sub-orbital vehicle. The Doppler effect and its rate of change due to the speed and acceleration of sub-orbital vehicles during some flight phases may have to be further analysed including the avoidance of impact on other services.

#### **5/9.1.4/3.5 Further regulatory analysis and technical studies**

Regulatory analyses may be required on how applications commonly operated under terrestrial services, in particular aeronautical mobile services, or under satellite services could also be used in space and to which radio station category this would be considered.

Consideration is needed for the definition of a sub-orbital flight and a sub-orbital vehicle.

Technical studies to assess the potential for interference between services may have to be considered in the case of a sub-orbital vehicle operated in space with:

- stations commonly operated under terrestrial services;
- stations commonly operated under satellite services.

#### **Existing relevant Recommendations and Reports are listed as follows:**

- i) Working document towards a preliminary draft new Report ITU-R M.[SUBORBITAL VEHICLES] - Radiocommunications for sub-orbital vehicles

#### **5/9.1.4/4 Conclusions**

No change to the Radio Regulations is proposed for WRC-19. Further operational, technical and regulatory issues may need to be addressed, which require continuing studies, in particular of the status of the station aboard sub-orbital vehicles and type of applications, through the appropriate mechanism. No action has been taken with respect to retention, revision or suppression of Resolution **763 (WRC-15)**.

## CHAPTER 6

### General issues

(Agenda items 2, 4, 9.1 (issues 9.1.6, 9.1.7), 10)

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## Agenda item 2

### (CPM19-2 / -)

2 *to examine the revised ITU-R Recommendations incorporated by reference in the Radio Regulations communicated by the Radiocommunication Assembly, in accordance with Resolution 28 (Rev.WRC-15), and to decide whether or not to update the corresponding references in the Radio Regulations, in accordance with the principles contained in Annex 1 to Resolution 27 (Rev.WRC-12);*

**Resolution 28 (Rev.WRC-15):** *Revision of references to the text of ITU-R Recommendations incorporated by reference in the Radio Regulations*

**Resolution 27 (Rev.WRC-12):** *Use of incorporation by reference in the Radio Regulations*

In response to Resolutions **28 (Rev.WRC-15)** and **27 (Rev.WRC-12)**, the Director of the Radiocommunication Bureau is preparing a Report to the second session of CPM-19.

## Agenda item 4

**(CPM19-2 / -)**

4 *in accordance with Resolution 95 (Rev.WRC-07), to review the Resolutions and Recommendations of previous conferences with a view to their possible revision, replacement or abrogation;*

**Resolution 95 (Rev.WRC-07):** *General review of the Resolutions and Recommendations of world administrative radio conferences and world radiocommunication conferences*

In response to Resolution 95 (Rev.WRC-07), the Director of the Radiocommunication Bureau is preparing a Report to the second session of CPM-19.

## Agenda item 9.1

9 *to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:*

9.1 *on the activities of the Radiocommunication Sector since WRC-15;*

NOTE: Nine issues have been identified by CPM19-1 under this agenda item.

### Agenda item 9.1 (9.1.6)

#### **6/9.1.6 Issue 1) in the annex to Resolution 958 (WRC-15)**

*Urgent studies required in preparation for the 2019 World Radiocommunication Conference:*

- 1) *Studies concerning Wireless Power Transmission (WPT) for electric vehicles:*
  - a) *to assess the impact of WPT for electric vehicles on radiocommunication services;*
  - b) *to study suitable harmonized frequency ranges which would minimize the impact on radiocommunication services from WPT for electrical vehicles.*

*These studies should take into account that the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO) and the Society of Automotive Engineers (SAE) are in the process of approving standards intended for global and regional harmonization of WPT technologies for electric vehicles.*

**(WP 1B / WP 1A, WP 5B, WP 6A)**

#### **6/9.1.6/1 Executive summary**

WRC-19 agenda item 9.1, issue 9.1.6, Resolution **958 (WRC-15)**, requested the ITU-R to study the impact of Wireless Power Transmission (WPT) for electric vehicles (WPT-EV) on radiocommunications and suitable harmonized frequency ranges.

The results of the studies conducted within the ITU-R identified two frequency ranges for high-power WPT-EV and one frequency range for medium-power WPT-EV, as shown in Table 6/9.1.6-2.

Based on these studies, further work will continue within the ITU-R and no change to the RR is required.

#### **6/9.1.6/2 Background**

WPT technologies are being developed to support the easy and fast transfer of power wirelessly. WPT-EV is becoming an important charging technology, which aims to reduce the size of vehicle batteries and consequently improve their practical driving distance. Recommendation ITU-R SM.2110 addresses WPT technologies in general. Due to the necessary power and capacities of the batteries, low-power WPT will not be relevant for WPT-EV charging purposes.

Throughout all Regions, some administrations have already implemented national approaches to allow for WPT-EV charging. Notably, the power level required to charge the battery of an electric vehicle depends on the vehicle's use case. For example, passenger vehicles being charged in a home garage may require around 3.3 kW equivalent charging power over a certain number of hours. However, faster charging requires higher power levels: around 22 kW or more.

Heavy-duty vehicles, such as buses and trucks, may also require higher power levels that range from 75 kW equivalent charging power. This category encompasses examples such as 120 kW

(achieved by 4x30 kW transducers) used for charging the batteries of passenger busses and other heavy-duty vehicles. The power categories and frequency ranges studied for WPT-EV are summarized in Table 6/9.1.6-1.

TABLE 6/9.1.6-1  
Frequency bands and power levels studied for WPT-EV

Categories	Power level	Frequency band	Applications
High power WPT	22 kW – 120 kW	19-25 kHz	Specific heavy-duty electric vehicles (e.g. bus, tram, truck)
High power WPT	22 kW – 120 kW	55-65 kHz	Specific heavy-duty electric vehicles (e.g. bus, tram, truck)
Medium power WPT	3.3 kW – 22 kW	79-90 kHz	Generic light-duty electric vehicles

These frequency bands are allocated to the following services: fixed, maritime mobile, standard frequency and time signal (SFTS), radionavigation, maritime radionavigation, and radiolocation. Other services may also be affected by unwanted emissions, including harmonics, and receiver blocking from WPT-EV.

The frequency bands and related power levels were taken into account as a baseline by the studies.

The impacts of WPT-EV charging applications were not sufficiently known, and in particular, the use of high transmission power was thought to potentially create disturbances that would affect existing radio systems or services. In order to examine any possible impact of WPT-EV charging on radiocommunication services, WRC-15 decided, via its Resolution **958 (WRC-15)** Annex item 1 a) and b), that ITU-R should study this impact and suitable harmonized frequency ranges to minimize it. This was deemed one of the urgent studies required in preparation for the World Radiocommunication Conference 2019 (WRC-19). As such, CPM19-1 identified this item as issue 9.1.6, to be considered under WRC-19 agenda item 9.1.

In this CPM text, the term “unwanted emissions” is used to refer to unwanted radio frequency energy, including harmonics, from WPT-EV into what is considered the out-of-band or spurious domain for radiocommunication services.

### 6/9.1.6/3 Summary and analysis of the results of ITU-R studies

A number of studies were undertaken to assess the possible impact of WPT-EV transmissions on various applications of incumbent services. The details of these studies are included in WDPDN Report ITU-R SM.[WPT-SPEC-MNGM].

The following studies dealt with frequencies ranges for the operation of WPT-EV in the bands 19-25 kHz, 55-5X kHz, 6Y-65 kHz, and 79-90 kHz (see Table 6/9.1.6-2), which were found to be compatible with the existing radiocommunication services, subject to the conditions contained in the conclusions section.

#### 6/9.1.6/3.1 Impact studies for WPT-EV operating in the 19-25 kHz frequency range

In some of the studies, measurements were taken with a 10 m distance between the loop antenna and the charger; the measurement environments are detailed in Report ITU-R SM.2303-2. The measurement results are compared to two limits that are being developed in standards developing organizations (SDOs) (CISPR/B and ETSI EN 303 417). These limits do not necessarily ensure protection of radio services.

#### **6/9.1.6/3.1.1 Impact studies on standard frequency and time signal service**

The study on SFTS was conducted by both simulation and field measurements.

The standard frequencies and time signals considered in the study are systems operating at 20 kHz globally; 40 kHz in Japan; 60 kHz in the United Kingdom, the United States, and Japan; 68.5 kHz in China; 77.5 kHz in Germany; 100 kHz in China; and 162 kHz in France.

The measurement results are compared to two limits that are being developed in SDOs (CISPR/B and ETSI EN 303 417). These limits do not necessarily ensure protection of radio services.

#### **6/9.1.6/3.1.2 Impact studies on ripple control**

The study on 129.1 kHz and 139 kHz of ripple control was conducted by both simulation and field measurements. The measurement results are compared to the limits of CISPR/B/687/CDV and ETSI EN 303 417. The measurement results meet limits of CISPR/B/687/CDV. These limits do not necessarily ensure protection of radio services.

#### **6/9.1.6/3.1.3 Impact studies on train protection automatic warning systems**

This study concludes that a 5 m separation distance is necessary to protect Automatic Train Stop Systems (ATS).

#### **6/9.1.6/3.1.4 Impact studies on maritime radio**

Only Loran-C systems have been studied, and in this study of such systems the emission and field strength of 19-25 kHz, including the harmonics of WPT-EV charging applications, refer to CISPR proposed limits. The Loran-C system protection criterion refers to Recommendations ITU-R M.589-3 and ITU-R P.372-13. According to the impact study, there would be no risk of WPT-EV charging interfering with Loran receivers at sea under marine coverage.

#### **6/9.1.6/3.1.5 Impact studies on AM broadcasting**

These studies entailed conducting analyses based on the protection criteria for AM broadcast reception and on possible separation distances in the case of WPT-EV chargers used for specific heavy-duty electric vehicles (e.g. bus, tram, truck). The studies considered that it is likely that WPT-EV for heavy-duty electric vehicles would be located at a minimum separation distance of 10 m from an AM broadcast receiver. The studies also found that mitigation would be required to protect AM broadcasting in cases where the unwanted emissions would need to be reduced and/or WPT-EV would need to operate, with enhanced stability and purity, on specific frequencies such that the corresponding harmonics fall in frequencies that reduce the impact on AM broadcast reception, taking into account the AM channel rasters.

#### **6/9.1.6/3.1.6 Impact studies on amateur radio**

Among amateur radio bands, the field measurements were conducted for 135.7 kHz-137.8 kHz and 472 kHz-479 kHz. The measurement results are compared to and meet the limits of CISPR/B/687/CDV. These limits do not necessarily ensure protection of radio services.

#### **6/9.1.6/3.1.7 Study on the impact of WPT-EV to aeronautical service**

Among aeronautical service bands, the field measurements were conducted for 190 kHz-535 kHz (Recommendation ITU-R SM.1535) and 2 800 kHz-22 000 kHz (Recommendation ITU-R M.1458). The measurements results meet the limits of CISPR/B/687/CDV and ETSI EN 303 417. These limits do not necessarily ensure protection of radio services.

### **6/9.1.6/3.1.8 Study on the impact of WPT-EV to lightning detection system**

Field measurements were taken for lightning detection systems that operate at 5-200 kHz. The results of the measurements meet the limits of CISPR/B/687/CDV and ETSI EN 303 417. These limits do not necessarily ensure protection of radio services.

### **6/9.1.6/3.2 Impact studies for WPT-EV operating in the 55-65 kHz frequency range**

#### **6/9.1.6/3.2.1 Impact studies on the standard frequency and time signal service**

One study found that WPT-EV operating in the 55-65 kHz frequency range will cause harmful interference to SFTS operating at 60 kHz. 60 kHz SFTS stations are operated in Japan, the United States of America, and the United Kingdom with millions using the service. The results of measurements of a WPT-EV system were compared with the minimum usable field strength. It was found that the measured emissions of WPT-EV at 10 m exceeded the minimum usable field strength by 45.7 dB. WPT-EV operating at 55-65 kHz will have an impact, causing harmful interference to SFTS.

One study on SFTS conducted measurements and considered SFTS stations operating at 20 kHz globally; 40 kHz in Japan; 60 kHz in the United Kingdom, the United States, and Japan; 68.5 kHz in China; 77.5 kHz in Germany; 100 kHz in China; and 162 kHz in France. The measurement results were compared to two limits that are being developed in SDOs (CISPR/B and ETSI EN 303 417). These limits do not necessarily ensure protection of radio services.

#### **6/9.1.6/3.2.2 Impact studies on ripple control**

The study on 129.1 kHz and 139 kHz of ripple control was conducted by both simulation and field measurements. The measurement results are compared to the limits of CISPR/B/687/CDV and ETSI EN 303 417, and they meet the former. These limits do not necessarily ensure protection of radio services.

#### **6/9.1.6/3.2.3 Impact studies on train protection automatic warning systems**

In the study, a 5 m separation distance is needed to protect ATS.

#### **6/9.1.6/3.2.4 Impact studies on maritime radio including navigation system**

Only Loran-C systems have been studied, and in this study of such systems the emission and field strength of 55-65 kHz, including the harmonics of WPT-EV charging applications, refers to CISPR proposed limits. The Loran-C system protection criterion refers to Recommendations ITU-R M.589-3 and ITU-R P.372-13. According to the impact study, there would be no risk of WPT-EV charging interfering with Loran receivers at sea under marine coverage

#### **6/9.1.6/3.2.5 Impact studies on AM broadcasting**

These studies entailed conducting analyses based on the protection criteria for AM broadcast reception and on possible separation distances in the case of WPT-EV chargers used for specific heavy-duty electric vehicles (e.g. bus, tram, truck). The studies considered that it is likely that WPT-EV for heavy-duty electric vehicles would be located at a minimum separation distance of 10 m from an AM broadcast receiver. The studies also found that mitigation would be required to protect AM broadcasting in cases where the unwanted emissions would need to be reduced and/or WPT-EV would need to operate, with enhanced stability and purity, on specific frequencies such that the corresponding harmonics fall in frequencies that reduce the impact on AM broadcast reception, taking into account the AM channel rasters.



### **6/9.1.6/3.2.6 Impact studies on amateur radio**

Among amateur radio bands, the field measurements were conducted for 135.7 kHz-137.8 kHz and 472 kHz-479 kHz. The measurement results are compared to and meet the limits of CISPR/B/687/CDV. These limits do not necessarily ensure protection of radio services.

