Conference Preparatory Meeting for WRC-15
Geneva, 23 March - 2 April 2015

PLENARY MEETING

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Director, Radiocommunication Bureau

DRAFT CPM REPORT

Attached please find the draft CPM Report to WRC-15 for consideration during the second session of the 2015 Conference Preparatory Meeting (CPM15-2) to be held in Geneva, 23 March – 2 April 2015 (see Administrative Circular CA/216 of 8 August 2014). 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-15, according to its agenda as contained in ITU Council Resolution 1343 (C12).

The structure of the Report is in accordance with the decisions of the first session of the 2015 Conference Preparatory Meeting (CPM15-1), (Geneva, 20 to 21 February 2012), as reported in Administrative Circular CA/201 of 19 March 2012 and complemented by its Addendum 1 of 15 January 2013.

In accordance with Resolution ITU-R 2-6 and its guidelines, the draft CPM Report was consolidated and compiled at the CPM Management Team meeting (Geneva, 1-5 September 2014). 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 the second session of the CPM:

- the abbreviations used in the draft CPM Report are listed at the beginning of the draft CPM Report; radiocommunication service 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 CPM15-2 or, at the latest, WRC-15. Similarly, any case in which the approval process has not been successfully completed will be reported. It is noted that CCIR Report 455-5 is also included for information in the above-mentioned list.
- it should be noted that the texts dealing with regulatory and procedural matters is being forwarded to the Special Committee for further consideration at its meeting in

December 2014. The outcome of the Special Committee on the matter will be submitted as a contribution to CPM15-2 (Resolution ITU-R 2 refers).

- to limit the number of pages in contributions to the CPM, 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 will be provided 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;
- the sections titled "Summary of technical and operational studies, including a list of relevant ITU-R Recommendations" may also contain references to other ITU-R publications such as Reports;
- in general, the word "frequency" has to be used in references to bands or ranges.

The CPM-15 Management Team identified the following issues:

- for Chapter 1, agenda item 1.1,
  - section 1/1.1/1, the text in the first bullet under the Executive Summary that summarizes the spectrum requirements for IMT is unclear in regards to the association between the spectrum requirement range and the lower and higher user density settings;
  - section 1/1.1/4.1.1.1.1.1.2.1, the meaning of the term "(N-14)" needs to be clarified;
  - upon reviewing the examples provided in section 1/1.1/6 for new footnotes for a primary mobile service allocation, it was noted that there are potential candidate frequency bands in which a secondary mobile service allocation already exists; in these cases, the preface "*Different category of service*:" would be used instead of '*Additional allocation:*';
  - upon reviewing the examples provided in section 1/1.1/6 for new, or modifications to existing, footnotes, it was noted that there were inconsistencies in the use of the phrase "as the case may be" and its intention; a decision was taken to delete this phrase in footnotes that are identifying a band, or portions of it, for IMT in line with existing IMT footnotes; in cases where the proposed footnote is for an allocation to the mobile service, there is a clarifying note that provides guidance to the phrase "or portions of that band as the case may be"; this note indicates that the proposed footnote may be for an allocation to the entire candidate frequency band or to a portion of that band, noting that the frequencies for the portion of the band must be specified exactly; given this guidance, the text "or portions of the band as the case may be" is not meant to remain in the footnote but instead was put in square brackets and italicized to indicate that it is a placeholder for the exact frequencies to which the allocation is made;
  - sections 1/1.1/6.17 and 1/1.1/6.18 contain no text and are related to two frequency bands for which currently the only method is no change; as such, there would be no regulatory example to provide;

- for Chapter 2, agenda item 1.14, extensive edits were made;
- for Chapter 3, agenda item 1.5, section 3/1.5/4, it was noted that no texts with regard to the analysis of the results of studies was developed as no agreement on this issue was reached by the responsible group; text for this section needs to be developed in line with the requirements of Resolution ITU-R 2-6;
- for Chapter 3, agenda item 1.16, there are several references to the mobile-satellite service and the maritime mobile-satellite service, which need to be clarified;
- for Chapter 4, Sub-Chapter 4.1, agenda item 1.6.1, edits were made to sections 4.1/1.6.1/4.3.2 and 4.1/1.6.1/4.6.2.

D R A F T

CPM Report on technical, operational and regulatory/procedural matters to be considered by the 2015 World Radiocommunication Conference

GENEVA, 2014

Cross-reference between the WRC-15 agenda items and the chapters or sub-chapters of the draft CPM Report

WRC-15 agenda item		Chapter or sub-chapter of the draft CPM Report to WRC-15
1	on the basis of proposals from administrations, taking account of the results of WRC-12 and the Report of the Conference Preparatory Meeting, and with due regard to the requirements of existing and future services in the bands under consideration, to consider and take appropriate action in respect to the following items:	-
1.1	to consider additional spectrum allocations to the mobile service on a primary basis and identification of additional frequency bands for International Mobile Telecommunications (IMT) and related regulatory provisions, to facilitate the development of terrestrial mobile broadband applications, in accordance with Resolution **233 (WRC-12);**	1
1.2	to examine the results of ITU-R studies, in accordance with Resolution **232 (WRC-12)**, on the use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 and take the appropriate measures.	1
1.3	to review and revise Resolution **646 (Rev.WRC-12)** for broadband public protection and disaster relief (PPDR), in accordance with Resolution **648 (WRC-12)**;	1
1.4	to consider possible new allocation to the amateur service on a secondary basis within the band 5 250-5 450 kHz in accordance with Resolution **649 (WRC-12)**;	1
1.5	to consider the use of frequency bands allocated to the fixed-satellite service not subject to Appendices **30**, **30A** and **30B** for the control and non-payload communications of unmanned aircraft systems (UAS) in non-segregated airspaces, in accordance with Resolution **153 (WRC-12)**;	3
1.6	to consider possible additional primary allocations:	-
	1.6.1 to the fixed-satellite service (Earth-to-space and space-to-Earth) of 250 MHz in the range between 10 GHz and 17 GHz in Region 1;	4.1
	1.6.2 to the fixed-satellite service (Earth-to-space) of 250 MHz in Region 2 and 300 MHz in Region 3 within the range 13-17 GHz;	4.1
	and review the regulatory provisions on the current allocations to the fixed-satellite service within each range, taking into account the results of ITU-R studies, in accordance with Resolutions **151 (WRC-12)** and **152 (WRC-12)**, respectively;	-
1.7	to review the use of the band 5 091-5 150 MHz by the fixed-satellite service (Earth-to-space) (limited to feeder links of the non-geostationary mobile-satellite systems in the mobile-satellite service) in accordance with Resolution **114 (Rev.WRC-12)**;	4.1
1.8	to review the provisions relating to earth stations located on board vessels (ESVs), based on studies conducted in accordance with Resolution **909 (WRC-12)**;	4.1
1.9	to consider, in accordance with Resolution **758 (WRC-12)**:	-
	1.9.1 possible new allocations to the fixed-satellite service in the frequency bands 7 150-7 250 MHz (space-to-Earth) and 8 400-8 500 MHz (Earth-to-space), subject to appropriate sharing conditions;	4.1
	1.9.2 the possibility of allocating the bands 7 375-7 750 MHz and 8 025-8 400 MHz to the maritime-mobile satellite service and additional regulatory measures, depending on the results of appropriate studies;	4.2

WRC-15 agenda item		Chapter or sub-chapter of the draft CPM Report to WRC-15
1.10	to consider spectrum requirements and possible additional spectrum allocations for the mobile-satellite service in the Earth-to-space and space-to-Earth directions, including the satellite component for broadband applications, including International Mobile Telecommunications (IMT), within the frequency range from 22 GHz to 26 GHz, in accordance with Resolution **234 (WRC-12)**;	4.2
1.11	to consider a primary allocation for the Earth exploration-satellite service (Earth-to-space) in the 7-8 GHz range, in accordance with Resolution **650 (WRC-12)**;	2
1.12	to consider an extension of the current worldwide allocation to the Earth exploration-satellite (active) service in the frequency band 9 300-9 900 MHz by up to 600 MHz within the frequency bands 8 700-9 300 MHz and/or 9 900-10 500 MHz, in accordance with Resolution **651 (WRC-12)**;	2
1.13	to review No. **5.268** with a view to examining the possibility for increasing the 5 km distance limitation and allowing space research service (space-to-space) use for proximity operations by space vehicles communicating with an orbiting manned space vehicle, in accordance with Resolution **652 (WRC-12)**;	2
1.14	to consider the feasibility of achieving a continuous reference time-scale, whether by the modification of coordinated universal time (UTC) or some other method, and take appropriate action, in accordance with Resolution **653 (WRC-12)**;	2
1.15	to consider spectrum demands for on-board communication stations in the maritime mobile service in accordance with Resolution **358 (WRC-12)**;	3
1.16	to consider regulatory provisions and spectrum allocations to enable possible new Automatic Identification System (AIS) technology applications and possible new applications to improve maritime radiocommunication in accordance with Resolution **360 (WRC-12)**;	3
1.17	to consider possible spectrum requirements and regulatory actions, including appropriate aeronautical allocations, to support wireless avionics intra-communications (WAIC), in accordance with Resolution **423 (WRC-12)**;	3
1.18	to consider a primary allocation to the radiolocation service for automotive applications in the 77.5-78.0 GHz frequency band in accordance with Resolution **654 (WRC-12)**;	3
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-03)**, 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)**;	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 **95 (Rev.WRC-07)**, 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
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)** to facilitate rational, efficient, and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit;	5

	WRC-15 agenda item	Chapter or sub-chapter of the draft CPM Report to WRC-15
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 **26 (Rev.WRC-07)**;	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-12;	-
	9.1.1* Res. **205 (Rev.WRC-12)** − Protection of the systems operating in the mobile-satellite service in the band 406-406.1 MHz	5
	9.1.2* Resolution **756 (WRC-12)** − Studies on possible reduction of the coordination arc and technical criteria used in application of No. **9.41** in respect of coordination under No. **9.7**	5
	9.1.3* Resolution **11 (WRC-12)** − Use of satellite orbital positions and associated frequency spectrum to deliver international public telecommunication services in developing countries	5
	9.1.4* Resolution **67 (WRC-12)** − Updating and rearrangement of the Radio Regulations	6
	9.1.5* Resolution **154 (WRC-12)** − Consideration of technical and regulatory actions in order to support existing and future operation of fixed-satellite service earth stations within the band 3 400-4 200 MHz, as an aid to the safe operation of aircraft and reliable distribution of meteorological information in some countries in Region 1	5
	9.1.6* Resolution **957 (WRC-12)** − Studies towards review of the definitions of *fixed service*, *fixed station* and *mobile station*	6
	9.1.7* Resolution **647 (Rev. WRC-12)** − Spectrum management guidelines for emergency and disaster relief radiocommunication	6
	9.1.8* Resolution **757 (WRC-12)** − Regulatory aspects for nano- and picosatellites	5
	9.2 on any difficulties or inconsistencies encountered in the application of the Radio Regulations; and	-
	9.3 on action in response to Resolution **80 (Rev.WRC-07)**;	5
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

* Issue identified by CPM15-1 under WRC-15 agenda item 9.1.

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/ITU-R/go/rcpm-chp-rapporteurs).

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* Issue identified by CPM15-1 under WRC-15 agenda item 9.1.

List of abbreviations used in the draft CPM Report

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

Other abbreviations:

Abbreviations	Description
3DTV	three dimensional television
3GPP	Third Generation Project Partnership
ACLR	adjacent channel leakage ratio
ACS	adjacent channel selectivity
AGC	automatic gain control
A-GPS	Assisted Global Positioning System
AIS	automatic identification system
ALC	automatic level control
ALS	aircraft landing system
ANSPs	air navigation service providers
API	advance publication information
App.	Appendix of the RR
APT	Asia-Pacific Telecommunity
Art.	Article of the RR
ASDE-3	airport surveillance detection equipment
ASM	application specific messages
ATPC	automatic transmit power control
ATSC	Advanced Television Systems Committee
ATU	African Telecommunication Union
AWG	APT Wireless Group
BBIU	bringing back into use
BDT	Telecommunication Development Bureau
BIPM	International Bureau of Weights and Measures
BIU	bringing into use
BLOS	beyond line-of-sight
B-PPDR	broadband PPDR
BR	Radiocommunication Bureau
BR IFIC	International Frequency Information Circular
CAP	common alerting protocol
CCIR	Consultative Committee on International Radio
CCTF	Consultative Committee on Time and Frequency
CEPT	Conférence Européenne des Administrations des Postes et Télécommunications
C/(N+I)	carrier to noise plus interference ratio
CITEL	Inter-American Telecommunication Commission
COMPAT	compatibility
CNPC	command and non-payload communication (CNPC)
CPM	conference preparatory meeting
CTCSS	continuous tone coded squelch systems
DFS	dynamic frequency selection
DMR	digital mobile radio

Abbreviations	Description
DNS	Doppler navigation system
dPMR	digital private mobile radio
DRS	data relay satellite
DTH	direct-to-home
DTT	digital terrestrial television
DTTB	digital terrestrial television broadcasting
DUT1	the value of the predicted difference UT1 – UTC
DVB-T	terrestrial digital video broadcasting
ECC	Electronic Communications Committee
e.i.r.p.	effective isotropically radiated power
EPM	equivalent protection margin
e.r.p.	effective radiated power
ELT	emergency locator transmitters
ENG	electronic news gathering
EPIRB	emergency position indicating radio beacon
E-s	Earth-to-space
E/S	earth station
E/Ss	earth stations
ESA	European Space Agency
ESVs	earth stations on board vessels
ETC	United Nations Emergency Telecommunications Cluster
ETSI	European Telecommunication Standard Institute
EVA	extra-vehicular activity
FDMA	frequency division multiple access
FDOA	frequency difference of arrival
FDP	fractional degradation in performance
FEC	forward error-correction
FRF	frequency reuse factor
FSK	frequency-shift keying
FSR	fixed service receiver
GE06	Geneva 2006 Agreement
GLONASS	Global Navigation Satellite System
GMDSS	global maritime distress and safety system
GMT	Greenwich Mean Time
GNSS	global navigation satellite system
GPM	Global Precipitation Mission
GPS	Global Positioning System
GSO	geostationary-satellite orbit (see RR No. **1.190)**
HEO	highly elliptical Earth orbit
HF	high frequency
HGA	high gain antenna
HP	high power