### **6/9.1.6/3.3 Impact studies for WPT-EV operating in the 79-90 kHz frequency range**

#### **6/9.1.6/3.3.1 Impact studies to standard frequency and time signal service**

##### **6/9.1.6/3.3.1.1 Impact studies to standard frequency and time signal service using 40 and 60 kHz**

The study on interference between SFTS and WPT-EV at 40-60 kHz was completed. Based on a 10 m separation distance, the study establishes that operation time does not overlap with WPT-EV operation, the variation of propagation direction of SFTS services, and the possible performance improvement of those devices.

This study confirmed the impact of WPT-EV systems on radio-controlled clocks/watches (parts of SFTS) operating at 40-60 kHz to be small enough.

##### **6/9.1.6/3.3.1.2 Impact studies to standard frequency and time signal service using 77.5 kHz**

One study, taking into account a WPT field strength of 68.5 dB $\mu$ A/m at 10 m, shows that a maximum of 50% blocking of the considered standard clock radio receivers using 77.5 kHz (DCF77) will only occur within a distance of 18 m of a WPT-EV charging installation. In order to account for the possible field strength increase to a maximum of 82 dB $\mu$ A/m at 10 m, this distance would be extended to 31 m. This impact can be reduced by restricting the transmission power of the WPT-EV charging installation and carefully selecting its centre frequency within 79-90 kHz and potentially by other mitigation techniques (e.g. periodically interrupting the charging process).

#### **6/9.1.6/3.3.2 Impact studies on ripple control**

Not studied.

#### **6/9.1.6/3.3.3 Impact to specific railway radiocommunication system**

These studies considered and discussed harmful interference to railway communication systems in actual operational use cases through simulations and measurements. Specifically, the ATS system, which is used globally, was studied operating at 10-250 kHz. The results of the study establish that a minimum 5 m separation distance is required to not produce harmful interference.

#### **6/9.1.6/3.3.4 Impact studies to maritime radio including navigation system**

##### **6/9.1.6/3.3.4.1 Loran-C systems in 81.38-90 kHz**

In the study between Loran-C systems and WPT-EV, the emission and field strength of the proposed frequency range 81.38-90 kHz, including the 2nd harmonics of WPT-EV charging applications, refer to the CISPR proposed limits. The Loran-C system protection criterion refers to Recommendations ITU-R M.589-3 and ITU-R P.372-13.

According to the coexistence study, for single and multiple WPT-EV applications, there would be no risk of interference with Loran receivers under marine coverage by the charging emissions of WPT-EV. The results of the study indicate that the coexistence between WPT-EVs and Loran-C systems is feasible, provided the frequency range 81.38-90 kHz is identified for medium-power WPT-EV.

### **6/9.1.6/3.3.5 Impact studies to sound broadcasting**

These studies entailed conducting analyses based on the protection criteria for AM broadcast reception and on possible separation distances in the case of WPT-EV chargers used for generic light-duty electric vehicles. The studies considered that it is likely that WPT-EV would be located at minimum separation distances of 1 and 3 metres from an AM broadcast receiver. The studies also found that mitigation would be required to protect AM broadcasting in cases where the unwanted emissions would need to be reduced and/or WPT-EV would need to operate, with enhanced stability and purity, on specific frequencies such that the corresponding harmonics fall in frequencies that reduce the impact on AM broadcast reception, taking into account the AM channel rasters.

Other studies – including a field interference test, a theoretical analysis, and Monte Carlo simulations – were performed in some urban areas with high levels of both wanted broadcast signal and environment noise floor. They showed that higher levels of WPT-EV emissions may be tolerated by AM receivers in such environments. For other scenarios, such as suburban and rural areas, mitigating the interference would require increased separation distances between the WPT-EV equipment and the AM broadcast receiver.

More precisely, 2nd to 21st order harmonics of WPT-EV systems may fall in the frequency range of LF and MF sound broadcasting services. Two approaches for compatibility between WPT-EV systems and sound broadcasting systems are described in Report ITU-R SM.2303-2. The first approach is based on existing ITU-R – protection criteria for AM broadcasting signal. The second approach is based on the criteria that WPT-EV harmonic emissions falling in the LF or MF broadcasting bands should be kept below the environmental noise levels.

Based on the provisions of Recommendations ITU-R BS.703 and ITU-R BS.560, the first approach derives tolerable interference levels of  $-44$  dB $\mu$ A/m in the LF broadcasting band (148.5-283.5 kHz) and  $-51$  dB $\mu$ A/m in the MF broadcasting band (526.5-1 606.5 kHz) at the location of the receiver. If the interferer (including harmonic emissions) is a plain, unmodulated sinusoid with good spectral purity and is accurately co-incident in frequency (within  $\pm 50$  Hz) with the victim radio service, these levels can be relaxed by 38 dB.

Based on the environmental noise levels derived from Recommendation ITU-R P.372-13, the second approach derives tolerable interference levels of  $-25.5$  dB $\mu$ A/m in cities,  $-30.5$  dB $\mu$ A/m in residential areas,  $-34.5$  dB $\mu$ A/m in rural areas, and  $-48.5$  dB $\mu$ A/m in quiet rural areas, at 500 kHz, at the location of receiver. The results of some measurements show that environmental noise levels in some cities and residential areas are significantly higher than the above levels.

ITU-R is developing recommendations on limits required for the protection of radiocommunication services from WPT, including WPT-EV.

### **6/9.1.6/3.3.6 Impact studies to the amateur service**

The frequency range for WPT-EV, 79-90 kHz, does not overlap with, and has enough separation from, frequency bands for amateur radio services using 135.7-137.8 kHz. Therefore, receiver sensitivity suppression (out-of-band) by interference is not taken into consideration. Radiated emission levels of harmonics (spurious emission) from WPT-EV will need to be considered where they fall into the amateur radio services bands.

Report ITU-R SM.2303-2 states that interference to amateur services was not studied. Subsequent papers submitted to ITU-R show that the current emission limits in the spurious domain, as defined by ITU-R and/or CISPR documents, fall well short of providing adequate protection from harmful interference to amateur services from WPT-EV, given that antennas used in this service are generally located in urban/suburban residential areas.

The high duty cycle of WPT-EV systems, their planned location close to or inside dwellings, and their anticipated deployment density show that the current CISPR or ITU limits are inadequate for such a technology deployed in this way. Harmful interference to the amateur service seems likely if WPT-EV systems operate at or near the existing limits. The necessary limits for harmonic emissions from WPT-EV systems can be less stringent (although still stricter than current limits) if:

- a) WPT-EV systems adopt a harmonized, tightly toleranced frequency of operation; and
- b) the phase noise and noise sidebands from WPT-EV are at least 40 dB below the equivalent of the current emission limits.

#### **6/9.1.6/3.4 ITU-R collaboration with standards developing organizations**

Throughout the studies, it was found that close collaboration between SDOs and the ITU-R is important to achieve harmonized outcomes and ensure that WPT-EV does not cause harmful interference/disturbance. Work is ongoing between the ITU-R and SDOs such as IEC-CISPR to define appropriate frequency ranges and technical limits in standards to protect radiocommunication services.

#### **6/9.1.6/4 Conclusions**

The studies show that WPT-EV operating at 55-65 kHz will cause harmful interference to SFTS operating at 60 kHz. It may be possible to define two separate frequency ranges below and above 60 kHz to create an exclusion within the 55-65 kHz frequency range to mitigate the impact. The appropriate frequency separation from SFTS still needs to be studied but is likely to be several kHz.

The magnetic resonance frequencies and power levels for WPT-EV operation should be chosen in a way that avoids interference to existing radio services around these frequencies and mitigates the potential for harmful interference to radiocommunication services from WPT-EV unwanted emissions.

Additionally, the studies indicate that the operation of WPT-EV in the 19-25 kHz, 55-5X kHz, 6Y-65 kHz, and 79-90 kHz bands (see Table 6/9.1.6-2) is compatible with existing radiocommunication services operating at other frequencies, provided that the WPT-EV unwanted emissions are tightly controlled. The exact limits and mitigation techniques, as well as potential other matters, still need to be defined through further studies.

Methodology and guidance to administrations are/will be included in several ITU-R documents:

- appropriate bands are specified in preliminary draft revision of Recommendation ITU-R SM.2110-0;
- limits on unwanted emissions, including harmonics, are expected to be specified in a new ITU-R Recommendation; and
- results of related studies and examples of existing national implementations throughout the Regions are provided in Report ITU-R SM.2303-2 and WDPDN Report ITU-R SM.[WPT-SPEC-MNGM].

Consequently, there is no need for activity related to WRC-19 to amend the RR.

The ITU-R will need to continue to closely collaborate with SDOs. This is to ensure that appropriate frequency ranges and technical limits are incorporated into standards to protect radiocommunication services.

TABLE 6/9.1.6-2

**Frequency bands and power levels for WPT-EV**

<b>Categories</b>	<b>Power Level</b>	<b>Frequency band</b>	<b>WPT applications</b>
High power WPT-EV	More than 22 kW	19-25 kHz	Specific heavy-duty electric vehicles (e.g. bus, tram, truck)
	More than 22 kW	55-5X kHz	Specific heavy-duty electric vehicles (e.g. bus, tram, truck)
	More than 22 kW	6Y-65 kHz	Specific heavy-duty electric vehicles (e.g. bus, tram, truck)
Medium power WPT-EV	Up to 22 kW	79-90 kHz	Generic light-duty electric vehicles

NOTE: Regarding the 55-5X kHz and 6Y-65 kHz bands, frequency separation below and above 60 kHz (exclusion band) is needed to protect SFTS. The appropriate frequency separation still needs to be studied to define values for X and Y.

## Agenda item 9.1(9.1.7)

### **6/9.1.7 Issue 2) in the Annex to Resolution 958 (WRC-15)**

*Urgent studies required in preparation for the 2019 World Radiocommunication Conference*

2) *Studies to examine:*

- a) *whether there is a need for possible additional measures in order to limit uplink transmissions of terminals to those authorized terminals in accordance with No. 18.1;*
- b) *the possible methods that will assist administrations in managing the unauthorized operation of earth station terminals deployed within its territory, as a tool to guide their national spectrum management programme, in accordance with Resolution ITU-R 64 (RA-15).*

**(WP 1B / WP 1C, WP 4A)**

#### **6/9.1.7/1 Executive summary**

Studies under WRC-19 agenda item 9.1, issue 9.1.7 examined the need for additional measures to limit uplink transmissions of terminals to authorized ones and possible methods to assist administrations in managing unauthorized operation of earth terminals.

With respect to *Issue 2a)* in the Annex of Resolution **958 (WRC-15)**, two options have been identified:

- Option 1: no change to the Radio Regulations as current measures are sufficient.
- Option 2: to develop a new WRC Resolution to assist administrations with the application of RR No. **18.1**.

With respect to *Issue 2b)* in the Annex of Resolution **958 (WRC-15)**, one option has been identified:

- to provide necessary guidelines on satellite monitoring capabilities, along with possible revision and/or further development of ITU-R Reports or Handbooks to assist administrations with managing unauthorized operation of earth station terminals deployed within their territory, as a tool to guide their national spectrum management.

#### **6/9.1.7/2 Background**

Fixed-satellite services designed to meet the demand for global communication services are characterized by flexible, rapid and ubiquitous deployment of large numbers of cost-optimized earth stations employing small antennas and having common technical characteristics.

The issue under study is uplink transmissions from such satellite terminals not adhering to certain international regulations or national service rules: i.e. an earth station operating in the territory of a country without any authorization obtained from that country.

Unauthorized uplink satellite transmissions may also cause interference to legitimate users as well as raise other difficulties for administration spectrum managers.

For these reasons, the Radiocommunication Assembly 2015 (RA-15) approved Resolution ITU-R 64, titled “Guidelines for the management of unauthorized operation of earth station terminals”. The *resolves* of this Resolution invited ITU-R study groups concerned:

- 1) to conduct studies to examine whether there is a need for possible additional measures in order to limit uplink transmissions of terminals to those terminals authorized in accordance with No. **18.1**;
- 2) to study the possible methods that will assist administrations in managing the unauthorized operation of earth station terminals deployed within their territory, as a tool to guide their national spectrum management programme.

In addition, WRC-15 also considered this subject and approved Issue 2) in the Annex to Resolution **958 (WRC-15)** recognizing the urgency of these studies in preparation for, and to be reported to, WRC-19.

#### **6/9.1.7/2.1 Issues arising from the use of unauthorized satellite uplinks**

The difficulties facing administrations from the use of unauthorized satellite uplinks are listed below:

- a) Administrations may not have the capability to monitor if there is an unauthorized uplink transmission from an earth station terminal in their territory.
- b) If an unauthorized uplink transmission is discovered in their territory, administrations may not have the capability to geolocate the earth station terminal.
- c) If the location of the unauthorized earth station terminal is identified, administrations may need assistance to resolve the issue with satellite networks notified by other administrations.
- d) Administrations may discover earth terminals operating without proper licence, violating RR No. **18.1**.

#### **6/9.1.7/3 Summary and analysis of the results of ITU-R studies**

ITU-R studies focused on addressing *Issue 2a*) and *2b*) in the Annex of Resolution **958 (WRC-15)** in Sections 6/9.1.7/3.3.1 and 6/9.1.7/3.3.2 respectively.

To this effect, the ITU-R conducted work in the following three areas:

##### **1) ITU questionnaire to administrations**

A questionnaire for administrations was prepared by ITU-R relating to the operation of ubiquitously deployed earth station terminals. Responses from administrations were sought about their experience regarding the management of any unauthorized operation of earth station terminals deployed within their territory.

Twenty-eight responses were received from all of the ITU Member States and are provided in input Document 1B/153.

A summary of the responses is reported below.

- a) Twenty-seven Member States license satellite uplink transmission to ubiquitously deployed earth station terminals and 26 of these 27 include a revocation clause(s) (i.e. withdrawal of the authorization/licence) as their national choice.
- b) Fifteen Member States authorizing the uplink transmission of earth station terminals require that the assignment of the satellite networks, to which the authorized earth stations are associated, is recorded in the MIFR.
- c) Eight Member States indicated issues with unauthorized earth stations and have problems in relation to the operation of unauthorized uplink transmission. Not all

administrations encountered the same difficulties. Some of the difficulties could be presented as follows:

- i) There is a difficulty in monitoring and locating unauthorized deployed earth stations terminals, especially with irregular and short-term operation.
  - ii) There is no clear framework in the Radio Regulations (RR) for administrations to apply their complaints regarding RR No. **18.1**.
  - iii) There is no clear provision in the RR to address unauthorized transmission of earth station terminals operating within a given satellite network, taking into account difficulties outlined in the two points above.
  - iv) There is no obligation in the RR identified for a notifying administration to deal with unauthorized earth station terminals operating in the territory of another administration.
  - v) Three out of the eight administrations experienced issues with unauthorized earth stations that were not resolved.
- d) Twelve out of 28 Member States have the capability of monitoring and identifying the location of potential unauthorized uplink transmissions. Five of these 12 do not share monitoring information with other administrations.