Abbreviations	Description
HTS	high throughput satellite
IAU	International Astronomical Union
IB	in-band
ICAO	International Civil Aviation Organization
ICRC	International Committee of the Red Cross
ICT	information and communication technologies
IERS	International Earth Rotation and Reference Service
IFOV	instantaneous field of view
IMO	International Maritime Organization
IMT	International Mobile Telecommunications
I/N	interference to noise ratio
I/(N+I)	interference to noise plus interference ratio
IP	interference probability
ISDB-T	Integrated Services Digital Broadcasting − Terrestrial
ISM	industrial, scientific and medical (see RR No. **1.15)**
ISO	International Organization for Standardization
ISO-TC 37	International Standardization Organization − Technical Committee 37
ITS	intelligent transportation systems
ITU-R	ITU Radiocommunication Sector
IUGG	International Union for Geodesy and Geophysics
JAXA	Japan Aerospace Exploration Agency
JTG 4-5-6-7	Joint Task Group 4-5-6-7
LBT	listen before talk
LEO	Low Earth Orbit / low Earth orbit
LEOP	launch-and-early-orbit phase
LGA	low gain antenna
LNA	low noise amplifier
LNB	low noise block
LOS	line-of-sight
LTE	long-term evolution
LUF	lowest usable frequency
MBB	mobile broadband
MC	Monte Carlo
MCL	minimum coupling loss
MDGs	Millennium Development Goals
MEO	medium Earth orbit
MES	mobile earth station
MESA	mobility for emergency and safety applications
MGA	medium gain antenna
MIFR	Master International Frequency Register (or Master Register)
MLS	microwave landing system
MP	medium power

Abbreviations	Description
MUF	maximum usable frequency
NASA	National Aeronautics and Space Administration
NGSO	non geostationary-satellite orbit
OCHA	Office for the Coordination of Humanitarian Affairs (United Nations)
OOB	out-of-band
OOBE	out-of-band emission
PDN	preliminary draft new
pfd	power flux-density
PLB	personal locator beacon
PMP	point-to-multipoint
PMR2	precipitation measurement radar 2
PP	point-to-point
PPDR	public protection and disaster relief
PR	precipitation radar
PSD	power spectrum density
Rec.	Recommendation
Rep.	Report
Res.	Resolution
RF	radio frequency
RLAN	radio local area network
RLP	reception location probability
RoP	Rule of Procedure
RR	Radio Regulations
RRB	Radio Regulation Board
RSBN	radio systems for short-range navigation
SAB	services ancillary to broadcasting
SAP	services ancillary to production / programme-making
SARPs	standards and recommended practices
s-E	space-to-Earth
SIA	Satellite Industry Association
SI	International Systems of Units
SMATV	satellite master antenna television
SOLAS	International Convention for the Safety of Life at Sea
TAI	International Atomic Time
T-DAB	terrestrial digital audio broadcasting
TDD	time-division duplex
TDMA	time division multiple access
TDOA	time difference of arrival
TDR	Telecommunication for Disaster Relief
TIA	Telecommunications Industry Association
TIG	time-invariant gain
TRPC	Telecommunications Research Project Corporate

Abbreviations	Description
TT&C	tracking, telemetry and command
TV	television
TVG	time-variant gain
TW	time window
UA	unmanned aircraft
UACS	unmanned aircraft control station
UAE	United Arab Emirates
UE	user equipment
UHDTV	ultra high definition television
UHF	ultra high frequency
UT1	mean solar time of the prime meridian corrected for polar variation
UTC	Coordinated Universal Time
VDEL	VHF data link
VDES	VHF data exchange system
VPN	virtual private network
VSAT	very small aperture terminal
WAIC	wireless avionic intra-aircraft communications
WARC	World Administrative Radio Conference
WGET	(United Nations) Working Group on Emergency Telecommunications
WFP	World Food Programme
WMO	World Meteorological Organization
WRC	World Radiocommunication Conference
WTDC	World Telecommunication Development Conference
X-QAM	quadrature amplitude modulation (X states)

CHAPTER 1

Mobile and Amateur issues

(Agenda items 1.1, 1.2, 1.3, 1.4)

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AGENDA ITEM 1.1

(**JTG 4-5-6-7 / WP 4A, WP 4B, WP 4C, WP 5A, WP 5B, WP 5C, WP 5D, WP 6A, WP 7B, WP 7C, WP 7D**, (WP 1A), (WP 3K), (WP 3M))[1]

1.1 to consider additional spectrum allocations to the mobile service on a primary basis and identification of additional frequency bands for International Mobile Telecommunications (IMT) and related regulatory provisions, to facilitate the development of terrestrial mobile broadband applications, in accordance with Resolution ***233 (WRC-12)****;*

Resolution **233 (WRC-12)**: *Studies on frequency-related matters on International Mobile Telecommunications and other terrestrial mobile broadband applications*

1/1.1/1 Executive summary

Mobile communications including mobile broadband communications contribute positively to the economic and social developments of both developed and developing countries.

Section 1/1.1/2 provides the background for agenda item 1.1.

Section 1/1.1/3 describes:

- the results of studies that estimate the global spectrum requirements for International Mobile Telecommunications (IMT) to be in the range of 1 340 to 1 960 MHz for the year 2020, for lower user density settings and higher user density settings respectively;
- the results of ITU-R studies that indicate the minimum spectrum requirement for radio local area networks (RLAN) 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 for various frequency ranges.

Section 1/1.1/4 includes:

- analyses of the results of studies for various frequency ranges;
- a list of potential candidate frequency bands: 470-694/698 MHz, 1 350-1 400 MHz, 1 427-1 452 MHz, 1 452-1 492 MHz, 1 492-1 518 MHz, 1 518-1 525 MHz, 1 695-1 710 MHz, 2 700-2 900 MHz, 3 300-3 400 MHz, 3 400-3 600 MHz, 3 600-3 700 MHz, 3 700-3 800 MHz, 3 800-4 200 MHz, 4 400-4 500 MHz, 4 500-4 800 MHz, 4 800-4 990 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz, and 5 925-6 425 MHz.

Methods to satisfy the agenda item are included in section 1/1.1/5. Also, the regulatory and procedural considerations can be found in section 1/1.1/6.

1/1.1/2 Background

Mobile communications including mobile broadband communications contribute positively to the economic and social developments of both developed and developing countries. Many

[1] See the CPM15-1 Decision on the Establishment and Terms of Reference of Joint Task Group 4-5-6-7, Annex 10 to Administrative Circular CA/201.

administrations are investigating a wide range of applications and systems to bridge the digital divide using, inter alia, IMT and other terrestrial mobile broadband applications.

Since WRC-07, the demand for mobile broadband applications has been growing rapidly. Report ITU-R M.2243[2] provides detailed information on the global mobile broadband deployments and forecasts for IMT.

According to Resolution **233 (WRC-12)**, adequate and timely availability of spectrum with appropriate regulatory provisions, as well as improved technologies, are essential to support the future growth of IMT and other mobile broadband systems. Harmonized worldwide frequency bands and harmonized frequency arrangements for these systems are highly desirable in order to facilitate global roaming and the benefits of economies of scale.

Resolution **233 (WRC-12)** is also calling in particular for studies on future spectrum requirements and potential candidate frequency bands for IMT and other terrestrial mobile broadband applications. When considering potential candidate frequency bands, sharing and compatibility studies with services already having allocations in these frequency bands and in adjacent bands are necessary, taking into account the current and planned use of these frequency bands by existing services and their necessary protection.

1/1.1/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

1/1.1/3.1 Spectrum requirements

1/1.1/3.1.1 IMT

ITU figures[3] released in October 2013 and again in May 2014 show that the number of mobile-broadband subscriptions will reach 2.3 billion globally by the end of 2014, with fifty-five percent of these subscriptions in the developing world. Mobile cellular subscriptions will reach almost 7 billion by the end of 2014 and 3.6 billion of these will be in the Asia-Pacific region. Mobile broadband (delivered) over smartphones and tablets has become the fastest growing segment of the global ICT market and is now more affordable than fixed broadband.

Report ITU-R M.2290[4] provides the results of studies that estimate the global spectrum requirements for IMT to be in the range of 1 340 to 1 960 MHz for the year 2020, for lower and higher user density settings respectively (See also relevant parts of Report ITU-R M.2243[5]).

Since there are large differences between market developments and timing of network deployments around the world, the lower and higher user density settings of the estimate are meant to reflect the variation of the mobile data growth in different countries.

Report ITU-R M.2290 provides a global perspective on the future spectrum requirement estimate for terrestrial IMT. The input parameters in this Report are not country specific. In some countries, the spectrum requirements can be lower than the low estimate and in some other countries, the

[2] Report ITU-R M.2243 - “Assessment of the global mobile broadband deployments and forecasts for International Mobile Telecommunications”.

[3] ITU Press Release, 5 May 2014, ITU Releases 2014 ICT Figures http://www.itu.int/net/pressoffice/press_releases/2014/23.aspx.

[4] Report ITU-R M.2290 - “Future spectrum requirements estimate for terrestrial IMT”.

[5] Report ITU-R M.2243 - “Assessment of the global mobile broadband deployments and forecasts for International Mobile Telecommunications”.

spectrum requirements can be higher than the high estimate (see Annex 4 of Report ITU-R M.2290: Summary of national spectrum requirements in some countries). The methodology utilised in the Report can be used to estimate the total IMT spectrum requirements of a given country only if all the current input parameter values used in this report are replaced by the values which apply to that specific country (as described in the methodology itself). The introductory part of Report ITU-R M.2290 indicates that there is no information in the ITU on the use of the spectrum already identified for terrestrial IMT by a previous WRC.

The above mentioned global estimate is based on assumed traffic density figures intended to represent demand in the year 2020, taking into account the traffic off-loading from IMT networks to RLANs. However, if real traffic trends in 2020 differ from the assumptions (e.g., high density of users, high data rate applications), then the resulting spectrum estimates would differ from those provided.

Table 1/1.1/3-1 shows the "additional" spectrum requirements for IMT by the year 2020 per ITU Region based on the estimates from Report ITU-R M.2290.

When identifying additional frequency bands for IMT, the amount of spectrum already identified and currently used for IMT in each Region should be taken into account with a view to optimizing the use of these bands to increase the efficiency of spectrum use.

The demand for high bit rates, especially in densely populated areas, could be accommodated in higher frequency bands (e.g. above 6 GHz) than those currently being considered in studies, however the technical information required for compatibility studies has yet to be developed and these studies and proposals are being explored for future work, beyond WRC-15.

TABLE 1/1.1/3-1

Estimated additional spectrum requirements for IMT by the year 2020

User density settings	Total spectrum requirements (MHz)	Region 1**		Region 2		Region 3	
		Already identified (MHz)*	Additional spectrum requirements (MHz)*, ***	Already identified (MHz)	Additional spectrum requirements (MHz)***	Already identified (MHz)*	Additional spectrum requirements (MHz)*, ***
Low	1 340	981-1 181	**159-359**	951	**389**	885-1 177	**163-455**
High	1 960	981-1 181	**779-979**	951	**1 009**	885-1 177	**783-1 075**

Note *: The values in these columns have ranges since some of the frequency bands are identified for IMT only in some countries in Regions 1 and 3 as per RR Nos. **5.317A**, **5.430A**, **5.432A**, **5.432B**, and **5.433A**.

Note **: The values for Region 1 are based on the assumption that the lower edge of the frequency band identified in RR No **5.312A** remains at 694 MHz.

Note ***: The values in these columns do not necessarily represent additional spectrum requirements for some countries.

The ITU-R has indicated the following frequency ranges as suitable for possible future deployment of IMT: 410-430 MHz, 470-790 MHz[6], 1 000-1 700 MHz, 2 025-2 110 MHz, 2 200-2 290 MHz, 2 700-5 000 MHz, 5 350-5 470 MHz and 5 850-6 425 MHz.

[6] Note: The frequency band 694-790 MHz is under consideration for Region 1 in WRC-15 agenda item 1.2.

It should be noted that these suitable frequency ranges are indicated only from the view point of suitability for future development of IMT systems and not from the view point of: compatibility with the other services and applications in these bands; the current allocations in the Radio Regulations and the associated footnotes; the status of the use of the frequency band by the services to which they are allocated; or the planned use of these services.

It is noted that no single frequency range satisfies all the criteria required to deploy IMT systems, particularly in countries with diverse geography and population density; therefore, to meet the capacity and coverage requirements of IMT systems multiple frequency ranges would be needed.

1/1.1/3.1.2 Radio local area networks (RLAN)

The results of ITU-R studies indicate that the minimum spectrum requirement for RLAN using the 5 GHz frequency range in the year 2018 is estimated to be 880 MHz. This figure includes 455-580 MHz of spectrum already utilised by non-IMT mobile broadband applications operating in the 5 GHz frequency range resulting in 300-425 MHz of additional spectrum being required. The ranges above are due to some of the frequency bands being identified for RLAN only in some countries.

Currently, within the 5 GHz range, RLAN devices utilize the following frequency bands: 5 150-5 250 MHz, 5 250-5 350 MHz, 5 470-5 725 MHz and 5 725-5 850 MHz (in some countries). Pursuant to Resolution **229 (Rev.WRC-12)**, operation in the 5 150-5 250 MHz frequency band is limited to indoor use while dynamic frequency selection rules apply in the 5 250-5 350 MHz and 5 470-5 725 MHz frequency bands.