### 2) **Enquiry to the BR on the application of No. 18.1 of the Radio Regulations**

With respect to the application of No. **18.1** of the Radio Regulations in relation with any unauthorized uplink transmission from earth station terminals, the Bureau replied that it has reviewed all correspondences from administrations between November 2007 and April 2017 and has not found any administration request for assistance with the application of the provision No. **18.1** of the Radio Regulations concerning unauthorized uplink earth stations terminals.

### 3) **Uplink monitoring capabilities**

For unreported cases of unauthorized uplink transmission, there are currently no spectrum monitoring techniques and/or methods to identify the emission and location of unauthorized earth station terminals in FSS frequency bands.

However, for reported cases of unauthorized uplink transmission, geolocation methods are available, noting that only few administrations currently have the necessary geolocation capabilities. Additional information is included in Report ITU-R SM.2424.

### 6/9.1.7/3.1 **Application of Article 18 in the Radio Regulations**

RR No. **18.1** provides that:

“No transmitting station may be established or operated by a private person or by any enterprise without a licence issued in an appropriate form and in conformity with the provisions of these Regulations by or on behalf of the government of the country to which the station in question is subject”.

The phrase “to which the station in question is subject” covers many different situations, including those of transmitters moving over or in the territories of different countries.

The requirement of RR No. **18.1** for stations to be licensed applies to all transmitting earth stations. In practice, RR No. **18.1** could be implemented by administrations in various ways – individual licensing, simplified licensing, voluntary registration of terminals, etc. RR No. **18.1** implies that any transmitting earth stations communicating with fixed satellite networks, not in compliance with the licence regime of the country where it is deployed, is not in compliance with the Radio Regulations.

In some cases, additional provisions are included in the RR to assist in avoiding unauthorized use for specific cases of terminal deployment and usage.

For example, for Global Mobile Personal Communications by Satellite (GMPCS) using fixed, mobile or transportable terminals, in addition to RR No. **18.1**, Resolution **25 (Rev. WRC-03)** “Operation of global satellite systems for personal communications” states in *resolves*:

“that administrations licensing global satellite systems and stations intended to provide public personal communications by means of fixed, mobile or transportable terminals shall ensure, when licensing these systems and stations, that they can be operated only from the territory or territories of administrations having authorized such service and stations in compliance with Articles **17** and **18**, in particular No. **18.1**.”

Also, Resolution **156 (WRC-15)** “Use of the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz by earth stations in motion communicating with geostationary space stations in the fixed-satellite service” states in *resolves* 3:

“that the notifying administration for the satellite network within which the earth stations in motion operate by means of fixed, mobile or transportable terminals shall ensure that they have the capability to limit operations of such earth stations to the territory or territories of administrations having authorized those earth stations and to comply with Article **18**”

Resolution **156 (WRC-15)** contains additional measures to RR Article **18** to limit uplink transmissions of earth stations in motion operating in frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz to only authorized terminals.

It is worth to mention that earth stations in motion operating in the 17.7-20.2 GHz and 27.5-30 GHz should not be considered under agenda item 9.1, issue 9.1.7.

#### **6/9.1.7/3.2 Licensing responsibilities of satellite operators and administrations**

The licensing of earth station terminals under RR No. **18.1** is a process under the purview of the administration on whose territory the earth stations will be located and operated. This course of action is carried out between the administration on the territory of which the earth station terminal is located and operated and the notifying administration of the subject satellite network, usually through a satellite operator.

Successful satellite network coordination, notification and registration do not imply in any way authorization of earth station terminals within the territory of any Member State.

It is understood that a notifying administration of a satellite network, through a satellite operator, is responsible for:

- obtaining permission/authorization from administrations on the territory of which the earth stations would be located to communicate with the satellite network in question. However, in some cases this permission/authorization, based on national legislation, is not required.
- obtaining the required licences for the gateway earth stations associated with the satellite for feeder links or for telemetry and user earth terminals from the administration on whose territory the gateways and earth stations will be located and operate, noting that the operator of the gateway station(s) may be a separate entity.



The satellite operator is generally responsible for making sure that the approvals/licences/permissions necessary to deploy earth station terminals in a given country and provide service accordingly are duly obtained. However,

- a) in certain cases, satellite operators provide services indirectly via national or international/regional service providers;
- b) in certain countries, the domestic licensing framework does not allow the satellite operator (especially when foreign) to hold licences/permissions for use of spectrum and/or service provision. Such licences/permissions can be assigned only to local service providers.

As such, in most cases, it is the satellite service provider that interacts with the licensing administration to meet the precise regulatory and licensing requirements to offer satellite services.

The administration which authorizes earth stations located on its territory is responsible for:

- a) protection of its national frequency assignments to space and terrestrial services from possible harmful interference caused by such earth stations; and
- b) ensuring that such earth stations do not cause harmful interference to services of its neighbouring countries.

### **6/9.1.7/3.3 Analysis of studies**

#### **6/9.1.7/3.3.1 Issue 2a in Annex to Resolution 958 (WRC-15)**

##### **6/9.1.7/3.3.1.1 Situational status and potential additional measures in order to limit unauthorized uplink transmissions of earth station terminals**

From Section 6/9.1.7/3 there were four issues identified with the use of unauthorized earth stations and each issue is addressed in this section:

##### **6/9.1.7/3.3.1.2 Administrations' monitoring capabilities**

The main obstacle for some administrations in resolving the issue of unauthorized earth stations is the inability to know when there is unauthorized uplink transmissions from an earth station terminal in their territory. This is normally because of a lack of monitoring equipment and expertise to actively monitor the uplink of earth station terminals, especially with short time of transmission and/or movement of the earth station terminals. This capability can be cost-prohibitive and only few administrations have it. Additionally, the potential ability of the unauthorized terminal (e.g. a VSAT) to be transported to another location in a short period of time and transmit further complicates detection of the uplink signal.

Administrations without the monitoring capabilities could request the BR for help. The BR can help the administration by pointing to other resources such as commercial entities that provide monitoring services or to other administrations or agencies willing to assist.

These measures could be included in a new WRC Resolution (see example for Option 2 below).

##### **6/9.1.7/3.3.1.2.1 Geolocation capabilities**

Geolocation of an active transmitter is not an easy or straightforward task and most administrations do not have the capability to geolocate an unauthorized transmitting earth station. Geolocation capabilities are costly and only few administrations have them. Additionally, like in the case for monitoring, the fact that small VSAT terminals are easy to move, further complicates this issue.

Administrations without the capability to geolocate unauthorized earth stations uplink transmission can request assistance from the BR or other administrations with the ability to geolocate. The BR

can help in obtaining assistance from other administrations. For such requests to be effective, information on the suspected unauthorized uplink earth terminal should be provided from the administration to the BR. Such information, if available, may include:

- 1) the country on the territory of which an unauthorized uplink transmission is detected;
- 2) the starting date;
- 3) the duration and periodicity of such transmission;
- 4) frequency bands and other available information on the suspected satellites networks;
- 5) where possible, motivation and objective of the unauthorized transmission;
- 6) actions, if any, being taken by the reporting administration.

Without some of the above information, it may not be possible to geolocate the unauthorized earth station. Upon receipt of notice accompanied by the available information from an administration detecting an unauthorized uplink transmission to an identified or unidentified FSS satellite network, the Bureau shall immediately inform relevant Member States and satellite operating agencies of the matter by a circular telegram. All notifying administrations and satellite operating agencies of FSS networks whose service area covers the country reporting the unauthorized uplink transmission as well as international space monitoring stations are encouraged to jointly collaborate with the administration detecting such transmission in an effort to identify the satellite network and locate the earth station terminal.

Should the above joint action result in clear identification of the source of unauthorized transmission, the BR, together with the administration responsible for the identified FSS satellite network with which such unauthorized transmission occurs, shall immediately take necessary action to resolve the matter in a satisfactory manner.

These measures could be included in a new WRC Resolution (see example for Option 2 below).

#### **6/9.1.7/3.3.1.3 Assistance from ITU, notifying administrations and/or satellite operators**

Once an administration discovers an unauthorized satellite earth station terminal operating on its territory, there may be a need to work with the notifying administration of the satellite network to request assistance. If the notifying administration refuses to cooperate, ITU assistance may be necessary.

Along similar lines as in the sections above, all administrations, space operating agencies and satellite network operators should respond to requests for assistance for locating and identifying unauthorized uplink transmission from earth station terminals, to the maximum extent practicable. The BR can help by notifying the concerned administrations and agencies of a problem.

Cooperation is key to jointly resolving the issue.

Once a satellite network operator has been identified in relation to unauthorized transmission from earth station terminals, the satellite network operator, along with the notifying administration shall take all actions to cease the transmission as quickly as possible. The BR can further facilitate communications and cooperation between the administrations involved.

These measures could be included in a new WRC Resolution (see example for Option 2 below).

#### **6/9.1.7/3.3.1.4 Operating in contravention of RR No. 18.1**

Some administrations may experience difficulties in ensuring that the requirement of RR Article 18 for authorization of earth station transmissions are fully complied with in the framework of their national regulations. There could be several reasons for this, for example, but not limited to:

- satellite service providers not familiar with the authorization process within an administration;
- lack of awareness that authorization is required;
- intentional non-observance of an administration's rules and procedures relating to earth station terminals authorization.

An example of an earth station operating in contravention of RR No. 18.1 occurs when an earth station registers for satellite service in Administration A and then the earth station is moved to Administration B, without informing the satellite operator (or service provider) and the Administration B's regulatory authority. The earth station operating in Administration B is not licensed or authorized to operate in Administration B's territory, thereby not respecting RR No. 18.1.

For the connection of any earth station terminal to operate within a FSS network from any administration, the notifying administration for the satellite network needs to ensure that the earth station terminals have obtained the required authorization as referred to in RR No. 18.1, from the administrations on whose territory the earth station terminals intend to operate.

Administrations are encouraged to post on their website relevant procedures for licensing or authorizing the operation of earth station terminals on their territories.

These measures could be included in a new WRC Resolution (see example for Option 2 below).

#### **6/9.1.7/3.3.1.5 Unauthorized earth stations operating while in motion**

An issue of unauthorized uplink earth station transmission can occur with respect to earth station terminals that operate while moving. An earth station on a boat, plane, or train could cross into the territory of an administration that has not authorized the use of the earth station terminal.

One of the possible options to address the issue is that, similarly to *resolves* 3 of Resolution 156 (WRC-15), the notifying administration for the FSS satellite network within which the earth stations operating while in motion are associated shall ensure that they have the capability to limit operations of such earth stations to the territory or territories of administrations having authorized those earth stations and to comply with RR Article 18.

It is emphasized that nothing in this option should in no way contradict the outcome of WRC-19 agenda item 1.5 and the provisions of Resolution 156 (WRC-15).

These measures could be included in a new WRC Resolution (see example for Option 2 below).

#### **6/9.1.7/3.3.2 Issue 2b in Annex to Resolution 958 (WRC-15)**

##### **6/9.1.7/3.3.2.1 Possible methods/courses of action for managing the unauthorized operation of earth station terminals, as a tool to guide national spectrum management programme**

In cases where administrations and/or network operators can identify unauthorized use of their satellites and report to the relevant radio monitoring service, geolocation methods are available to determine the location of the transmitter. However, not all administrations have the necessary geolocation capabilities.

Spectrum management training and domestic spectrum monitoring to identify unauthorized uplink transmissions are useful tools to enable administrations to regulate and enforce regulations associated with transmissions originating in their territory. The development of ITU-R Reports or Handbooks may assist administrations in the management of their satellite spectrum resources to prevent or limit the unauthorized use of uplink terminals and enable the administration to locate and terminate the unauthorized transmissions.

In this context, the regulatory regimes of those administrations experiencing difficulties can also be reviewed and compared with those administrations deploying the ubiquitous uplink satellite terminals and not experiencing any issues with unauthorized uplink transmissions. On the basis of such a comparison, taking into consideration that administrations may not manage their national spectrum in the same way, the administration experiencing difficulties can determine rules or procedures that will work best for their administration.

## **6/9.1.7/4 Conclusions**

### **6/9.1.7/4.1 Issue 2a in the Annex to Resolution 958 (WRC-15)**

#### **Issue 2a Option 1: No changes to the Radio Regulations**

NOC

## **RESOLUTIONS**

**Issue 2a Option 2: Develop a new WRC Resolution to introduce additional measures in order to address the issue of unauthorized uplink transmissions of earth station terminals (see example of new WRC Resolution below)**

ADD

### **DRAFT NEW RESOLUTION [9.1.7] (WRC-19)**

#### **Measures to limit unauthorized uplink transmissions from earth station terminals**

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

*considering*

that in accordance with Resolution **958 (WRC-15)** and Resolution ITU-R 64 (RA-15) the following issues were studied:

- whether there is a need for possible additional measures in order to limit uplink transmissions of terminals to those authorized terminals in accordance with No. **18.1**;
- the possible methods that will assist administrations in managing the unauthorized operation of earth station terminals deployed within its territory, as a tool to guide their national spectrum management programme,

*recognizing*

a) that the notifying administration of an FSS satellite network has the responsibility to ensure that the earth station terminals associated with the FSS network have obtained the required

authorization as referred to in No. **18.1** of the RR, from the administrations on whose territory the earth station terminals intend to operate;

b) that successful coordination of a satellite network or system does not imply licensing authorization to provide a service within the territory of a Member State,

*resolves*

1 that notifying administrations for the satellite network shall take appropriate actions to limit operation of earth station terminals to only those licensed or authorized by the administrations on the territory of which they are located and operated;

2 that the notifying administration for the satellite network within which earth stations that can operate while in motion are associated shall ensure that they have the capability to limit operations of such earth stations to the territory or territories of administrations having authorized those earth stations and to comply with Article **18**;

Note: The necessity of retention of this *resolves* needs to be examined at CPM19-2.