The ITU-R has indicated that the 5 350-5 470 MHz and 5 725-5 850 MHz frequency ranges would provide contiguous spectrum with the existing spectrum allocations for RLANs. It should be noted that these frequency ranges will not fully address estimated spectrum requirements for RLANs.

It should also be noted that these frequency ranges are not indicated from the view point of: compatibility with the other services and applications in these bands; the current allocations in the Radio Regulations and the associated footnotes; the status of the use of the frequency band by the services to which they are allocated; or the planned use of these services.

1/1.1/3.2 Sharing and compatibility studies

In accordance with *resolves to invite ITU-R* 2 of Resolution **233 (WRC-12)**, administrations proposed to study the frequency bands: 470-694/698 MHz, 1 300-1 525 MHz, 1 695-1 710 MHz, 2 025-2 110 MHz and 2 200-2 290 MHz, 2 700-2 900 MHz, 2 900-3 100 MHz, 3 300-3 400 MHz, 3 400-3 600 MHz, 3 600-4 200 MHz, 4 400-4 900 MHz, 4 800-5 000 MHz, 5 350-5 470 MHz, 5 725-5 850 MHz, 5 925-6 425 MHz.

As stated in *further resolves* 1 of Resolution **233 (WRC-12)** those studies were to:

> *"include sharing and compatibility studies with services already having allocations in the frequency bands and in adjacent bands, as appropriate, taking into account the current and planned use of these bands by the existing services, as well as the applicable studies already performed in ITU-R."*

The following sub-sections briefly summarise the sharing and compatibility studies for each frequency band. The conclusions of these studies and the analysis on the results are contained in section 1/1.1/4.1 below.

A list of relevant Recommendations and Reports can be found in Annex 2 of the Chairman's Report of the final meeting of JTG 4-5-6-7 (Document 4-5-6-7/715).

1/1.1/3.2.1 Frequency range 470 to 694/698 MHz

The frequency range 470-694/698 MHz, or parts thereof, is allocated to the BS, FS, MS, MSS, RAS ARNS and RNS. The frequency bands adjacent to this frequency range are allocated to the FS, MS, MetSat and BS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

In Region 1, use of the frequency band 470-694 MHz for digital terrestrial broadcasting is governed by the *Regional Agreement relating to the planning of the digital terrestrial broadcasting service in Region 1 (parts of Region 1 situated to the west of meridian 170° E and to the north of parallel 40° S, except the territory of Mongolia) and in the Islamic Republic of Iran, in the frequency bands 174-230 MHz and 470-862 MHz (Geneva, 2006)* ("GE06 Agreement"), to which all Region 1 administrations except Mongolia as well as that of the Islamic Republic of Iran are party.

1/1.1/3.2.1.1 Broadcasting service and mobile service/IMT

1/1.1/3.2.1.1.1 Broadcasting service in the GE06 planning area

Draft new Report ITU-R BT.[MBB_DTTB_470_694] contains the sharing and compatibility studies between digital terrestrial television broadcasting and terrestrial mobile broadband applications, including IMT, for the BS in the GE06 planning area (see Section 1 of the Report), in the frequency band 470-694/698 MHz (see Annex 5 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

Some administrations are of the view that information on the use of the frequency band 470-862 MHz for terrestrial broadcasting in Region 1 summarized in Report ITU-R BT.2302 is inappropriate for inclusion in the CPM Report for WRC-15 agenda item 1.1. The information summarized in Report ITU-R BT.2302 was collected in response to the Circular Letter 6/LCCE/78, questionnaire on spectrum requirements for terrestrial television broadcasting in connection with agenda item 1.2 and does not pertain to agenda item 1.1. Moreover, these administrations are particularly concerned that with the inclusion of information on only terrestrial broadcasting and only in Region 1, the text of the CPM Report under agenda item 1.1 is significantly unbalanced because it fails to provide the same information for spectrum requirements for other incumbent services (e.g., the EESS, FS, FSS, RLS) or to consider spectrum requirements of other Regions.

Some other administrations are of the view that the spectrum requirements for terrestrial television are covered by decides 3 of the Terms of Reference of JTG 4-5-6-7 as decided by CPM15-1 in Annex 10 to CA/201, which states that JTG 4-5-6-7 is to consider, in accordance with Resolutions **232 (WRC-12)** and **233 (WRC-12)**, other specific requirements as well as results of studies from any concerned Working Parties on technical and operational characteristics, spectrum requirements and performance objectives or protection requirements of other services. Therefore, these administrations are of the view that the information below is also relevant for WRC-15 agenda item 1.1 and should be included in the CPM Report for WRC-15 agenda item 1.1 as reflected below.

Report ITU-R BT.2302 provides the results of a questionnaire on the spectrum requirements for terrestrial television broadcasting in the UHF frequency band in Region 1 and the Islamic Republic of Iran. Based on this report it is concluded that at least the 28 channels of 8 MHz bandwidth in the range 470-694 MHz are required to satisfy spectrum requirements for the BS for the majority of administrations who responded. This has been confirmed by a recent re-planning exercise[7] in the African Broadcasting Area.

[7] http://www.itu.int/ITU-R/terrestrial/broadcast/ATU/index.html.

It should be emphasized that, in many countries which are party to the GE06 Agreement the need for broadcasting in the 470-694 MHz frequency band is critical, in particular with regard to those countries which intend to implement the MS in the 700 MHz band, due to the need to provide the required certainty for investment in broadcasting and to facilitate the migration outside 694-790 MHz.

1/1.1/3.2.1.1.2 Broadcasting service outside the GE06 planning area

Draft new Report ITU-R BT.[MBB_DTTB_470_694] contains the sharing and compatibility studies between digital terrestrial television broadcasting and terrestrial mobile broadband applications, including IMT, for the BS outside the GE06 planning area (see Section 2 of the Report), in the frequency band 470-694/698 MHz (see Annex 5 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.1.2 Applications ancillary to broadcasting (SAB/SAP) and mobile service/IMT in Region 1

Draft new Report ITU-R BT.[SAB_SAP] contains SAB/SAP spectrum use in Region 1 and the implication of a co-primary allocation for the MS in the frequency band 694-790 MHz (see Annex 8 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.1.3 Fixed service and mobile service/IMT

Draft new Report ITU-R F.[IMT-FS 470-694/698 MHz SHARING] addresses sharing and compatibility between IMT systems and FS systems in the 470-694/698 MHz frequency range (see Annex 6 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.1.4 Radio astronomy service and mobile service/IMT

Draft new Report ITU-R RA.[RAS-IMT] contains compatibility and sharing studies between the RAS and IMT systems in the frequency band 608-614 MHz (see Annex 7 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.2 Frequency range 1 300 MHz to 1 525 MHz

The frequency range 1 300-1 525 MHz, or parts thereof, is allocated to the RLS, ARNS, RNSS, FS, MS, EESS, RAS, SRS, SOS, BS, BSS, MSS and AMS. The frequency bands adjacent to this frequency range are allocated to the EESS, RLS, RNSS, SRS, ARS, FS, MS, ARNS, SOS, MSS and AMS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

1/1.1/3.2.2.1 Broadcasting service and mobile service/IMT

Draft new Report ITU-R BS.[BS_IMT] addresses sharing between the MS and the BS in the 1 452-1 492 MHz frequency band (see Annex 13 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.2.2 Radiodetermination and mobile service/IMT

Working document toward a PDN Report ITU-R M.[RADAR1300] contains studies on the impact of IMT use on radar systems in the frequency range 1 300-1 400 MHz (see Annex 25 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.2.3 Aeronautical mobile telemetry systems and the mobile service/IMT

Draft new Report ITU-R M.[AMT-IMT.SHARING.L-BAND] contains sharing studies between IMT systems and aeronautical mobile telemetry systems in the frequency band 1 429-1 535 MHz (see Annex 12 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.2.4 Broadcasting-satellite service in the frequency band 1 452-1 492 MHz

Working document toward PDN Report ITU-R M.[BSS-MS] addresses sharing and compatibility studies between IMT systems and BSS systems in the frequency band 1 452-1 492 MHz (see Annex 27 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.2.5 Radio astronomy service and mobile service/IMT

Draft new Report ITU-R RA.[RAS-IMT] contains compatibility and sharing studies between the RAS and IMT systems in the frequency band 1 330-1 400 MHz (see Annex 7 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.2.6 Unwanted emissions in the frequency band 1 400-1 427 MHz

Draft new Report ITU-R RS.[EESS-IMT 1.4 GHz] contains consideration of the frequency bands 1 375-1 400 MHz and 1 427-1 452 MHz for the MS compatibility with systems of the EESS within the 1 400-1 427 MHz frequency band (see Annex 11 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

Draft new Report ITU-R RA.[RAS-IMT] contains compatibility and sharing studies between the RAS and IMT systems in the frequency band 1 400-1 427 MHz (see Annex 7 of the Chairman's Report of the final meeting of JTG 4-5-6-7– Document 4-5-6-7/715).

1/1.1/3.2.2.7 Fixed service and the mobile service/IMT

Working document toward PDN Report ITU-R F.[IMT 1 350-1 530 MHz ADJACENT CHANNEL SHARING] addresses adjacent channel / adjacent band coexistence between IMT systems and FS point-to-point links currently operating in 1 350-1 527 MHz (see Annex 26 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

Draft new Report ITU-R F.[FS-IMT 1 350-1 530 MHz CO-CHANNEL SHARING] addresses co-channel compatibility/sharing between IMT systems and FS point-to-point links currently operating in the frequency band 1 350-1 527 MHz (see Annex 10 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.2.8 Mobile-satellite service and mobile service/IMT

Annex 29 of the Chairman's Report of the final meeting of JTG 4-5-6-7 (Document 4-5-6-7/715) contains sharing studies of IMT-Advanced systems in the MS with respect to systems in the MSS in the frequency bands 1 518-1 559 MHz, 1 626.5-1 660.5 MHz and 1 668-1 675 MHz.

Annex 28 of the Chairman's Report of the final meeting of JTG 4-5-6-7 (Document 4-5-6-7/715) addresses adjacent band compatibility studies of IMT-Advanced systems in the MS in the frequency band below 1 518 MHz with respect to systems in the MSS in the frequency band 1 518-1 559 MHz.

1/1.1/3.2.3 Frequency range 1 695-1 710 MHz

The frequency range 1 695-1 710 MHz, or parts thereof, is allocated to the MetAids, MetSat, FS and MS. The frequency bands adjacent to this are allocated to the MetAids, MetSat, FS, MS and SRS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

Draft new Report ITU-R SA.[METSAT-IMT 1.7 GHz] contains a sharing assessment between MetSat and IMT stations in the 1 695-1 710 MHz frequency band (see Annex 14 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.4 Frequency ranges 2 025-2 110 MHz and 2 200-2 290 MHz

The frequency range 2 025-2 110 MHz, or parts thereof, is allocated to the SOS, EESS, FS, MS and SRS. The frequency bands adjacent to this frequency range are allocated to the FS, MS, MSS and SRS. The frequency range 2 200-2 290 MHz, or parts thereof, is allocated to the SOS, EESS, FS, MS and SRS. The frequency bands adjacent to this frequency range are allocated to the FS, MS, MSS and SRS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

Draft new Report ITU-R SA.[EESS-IMT 2 025-2 290 MHz] addresses sharing between space-to-space links in the SRS, SOS and EESS and IMT systems in the frequency bands 2 025-2 110 MHz and 2 200-2 290 MHz (see Annex 15 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.5 Frequency range 2 700-2 900 MHz

The frequency range 2 700-2 900 MHz, or parts thereof, is allocated to the ARNS, RLS and MRNS. The frequency bands adjacent to this frequency range are allocated to the EESS, RAS, SRS, FS, MS, RLS and RNS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

Working document toward PDN Report ITU-R M.[RADAR2700] contains studies on the impact of IMT use on radar systems in the frequency range 2 700-2 900 MHz (see Annex 30 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

Draft new Report ITU-R RA.[RAS-IMT] contains compatibility and sharing studies between the RAS and IMT systems in the frequency band 2 690-2 700 MHz (see Annex 7 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.6 Frequency range 2 900-3 100 MHz

The frequency range 2 900-3 100 MHz, or parts thereof, is allocated to the RLS and the ARNS. The frequency bands adjacent to this frequency range are allocated to the ARNS, RLS, MRNS, EESS, SRS and RNS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

Working document toward PDN Report ITU-R M.[RADAR2900] contains studies on the impact of IMT use on radar systems in the frequency range 2 900-3 100 MHz (see Annex 31 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.7 Frequency range 3 300-3 400 MHz

The frequency range 3 300-3 400 MHz, or parts thereof, is allocated to the RLS, ARS, FS, MS and RNS. The frequency bands adjacent to this frequency range are allocated to the RLS, EESS, SRS, RNS, FS, FSS, ARS and MS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

PDN Report ITU-R M.[RADAR3300] addresses sharing between indoor IMT systems and radar systems in the frequency band 3 300-3 400 MHz (see Annex 32 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.8 Frequency range 3 400-4 200 MHz

The frequency range 3 400-4 200 MHz, or parts thereof, is allocated to the FS, FSS, ARS, MS and RLS. The frequency bands adjacent to this frequency range are allocated to the RLS, ARS, FS, MS, RNS and ARNS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

1/1.1/3.2.8.1 Fixed service and the mobile service/IMT

Draft new Report ITU-R F.[IMT-FS 3 400-4 200 MHz SHARING] studies sharing and compatibility between IMT systems and FS systems in the 3 400-4 200 MHz frequency range (see Annex 16 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.8.2 Fixed-satellite service and mobile service/IMT