3 that, when the source of unauthorized earth station terminal transmission is identified, the notifying administration responsible for the identified FSS satellite network shall immediately take appropriate action to resolve the matter in a satisfactory manner,

*invites administrations*

1 to take all appropriate actions to post on their website the procedures for licensing/authorizing the operation of earth station terminals in their territories;

2 that have identified unauthorized operation of earth station terminals within their territories to provide relevant information to BR to report such cases;

3 when requested by BR or another administration, to cooperate to the maximum extent practicable with assistance in identifying unauthorized earth stations with monitoring or geolocation services,

*instructs the Director of the Radiocommunication Bureau*

upon receipt of notice accompanied by the available information from an administration detecting an unauthorized uplink transmission from its territory, to immediately inform Member States and satellite operating agencies of the matter by appropriate means and work with the administrations involved to resolve the matter.

#### **6/9.1.7/4.2 Issue 2b in Annex to Resolution 958 (WRC-15)**

To further assist administrations in managing (identifying and geolocating) the unauthorized operation of earth station terminals deployed within their territory, the ITU-R needs to provide necessary guidelines on satellite monitoring capabilities, along with possible revision and further development of ITU-R Reports or Handbooks in this regard. These may provide guidance and support for administrations in managing the unauthorized operation of earth station terminals deployed within their territory and tools to guide their national spectrum management.

## Agenda item 10

(For information at CPM19-2)

10 *to recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, in accordance with Article 7 of the Convention,*

**Resolution 810 (WRC-15): Preliminary agenda for the 2023 World Radiocommunication Conference**

2 *on the basis of proposals from administrations and the Report of the Conference Preparatory Meeting, and taking account of the results of WRC-19, to consider and take appropriate action in respect of the following items:*

2.1 *to consider possible spectrum needs and regulatory actions to support Global Maritime Distress and Safety System (GMDSS) modernization and the implementation of e-navigation, in accordance with Resolution 361 (WRC-15);*

**Resolution 361 (WRC-15): Consideration of regulatory provisions for modernization of the Global Maritime Distress and Safety System and related to the implementation of e-navigation**

**(WP 5B)**

2.2 *to conduct, and complete in time for WRC-23, studies for a possible new allocation to the Earth exploration-satellite (active) service for spaceborne radar sounders within the range of frequencies around 45 MHz, taking into account the protection of incumbent services, in accordance with Resolution 656 (WRC-15);*

**Resolution 656 (WRC-15): Possible allocation to the Earth exploration-satellite service (active) for spaceborne radar sounders in the range of frequencies around 45 MHz**

**(WP 7C)**

2.3 *in accordance with Resolution 657 (WRC-15), to review the results of studies relating to the technical and operational characteristics, spectrum requirements and appropriate radio service designations for space weather sensors, with a view to providing appropriate recognition and protection in the Radio Regulations without placing additional constraints on incumbent services;*

**Resolution 657 (WRC-15): Spectrum needs and protection of space weather sensors**

**(WP 7C)**

2.4 *study of spectrum needs and possible new allocations to the fixed-satellite service in the frequency band 37.5-39.5 GHz (Earth-to-space), in accordance with Resolution 161 (WRC-15);*

**Resolution 161 (WRC-15): Studies relating to spectrum needs and possible allocation of the frequency band 37.5-39.5 GHz to the fixed-satellite service**

**(WP 4A)**

2.5 *to review the spectrum use and spectrum needs of existing services in the frequency band 470-960 MHz in Region 1 and consider possible regulatory actions in the frequency band 470-694 MHz in Region 1 on the basis of the review in accordance with Resolution 235 (WRC-15);*

**Resolution 235 (WRC-15): Review of the spectrum use of the frequency band 470-960 MHz in Region 1**

(-)

### **6/10/1 WRC-23 preliminary agenda item 2.1 – Resolution 361 (WRC-15)**

[Text to be developed as appropriate]

### **6/10/2 WRC-23 preliminary agenda item 2.2 – Resolution 656 (WRC-15)**

Resolution **656 (WRC-15)** was adopted to explore a possible allocation to the Earth exploration-satellite service (active) for spaceborne radar sounders operating in the range of frequencies around 45 MHz. The Resolution invites ITU-R to conduct studies on spectrum needs and sharing studies between the Earth exploration-satellite (active) service and the radiolocation, fixed, mobile, broadcasting and space research services in the 40-50 MHz frequency range in order to support an allocation for the EESS (active) service for this operation.

The mission scientific objectives of a spaceborne radar sounder operating in the 40-50 MHz frequency band are 1) to understand the global thickness, inner structure, and the thermal stability of the Earth's ice sheets and 2) to understand the occurrence, distribution and dynamics of the earth fossil aquifers in desertic environments.

Preliminary studies, provided in Report ITU-R RS.[VHF\_SOUNDER], were performed to assess sharing and compatibility with existing services allocated to, and adjacent to, the 40-50 MHz band, which include fixed, mobile, space research, broadcasting and radiolocation services. The sounding radar's operating parameters and geographical limitations, coupled with the preliminary study results, show that further studies need to be conducted to determine if the sounding radar can operate to collect important subsurface data without causing harmful interference to incumbent services.

### **6/10/3 WRC-23 preliminary agenda item 2.3 – Resolution 657 (WRC-15)**

Space weather refers to the physical processes occurring in the space environment. It is influenced by the solar wind and the interplanetary magnetic field (IMF) carried by the solar wind plasma. The solar wind and solar disturbances interact with the Earth's magnetic field and outer atmosphere in complex ways, causing strongly variable energetic particles and electric currents in the Earth's magnetosphere, ionosphere and surface.

The effects of space weather can impact a number of activities, services and global infrastructure (for communication, transport, energy supplies, etc.) at the Earth's surface, airborne, or in space. Resolution **657 (WRC-15)** calls for the ITU-R to document the technical and operational characteristics of space weather sensors, and determine their appropriate radio service designations, in time for WRC-19 so that the Conference may decide on the matter of recommending to Council that this matter be included in the agenda for WRC-23.

To address the requirements established in Resolution **657 (WRC-15)**, the ITU-R has developed Report ITU-R RS.[Space\_Weather\_Sensors] – *Technical and operational characteristics of RF-based space weather sensors*. This ITU-R Report documents the information called for by Resolution **657 (WRC-15)** to support studies to be performed under a possible agenda item on space weather at WRC-23. This Report also includes an assessment of potentially applicable radio services to the space weather sensor applications.

### **6/10/4 WRC-23 preliminary agenda item 2.4 – Resolution 161 (WRC-15)**

[Text to be developed as appropriate]

**6/10/5 WRC-23 preliminary agenda item 2.5 – Resolution 235 (WRC-15)**

[Text to be developed as appropriate]



## ANNEX TO THE DRAFT CPM REPORT

### **Reference List of ITU-R Resolutions, Recommendations and Reports, as well as other ITU and non-ITU publications, used in the draft CPM Report**

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## 1 List of existing ITU-R Resolutions

Resolution ITU-R*	Latest publication	Resolution title	Agenda item	CPM chapter
2-7	Res. <a href="#">ITU-R 2-7</a> (RA-15)	Conference Preparatory Meeting	1.9.1	5
			9.1, issue 9.1.1	2
54-2	Res. <a href="#">ITU-R 54-2</a> (RA-15)	Studies to achieve harmonization for short-range devices	9.1, issue 9.1.8	2
56	Res. <a href="#">ITU-R 56-2</a> (RA-15)	Naming for International Mobile Telecommunications	1.13	2
65	Res. <a href="#">ITU-R 65</a> (RA-15)	Principles for the process of future development of IMT for 2020 and beyond	1.13	2
68	Res. <a href="#">ITU-R 68</a> (RA-15)	Improving the dissemination of knowledge concerning the applicable regulatory procedures for small satellites, including nanosatellites and picosatellites	7, issue M	3
66	Res. <a href="#">ITU-R 66</a> (RA-15)	Studies related to wireless systems and applications for the development of the Internet of Things	9.1, issue 9.1.8	2

## 2 List of preliminary draft new (PDN) or revised (PDR) ITU-R Resolution(s)

Resolution draft number*	Available document / status	Draft Resolution title	Agenda item	CPM chapter
–	–	–	–	–

## 3 List of existing ITU-R Recommendations

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
SM. 329		Rec. <a href="#">ITU-R SM.329-12</a>	Unwanted emissions in the spurious domain	1.13	2
SA. 363-5		Rec. <a href="#">ITU-R SA.363-5</a>	Space operation systems	1.7	4

\* Reference(s) used in the the draft CPM Report.

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
P. 372-13		Rec. <a href="#">ITU-R P.372-13</a>	Radio noise	9.1, issue 9.1.6	6
P. 368		Rec. <a href="#">ITU-R P.368-9</a>	Ground-wave propagation curves for frequencies between 10 kHz and 30 MHz	1.8	5
P. 452-16	Rec. <a href="#">ITU-R P.452-16</a>	Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz	1.7	4	
P. 452			1.13	2	
P. 452			1.14	1	
P. 452			9.1, issues 9.1.1, 9.1.2 & 9.1.9	2 3	
S. 465		Rec. <a href="#">ITU-R S.465-6</a>	Reference radiation pattern of earth station antennas in the fixed-satellite service for use in coordination and interference assessment in the frequency range from 2 to 31 GHz	9.1, issues 9.1.3 & 9.1.9	3
M. 493		Rec. <a href="#">ITU-R M.493-14</a>	Digital selective-calling system for use in the maritime mobile service	1.9.1	5
SA. 509		Rec. <a href="#">ITU-R SA.509-3</a>	Space research earth station and radio astronomy reference antenna radiation pattern for use in interference calculations, including coordination procedures, for frequencies less than 30 GHz	1.14	1
SA. 514-3		Rec. <a href="#">ITU-R SA.514-3</a>	Interference criteria for command and data transmission systems operating in the Earth exploration-satellite and meteorological-satellite services	1.7	4
RA. 517		Rec. <a href="#">ITU-R RA.517-4</a>	Protection of the radio astronomy service from transmitters operating in adjacent bands	9.1, issue 9.1.9	3
S. 524		Rec. <a href="#">ITU-R S.524-9</a>	Maximum permissible levels of off-axis e.i.r.p. density from earth stations in geostationary-satellite orbit networks operating in the fixed-satellite service transmitting in the 6 GHz, 13 GHz, 14 GHz and 30 GHz frequency bands	1.5	3
P. 525-3	Rec. <a href="#">ITU-R P.525-3</a>	Calculation of free-space attenuation	1.14	1	
P 525			1.6 9.1, issue 9.1.9	3	

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
P. 526		Rec. <a href="#">ITU-R P.526-14</a>	Propagation by diffraction	1.1	5
BS. 560		Rec. <a href="#">ITU-R BS.560-4</a>	Radio-frequency protection ratios in LF, MF and HF broadcasting	9.1, issue 9.1.6	6
S. 580		Rec. <a href="#">ITU-R S.580-6</a>	Radiation diagrams for use as design objectives for antennas of earth stations operating with geostationary satellites	9.1, issue 9.1.3	3
M. 585		Rec. <a href="#">ITU-R M.585-7</a>	Assignment and use of identities in the maritime mobile service	1.9.1	5
M. 589-3		Rec. <a href="#">ITU-R M.589-3</a>	Technical characteristics of methods of data transmission and interference protection for radionavigation services in the frequency bands between 70 and 130 kHz	9.1, issue 9.1.6	6
SA. 609-2	Rec. <a href="#">ITU-R SA.609-2</a>	Protection criteria for radiocommunication links for manned and unmanned near-Earth research satellites	1.7	4	
SA. 609			1.14	1	
RA. 611		Rec. <a href="#">ITU-R RA.611-4</a>	Protection of the radio astronomy service from spurious emissions	9.1, issue 9.1.9	3
P. 618		Rec. <a href="#">ITU-R P.618-13</a>	Propagation data and prediction methods required for the design of Earth-space telecommunication systems	1.6	3
P. 619	Rec. <a href="#">ITU-R P.619-3</a>	Propagation data required for the evaluation of interference between stations in space and those on the surface of the Earth	1.13	2	
P. 619-3			1.14	1	
S. 672-4	Rec. <a href="#">ITU-R S.672-4</a>	Satellite antenna radiation pattern for use as a design objective in the fixed-satellite service employing geostationary satellites	1.13	2	
S 672			9.1, issue 9.1.3	3	
P. 676		Rec. <a href="#">ITU-R P.676-11</a>	Attenuation by atmospheric gases	9.1, issue 9.1.9	3
F. 699-8	Rec. <a href="#">ITU-R F.699-8</a>	Reference radiation patterns for fixed wireless system antennas for use in coordination studies and interference assessment in the frequency range from 100 MHz to 86 GHz	1.7	4	
F. 699			1.14	1	
BS. 703		Rec. <a href="#">ITU-R BS.703-0</a>	Characteristics of AM sound broadcasting reference receivers for planning purposes	9.1, issue 9.1.6	6

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
S. 737		Rec. <a href="#">ITU-R S.737-0</a>	Relationship of technical coordination methods within the fixed-satellite service	9.1, issue 9.1.3	3
S. 738		Rec. <a href="#">ITU-R S.738-0</a>	Procedure for determining if coordination is required between geostationary-satellite networks sharing the same frequency bands	9.1, issue 9.1.3	3
S. 739		Rec. <a href="#">ITU-R S.739-0</a>	Additional methods for determining if detailed coordination is necessary between geostationary-satellite networks in the fixed-satellite service sharing the same frequency bands	9.1, issue 9.1.3	3
S. 740		Rec. <a href="#">ITU-R S.740-0</a>	Technical coordination methods for fixed-satellite networks	9.1, issue 9.1.3	3
S. 741		Rec. <a href="#">ITU-R S.741-2</a>	Carrier-to-interference calculations between networks in the fixed- satellite service	9.1, issue 9.1.3	3
F. 758-6	Rec. <a href="#">ITU-R F.758-6</a>	System parameters and considerations in the development of criteria for sharing or compatibility between digital fixed wireless systems in the fixed service and systems in other services and other sources of interference	1.7	4	
F. 758			1.14	1	
F. 758			1.9.2	5	
F. 758			9.1, issue 9.1.9	3	
RA. 769-2	Rec. <a href="#">ITU-R RA.769-2</a>	Protection criteria used for radio astronomical measurements	1.7	4	
RA 769			9.1, issue 9.1.9	3	
BO. 789		Rec. <a href="#">ITU-R BO.789-2</a>	Service for digital sound broadcasting to vehicular, portable and fixed receivers for broadcasting-satellite service (sound) in the frequency range 1 400-2 700 MHz	9.1, issue 9.1.2	3
P. 840		Rec. <a href="#">ITU-R P.840-7</a>	Attenuation due to clouds and fog	9.1, issue 9.1.9	3
SM. 851		Rec. <a href="#">ITU-R SM.851-1</a>	Sharing between the broadcasting service and the fixed and/or mobile services in the VHF and UHF bands	1.1	5
SA.1014		Rec. <a href="#">ITU-R SA.1014-3</a>	Telecommunication requirements for manned and unmanned deep-space research	1.14	1