Draft new Report ITU-R [FSS-IMT C-BAND DOWNLINK] contains sharing studies between IMT-Advanced systems and geostationary satellite networks in the FSS in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands (see Annex 17 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.9 Frequency range 4 400-4 900 MHz

The frequency range 4 400-4 900 MHz, or parts thereof, is allocated to the FS, MS, FSS and RAS. The frequency bands adjacent to this frequency range are allocated to the ARNS, FS, MS, RAS, SRS and EESS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

1/1.1/3.2.9.1 Radio astronomy service and mobile service/IMT

Draft new Report ITU-R RA.[RAS-IMT] contains compatibility and sharing studies between the RAS and IMT systems in the frequency band 4 800-4 990 MHz (see Annex 7 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.9.2 Aeronautical mobile systems and the mobile service/IMT

PDN Report ITU-R M.[AERO-IMT.SHARING.C-BAND] contains sharing and compatibility studies between aeronautical mobile/ground mobile applications and potential IMT systems in the 4 400-4 990 MHz frequency band (see Annex 33 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.9.3 Fixed service and the mobile service/IMT

Draft new Report ITU-R F.[FS-IMT 4 400-4 990 MHz SHARING AND COMPATIBILITY] contains a sharing and compatibility study between IMT systems and point-to-point fixed wireless systems in the frequency bands 4 400-4 500 MHz and 4 800-4 990 MHz (see Annex 18 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.9.4 Fixed-satellite service and the mobile service/IMT

Draft new Report ITU-R [FSS-IMT C-BAND DOWNLINK] contains sharing studies between IMT-Advanced systems and geostationary satellite networks in the FSS in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands (see Annex 17 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.10 Frequency range 4 800-5 000 MHz

The frequency range 4 800-5 000 MHz, or parts thereof, is allocated to the FS, MS, RAS, SRS and EESS. The frequency bands adjacent to this frequency range are allocated to the FS, FSS, MS, AMS(R)S, ARNS and RNSS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

1/1.1/3.2.10.1 Aeronautical mobile systems and mobile service/IMT

PDN Report ITU-R M.[AERO IMT.SHARING.C-BAND] contains sharing and compatibility studies between aeronautical mobile/ground mobile applications and potential IMT systems in the 4 400-4 990 MHz frequency band (see Annex 33 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.10.2 Fixed service and mobile service (IMT)

Draft new Report ITU-R F.[FS-IMT 4 400-4 990 MHz SHARING AND COMPATIBILITY] contains a sharing and compatibility study between IMT systems and point-to-point fixed wireless systems in the frequency bands 4 400-4 500 MHz and 4 800-4 990 MHz (see Annex 18 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.10.3 Radio astronomy service and the mobile service/IMT

Draft new Report ITU-R RA.[RAS-IMT] contains compatibility and sharing studies between the RAS and IMT systems in the frequency bands 4 800-4 990 MHz and 4 990-5 000 MHz (see Annex 7 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.11 Frequency range 5 350-5 470 MHz

The frequency range 5 350-5 470 MHz, or parts thereof, is allocated to the EESS, RLS, ARNS, SRS and RNS. The frequency bands adjacent to this frequency range are allocated to the EESS, MS, RLS, SRS, FS, RNS, MRNS, ARNS and LMS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

1/1.1/3.2.11.1 Earth exploration-satellite service (active) and the mobile service/RLAN

PDN Report ITU-R RS.[EESS RLAN 5 GHz] contains sharing studies between RLAN and EESS (active) systems in the frequency range 5 350-5 470 MHz (see Annex 35 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.11.2 Radar systems and the mobile service/RLANs

PDN Report ITU-R M.[5 350 MHz AERO] contains compatibility studies between RLAN and aeronautical airborne radar systems in the 5 350-5 470 MHz frequency band (see Annex 36 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

Working document toward PDN Report ITU-R M.[RLAN5GHz.SHAR] contains compatibility studies between RLAN and radiolocation systems in the 5 350-5 470 MHz frequency band (see Annex 34 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.12 Frequency range 5 725-5 850 MHz

The frequency range 5 725-5 850 MHz, or parts thereof, is allocated to the FSS, RLS, ARS, ARSS, LMS, FS and MS. The frequency bands adjacent to this frequency range are allocated to the MS, RLS, ARS, SRS, LMS, FS and FSS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

Some administrations submitted contributions indicating that the study results for the 5 350-5 470 MHz frequency range are applicable to the 5 725-5 850 MHz frequency range to ensure protection of certain radars that operate across or in portions of the 5 250-5 850 MHz frequency range. Some other administrations raised concerns regarding these results because no RLAN characteristics were previously agreed for the 5 725-5 850 MHz frequency range and that RLAN characteristics utilized for the 5 350-5 470 MHz frequency range cannot be applied similarly to the 5 725-5 850 MHz frequency range. Some administrations also highlighted that the sharing environment is significantly different between the two frequency bands due to the ISM designation of the 5 725-5 875 MHz frequency band. There are current deployments of RLAN in the 5 725-5 850 MHz frequency band in some countries in all three ITU Regions. Therefore, agreement was not reached on the conclusions in these documents.

No other sharing/compatibility studies were provided for this frequency band.

1/1.1/3.2.13 Frequency range 5 925-6 425 MHz

The frequency range 5 925-6 425 MHz, or parts thereof, is allocated to the FS, FSS and MS. The frequency bands adjacent to this frequency range are allocated to the FS, FSS, MS, ARS and RLS. The details of these allocations and those of the adjacent frequency bands can be found in RR Article **5**.

1/1.1/3.2.13.1 Fixed service and the mobile service/IMT

Draft new Report ITU-R F.[IMT-FS 5 925-6 425 MHz SHARING] contains a sharing and compatibility study between indoor IMT small cells and FS stations in the 5 925-6 425 MHz frequency band (see Annex 20 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.13.2 Fixed-satellite service and mobile service/IMT

Draft new Report ITU-R [FSS-IMT C-BAND UPLINK] addresses sharing and compatibility between IMT systems and FSS networks in 5 850-6 425 MHz frequency range (see Annex 19 of the Chairman's Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715).

1/1.1/3.2.14 Overview of studies for the potential candidate frequency bands listed in section 1/1.1/4.2

The following two overview tables (Tables 1/1.1/3-2 and 1/1.1/3-3) are provided for convenience and information only to indicate which studies were carried out in ITU-R during the preparation of WRC-15 for agenda item 1.1.

TABLE 1/1.1/3-2

Studies related to services having allocations within the potential candidate frequency bands

Potential Candidate Frequency Band	Allocations within band	Studies	Status
470-694/698 MHz (224/228 MHz)	BS	BT.[MBB_DTTB_470_694]	DNR
	MS	BT.[SAB_SAP]	DNR
	RNS (ARNS)	-	-
	FS	F.[IMT-FS 470-694/698 MHz]	DNR
	RAS	RA.[RAS-IMT]	DNR
	MSS, except aeronautical	-	-
	RLS	-	-
	SOS (s-E)	-	-
1 350-1 400 MHz (50 MHz)	RAS	RA.[RAS-IMT]	DNR
	RLS	M.[RADAR1300]	WD
	FS	F.[FS-IMT 1 350-1 530 CO-CHANNEL SHARING]	DNR
	SRS(passive)	-	-
	EESS (passive)	-	-
1 427-1 452 MHz (25 MHz)	FS	F.[FS-IMT 1 350-1 530 CO-CHANNEL SHARING]	DNR
	AMS (telemetry)	M.[AMT-IMT.SHARING.L-BAND]	DNR
	SOS (E-s)	-	-
1 452-1 492 MHz (40 MHz)	BS	BS.[BS-IMT]	DNR
	FS	F.[FS-IMT 1 350-1 530 CO-CHANNEL SHARING]	DNR
	AMS (telemetry)	M.[AMT-IMT.SHARING.L-BAND]	DNR
	BSS	M.[BSS-MS]	WD
1 492-1 518 MHz (26 MHz)	FS	F.[FS-IMT 1 350-1 530 CO-CHANNEL SHARING]	DNR
	AMS (telemetry)	M.[AMT-IMT.SHARING.L-BAND]	DNR
1 518-1 525 MHz (7 MHz)	FS	F.[FS-IMT 1 350-1 530 CO-CHANNEL SHARING]	DNR
	AMS (telemetry)	M.[AMT-IMT.SHARING.L-BAND]	DNR
	MSS	Attachment to Chairman's Report	WD
1 695-1 710 MHz (15 MHz)	FS	-	
	EESS (s-E) other than MetSat No. **5.289**	-	-
	METSAT (s-E)	SA.[METSAT-IMT 1.7 GHz]	DNR
	METAID	-	-
	SRS (s-E)	-	-
2 025-2 110 MHz and 2 200-2 290 MHz (175 MHz) **(these bands are no longer considered as potential candidate frequency bands; they are included for completeness)**	SOS	SA.[EESS-IMT 2 025-2 290 MHz]	DNR
	EESS	SA.[EESS-IMT 2 025-2 290 MHz]	DNR
	FS		
	MS		
	SRS	SA.[EESS-IMT 2 025-2 290 MHz]	DNR
2 700-2 900 MHz (200 MHz)	RLS, ARNS, MRNS	M.[RADAR2700]	WD
3 300-3 400 MHz (100 MHz)	RLS	M.[RADAR3300]	PDNR
	FS	-	-
	Amateur	-	-
	RNS	-	-
3 400-3 600 MHz (200 MHz)	FS	F.[IMT-FS 3 400-4 200 MHz SHARING]	DNR
	RLS		
	FSS (s-E)	[FSS-IMT C-BAND DOWNLINK]	DNR
	Amateur-satellite No.**5.282**	-	
	Amateur	-	-
3 600-3 800 MHz (200 MHz)	FS	F.[IMT-FS 3 400-4 200 MHz SHARING]	DNR
	FSS (s-E)	[FSS-IMT C-BAND DOWNLINK]	DNR
	RLS		
3 800-4 200 MHz (400 MHz)	FS	F.[IMT-FS 3 400-4 200 MHz SHARING]	DNR
	FSS (s-E)	[FSS-IMT C-BAND DOWNLINK]	DNR

Potential Candidate Frequency Band	Allocations within band	Studies	Status
4 400-4 500 MHz (100 MHz)	AMS	M.[AERO-IMT.SHARING.C-BAND]	PDNR
	FS	F.[FS-IMT 4 400-4 990 SHARING AND COMPATIBILITY]	DNR
4 500-4 800 MHz (300 MHz)	FSS (s-E)	[FSS-IMT C-BAND DOWNLINK]	DNR
	FS	F.[FS-IMT4400-4990 SHARING AND COMPATIBILITY]	DNR
	AMS	M.[AERO-IMT.SHARING.C-BAND]	PDNR
4 800-5 000 MHz (200 MHz)	AMS	M.[AERO-IMT.SHARING.C-BAND]	PDNR
	RAS	RA.[RAS-IMT]	DNR
	EESS (passive) No.**5.339**	-	-
	SRS (passive) No.**5.339**	-	-
	FS	F.[FS-IMT4400-4990 SHARING AND COMPATIBILITY]	DNR
5 350-5 470 MHz (120 MHz)	RNS	M.[5 350 MHz AERO]	PDNR
	RLS	M.[RLAN5GHz.SHAR]	WD
	SRS(active)	-	-
	EESS (active)	RS.[EESS RLAN 5 GHz]	PDNR
5 725-5 850 MHz (125 MHz)	RLS		-
	FS Nos. **5.453**, **5.455**, **5.456**	-	-
	Amateur	-	-
	Amateur-satellite (s-E)	-	-
	FSS (s-E)	-	-
5 925-6 425 MHz (500 MHz)	FS	F.[IMT-FS 5 925-6 425 MHz SHARING]	DNR
	Standard frequency and time signal-satellite (E-s)	-	-
	FSS (s-E)	[FSS-IMT C-BAND UPLINK]	DNR

TABLE 1/1.1/3-3

Studies relating to services having allocations in adjacent bands (or adjacent channel studies)

Potential Candidate Frequency Band	Allocations in adjacent bands	Studies	Status
470-694/698 MHz (224/228 MHz)	BS	BT.[MBB_DTTB_470_694]	DNR
	FS	F.[IMT-FS 470-694/698 MHz]	DNR
	RAS	RA.[RAS-IMT]	DNR
	METSAT (s-E) (5.290)	-	-
1 350-1 400 MHz (50 MHz)	RLS	M.[RADAR1300]	WD
	FS	F.[IMT 1 350-1 530 MHz ADJACENT CHANNEL SHARING]	WD
	RAS	RA.[RAS-IMT]	DNR
	EESS	RS.[EESS-IMT 1.4 GHz]	DNR
	SRS	RS.[EESS-IMT 1.4 GHz]	DNR
	ARNS	-	-
	RNSS (E-s)	-	-
1 427-1 452 MHz (25 MHz)	FS	F.[IMT 1 350-1 530 MHz ADJACENT CHANNEL SHARING]	WD
	RAS	RA.[RAS-IMT]	DNR
	EESS	RS.[EESS 1.4 GHz]	DNR
	SRS	RS.[EESS 1.4 GHz]	DNR
	AMS (telemetry)	M.[AMT-IMT.SHARING.L-BAND]	DNR
1 452-1 492 MHz (40 MHz)	FS	F.[IMT 1 350-1 530 MHz ADJACENT CHANNEL SHARING]	WD
	AMS (telemetry)	M.[AMT-IMT.SHARING.L-BAND]	DNR
1 492-1 518 MHz (26 MHz)	BS	-	-
	BSS	-	-
	AMS (telemetry)	M.[AMT-IMT.SHARING.L-BAND]	DNR