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
SA.1027		Rec. <a href="#">ITU-R SA.1027-5</a>	Sharing criteria for space-to-Earth data transmission systems in the Earth exploration-satellite and meteorological-satellite services using satellites in low-Earth orbit	1.14	1
RA.1031		Rec. <a href="#">ITU-R RA.1031-2</a>	Protection of the radio astronomy service in frequency bands shared with other services	9.1, issue 9.1.9	3
M.1036		Rec. <a href="#">ITU-R M.1036-5</a>	Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations	9.1, issues 9.1.1 & 9.1.8	2
SM.1055		Rec. <a href="#">ITU-R SM.1055-0</a>	The use of spread spectrum techniques	1.1	5
M.1084		Rec. <a href="#">ITU-R M.1084-5</a>	Interim solutions for improved efficiency in the use of the band 156-174 MHz by stations in the maritime mobile service	1.9.2	5
BO.1130		Rec. <a href="#">ITU-R BO.1130-4</a>	Systems for digital satellite broadcasting to vehicular, portable and fixed receivers in the bands allocated to BSS (sound) in the frequency range 1 400-2 700 MHz	9.1, issue 9.1.2	3
SA.1155		Rec. <a href="#">ITU-R SA.1155-2</a>	Protection criteria related to the operation of data relay satellite systems	1.14	1
SA.1159		Rec. <a href="#">ITU-R SA.1159-4</a>	Performance criteria for data dissemination, data collection and direct data readout systems in the Earth exploration-satellite service and meteorological-satellite service	1.2	4
SA.1161		Rec. <a href="#">ITU-R SA.1161-2</a>	Sharing and coordination criteria for data dissemination and direct data readout systems in the Earth exploration-satellite and meteorological-satellite services using satellites in geostationary orbit	1.14	1
SA.1163		Rec. <a href="#">ITU-R SA.1163-2</a>	Interference criteria for service links in data collection systems in the Earth exploration-satellite and meteorological-satellite services	1.2	4
SA.1164		Rec. <a href="#">ITU-R SA.1164-2</a>	Sharing and coordination criteria for service links in data collection systems in the Earth exploration-satellite and meteorological-satellite services	1.2	4
RS.1166		Rec. <a href="#">ITU-R M.1166-4</a>	Performance and interference criteria for active spaceborne sensors	1.16	2

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
M.1184		Rec. <a href="#">ITU-R M.1184-3</a>	Technical characteristics of mobile satellite systems in the frequency bands below 3 GHz for use in developing criteria for sharing between the mobile-satellite service and other services	1.8	5
M.1188		Rec. <a href="#">ITU-R M.1188-1</a>	Impact of propagation on the design of non-GSO mobile-satellite systems not employing satellite diversity which provide service to handheld equipment	1.8	5
BO.1213		Rec. <a href="#">ITU-R BO.1213-1</a>	Reference receiving Earth station antenna pattern for the broadcasting-satellite service in the 11.7-12.75 GHz band	7, issue F	3
F.1245		Rec. <a href="#">ITU-R F.1245-2</a>	Mathematical model of average and related radiation patterns for line-of-sight point-to-point fixed wireless system antennas for use in certain coordination studies and interference assessment in the frequency range from 1 GHz to about 70 GHz	1.14	1
F.1249		Rec. <a href="#">ITU-R F.1249-5</a>	Technical and operational requirements that facilitate sharing between point-to-point systems in the fixed service and the inter-satellite service in the band 25.25-27.5 GHz	1.14	1
SA.1276		Rec. <a href="#">ITU-R SA.1276-5</a>	Orbital locations of data relay satellites to be protected from the emissions of fixed service systems operating in the band 25.25-27.5 GHz	1.14	1
S.1323		Rec. <a href="#">ITU-R S.1323-2</a>	Maximum permissible levels of interference in a satellite network (GSO/FSS; non-GSO/FSS; non-GSO/MSS feeder links) in the fixed-satellite service caused by other codirectional FSS networks below 30 GHz	1.6 9.1, issue 9.1.3	3
S.1325		Rec. <a href="#">ITU-R S.1325-3</a>	Simulation methodologies for determining statistics of short-term interference between co-frequency, codirectional non-geostationary-satellite orbit fixed-satellite service systems in circular orbits and other non-geostationary fixed-satellite service systems in circular orbits or geostationary-satellite orbit fixed-satellite service networks	9.1, issue 9.1.3	3
S.1328		Rec. <a href="#">ITU-R S.1328-4</a>	Satellite system characteristics to be considered in frequency sharing analyses within the fixed-satellite service	9.1, issues 9.1. 3 & 9.1.9	3

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
F.1336-4			Reference radiation patterns of omnidirectional, sectoral and other antennas for the fixed and mobile service for use in sharing studies in the frequency range from 400 MHz to about 70 GHz	1.7	4
F.1336	Rec. <a href="#">ITU-R F.1336-4</a>			9.1, issue 9.1.1	2
BT.1368	Rec. <a href="#">ITU-R BT.1368-13</a>		Planning criteria, including protection ratios, for digital terrestrial television services in the VHF/UHF bands	1.1	5
M.1371	Rec. <a href="#">ITU-R M.1371-5</a>		Technical characteristics for an automatic identification system using time-division multiple access in the VHF maritime mobile band	1.9.1	5
SF.1395	Rec. <a href="#">ITU-R SF.1395-0</a>		Minimum propagation attenuation due to atmospheric gases for use in frequency sharing studies between the fixed-satellite service and the fixed service	1.14	1
SA.1396	Rec. <a href="#">ITU-R SA.1396-0</a>		Protection criteria for the space research service in the 37-38 and 40-40.5 GHz bands	1.14	1
P.1409	Rec. <a href="#">ITU-R P.1409-1</a>		Propagation data and prediction methods for systems using high altitude platform stations and other elevated stations in the stratosphere at frequencies greater than about 1 GHz	1.14	1
P.1411	Rec. <a href="#">ITU-R P.1411-9</a>		Propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz	1.11	3.2
SA.1414	Rec. <a href="#">ITU-R SA.1414-2</a>		Characteristics of data relay satellite systems	1.14	1
S.1426	Rec. <a href="#">ITU-R S.1426-0</a>		Aggregate power flux-density limits, at the FSS satellite orbit for radio local area network (RLAN) transmitters operating in the 5 150-5 250 MHz band sharing frequencies with the FSS (RR No. <b>S5.447A</b> )	1.16	2
M.1450	Rec. <a href="#">ITU-R M.1450-5</a>		Characteristics of broadband radio local area networks	1.16 9.1, issue 9.1.8	2
M.1452	Rec. <a href="#">ITU-R M.1452-2</a>		Millimetre wave vehicular collision avoidance radars and radiocommunication systems for intelligent transport system applications	1.12	1



ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
M.1453		Rec. <a href="#">ITU-R M.1453-2</a>	Intelligent transport systems – Dedicated short range communications at 5.8 GHz	1.12	1
M.1454		Rec. <a href="#">ITU-R M.1454-0</a>	E.i.r.p. density limit and operational restrictions for RLANS or other wireless access transmitters in order to ensure the protection of feeder links of non-geostationary systems in the mobile-satellite service in the frequency band 5 150-5 250 MHz	1.16	2
M.1457		Rec. <a href="#">ITU-R M.1457-13</a>	Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)	9.1, issues 9.1.1 & 9.1.8	2
M.1458		Rec. <a href="#">ITU-R M.1458-0</a>	Use of the frequency bands between 2.8-22 MHz by the aeronautical mobile (R) service for data transmission using class of emission J2D	9.1, issue 9.1.6	6
M.1478-3		Rec. <a href="#">ITU-R M.1478-3</a>	Protection criteria for Cospas-Sarsat search and rescue instruments in the band 406-406.1 MHz	1.7	4
F.1495		Rec. <a href="#">ITU-R F.1495-2</a>	Interference criteria to protect the fixed service from time varying aggregate interference from other radiocommunication services sharing the 17.7-19.3 GHz band on a co-primary basis	9.1, issue 9.1.9	3
F.1496		Rec. <a href="#">ITU-R F.1496-1</a>	Radio-frequency channel arrangements for fixed wireless systems operating in the band 51.4-52.6 GHz	9.1, issue 9.1.9	3
F.1500		Rec. <a href="#">ITU-R F.1500-0</a>	Preferred characteristics of systems in the fixed service using high altitude platforms operating in the bands 47.2-47.5 GHz and 47.9-48.2 GHz	1.14	1
F.1501		Rec. <a href="#">ITU-R F.1501-0</a>	Coordination distance for systems in the fixed service (FS) involving high-altitude platform stations (HAPSS) sharing the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz with other systems in the fixed service	1.14	1
S.1503		Rec. <a href="#">ITU-R S.1503-3</a> (Rec. <a href="#">ITU-R S.1503-2</a> )	Functional description to be used in developing software tools for determining conformity of non-geostationary-satellite orbit fixed-satellite service systems or networks with limits contained in Article 22 of the Radio Regulations	1.6 7, issue L	3
S.1524		Rec. <a href="#">ITU-R S.1524-0</a>	Coordination identification between geostationary-satellite orbit fixed-satellite service networks	7, issue F	3

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
S..1529		Rec. <a href="#">ITU-R S.1529-0</a>	Analytical method for determining the statistics of interference between non-geostationary-satellite orbit fixed-satellite service systems and other non-geostationary-satellite orbit fixed-satellite service systems or geostationary-satellite orbit fixed-satellite service networks	9.1, issue 9.1.3	3
SM.1535		Rec. <a href="#">ITU-R SM.1535-0</a>	The protection of safety services from unwanted emissions	9.1, issue 9.1.6	6
SM.1541		Rec. <a href="#">ITU-R SM.1541-6</a>	Unwanted emissions in the out-of-band domain	1.14	1
SM.1541				1.6	3
SM.1542		Rec. <a href="#">ITU-R SM.1542-0</a>	The protection of passive services from unwanted emissions	9.1, issue 9.1.9	3
P.1546-5		Rec. <a href="#">ITU-R P.1546-5</a>	Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3 000 MHz	1.1	5
P.1546				9.1, issue 9.1.2	3
S.1557		Rec. <a href="#">ITU-R S.1557-0</a>	Operational requirements and characteristics of fixed-satellite service systems operating in the 50/40 GHz bands for use in sharing studies between the fixed-satellite service and the fixed service	9.1, issue 9.1.9	3
F.1565		Rec. <a href="#">ITU-R F.1565-0</a>	Performance degradation due to interference from other services sharing the same frequency bands on a co-primary basis with real digital fixed wireless systems used in the international and national portions of a 27 500 km hypothetical reference path at or above the primary rate	9.1, issue 9.1.9	3
F.1569		Rec. <a href="#">ITU-R F.1569-0</a>	Technical and operational characteristics for the fixed service using high altitude platform stations in the bands 27.5-28.35 GHz and 31-31.3 GHz	1.14	1
F.1570		Rec. <a href="#">ITU-R F.1570-2</a>	Impact of uplink transmission in the fixed service using high altitude platform stations on the Earth exploration-satellite service (passive) in the 31.3-31.8 GHz band	1.14	1
M.1583		Rec. <a href="#">ITU-R M.1583-1</a>	Interference calculations between non-geostationary mobile-satellite service or radionavigation-satellite service systems and radio astronomy telescope sites	1.8	5

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
SF.1601		Rec. <a href="#">ITU-R SF.1601-2</a>	Methodologies for interference evaluation from the downlink of the fixed service using high altitude platform stations to the uplink of the fixed-satellite service using the geostationary satellites within the band 27.5-28.35 GHz	1.14	1
F.1606		Rec. <a href="#">ITU-R F.1606-0</a>	Interference criteria to protect fixed wireless systems from time varying aggregate interference produced by non-geostationary satellites operating in other services sharing the 37-40 GHz and 40.5-42.5 GHz bands on a co-primary basis	9.1, issue 9.1.9	3
F.1607		Rec. <a href="#">ITU-R F.1607-0</a>	Interference mitigation techniques for use by high altitude platform stations in the 27.5-28.35 GHz and 31.0-31.3 GHz bands	1.14	1
F.1608		Rec. <a href="#">ITU-R F.1608-0</a>	Frequency sharing between systems in the fixed service using high altitude platform stations and conventional systems in the fixed service in the bands 47.2-47.5 and 47.9-48.2 GHz	1.14	1
F.1609		Rec. <a href="#">ITU-R F.1609-1</a>	Interference evaluation from fixed service systems using high altitude platform stations to conventional fixed service systems in the bands 27.5-28.35 GHz and 31-31.3 GHz	1.14	1
F.1612		Rec. <a href="#">ITU-R F.1612-0</a>	Interference evaluation of the fixed service using high altitude platform stations to protect the radio astronomy service from uplink transmission in high altitude platform station systems in the 31.3-31.8 GHz band	1.14	1
SA.1627		Rec. <a href="#">ITU-R SA.1627-0</a>	Telecommunication requirements and characteristics of EESS and MetSat service systems for data collection and platform location	1.2	4
RA.1631		Rec. <a href="#">ITU-R RA.1631-0</a>	Reference radio astronomy antenna pattern to be used for compatibility analyses between non-GSO systems and radio astronomy service stations based on the epfd concept	1.8	5
RS.1632		Rec. <a href="#">ITU-R RS.1632-0</a>	Sharing in the band 5 250-5 350 MHz between the Earth exploration-satellite service (active) and wireless access systems (including radio local area networks) in the mobile service	1.16	2
RS.1632-0	9.1, issue 9.1.5			2	