Potential Candidate Frequency Band	Allocations in adjacent bands	Studies	Status
	FS	F.[IMT 1 350-1 530 MHz ADJACENT CHANNEL SHARING]	WD
	MSS (s-E)	Attachment to Chairman's Report	WD
1 518-1 525 MHz (7 MHz)	MSS (s-E)	Attachment to Chairman's Report	WD
	AMS	M.[AMT-IMT.SHARING.L-BAND]	DNR
	FS	-	-
	EESS	-	-
1 695-1 710 MHz (15 MHz)	-	The band has a guard band at the lower edge taking into account current wider allocation and at the upper edge the band is already identified for IMT	
2 700-2 900 MHz (200 MHz)	RAS	RA.[RAS-IMT]	DNR
	RLS	-	-
	RNS	M.[RADAR2700] M.[RADAR2900]	WD WD
	EESS (passive)	-	-
	SRS (passive)	-	-
	FS	-	-
3 300-3 400 MHz (100 MHz)	RLS	-	-
	RNS	-	-
	EESS (active)	-	-
	SRS (active)	-	-
	FS	F.[IMT-FS 3 400-4 200 MHz SHARING]	DNR
	FSS (s-E)	[FSS-IMT C-BAND DOWNLINK]	DNR
	Amateur	-	-
3 400-3 600 MHz (200 MHz)	FSS (s-E)	[FSS-IMT C-BAND DOWNLINK]	DNR
	FS	F.[IMT-FS 3 400-4 200 MHz SHARING]	DNR
	RLS		
3 600-3 800 MHz (200 MHz)	FSS (s-E)	[FSS-IMT C-BAND DOWNLINK]	DNR
	FS	F.[IMT-FS 3 400-4 200 MHz SHARING]	DNR
	RLS (5.433)		
3 800-4 200 MHz (400 MHz)	FSS (s-E)	[FSS-IMT C-BAND DOWNLINK]	DNR
	FS	F.[IMT-FS 3 400-4 200 MHz SHARING]	DNR
	ARNS (altimeters)	-	-
4 400-4 500 MHz (100 MHz)	FSS (s-E)	[FSS-IMT C-BAND DOWNLINK]	DNR
	FS	F.[FS-IMT 4 400-4 990 SHARING AND COMPATIBILITY]	DNR
	ARNS (altimeters)	-	-
	AMS	M.[AERO-IMT.SHARING.C-BAND] (Note: limited studies on AMT ground receivers)	PDNR
4 500-4 800 MHz (300 MHz)	FS	F.[FS-IMT 4 400-4 990 SHARING AND COMPATIBILITY]	DNR
	RAS	RA.[RAS-IMT]	DNR
	AMS	-	-
4 800-5 000 MHz (200 MHz)	FSS (s-E)	[FSS-IMT C-BAND DOWNLINK]	DNR
	FS	F.[FS-IMT 4 400-4 990 SHARING AND COMPATIBILITY]	DNR
	RAS	RA.[RAS-IMT]	DNR
	AMS	M.[AERO-IMT.SHARING.C-BAND] (Note: limited studies on AMT ground receivers)	PDNR
	AMSS(R)	-	-
	ARNS	-	-
	RNSS	-	-
5 350-5 470 MHz (120 MHz)	-	Both adjacent bands are already used by RLAN	
5 725-5 850 MHz (125 MHz)	FSS (s-E)	-	
	Amateur		
	RLS		
	FS	-	
5 925-6 425 MHz (500 MHz)	FS	F.[IMT-FS 5 925-6 425 MHz SHARING]	DNR
	FSS (s-E)	-	-
	Amateur		
	RLS		

1/1.1/4 Analysis of the results of studies

1/1.1/4.1 Analysis of the results for frequency bands studied

1/1.1/4.1.1 Frequency range 470-694/698 MHz

1/1.1/4.1.1.1 Broadcasting service and mobile service/IMT

Frequency bands below 1 GHz are the only available bands for terrestrial television broadcasting and they are harmonized worldwide leading to consumer benefits in terms of wider choice and competition in TV receiver markets, and thus lower consumer costs. They are primarily used to provide wide area coverage from high power transmitters serving large audiences.

1/1.1/4.1.1.1.1 Broadcasting in the GE06 planning area

1/1.1/4.1.1.1.1.1 Co-channel studies

1/1.1/4.1.1.1.1.1.1 Mobile service base stations as an interferer into broadcast reception

A generic study showed that the cumulative effect of interference can exceed 20 dB and that a separation distance of more than 200 km is needed to meet the field strength threshold of 23 dB(μV/m) which is equivalent to an I/N of -10 dB (95% locations, 16 dB antenna discrimination) at the lower end of the 694-790 MHz frequency band compared to 61 km for a single base station of the MS.

The results of another generic study showed that the excess of the cumulative interference from a MS network (from IMT to broadcast reception) over a single interferer can be up to 21 dB. This causes a corresponding increase of separation distance of up to 274 km on land and up to 1 000 km for land/sea paths (warm), when using the same field strength threshold for cumulative interference as for single entry interference.

A case study showed two particular examples where the excess of the cumulative interference from the MS network over a single interferer can be up to 21 dB, even when using fixed directional receiving antennas.

A generic study showed that even without accumulation of interfering field strength, a single IMT base station will need to be positioned 53 km (for land path) from the DTTB service edge, i.e. from the border of the affected administration, in order not to exceed 23 dB(μV/m). This field strength is equivalent to an I/N of -10 dB (95% locations, 16 dB antenna discrimination) at the input of the DTTB receiver at the lower end of the 694-790 MHz frequency band. Including multiple interfering base stations would increase the interfering field strength at the DTTB service edge by up to 20 dB which corresponds to a separation distance of up to 200 km based on the parameters used in this particular study, when using the same field strength threshold for cumulative interference as for single entry interference.

A case study showed that IMT base stations in one country which are not individually subject to coordination, i.e. meeting the trigger threshold of GE06 (25 dB(μV/m)), will not interfere with the DTTB receivers in the neighbouring country, even if the cumulative effect of those base stations is taken into account. This case study is based on C/(N+I) protection criteria of the BS.

1/1.1/4.1.1.1.1.1.2 Broadcasting as an interferer into mobile service base stations

A generic study showed that separation distances up to 427 km and 269 km, for high power (HP) and medium power (MP) DTTB transmitters respectively, would be required to protect the IMT base station receiver (uplink) for 99% time, a target I/N of -6 dB and with no additional discrimination by cross polarization or receive antenna directivity. The relaxation of the protection level to 90% time, a target I/N of 0 dB and mitigation by full receive antenna polarization and/or discrimination would reduce the separation distances to 159 km for HP and 76 km for MP.

A case study showed that co-channel sharing between DTTB transmitters and an IMT uplink receiver positioned at 30 meters height, will require separation distances of the order of 200 km on land paths even with antenna cross polarization and a relaxation of the percentage of time for the interfering signal from 1 to 10%.

1/1.1/4.1.1.1.1.1.2 Adjacent channel studies

1/1.1/4.1.1.1.1.2.1 IMT base station interference into DTTB

A field trial study indicated that the necessary line-of-sight separation distance between transmitting antennas of wireless broadband access systems and DTTB receiving antennas ranges from 180 to 995 metres for the technical parameters specified in this study (depending on the OOBE limit and frequency separation). The conclusions address a frequency offset up to 112 MHz (N-14), taking into account fundamental difficulties with the application of mitigation techniques such as additional sideband filters within the 470-694 MHz frequency band. During this field trial study, no further improvement to the mitigation techniques could be found while maintaining the basic features of the wideband access system available, because one end of the radio link is user-controlled.

1/1.1/4.1.1.1.1.1.3 Analysis of co-channel, adjacent channel and spectrum requirement studies

Analysis of the studies summarized above indicated a range of frequency and geographic separation distances required for sharing between DTTB systems and MS (IMT) systems. The ranges in the studies reflect the various assumptions and technical assumptions used in the studies.

The results of the studies summarized above show that, if one country wants to use the band for broadcasting and the other neighbouring country wants to deploy IMT networks, sharing will be very difficult. Based on these large separation distances, the conclusion of these studies emphasized constraints on the planning, implementation, and sharing of the two services regarding the use of the same or overlapping frequencies in neighbouring geographic areas.

The result of the adjacent channel study in section 1/1.1/4.1.1.1.1.2.1 shows that the adjacent channel selectivity of DTTB receivers and out-of-band emissions of user equipment (UE) should be addressed to decrease the interference. Depending on the situation, filters may need to be frequency adjustable.

A survey carried out by ITU-R showed that the frequency band 470-694 MHz is the minimum spectrum required for broadcasting for 68 out of 89 administrations that responded to a questionnaire in Region 1 and is currently used or planned to be used for that purpose. 72 administrations have expressed a clear view on the spectrum requirements. Of those, 28 expressed a requirement for more than 224 MHz, 40 require exactly 224 MHz and 4 administrations indicate a requirement for less than 224 MHz.

Some administrations are of the view that information on the use of the frequency band 470-862 MHz for terrestrial broadcasting in Region 1 is inappropriate for inclusion in the CPM Report for WRC-15 agenda item 1.1 because it was collected in response to the Circular Letter 6/LCCE/78, questionnaire on spectrum requirements for terrestrial television broadcasting in connection with agenda item 1.2 and does not pertain to agenda item 1.1.

1/1.1/4.1.1.1.2 Broadcasting outside the GE06 planning area

1/1.1/4.1.1.1.2.1 Co-channel and adjacent channel studies

Study 1 showed that for the co-frequency channel case, taking into account a single base station as interferer, the required separation distance can range from 10-12 for portable indoor BS systems and around 13-19 km for portable outdoor BS systems. The co-channel results for fixed outdoor reception BS systems range from around 28 to 70 km. For the adjacent channel case, the results show that in the worst-case scenarios (BS receive station pointing directly toward a macro suburban or rural deployment of IMT base stations), a separation distance of around 5 km combined with a frequency separation of one channel bandwidth is needed in order to meet the BS protection requirement. However, these pointing scenarios should be avoidable in practice, and for more realistic pointing scenarios, the interference can be mitigated through a combination of geographic separation and frequency separation. For these cases, the interference can be mitigated with a separation distance on the order of one kilometre coupled with a frequency separation of about one channel bandwidth. It is important to note that the frequency separation results reflect channel centre-to-channel centre separations and not guard bands, which are usually expressed as channel edge-to-channel edge. Finally, this study's results also show that the interference from the IMT UE is acceptable with a geographic separation as low as 1 km.

Studies 2 and 3 indicated that either a single IMT base station or a single IMT UE operating in the vicinity of a fixed DTTB receiving system will exceed the protection requirement for the BS. For the case of co-channel spectrum sharing, in order to remain within the BS protection requirement, a separation distance of 94 km from the IMT base station and 1 km from the IMT UE is required. For the case of first adjacent-channel spectrum sharing, a separation distance of 64 km from the IMT base station and 0.7 km from the IMT UE is required. Spectrum sharing of frequencies beyond the first adjacent-channel may be problematic. Frequency offsets up to 90 MHz were found to require separation distances of 5 km and 70 metres from the IMT base station and UE, respectively.

Study 4 indicated that the IMT base station receiving system is susceptible to interference from single DTTB transmitters even with mitigation measures such as down-tilt of antennas. For the case of co-channel spectrum sharing with typical broadcast transmitters, the separation distance must be greater than 550 km. For the case of first adjacent-channel spectrum sharing, the separation distance must be greater than 125 km. In both cases, the separation distances extend near and beyond the radio horizon. In conclusion, the required separation distances between IMT base stations and DTTB transmitters are significant in the frequency bands between 470 and 694/698 MHz. It is unlikely that spectrum sharing between DTTB and IMT is possible within a given geographic location.

Study 5 shows that the separation distance needed for different adjacent channels cases in order to protect DTTB from IMT base stations considering the accumulative effect would vary from 14 to 45 km.

Study 6 shows that the separation distance needed for the co channel case in order to protect DTTB from base stations considering the accumulative effect would exceed 200 km.

Study 7 on the adjacent channel case indicated the minimum separation distances between a DTTB System C (ISDB-T) receiver and a mobile broadband (MBB) UE operated in the same room. A minimum separation distance of 15 metres is required to achieve an I/N of −10 dB, even in instances where the MBB transmitter output power is −9 dBm, the OOB emission level is −55 dBm in a 6 MHz channel and the receiver ACS is 80 dB.

Considering the actual usage of a DTTB and a MBB UE in the same room, this separation distance seems unrealistic. In addition, to achieve the ACS value of 80 dB requires an insertion of external filters to the receivers concerned. Although it has not been considered in this study, additional measures may need to be taken into account for the effect of direct interference from a MBB UE into a DTTB receiver circuit. The above shows the difficulties of coexistence of both ISDB-T receivers and IMT in the same band in the same geographical area.

Study 8 on Monte Carlo simulations was made in order to evaluate interference from an IMT network into an ISDB-T receiver. In an urban environment, simulations for the IMT downlink show that sharing between both systems is only possible for frequency separations equal to or higher than 8 MHz between both systems. For a separation of 8 MHz, a 45 km distance is required between the DTTB receiver and the central cell of the IMT network. For a separation of 18 MHz, a 20 km distance is required between the DTTB receiver and the central cell of the IMT network.

In a rural environment, simulations of the IMT downlink show that sharing between both systems is only possible for frequency separations equal to or higher than 12 MHz between both systems, and with distances exceeding 50 km.

These results demonstrate that co-channel sharing between IMT and ISDB-T is not feasible in the same location within the 470-698 MHz range.

Also a sharing criterion is provided, based on needed spatial and frequency separation, for the adjacent channel case. This criterion highlights the difficulty for both systems to share in this frequency range.

Study 9 calculated aggregate interference from a cluster of 19 IMT base stations into DTT receivers for ATSC, DVB-T, DVB-T2 and ISDB-T technologies. Initial deterministic calculations with IMT base station antennas directed towards the DTTB coverage area indicated that separation distances between the edge of the DTT coverage area and the IMT network ranged from 30-43 km (for DVB-T/T2) to 72 km (for ATSC and ISDB-T).

Further analysis was then conducted to examine the potential impact of one possible mitigation technique which may be considered as standard practice when planning IMT networks close to borders. It was calculated that the separation distances were reduced to 14-20 km (for DVB-T/T2) and 33 km (for ATSC and ISDB-T) when it was assumed that the IMT base station antennas were pointing away from the DTT coverage area.

1/1.1/4.1.1.1.2.2 Analysis of co-channel and adjacent channel studies

Analysis of the studies indicated a range of frequency and geographic separation distances required for sharing between DTTB systems and MS (IMT) systems. The ranges reflect various assumptions and technical assumptions used in the studies.

The studies summarized above produced a range of separation distances for the following scenarios:

For co-channel interference:

From MS (IMT) base station to DTTB receiver:

– from 10 km to 106 km considering a single interferer;

– from 14 km to over 200 km considering cumulative interference.

From MS (IMT) UE to DTTB receiver:

– 1.2 km considering a single interferer;

– from 1 km to 37 km considering cumulative interference.

For adjacent-channel interference:

From MS (IMT) base station to DTTB receiver:

– from 5 km to 65 km for frequency offsets of 90 MHz and 8 MHz, respectively, considering a single interferer;

– from 1 km to over 100 km for the first adjacent channel case considering cumulative interference.

From MS (IMT) UE to DTTB receiver:

– from 15 metres to 700 metres for a frequency offset of 8 MHz considering a single interferer;

– from 2 km to 17 km for frequency offsets of 18 MHz and 8 MHz, respectively, for cumulative interference.

For co-channel interference:

From DTTB transmitter to MS (IMT) base station:

– from 559 km to 621 km considering a single interferer.

For adjacent-channel interference:

From DTTB transmitter to MS (IMT) UE:

– from 129 km to 153 km considering a single interferer.

The co-channel studies above show that separation distances between MS (IMT) base stations and DTTB receivers/transmitters are several tens of km, which makes sharing difficult.

1/1.1/4.1.1.2 Applications ancillary to broadcasting (SAB/SAP) and mobile service/IMT in Region 1

In Region 1, 72 administrations are using the frequency band 470-790 MHz or parts of it under RR No. **5.296** for applications ancillary to broadcasting (SAB/SAP). Due to the propagation and body absorption characteristics it is the core band for audio SAB/SAP. Parameters have been developed and can be found in the draft new Report ITU-R BT.[SAB_SAP] for sharing studies under WRC-15 agenda item 1.2 and are equally valid for this frequency range. Audio SAB/SAP needs to be operated in accordance with the parameters given in this report including acceptable levels of interference from any source. However, it should be noted that the results of the sharing studies show that a co-channel and co-location operation between SAB/SAP and IMT is not feasible.

1/1.1/4.1.1.3 Fixed service and mobile service/IMT

This study examines the compatibility of proposed IMT systems and FS systems operating in the 470-694/698 MHz frequency range.

The co-frequency channel results show that the required separation distance can range from around 25 km to nearly 220 km, depending on the interference scenario and deployment environment. These results are based on worst-case assumptions including the pointing direction of the IMT base station and the application of the propagation model. Furthermore, mobile operators can determine which locations are suitable for the deployment of IMT base stations, which can prove advantageous in terms of meeting any required separation distances.

The adjacent channel results show that in the worst-case scenarios (FS receive station pointing directly toward a macro deployment of IMT base stations) the separation distance needed to protect the FS station exceeds 30 km. However, these pointing scenarios should be avoidable in practice, and for more realistic pointing scenarios, the interference can be mitigated through a combination of geographic separation and frequency separation. For these cases, the interference can be mitigated with a separation distance between the FS receive station and the IMT base station on the order of 10 km coupled with a frequency separation of about one to two channel bandwidths. It is important to note that the frequency separation results reflect channel centre-to-channel centre separations and not guard bands, which are usually expressed as channel edge-to-channel edge.

These results also show that the interference from the IMT UE is acceptable with a geographic separation as low as one kilometre. It should be noted that certain assumptions such as FS receive station placement and direction, use of propagation model, etc. overestimate interference from the IMT network.

1/1.1/4.1.1.4 Radio astronomy service and mobile service/IMT

The results presented in draft new Report ITU-R RA.[RAS-IMT] show that, to ensure the protection of the RAS in the frequency band 608-614 MHz for the case of in-band sharing with IMT systems, a separation distance of 1 000 km is needed between IMT macro rural base stations and an RAS antenna, and of 130 km for UE, for an assumed flat terrain profile. This indicates that in-band sharing will be very difficult, if not impossible, to achieve in practice.

1/1.1/4.1.1.4.1 Unwanted emissions in the frequency band 608 - 614 MHz

For the case of IMT systems operating in the range 470-694 MHz and adjacent to the frequency band 608-614 MHz allocated to the RAS, a separation distance between IMT macro rural base stations and an RAS antenna of 75 km is needed, and of 1 km for UE, for an assumed unwanted emission level of –50 dBm/MHz and a flat terrain profile.

1/1.1/4.1.1.5 Aeronautical radionavigation service and mobile service/IMT

One compatibility study was presented to ITU-R for the frequency band 645-694 MHz and no new Report was created regarding the ARNS and the MS issues in the above mentioned frequency band due to the fact that this issue is covered in the working document toward PDN Report ITU-R.M.[ARNS-MS] (see Annex 23 of the Chairman’s Report of the final meeting of JTG 4-5-6-7 – Document 4-5-6-7/715). Other studies for the frequency band 694/698-790 MHz are summarized in the CPM Text for WRC-15 agenda item 1.2.

1/1.1/4.1.2 Frequency range 1 300-1 525 MHz

1/1.1/4.1.2.1 Radionavigation-satellite service and mobile service/IMT

RNSS systems are operational in the 1 164-1 300 MHz, 1 300-1 350 MHz, 1 559-1 610 MHz, 5 000-5 010 MHz and 5 010-5 030 MHz frequency bands. Certain RNSS signals are used for safety-of-life applications and subject to RR No. **4.10** which states that “*the safety aspects of radionavigation require special measures to ensure their freedom from harmful interference*”.

Recommendation ITU-R M.1318 provides a model for evaluating the impact of continuous interference to the RNSS, however no technical studies on compatibility between the RNSS in the frequency bands above and IMT-Advanced have been carried out by ITU-R. RNSS signals are very low-power, spread-spectrum signals coming from space that are difficult to detect. It takes special processing by RNSS receivers to extract the signal from the background noise. As shown in studies leading up to WRC-2000, if a higher-power, continuous-in-time signal in the same frequency band, or an adjacent band, is broadcast near an RNSS receiver, it could desensitize the RNSS receiver to the degree that the RNSS receiver is unable to extract the RNSS signal from space. As a result, frequency ranges near those used for the RNSS should not be identified for IMT.

1/1.1/4.1.2.2 Fixed service and mobile service/IMT

Co-channel case

The report presents an analysis of the feasibility of co-channel compatibility/sharing between IMT systems and FS point-to-point links currently operating in the frequency band 1 350-1 527 MHz.

Separation distances required for co-channel coexistence between IMT and fixed links will inevitably be larger than those required for adjacent channel / adjacent band coexistence. Separation distances that are calculated for co-channel operation under worst-case assumptions may appear quite large, however these are more like coordination distances than minimum separation distances that will be required to avoid interference in reality, and can give a misleading impression about the potential for coexistence.

The geographic separation required between an IMT transmitter and a co-channel fixed link is highly dependent on the orientation of the fixed link antenna, the transmitter and receiver antenna heights relative to the clutter/terrain, the power transmitted, and the fixed link receiver antenna performance. A much greater separation is required for base station transmitters than for UE, especially where base stations are located above the local clutter and their emission levels are high in order to provide wide area coverage for UE.

There are likely to be mitigation factors associated with many deployment scenarios that would significantly decrease separation distances. For example, the required separation will decrease where there is additional shielding introduced by local terrain and clutter. This is likely to be the case, for example, if the base station transmitters are deployed to serve micro/pico cells located in cluttered urban environments. The separation distances calculated in this study range from 6.5 to 21 km for IMT macro base stations deployed in urban areas. When the urban deployment is restricted to micro cells, the separation distances are reduced to between 2.5 and 11 km.

The above-mentioned separation distances were calculated under the assumption of 20 dB additional clutter loss from nearby buildings, this however may not be applicable in the case where a macrocell IMT base station antenna is located above roof top level and also taking into account that a FS station antenna is normally located above rooftop, at least relative to the buildings in the direction of the main lobe.

These calculated separation distances are going to be dependent on a number of local level considerations including deployment and geographical distribution of both IMT and FS stations at a national level and may require coordination with neighbouring administrations.

In actual deployment cases where a terrain database is available, a more accurate case-specific separation distance may be calculated using a point-to-point propagation model such as Recommendation ITU-R P.452.

In the case of IMT UE, the required separation is likely to be much smaller than for base stations. Interference aggregation through the fixed link receiver main beam is unlikely to be significant since the UE are likely to be located below terrain/clutter and the individual interference paths will be subject to different propagation losses. It is likely that coexistence of fixed links with IMT uplinks will be possible provided that the fixed links are not located close to major population centres or busy transport infrastructures where mobile devices are likely to be used in close proximity.

Adjacent channel case

An interference analysis of the feasibility of adjacent channel /adjacent band coexistence between IMT systems and FS point-to-point links currently operating in 1 350-1 527 MHz has been considered by the ITU-R. The analysis is based on deriving separation distances for different guard band assumptions. For a given guard band, the effective interfering emission power into the transmitter antenna resulting from the following two mechanisms has been considered:

– the IMT base station / UE unwanted emissions overlapping the fixed link receiver bandwidth. This is calculated by integrating the transmitter emission mask over the receiver bandwidth;

– the IMT base station / UE transmitter in-band power overlapping the fixed link receiver selectivity mask. This is calculated by integrating the receiver selectivity mask over the transmitter bandwidth.

With no guard band, separation distances in the range 8.3 to 25.9 km (depending on the assumed IMT base station emission mask and fixed link receiver antenna pointing and antenna pattern) have been calculated to satisfy the fixed link interference criterion for an IMT base station. This is reduced to 2.4 to 15.7 km when a 2 MHz guard band (which is equal to the fixed link receiver bandwidth) is assumed and 2.4 to 10.6 km when a 10 MHz guard band (which is equal to the IMT base station transmitter bandwidth) is assumed.

Depending on the assumed IMT base station emission mask and fixed link antenna pointing and antenna pattern, the calculated separation distance is between 0.9 and 14.9 km when the IMT base station transmitter is assumed to point away from the fixed link receiver. Similarly the separation is between 1.5 and 19.8 km when the fixed link margin loss due to IMT base station interference is 3 dB. If IMT base station transmitters are deployed in a cluttered urban area the separation is between 0.15 and 6.5 km.

The required separation is less than 2 km when interference from IMT UE transmitters is considered. Depending on the assumed guard band, interference alignment and IMT UE emission mask, the required distance is reduced to a few hundred metres.

1/1.1/4.1.2.3 Broadcasting service and mobile service/IMT 1 452-1 492 MHz

A sharing study between potential IMT systems and the BS in the frequency band 1 452-1 492 MHz was conducted. This study aims at analysing the feasibility of sharing between the BS and the MS through comparison of sharing between digital audio broadcasting networks and IMT networks with the case of sharing between networks within the BS. Only the case of IMT downlink is considered.

Sharing between the BS and the MS (IMT) in 1 452-1 492 MHz is not feasible in the same geographical area. Nevertheless, in the case of one administration implementing IMT and a neighbouring administration implementing a broadcast service, the maximum field strength value produced at the border of the neighbouring administration by a single IMT base station, together with the relevant coordination procedure, could be used in order to avoid interference from the IMT network to the T-DAB network. The concerned administrations could agree to use the above-mentioned value, as for example 41 dBμV/m or 21 dBμV/m at the border at 10 m height, depending on whether aggregated interference from the IMT network is to be considered or not.

1/1.1/4.1.2.4 Radiodetermination and mobile service/IMT

All studies carried out were based on the parameters provided by ITU-R and show that within the same geographical area co-frequency operation of mobile broadband systems and radar is not feasible. Furthermore, there is widespread usage of this frequency range in some countries for radar. In addition, harmonized usage of all or a portion of this frequency range by the MS for the implementation of IMT may not be feasible, in particular on a global basis.

In some countries the band is not fully used by radiodetermination systems, and there were studies undertaken in ITU-R which showed that sharing may be feasible in those countries subject to various mitigation measures, and to coordination with potentially affected neighbouring countries.

However no conclusions as to the applicability, complexity, practicability or achievability of these mitigations could be reached.

1/1.1/4.1.2.5 Aeronautical mobile telemetry systems and mobile service/IMT

In order to provide protection of aeronautical mobile telemetry ground receivers in Region 1 from co-frequency interference caused by IMT base stations, required separation distances would generally exceed 100 km:

– For interference from a single IMT base station, separation distances are around 225 km for a land path and up to 415 km for a sea path. For aggregate interference from an IMT network having multiple base stations, separation distances are up to 450 km for a land path and 500 km for a mixed path (40% of land and 60% of sea).

– For interference from a single IMT base station, separation distances are around 100-130 km and increasing up to 200 km when assuming the apportionment for urban 40-50% path and less than 10 % in the total path, respectively.

However, when applying mitigation techniques (e.g., sector antenna disabling at IMT base stations) separation distances may be reduced to a few tens of km. This will be addressed during coordination between the concerned administrations.

With respect to Region 1, Report ITU-R M.2286 indicated the operation of telemetry on-board receivers.

However, some administrations not listed in RR No. **5.342** expressed the view that such airborne relay receivers cannot be considered as an assignment in conformity with RR No. **5.342** and such stations cannot be considered as a part of the telemetry application and shall not be considered for protection.