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
SM.1633		Rec. <a href="#">ITU-R SM.1633-0</a>	Compatibility analysis between a passive service and an active service allocated in adjacent and nearby bands	9.1, issue 9.1.9	3
M.1634		Rec. <a href="#">ITU-R M.1634-0</a>	Interference protection of terrestrial mobile service systems using Monte Carlo simulation with application to frequency sharing	1.1	5
M.1638	Rec. <a href="#">ITU-R M.1638-1</a> (Rec. <a href="#">ITU-R M.1638-0</a> is incorporated by reference in the RR)		Characteristics of and protection criteria for sharing studies for radiolocation (except ground based meteorological radars) and aeronautical radionavigation radars operating in the frequency bands between 5 250 and 5 850 MHz	9.1, issue 9.1.5	2
M.1638-0					
M.1638-1					
M.1651		Rec. <a href="#">ITU-R M.1651-0</a>	A method for assessing the required spectrum for broadband nomadic wireless access systems including radio local area networks using the 5 GHz band	1.1	5
M.1652		Rec. <a href="#">ITU-R M.1652-1</a>	Dynamic frequency selection in wireless access systems including radio local area networks for the purpose of protecting the radiodetermination service in the 5 GHz band	1.16	2
M.1653		Rec. <a href="#">ITU-R M.1653-0</a>	Operational and deployment requirements for wireless access systems including radio local area networks in the mobile service to facilitate sharing between these systems and systems in the Earth exploration-satellite service (active) and the space research service (active) in the band 5 470-5 570 MHz within the 5 460 5 725 MHz range	1.16	2
M.1732		Rec. <a href="#">ITU-R M.1732-2</a>	Characteristics of systems operating in the amateur and amateur-satellite services for use in sharing studies	1.1	5
F.1764		Rec. <a href="#">ITU-R F.1764-1</a>	Methodology to evaluate interference from user links in fixed service systems using high altitude platform stations to fixed wireless systems in the bands above 3 GHz	1.14	1
S..1781		Rec. <a href="#">ITU-R S.1781-0</a>	Possible methodology for frequency sharing between bidirectional geostationary fixed-satellite service networks comprising ubiquitously deployed earth stations	9.1, issue 9.1.3	3
M.1798		Rec. <a href="#">ITU-R M.1798-1</a>	Characteristics of HF radio equipment for the exchange of digital data and electronic mail in the maritime mobile service	1.8	5

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
M.1808-0			Technical and operational characteristics of conventional and trunked land mobile systems operating in the mobile service allocations below 869 MHz to be used in sharing studies	1.7	4
M.1808	Rec. <a href="#">ITU-R M.1808-0</a>			1.9.2	5
SA.1811	Rec. <a href="#">ITU-R SA.1811-0</a>		Reference antenna patterns of large-aperture space research service earth stations to be used for compatibility analyses involving a large number of distributed interference entries in the bands 31.8-32.3 GHz and 37.0-38.0 GHz	1.14	1
RS.1813	Rec. <a href="#">ITU-R RS.1813-1</a>		Reference antenna pattern for passive sensors operating in the Earth exploration-satellite service (passive) to be used in compatibility analyses in the frequency range 1.4-100 GHz	1.14	1
F.1819	Rec. <a href="#">ITU-R F.1819-0</a>		Protection of the radio astronomy service in the 48.94-49.04 GHz band from unwanted emissions from HAPS in the 47.2-47.5 GHz and 47.9-48.2 GHz bands	1.14	1
F.1820	Rec. <a href="#">ITU-R F.1820-0</a>		Power flux-density at international borders for high altitude platform stations providing fixed wireless access services to protect the fixed service in neighbouring countries in the 47.2-47.5 GHz and 47.9-48.2 GHz bands	1.14	1
M.1825	Rec. <a href="#">ITU-R M.1825-0</a>		Guidance on technical parameters and methodologies for sharing studies related to systems in the land mobile service	1.1	5
M.1842	Rec. <a href="#">ITU-R M.1842-1</a>		Characteristics of VHF radio systems and equipment for the exchange of data and electronic mail in the maritime mobile service RR Appendix 18 channels	1.9.2	5
SF.1843	Rec. <a href="#">ITU-R SF.1843-0</a>		Methodology for determining the power level for high altitude platform stations ground terminals to facilitate sharing with space station receivers in the bands 47.2-47.5 GHz and 47.9-48.2 GHz	1.14	1
M.1849	Rec. <a href="#">ITU-R M.1849-1</a>	(Rec. <a href="#">ITU-R M.1849-0</a> is incorporated by reference in the RR)	Technical and operational aspects of ground-based meteorological radars	9.1, issue 9.1.5	2
M.1849-0					
M.1849-1					
M.1850	Rec. <a href="#">ITU-R M.1850-2</a>		Detailed specifications of the radio interfaces for the satellite component of International Mobile Telecommunications-2000 (IMT-2000)	9.1, issue 9.1.1	2

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
RS.1858		Rec. <a href="#">ITU-R RS.1858-0</a>	Characterization and assessment of aggregate interference to the Earth exploration-satellite service (passive) sensor operations from multiple sources of man-made emissions	1.14	1
RS.1861		Rec. <a href="#">ITU-R RS.1861-0</a>	Typical technical and operational characteristics of Earth exploration-satellite service (passive) systems using allocations between 1.4 and 275 GHz	1.13	2
RS.1861	1.14			1	
RS1861	9.1, issue 9.1.9			3	
SA.1862		Rec. <a href="#">ITU-R SA.1862-0</a>	Guidelines for efficient use of the band 25.5-27.0 GHz by the Earth exploration-satellite service (space-to-Earth) and space research service (space-to-Earth)	1.13	2
F.1891		Rec. <a href="#">ITU-R F.1891-0</a>	Technical and operational characteristics of gateway links in the fixed service using high altitude platform stations in the band 5 850-7 075 MHz to be used in sharing studies	1.14	1
SM.1896		Rec. <a href="#">ITU-R SM.1896-1</a>	Frequency ranges for global or regional harmonization of short-range devices (SRDs)	9.1, issue 9.1.8	2
P.2001-2		Rec. <a href="#">ITU-R P.2001-2</a>	A general purpose wide-range terrestrial propagation model in the frequency range 30 MHz to 50 GHz	1.1	5
P.2001	9.1, issue 9.1.2			3	
M.2002		Rec. <a href="#">ITU-R M.2002-0</a>	Objectives, characteristics and functional requirements of wide-area sensor and/or actuator network (WASN) systems	9.1, issue 9.1.8	2
M.2003-2		Rec. <a href="#">ITU-R M.2003-2</a>	Multiple gigabit wireless systems in frequencies around 60 GHz	1.13	2
M.2007		Rec. <a href="#">ITU-R M.2007-0</a>	Characteristics of and protection criteria for radars operating in the aeronautical radionavigation service in the frequency band 5 150-5 250 MHz	1.16	2
M.2010		Rec. <a href="#">ITU-R M.2010-0</a>	Characteristics of a digital system, named Navigational Data for broadcasting maritime safety and security related information from shore-to-ship in the 500 kHz band	1.8	5
F.2011		Rec. <a href="#">ITU-R F.2011-0</a>	Evaluation of interference from high-altitude platform (HAPS) gateway links (HAPS-to-ground direction) in the fixed service to conventional fixed wireless systems in the range 5 850-7 075 MHz	1.14	1

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
M.2012		Rec. <a href="#">ITU-R M.2012-3</a>	Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications Advanced (IMT-Advanced)	9.1, issues 9.1.1 & 9.1.8	2
RS.2017		Rec. <a href="#">ITU-R RS.2017-0</a>	Performance and interference criteria for satellite passive remote sensing	1.13	2
RS.2017	1.14			1	
RS2017	1.6 9.1, issue 9.1.9			3	
BT.2020		Rec. <a href="#">ITU-R BT.2020-2</a>	Parameter values for ultra-high definition television systems for production and international programme exchange	7, issue J	3
BT.2033		Rec. <a href="#">ITU-R BT.2033-1</a>	Planning criteria, including protection ratios, for second generation of digital terrestrial television broadcasting systems in the VHF/UHF bands	1.1	5
SA.2044		Rec. <a href="#">ITU-R SA.2044-0</a>	Protection criteria for non-GSO data collection platforms in the band 401-403 MHz	1.2	4
SA.2044	1.7			4	
SA.2045		Rec. <a href="#">ITU-R SA.2045</a>	Basic general partitioning and sharing conditions for the band 401-403 MHz for future long-term coordinated use of data collection systems on geostationary and non-geostationary METSAT and EESS systems	1.2	4
SA.2045	1.7			4	
M.2046		Rec. <a href="#">ITU-R M.2046-0</a>	Characteristics and protection criteria for non-geostationary mobile-satellite service systems operating in the band 399.9-400.05 MHz	1.2	4
M.2046	1.7			4	
M.2047		Rec. <a href="#">ITU-R M.2047-0</a>	Detailed specifications of the satellite radio interfaces of International Mobile Telecommunications-Advanced (IMT-Advanced)	9.1, issue 9.1.1	2
M.2057		Rec. <a href="#">ITU-R M.2057-1</a>	Systems characteristics of automotive radars operating in the frequency band 76-81 GHz for intelligent transport systems applications	1.13	2
M.2058		Rec. <a href="#">ITU-R M.2058-0</a>	Characteristics of a digital system, named navigational data for broadcasting maritime safety and security related information from shore-to-ship in the maritime HF frequency band	1.8	5

ITU-R Series	Recommendation number*	Latest publication	Recommendation title	Agenda item	CPM chapter
M.2083		Rec. <a href="#">ITU-R M.2083-0</a>	IMT Vision – "Framework and overall objectives of the future development of IMT for 2020 and beyond"	1.13	2
M.2083				9.1, issue 9.1.8	2
F.2086-0		Rec. <a href="#">ITU-R F.2086-0</a>	Deployment scenarios for point-to-point systems in the fixed service	1.14	1
F.2086				9.1, issue 9.1.9	3
M.2092		Rec. <a href="#">ITU-R M.2092-0</a>	Technical characteristics for a VHF data exchange system in the VHF maritime mobile band	1.9.2	5
BO.2098		Rec. <a href="#">ITU-R BO.2098-0</a>	Transmission system for UHDTV satellite broadcasting	7, issue J	3
M.2101		Rec. <a href="#">ITU-R M.2101-0</a>	Modelling and simulation of IMT networks and systems for use in sharing and compatibility studies	1.13	2
M.2101-0				1.14	1
M.2101				9.1, issues 9.1.1, 9.1.2 & 9.1.9	2 3
SM.2103		Rec. <a href="#">ITU-R SM.2103-0</a>	Global harmonization of SRD categories	9.1, issue 9.1.8	2
P.2108		Rec. <a href="#">ITU-R P.2108-0</a>	Prediction of Clutter Loss	1.13	2
P.2108				1.14	1
P.2108				1.16	2
P.2108-0				1.7	4
P.2109		Rec. <a href="#">ITU-R P.2109-0</a>	Prediction of Building Entry Loss	1.16	2
M.2114		Rec. <a href="#">ITU-R M.2114-0</a>	Technical and operational characteristics of and protection criteria for aeronautical mobile service systems in the frequency bands 22.5-23.6 GHz and 25.25-27.5 GHz	1.14	1



**4 List of draft new (DN) or draft revised (DR) ITU-R Recommendations (may include preliminary draft new (PDN) or revised (PDR) ITU-R Recommendations and working documents toward preliminary draft new (WDPDN) or revised (WDPDR) ITU-R Recommendations)**

ITU-R Series	Recommendation draft number *	Available document / status	Draft Recommendation title	Agenda item	CPM chapter
SA.1163		DR Rec. <a href="#">ITU-R SA.1163-2</a> ( <a href="#">Doc. 7/77</a> )	Aggregate interference criteria for service links in data collection systems for GSO satellites in the Earth exploration-satellite and meteorological-satellite services	1.7	4
SA.1164		DR Rec. <a href="#">ITU-R SA.1164-2</a> ( <a href="#">Doc. 7/78</a> )	Sharing and coordination criteria for service links in data collection systems using GSO satellites in the Earth exploration-satellite and meteorological-satellite services	1.7	4
RS.1165-2		DR Rec. <a href="#">ITU-R RS.1165-2</a> ( <a href="#">Doc.7/79</a> )	Technical characteristics and performance criteria for systems in the meteorological aids service in the 403 MHz and 1 680 MHz bands	1.7	4
RS.1263-1		DR Rec. <a href="#">ITU-R RS.1263-1</a> ( <a href="#">Doc.7/80</a> )	Interference criteria for meteorological aids operated in the 400.15-406 MHz and 1 668.4-1 700 MHz bands	1.7	4
M.1890		PDR Rec. <a href="#">ITU-R M.1890-0</a> (Doc. <a href="#">5A/844</a> , <a href="#">Annex 31</a> )	Operational radiocommunication objectives and requirements for advanced intelligent transport systems	1.12	1
M.2084		[P]DN Rec. <a href="#">ITU-R M.2084-0</a> (Doc. <a href="#">5A/844</a> , <a href="#">Annex 28</a> )	Radio interface standards of vehicle-to-vehicle and vehicle-to-infrastructure communications for Intelligent Transport Systems applications	1.12	1
SM.2110		PDR Rec. <a href="#">ITU-R SM.2110-0</a> (Doc. <a href="#">1A/340</a> , <a href="#">Annex 4</a> )	Frequency ranges for operation of non-beam wireless power transmission systems	9.1, issue 9.1.6	6
[50/40 GHz FSS S.SHARING METHODOLOGY]		PDN Rec. ITU-R S.[50/40 GHz FSS SHARING METHODOLOGY] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 1</a> )	Maximum permissible levels of interference in a satellite network (GSO and non-GSO) in the fixed-satellite service caused by other co-directional FSS and BSS networks operating in the 50/40 GHz frequency bands	1.6	3
S.[50/40 REFERENCE LINKS]		WDPDN Rec. ITU-R S.[50/40 REFERENCE LINKS] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 5</a> )	Satellite system characteristics to be considered in frequency sharing analyses within the fixed-satellite service in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz	1.6	3
M.[AMRD]		WDPDN Rec. ITU-R M.[AMRD] (Doc. <a href="#">5B/538</a> , <a href="#">Annex 18</a> )	Definition, technical and operational characteristics of autonomous maritime radio devices	1.9.1	5