Providing protection for such air-borne receivers in Region 1 from co-frequency interference caused by an IMT base station may require separation distances exceeding line-of-sight (460 km for typical flight altitudes). In the case of an airborne aeronautical receiver, the necessary separation distance is equal to the line of sight distance. In the case of a ground-based aeronautical receiver, due to the finite value of the telemetry receiver antenna pattern width, its main lobe may be affected by emissions from several interferers located at different distances from a given aeronautical mobile telemetry receiver. In that case the aggregate effect of interference from IMT base stations would be defined by the density of their deployment and would result in increasing the required protection distances.

In order to provide protection for IMT base stations from co-frequency interference caused by an air-borne aeronautical mobile telemetry station in Region 1, maximum required separation distances would be around 460 km. It has to be noted that the duration of interference and required separation distance is dependent on the visibility of the airborne telemetry transmitter, of the scenario of the flight and of parameters such as the antenna diagram. Thus, such interference would not be permanent.

Taking into account the protection criteria of average long-term throughput loss per cell, in order to protect IMT UE from cross-border co-frequency interference caused by an airborne aeronautical mobile telemetry station in Region 1, separation distances up to 25 km would be required.

In Region 2, co-channel sharing between IMT and AMT in the sub-band 1 435-1 525 MHz has been studied by one administration. Based on that study, it is concluded that such sharing is not practical in the geographic areas located within the exclusion zones required below for all of the possible uplink/downlink combinations:

– For interference from IMT UE to AMT ground stations, typical protection distances are 47 km and more in the absence of extreme (>20 dB) clutter loss.

– For interference from IMT base stations to AMT ground stations, the distance beyond which an IMT base station needs to be from an AMT ground station exceeds 100 km, even for "typical" terrain.

– For interference from AMT equipped aircraft to IMT UE and IMT base stations, the separation distances will be 45 km in the case of interference to IMT UE, and 80 km or more in the case of interference to IMT base stations.

Adjacent channel coexistence of IMT systems was studied by a different Region 2 administration operating AMT in the frequency band 1 452-1 472 MHz, with IMT operating in adjacent channels. Adjacent channel operation has been determined feasible with a separation distance of one kilometre from the IMT base station to the AMT receiver. However, this conclusion depends on certain assumptions not characteristic of flight testing as conducted in another administration (such as AMT antenna elevation angle, maximum flight distance from the AMT antenna, and maximum altitude). For this case, there would be a significant protection shortfall using a 1 km separation distance for the adjacent channel case.

1/1.1/4.1.2.6 Broadcasting-satellite service in the frequency band 1 452-1 492 MHz

ITU-R studies concluded that co-frequency sharing between the BSS and IMT is not feasible in the same area.

The sharing and compatibility for adjacent frequency bands (in the same and in adjacent service areas) between IMT and the BSS was not studied. Some studies considered co-frequency sharing between the BSS and IMT in adjacent service areas.

With respect to the interference from IMT to the BSS, the results of the preliminary studies are that, in the case of implementation of IMT networks on adjacent territory to the BSS service area, the maximum power flux-density (pfd) values produced by each IMT base station at the edge of the BSS service area to protect BSS earth stations is in the range of –139 to -150 dBW/m²/MHz if aggregated interference is taken into account and is in the range of -119 to -130 dBW/m²/MHz if aggregated interference is not taken into account.

No consensus was reached with respect to the results of the studies outlined below, in particular the pfd mask concept, assumptions and parameters used in the studies.

Two views were expressed:

One view is that a BSS pfd mask for the protection of IMT may facilitate the coexistence:

– The power flux-density value of BSS satellite to protect receiver terminals of the MS, including IMT, in the frequency band 1 452-1 492 MHz is −113 dBW/m²/MHz.

– The pfd value of BSS satellite to protect base stations of the MS, including IMT, in the frequency band 1 452-1 492 MHz is in the range of −122 to −134 dBW/m²/MHz depending on the vertical arrival angle.

Another view is that no additional limitation shall be imposed on the incumbent services in ITU-R studies related to WRC preparations. Therefore, there shall be no pfd mask limiting BSS space station power in the RR. The pfd limits for BSS space station proposed above neither could be met by the current and future satellite systems nor approved by ITU-R.

1/1.1/4.1.2.7 Radio astronomy service and mobile service/IMT

The results presented in draft new Report ITU-R RA.[RAS-IMT] show that to ensure the protection of the RAS in the frequency band 1 330-1 400 MHz for the case of in-band sharing with IMT systems operating in the frequency band 1 375-1 400 MHz, a separation distance of about 500 km is needed between IMT macro rural base stations and an RAS antenna, and of 85 km for UE, for an assumed flat terrain profile. This indicates that in-band sharing may be very difficult to achieve in practice.

1/1.1/4.1.2.8 Unwanted emissions in the frequency band 1 400-1 427 MHz

1/1.1/4.1.2.8.1 Earth exploration-satellite service (passive) and mobile service/IMT

Draft new Report ITU-R RS.[EESS-IMT 1.4 GHz] shows that, in order to protect EESS (passive) systems, the unwanted emission level of –60 dBW/27 MHz as currently recommended in Resolution **750 (Rev. WRC-12)** is not sufficient and that the following levels of unwanted emissions in the 1 400-1 427 MHz frequency band are required:

For base stations:

– −80 dBW/27 MHz in the case both 1 375-1 400 MHz and 1 427-1 452 MHz frequency bands are considered to be used simultaneously by IMT systems;

– −75 dBW/27 MHz in the case only one of the 1 375-1 400 MHz or 1 427-1 452 MHz frequency bands is to be considered for IMT systems.

For user equipment:

– −65 dBW/27 MHz (This value is derived under the assumption that one UE is transmitting at an average output power of 15 dBm (over all resource blocks (RB)) per sector. It would therefore have to be verified consistently according to these conditions.)

These values are assumed to protect also the SRS (passive).

During the course of the studies, it was shown in particular that current UE specifications in certain standards in the frequency band 1 427-1 452 MHz present unwanted emission levels that are higher than those recommended in Resolution **750 (Rev.WRC-12)**. It was also shown that measured unwanted emission levels of UE based on these standards are lower than those recommended values if some operational conditions are applied, such as average transmission power, narrow transmitting bandwidth and appropriately sized guard bands.

It is confirmed that a relevant combination of channel arrangements, guard bands and/or improved filters and other measures should allow the design of mobile systems (base stations and UE) compliant with the above values.

1/1.1/4.1.2.8.2 Radio astronomy service (1 400-1 427 MHz) and the mobile service/IMT in adjacent band

The results of three independent studies presented in draft new Report ITU-R RA.[RAS-IMT] show that to ensure the protection of RAS stations in the frequency band 1 400-1 427 MHz a separation distance of about 100 km is needed between an RAS antenna and IMT macro rural base stations, whereas it is between 1 and 10 km for UE.

1/1.1/4.1.2.9 Mobile-satellite service and mobile service/IMT

The frequency bands 1 518-1 559 MHz (space-to-Earth), 1 626.5-1 660.5 MHz (Earth-to-space) and 1 668-1 675 MHz (Earth-to-space) are currently in use by GSO MSS operators.

The ITU-R has studied sharing and compatibility between terrestrial IMT-Advanced systems in the frequency band 1 518-1 527 MHz and mobile earth stations (MESs) in the MSS space-to-Earth frequency bands, considering aeronautical, maritime and land MSS applications.

Geographic separation between IMT-Advanced stations and MES would be required to avoid harmful interference to MESs. The minimum separation distances depend on a number of factors, including the operational scenario for the MESs (whether land, maritime or aeronautical), and the propagation conditions between the two stations. Depending on these factors, amongst others, the example minimum separation distances for the assumed dB I/N[8] value range from 1 to 546 km in normal propagation conditions, and from 105 to 830 km in anomalous propagation conditions. Studies on sharing between terrestrial IMT-Advanced systems in the frequency band 1 518-1 527 MHz to MESs in in the MSS have not been finalized.

Regarding adjacent band compatibility, preliminary studies have been presented to the ITU-R but no conclusions were reached. Further study of adjacent band interference may be needed to assess the potential for interference from IMT-Advanced systems operating below 1 518 MHz to MESs operating above 1 518 MHz.

1/1.1/4.1.3 Frequency range 1 695-1 710 MHz

1/1.1/4.1.3.1 Meteorological-satellite service and the mobile service/IMT

There are hundreds of MetSat stations worldwide in the 1 695-1 710 MHz frequency band operated by almost all national meteorological services and many other users.

Draft new Report ITU-R SA.[METSAT-IMT 1.7 GHz] shows that the required protection area around MetSat stations from potential IMT base stations in the 1 695-1 710 MHz frequency band would be up to several hundred km. Therefore, sharing between IMT base stations and MetSat stations in the 1 695-1 710 MHz frequency band is not feasible.

This report also provides assessments of protection areas around MetSat stations from which IMT UE in the 1 695-1 710 MHz frequency band would have to be excluded, with diverging results depending on the assumptions, parameters, and methodologies used.

Two studies depict required separation distances from 46 km (GSO case) and 60 km (NGSO case) up to more than 120 km (NGSO case), even considering low rural deployment and conclude that sharing is not feasible between IMT UE and MetSat stations in the 1 695-1 710 MHz. Another study provides an example calculation resulting in separation distances ranging from 32 to 46 km (NGSO case) and concludes that sharing between IMT UE and MetSat stations is feasible.

1/1.1/4.1.4 Frequency ranges 2 025-2 110 MHz and 2 200-2 290 MHz

1/1.1/4.1.4.1 Space research, Earth exploration-satellite, space operation services and mobile service/IMT

Draft new Report ITU-R SA.[2 025-2 290 MHz] assesses the feasibility for accommodation of IMT (including IMT-Advanced) systems in both the 2 025-2 110 MHz and 2 200-2 290 MHz frequency bands. These analyses show that sharing is not feasible between IMT systems and incumbent data relay satellites forward and return links operating in these frequency bands in the SRS (space-to-space), EESS (space-to-space) and SOS (space-to-space).

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[8] The I/N value assumed was −10 dB. It is noted that other values may also apply.

These new studies reaffirmed earlier ITU-R studies, as in Recommendation ITU-R SA.1154, which resulted in the adoption of RR No. **5.391** at WRC-97 that prohibits high-density mobile systems from operation within these frequency bands.

1/1.1/4.1.5 Frequency bands within the range 2 700-2 900 MHz

1/1.1/4.1.5.1 Radiodetermination and mobile service (IMT)

The studies conducted in ITU-R were between IMT base stations and UE and all relevant types of radar systems described in the Recommendation ITU-R M.1464, as well as radar systems into IMT base stations and UE.

All studies carried out were based on the parameters provided by ITU-R and show that within the same geographical area co-frequency operation of mobile broadband systems and radar is not feasible. Furthermore, there is widespread usage of this frequency range in some countries for radar. In addition, harmonized usage of all or a portion of this frequency range by the MS for the implementation of IMT may not be feasible, in particular on a global basis.

In some countries the frequency band is not fully used by radiodetermination systems, and there were studies undertaken in ITU-R which showed that sharing may be feasible in those countries subject to various mitigation measures, and to co-ordination with potentially affected neighbouring countries. However no conclusions as to the applicability, complexity, practicability or achievability of these mitigations could be reached.

1/1.1/4.1.5.2 Unwanted emissions in the frequency band 2 690-2 700 MHz

1/1.1/4.1.5.2.1 Radio astronomy service and the mobile service/IMT

The results presented in draft new Report ITU-R RA.[RAS-IMT] show that to ensure the protection of RAS stations in the frequency band 2 690-2 700 MHz a separation distance of about 60 km is needed between an RAS antenna and IMT macro rural base stations and of one kilometre for UE, for an assumed unwanted emission level of –50 dBm/MHz and a flat terrain profile.

1/1.1/4.1.6 Frequency bands within the range 2 900-3 100 MHz

1/1.1/4.1.6.1 Radiodetermination and mobile service (IMT)

See section 1/1.1/4.1.5.1 above.

1/1.1/4.1.7 Frequency bands within the range 3 300-3 400 MHz

1/1.1/4.1.7.1 Radiodetermination and the mobile service/IMT

The studies conducted in ITU-R were between IMT base stations and UE and all relevant types of radar systems described in the Recommendation ITU-R M.1465, as well as radar systems into IMT base stations and UE.

The results show that sharing between IMT and land based Radar B is not feasible in the same geographical area. As to other radar systems taken into account, the results vary depending on the study. However 3 out of 4 studies conclude that sharing between IMT and airborne Radar A is not feasible in the same geographical area. The study that shows that sharing between IMT and airborne Radar A may be feasible relies on a level of additional isolation that may be very difficult to achieve and will not be guaranteed in all deployment scenarios.

For one study sharing between IMT indoor and land based Radar A was shown to be possible with a separation distance up to 1.1 km. However two other studies showed that sharing would not be possible unless a separation distance from 25 to 45 km is maintained.

The possible impact of radar systems on IMT has been also studied. The overall conclusion is that indoor IMT systems shall be separated from all the radar types specified in Recommendation ITU-R M.1465 by hundreds of km.

All of the studies on the protection of in-door IMT from airborne Radar A indicate that the required separation distance exceeds hundreds of km. Some of the included studies indicate that the required separation distance between radar systems and IMT may even exceed 1 000 km.

1/1.1/4.1.8 Frequency bands within the range 3 400-4 200 MHz

1/1.1/4.1.8.1 Fixed service and the mobile service/IMT

This study examines the compatibility of proposed IMT systems and FS systems operating in the 3 400-4 200 MHz frequency range.