ITU-R Series	Recommendation draft number *	Available document / status	Draft Recommendation title	Agenda item	CPM chapter
	F.[BROADBAND HAPS CHARACTERISTICS]	PDN Rec. ITU-R F.[BROADBAND HAPS CHARACTERISTICS] (Doc. <a href="#">5C/531</a> , <a href="#">Annex 14</a> )	Deployment and technical characteristics of broadband high altitude platform stations in the bands 6 440-6 520 MHz, 6 560-6 640 MHz, 21.4-22.0 GHz, 24.25-27.5 GHz, 27.9-28.2 GHz, 31.0-31.3 GHz, 38.0-39.5 GHz, 47.2-47.5 GHz and 47.9-48.2 GHz to be used in sharing and compatibility studies	1.14	1
	M.[ITS.FRQ]	PDN Rec. ITU-R M.[ITS_FRQ] (Doc. <a href="#">5A/844</a> , <a href="#">Annex 30</a> )	Harmonization of frequency bands for Intelligent Transport Systems in the mobile service	1.12	1
	[MSS&IMT-M.ADVANCED SHARING]	WDPDN [Rec. or Rep.] ITU-R M.[MSS&IMT-ADVANCED SHARING] (Doc. <a href="#">4C/417</a> , <a href="#">Annex 4</a> )	Coexistence and compatibility study between the terrestrial component and the satellite component of IMT in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz in different countries	9.1, issue 9.1.1	2
	M.[RSTT_FRQ]	WDPDN Rec. ITU-R ITU-R M.[RSTT_FRQ] (Doc. <a href="#">5A/844</a> , <a href="#">Annex 15</a> )	[Harmonization of] frequencies and related frequency arrangements, for railway radiocommunication systems between train and trackside	1.11	1

## 5 List of existing ITU-R Reports

ITU-R Series	Report number *	Latest publication	Report title	Agenda item	CPM chapter
	SM.2028	Rep. <a href="#">ITU-R SM.2028-2</a>	Monte Carlo simulation methodology for the use in sharing and compatibility studies between different radio services or systems	1.1	5
	M.2039	Rep. <a href="#">ITU-R M.2039-3</a>	Characteristics of terrestrial IMT-2000 systems for frequency sharing/interference analyses	9.1, issue 9.1.1	2
	SM.2091	Rep. <a href="#">ITU-R SM.2091-0</a>	Studies related to the impact of active space services allocated in adjacent or nearby bands on radio astronomy service	9.1, issue 9.1.9	3
	SM.2092	Rep. <a href="#">ITU-R SM.2092-0</a>	Studies related to the impact of active services allocated in adjacent or nearby bands on Earth exploration-satellite service (passive)	9.1, issue 9.1.9	3
	M.2115	Rep. <a href="#">ITU-R M.2115-1</a>	Testing procedures for implementation of dynamic frequency selection	1.16	2

ITU-R Series	Report number*	Latest publication	Report title	Agenda item	CPM chapter
RA.2126		Rep. <a href="#">ITU-R RA.2126-1</a>	Techniques for mitigation of radio frequency interference in radio astronomy	9.1, issue 9.1.9	3
RA.2131		Rep. <a href="#">ITU-R RA.2131-0</a>	Supplementary information on the detrimental threshold levels of interference to radio astronomy observations in Recommendation ITU-R RA.769	9.1, issue 9.1.9	3
SM.2153		Rep. <a href="#">ITU-R SM.2153-6</a>	Technical and operating parameters and spectrum requirements for short range radiocommunication devices	9.1, issue 9.1.8	2
SM.2181		Rep. <a href="#">ITU-R SM.2181-0</a>	Use of Appendix 10 of the Radio Regulations to convey information related to emissions from both GSO and non-GSO space stations including geolocation information	7, issue G	3
RA.2188		Rep. <a href="#">ITU-R RA.2188-0</a>	Power flux-density and e.i.r.p. levels potentially damaging to radio astronomy receivers	9.1, issue 9.1.9	3
RA.2189		Rep. <a href="#">ITU-R RA.2189-0</a>	Sharing between the radio astronomy service and active services in the frequency range 275-3 000 GHz <b>Note - This Report has been published only in English</b>	1.15	1
RS.2194		Rep. <a href="#">ITU-R RS.2194-0</a>	Passive bands of scientific interest to EESS/SRS from 275 to 3 000 GHz <b>Note - This Report has been published only in English</b>	1.15	1
M.2201		Rep. <a href="#">ITU-R M.2201-0</a>	Utilization of the 495-505 kHz band by the maritime mobile service for the digital broadcasting of safety and security related information from shore-to-ships	1.8	5
M.2224		Rep. <a href="#">ITU-R M.2224-0</a>	System design guidelines for wide area sensor and/or actuator network (WASN) systems	9.1, issue 9.1.8	2
M.2227-1		Rep. <a href="#">ITU-R M.2227-2</a>	Use of multiple gigabit wireless systems in frequencies around 60 GHz	1.13	2
M.2228		Rep. <a href="#">ITU-R M.2228-1</a>	Advanced intelligent transport systems (ITS) radiocommunications	1.12	1
F.2239		Rep. <a href="#">ITU-R F.2239-0</a>	Coexistence between fixed service operating in 71-76 GHz, 81-86 GHz and 92-94 GHz bands and passive services	9.1, issue 9.1.9	3
F.2240		Rep. <a href="#">ITU-R F.2240-0</a>	Interference analysis modelling for sharing between HAPS gateway links in the fixed service and other systems/services in the range 5 850-7 075 MHz	1.14	1

ITU-R Series	Report number*	Latest publication	Report title	Agenda item	CPM chapter
M. 2292		Rep. <a href="#">ITU-R M.2292-0</a>	Characteristics of terrestrial IMT-Advanced systems for frequency sharing/interference analyses	9.1, issues 9.1.1 & 9.1.2	2 3
SM. 2303-2		Rep. <a href="#">ITU-R SM.2303-2</a>	Wireless power transmission using technologies other than radio frequency beam	9.1, issue 9.1.6	6
SA. 2312		Rep. <a href="#">ITU-R SA.2312-0</a>	Characteristics, definitions and spectrum requirements of nanosatellites and picosatellites, as well as systems composed of such satellites	7, issue M	3
M. 2320		Rep. <a href="#">ITU-R M.2320-0</a>	Future technology trends of terrestrial IMT systems	1.13	2
RS. 2336		Rep. <a href="#">ITU-R RS.2336-0</a>	Consideration of the frequency bands 1 375-1 400 MHz and 1 427-1 452 MHz for the mobile service – Compatibility with systems of the Earth exploration-satellite service within the 1 400-1 427 MHz frequency band	9.1, issue 9.1.9	3
SA. 2348		Rep. <a href="#">ITU-R SA.2348-0</a>	Current practice and procedures for notifying space networks currently applicable to nanosatellites and picosatellites	7, issue M	3
SM. 2352		Rep. <a href="#">ITU-R SM.2352-0</a>	Technology trends of active services in the frequency range 275-3 000 GHz	1.15	1
S. 2361		Rep. <a href="#">ITU-R S.2361-0</a>	Broadband access by fixed-satellite service systems	9.1, issue 9.1.9	3
M. 2369		Rep. <a href="#">ITU-R M.2369-0</a>	Use of non-geostationary orbit mobile satellite systems to enhance maritime safety	1.8	5
M. 2370		Rep. <a href="#">ITU-R M.2370-0</a>	IMT Traffic estimates for the years 2020 to 2030	1.13	2
M. 2376		Rep. <a href="#">ITU-R M.2376-0</a>	Technical feasibility of IMT in bands above 6 GHz	1.13	2
BT. 2387		Rep. <a href="#">ITU-R BT.2387-0</a>	Spectrum/frequency requirements for bands allocated to broadcasting on a primary basis	1.1	5
BO. 2397		Rep. <a href="#">ITU-R BO.2397-0</a>	Satellite transmission for UHDTV satellite broadcasting	7, issue J	3
M. 2412		Rep. <a href="#">ITU-R M.2412-0</a>	Guidelines for evaluation of radio interface technologies for IMT-2020	1.13	2
F. 2416		Rep. <a href="#">ITU-R F.2416-0</a>	Technical and operational characteristics and applications of the point-to-point fixed service applications operating in the frequency band 275-450 GHz	1.15	1

ITU-R Series	Report number*	Latest publication	Report title	Agenda item	CPM chapter
M.2417		Rep. <a href="#">ITU-R M.2417-0</a>	Technical and operational characteristics of land-mobile service applications in the frequency range 275-450 GHz	1.15	1
M.2418		Rep. <a href="#">ITU-R M.2418-0</a>	Description of Railway Radiocommunication Systems between Train and Trackage (RSTT)	1.11	1
SM.2423		Rep. <a href="#">ITU-R SM.2423-0</a>	Technical and operational aspects of low-power wide-area networks for machine-type communication and the Internet of Things in frequency ranges harmonised for SRD operation	9.1, issue 9.1.8	2
SM.2424		Rep. <a href="#">ITU-R SM.2424-0</a>	Measurement techniques and new technologies for satellite monitoring	9.1, issue 9.1.7	6

**6 List of draft new (DN) or draft revised (DR) ITU-R Reports (may include preliminary draft new (PDN) or revised (PDR) ITU-R Reports and working documents toward preliminary draft new (WDPDN) or revised (WDPDR) ITU-R Reports)**

ITU-R Series	Report draft number*	Available document / status	Report title	Agenda item	CPM chapter
RS.	[275-450 GHz CHARS]	PDN Rep. ITU-R RS.[275-450GHZ CHARS] (Doc. <a href="#">7C/288</a> , <a href="#">Annex 13</a> )	Technical and operational characteristics of EESS (passive) systems in the frequency range 275-450 GHz	1.15	1
SM.	[275-450GHz_SHARING]	PDN Rep. ITU-R SM.[275-450GHZ_SHARING] (Doc. <a href="#">1A/340</a> , <a href="#">Annex 3</a> )	Sharing and compatibility studies between land-mobile, fixed and passive services in the frequency range 275-450 GHz	1.15	1
SA.	[400 MHz-LIMITS]	PDN Rep. ITU-R SA.[400 MHz-LIMITS] (Doc. <a href="#">7B/326</a> , <a href="#">Annex 12</a> )	To consider establishing in-band power limits for earth stations operating in the frequency ranges 399.9-400.05 MHz and 401-403 MHz within the MSS, EESS and MetSat services	1.2	4
SA.	[460 MHz METSAT-EESS]	PDN Rep. ITU-R SA.[460 MHz METSAT-EESS] (Doc. <a href="#">7B/326</a> , <a href="#">Annex 4</a> )	Studies related to proposed change in 460-470 MHz secondary allocation for METSAT (space-to-Earth) to primary and addition of primary allocation to EESS (space-to-Earth)	1.3	4

ITU-R Series	Report draft number*	Available document / status	Report title	Agenda item	CPM chapter
S.	[50/40 GSO-NGSO SHARING]	PDN Rep. ITU-R S.[50/40 GSO-NGSO SHARING] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 4</a> )	Sharing between 50/40 GHz GSO networks and non-GSO systems	1.6	3
S.	[50/40 NGSO-NGSO SHARING]	WDPDN Rep. ITU-R S.[50/40 NGSO-NGSO SHARING] (Document <a href="#">4A/826</a> , <a href="#">Annex 10</a> )	Study of mitigation techniques between non-GSO FSS systems in the bands 36-37 GHz and 50.2-50.4 GHz	1.6	3
	[50/40 GHz S.ADJACENT BAND STUDIES]	WDPDN Rep. ITU-R S.[50/40 GHz ADJACENT BAND STUDIES] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 11</a> )	Protection of EESS (passive) and RAS systems from non-GSO fixed satellite systems operating in the 37.5-42.5 GHz, 47.2 50.2 GHz and 50.4-51.4 GHz frequency bands	1.6	3
	S. [AGENDA ITEM 1.5]	WDPDN Rep. ITU-R S.[AGENDA ITEM 1.5] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 12</a> )	Operation of earth stations in motion (ESIM) communicating with geostationary space stations in the fixed-satellite service allocations at 17.7-19.7 GHz and 27.5-29.5 GHz	1.5	3
M.	[AMATEUR_50_MHZ]	WDPDN Rep. ITU-R M.[AMATEUR_50_MHZ] (Doc. <a href="#">5A/650</a> , <a href="#">Annex 14</a> )	Spectrum needs for the amateur service in the frequency band 50-54 MHz in Region 1 and sharing with mobile, fixed, radiolocation and broadcasting services	1.1	5
M.	[AMRD]	WDPDN Rep. ITU-R M.[AMRD] (Doc. <a href="#">5B/305</a> , <a href="#">Annex 22</a> )	Autonomous maritime radio devices	1.9.1	5
BO.	[AP30.ANNEX7]	WDPDN Rep. ITU-R BO.[AP30.ANNEX7] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 18</a> )	Assessment on limitations mentioned in Annex 7 to RR Appendix <b>30 (Rev.WRC-15)</b> in the 11.7-12.7 GHz band for the GSO broadcasting-satellite service in all Regions	1.4	3
	S. [ESIM]	WDPDN Rep. ITU-R S.[ESIM] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 15</a> )	Earth stations in motion (ESIM) compatibility with non-GSO MSS feeder links in the bands 19.3-19.7 GHz and 29.1-29.5 GHz	1.5	3
	S./F. [ESIM-FS]	WDPDN Rep. ITU-R S./F.[ESIM-FS] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 13</a> )	Sharing and compatibility between earth stations in motion operating with geostationary FSS networks and current and planned stations of the FS in the frequency bands 27.5-29.5 GHz and 17.7-19.7 GHz	1.5	3
	S./M. [ESIM-MS]	WDPDN Rep. ITU-R S./M.[ESIM-MS] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 14</a> )	Sharing and compatibility between earth stations in motion operating with geostationary FSS networks and current and planned stations of the MS in the frequency band 27.5-29.5 GHz	1.5	3

ITU-R Series	Report draft number*	Available document / status	Report title	Agenda item	CPM chapter
M.[GADSS]		PDN Rep. ITU-R M.[GADSS] (Doc. <a href="#">5B/538</a> , <a href="#">Annex 21</a> )	The global aeronautical distress and safety system	1.10	5
M.[GMDSS-SATREG]		PDN Rep. ITU-R M.[GMDSS-SATREG] (Doc. <a href="#">4C/417</a> , <a href="#">Annex 2</a> )	Introduction of additional mobile-satellite service systems into the GMDSS	1.8	5
F.[HAPS-SPECTRUM-NEEDS]		PDN Rep. ITU-R F.[HAPS-SPECTRUM-NEEDS] (Doc. <a href="#">5C/531</a> , <a href="#">Annex 12</a> )	Spectrum needs of high altitude platform stations (HAPS) broadband links operating in the fixed service	1.14	1
F.[HAPS-6 GHz]		PDN Rep. ITU-R F.[HAPS-6 GHz] (Doc. <a href="#">5C/531</a> , <a href="#">Annex 15</a> )	Sharing and compatibility studies of HAPS systems in the 6 440-6 520 MHz frequency range	1.14	1
F.[HAPS-21 GHz]		PDN Rep. ITU-R F.[HAPS-21 GHz] (Doc. <a href="#">5C/531</a> , <a href="#">Annex 16</a> )	Sharing and compatibility studies of HAPS systems in the 21.4-22 GHz frequency range	1.14	1
F.[HAPS-25 GHz]		PDN Rep. ITU-R F.[HAPS-25 GHz] (Doc. <a href="#">5C/531</a> , <a href="#">Annex 17</a> )	Sharing and compatibility studies of HAPS systems in the 24.25-27.5 GHz frequency range	1.14	1
F.[HAPS-31 GHz]		PDN Rep. ITU-R F.[HAPS-31 GHz] (Doc. <a href="#">5C/531</a> , <a href="#">Annex 18</a> )	Sharing and compatibility studies of HAPS systems in the 27.9-28.2 GHz and 31.0-31.3 GHz frequency ranges	1.14	1
F.[HAPS-39 GHz]		PDN Rep. ITU-R F.[HAPS-39 GHz] (Doc. <a href="#">5C/531</a> , <a href="#">Annex 19</a> )	Sharing and compatibility studies of HAPS systems in the 38-39.5 GHz frequency range	1.14	1
F.[HAPS-47 GHz]		PDN Rep. ITU-R F.[HAPS-47 GHz] (Doc. <a href="#">5C/531</a> , <a href="#">Annex 20</a> )	Sharing and compatibility studies of HAPS systems in the 47.2-47.5 and 47.9-48.2 GHz frequency range	1.14	1
M. [IMT&BSS COMPATIBILITY]		WDPDN Rep. ITU-R M.[IMT&BSS COMPATIBILITY] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 19</a> )	Compatibility studies between IMT systems and BSS (sound) systems in the band 1 452-1 492 MHz in different countries in Regions 1 and 3	9.1, issue 9.1.2	3
M. [IMT.MTC]		PDN Rep. ITU-R M.[IMT.MTC] (Doc. <a href="#">5D/1011</a> , <a href="#">Chapter 03</a> )	The use of the terrestrial component of International Mobile Telecommunication (IMT) for Narrowband and Broadband Machine-Type Communication	9.1, issue 9.1.8	2
M. [NON_IMT.MTC_USAGE]		PDN Rep. ITU-R M.[NON_IMT.MTC_USAGE] (Doc. <a href="#">5A/844</a> , <a href="#">Annex 34</a> )	Technical and operational aspects of Internet of Things and Machine-to-Machine applications by systems in the Mobile Service (excluding IMT)	9.1, issue 9.1.8	2
M. [ITS USAGE]		[WD]PDN Rep. ITU-R M.[ITS USAGE] (Doc. <a href="#">5A/844</a> , <a href="#">Annex 29</a> )	Intelligent transport systems (ITS) usage in ITU Member States	1.12	1

ITU-R Series	Report draft number*	Available document / status	Report title	Agenda item	CPM chapter
[LESIM-FS]		WDPDN Rep. ITU-R [LESIM-FS] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 16</a> )	Statistical methodologies to estimate the interference from land earth stations in motion (L-ESIM) communicating with geostationary space stations in the fixed satellite service into fixed service (FS) stations operating in the frequency band 27.5-29.5 GHz	1.5	3
[LESIM-MS]		WDPDN Rep. ITU-R [LESIM-MS] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 17</a> )	Statistical methodologies to estimate the interference from land earth stations in motion (L-ESIM) communicating with geostationary space stations in the fixed-satellite service into mobile service (MS) stations operating in the frequency band 27.5-29.5 GHz	1.5	3
[MSS&IMT-M. ADVANCED SHARING]		WDPDN [Rec. or Rep.] ITU-R M.[MSS&IMT-ADVANCED SHARING] (Doc. <a href="#">4C/417</a> , <a href="#">Annex 4</a> )	Coexistence and compatibility study between the terrestrial component and the satellite component of IMT in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz in different countries	9.1, issue 9.1.1	2
M.[NEW_MARNUM]		WDPDN Rep. ITU-R M.[NEW_MARNUM] (Doc. <a href="#">5B/411</a> , <a href="#">Annex 23</a> )	Autonomous maritime radio devices	1.9.1	5
S.[NGSO_6/4-GHz]		WDPDN Rep. ITU-R S.[NGSO_6/4-GHz] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 23</a> )	Technical and regulatory studies for 6/4 GHz non-GSO FSS sharing	9.1, issue 9.1.3	3
S. <sup>[NGSO_BIU+MILESTONES]</sup>		WDPDN Rep. ITU-R S.[NGSO_BIU+MILESTONES] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 20</a> )	Studies relating to the bringing into use of frequency assignments for all non-GSO satellite systems, and consideration of a milestone-based deployment approach for non-GSO satellite systems in specific bands and services	7	3
S. <sup>[NGSO FSS 6/4 GHz SHARING]</sup>		WDPDN Rep. ITU-R S.[NGSO FSS 6/4 GHz SHARING] (Doc. <a href="#">4A/364</a> , <a href="#">Annex 16</a> )	Sharing between non- geostationary-satellite orbit systems in the fixed-satellite service and existing and planned systems in the terrestrial and space services allocated on a primary basis in the frequency bands 3 700-4 200 MHz, 4 500-4 800 MHz, 5 925-6 425 MHz and 6 725-7 025 MHz	9.1, issue 9.1.3	3
M.[RAS-COMPAT]		WDPDN Rep. ITU-R M.[RAS-COMPAT] (Doc. <a href="#">4C/417</a> , <a href="#">Annex 6</a> )	Unwanted emissions in the RAS band from space-to-Earth transmissions from MSS satellites	1.8	5
M.[RLAN REQ-PAR]		WDPDN Rep. ITU-R M.[RLAN REQ-PAR] (Doc. <a href="#">5A/650</a> , <a href="#">Annex 21</a> )	Technical characteristics and operational requirements of WAS/RLAN in the 5 GHz frequency range	1.16	2



ITU-R Series	Report draft number*	Available document / status	Report title	Agenda item	CPM chapter
M.[RSTT.USAGE]		PDN Rep. ITU-R ITU-R M.[RSTT.USAGE] (Doc. <a href="#">5A/844</a> , <a href="#">Annex 14</a> )	Current and future usage of railway radiocommunication systems between train and trackside (RSTT)	1.11	1
	[SHORT DURATION SA.NGSO – REQUIREMENTS]	DN Report ITU-R SA.[SHORT DURATION NGSO – REQUIREMENTS] (Doc. <a href="#">7/72</a> )	Studies to accommodate spectrum requirements in the space operation service for non-geostationary satellites with short duration missions	1.7	4
	[SHORT DURATION SA.NGSO – CHARACTERISTICS]	DN Report ITU-R SA.[SHORT DURATION NGSO – CHARACTERISTICS] (Doc. <a href="#">7/73</a> )	Technical characteristics for telemetry, tracking and command in the space operation service below 1 GHz for non-GSO satellites with short duration missions	1.7	4
	[SHORT DURATION SA.NGSO – SHARING STUDIES]	PDN Report ITU-R SA.[SHORT DURATION NGSO – SHARING STUDIES] (Doc. <a href="#">7B/326</a> , <a href="#">Annex 5</a> )	Studies on the suitability of existing allocations to the space operation service below 1 GHz and additional sharing studies on possible new and/or upgraded allocations	1.7	4
RS.	[Space_Weather_Sensors]	PDN Rep. ITU-R RS.[SPACE_WEATHER_SENSORS] (Doc. <a href="#">7C/288</a> , <a href="#">Annex 5</a> )	Technical and operational characteristics of RF-based space weather sensors	10	6
	S.[SPECTRUM_NEEDS]	DN Rep. ITU-R S.[SPECTRUM_NEEDS] (Doc. <a href="#">4A/826</a> ( <a href="#">Attachment</a> ))	Spectrum needs for the FSS in the 51.4-52.4 GHz band	9.1, issue 9.1.9	3
	S.[SPECTRUM_SHARING]	PDN Rep. ITU-R S.[SPECTRUM_SHARING] (Doc. <a href="#">4A/826</a> , <a href="#">Annex 3</a> )	Sharing with incumbent services in the 51.4-52.4 GHz band and adjacent and nearby bands	9.1, issue 9.1.9	3
M.	[SUBORBITAL VEHICLES]	WDPDN Rep. ITU-R M.[SUBORBITAL VEHICLES] (Doc. <a href="#">5B/538</a> , <a href="#">Annex 24</a> )	Radiocommunications for suborbital vehicles	9.1,9.1.4	5
M.	[VDES-SAT]	WDPDN Rep. ITU-R M.[VDES-SAT] (Doc. <a href="#">5B/538</a> , <a href="#">Annex 27</a> )	Technical characteristics and feasibility assessment of the satellite component for the VHF data exchange system in the VHF maritime mobile band	1.9.2	5

ITU-R Series	Report draft number*	Available document / status	Report title	Agenda item	CPM chapter
RS.[VHF_SOUNDER]		PDN Rep. ITU-R RS.[VHF SOUNDER] (Doc. <a href="#">7C/288</a> , <a href="#">Annex 7</a> )	Preliminary results of sharing studies between a 45 MHz radar sounder and incumbent fixed, mobile, broadcasting and space research services operating in the 40-50 MHz frequency range	10	6
SM.[WPT-SPEC-MNGM]		WDPDN Rep. ITU-R SM.[WPT-SPEC-MNGM] (Doc. <a href="#">1B/303</a> , <a href="#">Annex 4</a> )	[Methodology for spectrum management of wireless power transmission (WPT)]	9.1, issue 9.1.6	6

## 7 Other ITU publications

Reference*	Publication	Title	Agenda item	CPM chapter
Annex 1 to the Task Group 5/1 Chairman's Report	Document <a href="#">5-1/478</a> ( <a href="#">Annex 1</a> )	System parameters and propagation models to be used in sharing and compatibility studies	1.13	2
BR IFIC 2081	BR IFIC No. 2081	BR International Frequency Information Circular	1.8	5
BR IFIC 2418	BR IFIC No. 2418	BR International Frequency Information Circular	1.8	5
BR IFIC N° 2788	<a href="#">BR IFIC No. 2788</a> (2015)	BR International Frequency Information Circular (BR IFIC) – Space Services: <i>SRS – Removal</i>	1.6	3
BR IFIC N° 2833	<a href="#">BR IFIC No. 2833</a> (2016)	BR International Frequency Information Circular (BR IFIC) – Space Services: <i>BR Soft and SRS V8-BETA</i>	7, issue H	3
Annex 9 to BR Administrative Circular CA/226	<a href="#">CA/226</a>	Results of the first session of the Conference Preparatory Meeting for WRC-19 (CPM19-1)	1.13	2
CA/226				
CR/172	Circular Letter <a href="#">CR/172</a>	Coordination request special section (CR/C)	7, issue D	3
ITU Art. 44	Article 44 of the <a href="#">ITU Constitution</a>	Use of the Radio-Frequency Spectrum and of the Geostationary-Satellite and Other Satellite Orbits	1.4 7, issue F	3
PP Resolution 71	Resolution <a href="#">71</a> (Rev. Busan, 2014)	Strategic plan for the Union for 2016-2019	1.4	3
PP Resolution 86	Resolution <a href="#">86</a> (Rev. Marrakesh, 2002)	Advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks	7	3

Reference*	Publication	Title	Agenda item	CPM chapter
Question ITU-R 77-7/5	Question <a href="#">ITU-R 77-7/5</a>	Consideration of the needs of developing countries in the development and implementation of IMT	1.13	2
Question ITU-R 229/5	Question <a href="#">ITU-R 229-4/5</a>	Further development of the terrestrial component of IMT	1.13	2
R-HDB-20	<a href="#">DSB Handbook</a> (2002)	Terrestrial and satellite digital sound broadcasting to vehicular, portable and fixed receivers in the VHF/UHF bands	9.1, issue 9.1.2	3
RRB17-1/2	<a href="#">Document RRB17-1/2</a>	Submission by the Administrations of Latvia, Lithuania, The Netherlands, Spain and Switzerland concerning the Iridium satellite system (HIBLEO-2) causing harmful interference to the radio astronomy service in the frequency band 1 610.6-1 613.8 MHz	1.8	5
RRB17-1/5	<a href="#">Document RRB17-1/5</a>	Submission from the Administration of the United States in response to Document RRB17-1/2, "Submission by the Administrations of Latvia, Lithuania, The Netherlands, Spain and Switzerland concerning the Iridium satellite system (HIBLEO-2) causing harmful interference to the radio astronomy service in the frequency band 1 610.6-1 613.8 MHz"	1.8	5
R-HDB-20	<a href="#">DSB Handbook</a> (2002)	Terrestrial and satellite digital sound broadcasting to vehicular, portable and fixed receivers in the VHF/UHF bands	9.1, issue 9.1.2	3

## 8 Non-ITU publications

Reference*	Publication	Title	Agenda item	CPM chapter
ConOps version 6.0	<a href="#">ConOps version 6.0</a>	Global Aeronautical Distress & Safety System (GADSS)	1.10	5
MSC.434(98)	<a href="#">IMO Resolution MSC.434(98)</a>	Performance Standards for a Ship Earth Station for use in the GMDSS (June 2017)	1.8	5
NAVTEX Manual	<a href="#">NAVTEX Manual</a>	NAVTEX Manual	1.8	5
SOLAS, 1974	<a href="#">International Convention for the Safety of Life at Sea, 1974</a> (amendments 1988)	International Convention for the Safety of Life at Sea, 1974	1.8	5
SOLAS, 1974			1.9.1	5

<b>Reference*</b>	<b>Publication</b>	<b>Title</b>	<b>Agenda item</b>	<b>CPM chapter</b>
SOLAS, 1974			1.10	5

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