The co-frequency channel results show that the required separation distance can range from less than one kilometre to nearly 100 km, depending on the interference scenario and deployment environment. These results are based on worst-case assumptions including the pointing direction of the IMT base station and the application of the propagation model. Furthermore, mobile operators can determine which locations are suitable for the deployment of IMT base stations, which can prove advantageous in terms of meeting any required separation distances.

The adjacent channel results show that in the worst-case scenarios (FS receive station pointing directly toward a macro deployment of IMT base stations) the separation distance needed to protect the FS station exceeds 30 km. However, these pointing scenarios should be avoidable in practice, and for more realistic pointing scenarios, the interference can be mitigated through a combination of geographic separation and frequency separation. For these cases, the separation distance between macro base stations and FS receive stations is on the order of a few km coupled with a frequency separation of about one or two channel bandwidths, depending on the separation distance. It is important to note that the frequency separation results reflect channel centre-to-channel centre separations and not guard bands, which are usually expressed as channel edge-to-channel edge. It should also be noted that operators decide where to deploy IMT base stations based on a variety of factors including minimizing interference near international borders in accordance with regulations.

The required geographic and frequency separations are significantly reduced for the small cell indoor base station deployment scenario. For this case, the separation distance between small cell base stations and FS receive stations is on the order of one kilometre coupled with a frequency separation of about one channel bandwidth or a few km with no frequency separation, depending on the relative pointing directions of the IMT and FS stations.

These results also show that the interference from the IMT UE is relatively low. This interference can be mitigated by either a frequency separation of about one channel or a geographic separation of a few km.

It should be noted that certain assumptions such as FS receive station placement and direction, use of propagation model, etc. overestimate interference from the IMT network.

1/1.1/4.1.8.2 Fixed-satellite service and mobile service/IMT

This frequency band has been used by the FSS for space-to-Earth links, together with the 5 850-6 725 MHz frequency band for Earth-to-space links, since the 1970s. The technology is mature and equipment is available at low cost.

The low gaseous atmospheric absorption combined with lower attenuation due to rain enables satellite communication links utilising the frequency band 3 400-4 200 MHz to be established with high availability. This frequency band is used by earth stations throughout the world, but is particularly important in areas with severe rain fade conditions where use of higher frequencies (e.g. 11/14 GHz or 20/30 GHz) would not enable the required availabilities to be provided efficiently.

Furthermore, the wide coverage of satellites in these frequency bands enable services to be provided to developing countries, to sparsely populated areas and over large distances (e.g. providing program content and data distribution between continents).

These factors have led to satellites networks in these frequency bands being an important part of the telecommunications infrastructure in many countries, including developing countries offering a multitude of services, including very small aperture terminal (VSAT) networks, internet providers, point-to-multipoint links, satellite news gathering, TV and data broadcasting to satellite master antenna television (SMATV) and direct-to-home (DTH) receivers. In many countries receive-only earth stations or VSAT terminals are not individually licensed and their number, location or detailed characteristics are therefore not typically available.

Different types of FSS receiving earth stations are described in Reports ITU-R M.2109 and ITU-R S.2199. Due to their wide coverage characteristics, satellites operating in these frequency bands have been extensively employed for disaster relief operations. In cases of major disasters such as tsunamis, earthquakes, hurricanes, etc., when the “wired” telecommunication infrastructure is significantly or completely destroyed by a disaster, only radiocommunication services and, especially networks operating in the FSS, can be employed for disaster relief operations providing the vital links between on-the-ground aid teams, governments and health care facilities. Satellite networks using small aperture earth stations, such as fixed VSATs and transportable earth stations, are one of the most viable solutions to provide emergency telecommunication services for relief operations. Systems operating in the FSS, are not only vital during relief operations, but are also extremely important even before a disaster happens, enabling alerting all those who may be concerned.

In addition, FSS systems in this frequency range are used as part of the ground infrastructure for transmission of aeronautical and meteorological information. Some mobile-satellite systems use parts of the frequency band 3 400-4 200 MHz for feeder links to provide a variety of services, including aeronautical and maritime services. The use of these frequency bands by the FSS furthermore includes governmental uses and collection and distribution of meteorological data by the WMO.

As of December 2012, a total of about 180 geostationary satellites were operating in these frequency bands, about one satellite every second degree around the geostationary arc and the number of both satellites and earth stations operating in these bands are expected to increase.

In addition to the satellites carrying traffic in these bands, many satellites that operate in other frequency bands have their TT&C operations (telemetry, tracking and command) in the 3 400-4 200 MHz frequency range.

(1) In-band emissions

In the case of IMT-Advanced suburban/urban macro-cell deployment scenarios:

– For the long-term interference criterion, the required separation distances are at least in the tens of km. For the short-term interference criterion, the required separation distances, including when the effects of terrain are taken into account, exceed 100 km for most of the cases. Both the long-term and short-term interference criteria would have to be met.

– In some cases, the required separation distances are larger, up to 525 km. In other cases, the required separation distances could be reduced by taking into account additional effects of natural and artificial shielding. However these effects are site specific.

In the case of IMT-Advanced small-cell outdoor deployment scenarios:

– For the long-term interference criterion, the required separation distances are in the tens of km. For the short-term interference criterion, the required separation distances, including when the effects of terrain and clutter are taken into account, are around 30 km in typical IMT-Advanced small-cell deployment using low antenna height in urban environment. In some cases the required separation distances were found to exceed 100 km. Both the long-term and short-term interference criteria would have to be met.

In the case of IMT-Advanced small-cell indoor deployment scenarios:

– The required protection distance for an indoor small cell deployment was smaller relative to small cell outdoor due to the fact that some degree of building attenuation was assumed, as well as lower base station e.i.r.p. and antenna height.

– For the long-term interference criterion, the required separation distances vary from about 5 km to tens of km. For the short-term interference criterion, the required separation distances vary from about 5 km to tens of km, and in some instances up to 120 km. Both the long-term and short-term interference criteria would have to be met.

– The wide range of distances is a consequence of earth stations in a variety of terrain conditions, assumed clutter loss, and different assumptions for the building penetration loss (0 to 20 dB).

The above-mentioned separation distances were derived assuming an IMT-Advanced deployment limited to indoor. If a percentage of IMT-Advanced UE is used outdoors, the required separation distances would normally be larger.

FSS earth station receivers that are deployed with low elevation angles require a path between space and earth to and from the satellite that is clear of ground clutter. For this reason, it should not be assumed that clutter is available to attenuate emissions from an IMT-Advanced UE that is located in the azimuth of the main beam of the FSS earth station receiver, especially those that have been installed with low elevation angles.

(2) Adjacent band emissions

Adjacent band compatibility between IMT-Advanced systems in the frequency bands or parts of the bands 3 300-3 400 MHz / 4 400-4 500 MHz / 4 800-4 990 MHz and FSS systems in the frequency bands 3 400-4 200 MHz/4 500-4 800 MHz have been studied.

– Using the long-term interference criteria, the required separation distance is from 5 km up to tens of km for IMT-Advanced macro-cell and from 900 metres to less than 5 km for IMT-Advanced small-cell outdoor deployments, respectively, with no guard band.

– In the case of IMT-Advanced deployment in the adjacent band, the separation distance between IMT-Advanced base stations and a single FSS receiver earth station could be reduced by employing a guard band between the edge of the IMT-Advanced emission and the FSS allocation.

– For a specific macro-cell deployment scenario studied, the required separation distances from the edge of the IMT-Advanced deployment area are in the range of 30 km to 20 km with an associated guard band of 2 MHz to 80 MHz respectively. Likewise, for a specific small-cell deployment studied, the required separation distances from the edge of the IMT-Advanced deployment area are in the range of 20 km to 5 km with an associated guard band of 1 MHz to 2 MHz respectively.

One study shows that the use of a common representative FSS receive LNA/LNB front-end RF filter provides an insignificant decrease in the required separation distance to protect the FSS earth station receiver from adjacent band emissions. Moreover, inclusion of an RF filter provides little additional rejection of adjacent band emissions over what is already provided by the IF selectivity of the tuner.

(3) LNA/LNB overdrive

The results show that emissions from one IMT-Advanced base station can overdrive the FSS receiver LNA, or bring it into non-linear operation, if a macro cell deployment is closer than a required protection distance that ranges from 4 km to 9 km to an earth station in the frequency bands 3 400-4 200 MHz and 4 500-4 800 MHz. The required protection distance to prevent overdrive of the FSS receiver by IMT-Advanced emissions ranges from 100 metres to 900 metres for the case of small cell deployments.

(4) Intermodulation

The required protection distance to prevent intermodulation interference produced in the receiver of the FSS earth station from being caused by multiple IMT-Advanced base stations ranges from 2 km to 8 km in the case of macro cell deployments. The required protection distance in the small cell deployment scenario to limit the possibility of intermodulation interference being caused into the earth station receivers in the frequency bands 3 400-4 200 MHz and 4 500-4 800 MHz is at least 100 metres to as high as 0.5 km.

Conclusions

The sharing between IMT-Advanced and the FSS is feasible only when FSS earth stations are at known, specific locations, and deployment of IMT-Advanced is limited to the areas outside of the minimum required separation distances for each azimuth to protect these specific FSS earth stations. In this case, the FSS protection criteria should be used to determine the necessary separation distances to ensure protection of the existing and planned FSS earth stations.

When FSS earth stations are deployed in a typical ubiquitous manner or with no individual licensing, sharing between IMT-Advanced and the FSS is not feasible in the same geographical area since no minimum separation distance can be guaranteed.

Deployment of IMT-Advanced would constrain future FSS earth stations from being deployed in the same area in the bands 3 400-4 200 MHz as shown by the studies.

1/1.1/4.1.8.3 Unwanted emissions into the frequency band 4 200-4 400 MHz

Radio altimeters are operational in the frequency band 4 200-4 400 MHz, and operational and technical characteristics and protection criteria are provided in Recommendation ITU-R M.2059. Those altimeters are an essential component of aeronautical safety of life systems, including precision approach, landing, ground proximity and collision avoidance systems.

No studies were provided regarding protection of radio altimeters from unwanted emissions from IMT operating in the frequency band 3 400-4 200 MHz.

1/1.1/4.1.9 Frequency bands within the range 4 400-4 900 MHz

1/1.1/4.1.9.1 Aeronautical mobile systems and mobile service/IMT

For co-channel interference, one sharing study shows large separation distances are required to protect certain types of AMS stations. In the case of protecting airborne station receivers from a single IMT base station interference, the protection distances vary between 162-509 km for aircraft altitude of 2.4 km and 19 km respectively. In the case of protecting airborne station receivers from IMT base station aggregated interference, the protection distances range from 446-706 km for aircraft altitudes at 2.4 km and 19 km respectively. In this case, the corresponding protection zones encompass an area of about 623 318 km^2 and 1.5 million km^2, respectively. Based on this analysis, co-channel sharing between aeronautical mobile applications and IMT systems in 4 400-4 990 MHz is not practical in the geographic areas located within the required exclusion zones of up to 706 km.

Also for co-channel interference, another sharing study shows large separation distances are required to protect certain types of AMS stations. For separation distances between IMT base stations and airborne receivers close to 400 km based on a free-space propagation model, it is shown that IMT base station e.i.r.p. levels need to be restricted to 38.8 dBm/MHz in order for a single IMT base station interferer to protect an airborne receiver.

For adjacent channel interference, one study shows the separation distance required to protect one of three mobile ground receivers (i.e. AMT ground receiver) is approximately five km assuming a 43.6 dB frequency offset factor.

Some administrations are of the view that the adjacent channel study assumes that incumbent systems for aeronautical/ground mobile applications do not use the entire 4 400-4 990 MHz frequency band and there could be free spectrum available to implement potential IMT systems using the adjacent channel solution in this band. If systems in incumbent services, the FS and the MS, currently use the entire band, the use of adjacent channel solutions would result in a loss of spectrum for these services, which may impact operations and future planning for the incumbent services. Some administrations are of the view that the use of an adjacent channel solutions for IMT may be feasible in some countries due to incumbent aeronautical/ground mobile applications not using the entire 4 400-4 990 MHz band.

1/1.1/4.1.9.2 Fixed service and mobile service (IMT)

The report provides the results of compatibility studies between IMT systems and point-to-point fixed wireless systems in the frequency band 4 400-4 990 MHz. Three studies were performed, each of which is presented in a separate Annex to the Report. The results of these studies can be summarized as follows.

Study #1: With regard to the IMT base station (using 61 dBm e.i.r.p.) interfering into the FS receiver (assuming 22.5 dBi antenna gain based on Recommendation ITU-R F.758) in the frequency bands 4 400-4 500 MHz and 4 800-4 990 MHz analysis, the following observations may be reached:

- Co-channel interference analysis between a single IMT base station and a FS receiver predicts that the required separation distance to protect the FS station receiver is up to 70 km for the worst case, taking into account the terrain. The required separation distance to protect FS stations from an aggregated IMT interference would be worse.

For adjacent channel interference, 45 dB of adjacent channel leakage ratio (ACLR) is assumed for IMT base station to the FS receiver. This results in a required separation distance on the order of several tens of km. If an additional 30 dB of attenuation can be found through filtering and/or additional guard bands this distance may be reduced to 5 km. It should be noted that at this time, methods to obtain this additional attenuation have not been documented in this report. The adjacent band study assumes that existing systems do not use the whole allocated frequency band and there is free spectrum available to implement the adjacent band solution for administrations. If an administration's incumbent FS systems currently use the all of the frequency band 4 400-4 990 MHz (for example as per Recommendation ITU-R F.1099), then the use of adjacent band solutions would result in loss of spectrum for the incumbent FS systems.

Study #2: With regards to the IMT base station (using 61 dBm e.i.r.p.) causing interference to FS receivers (assuming 22.5 dBi antenna gain) in the frequency bands 4 400-4 500 MHz and 4 800-4 990 MHz, the obtained results show that protection of FS station receivers from interference caused by a single outdoor IMT base station transmitter requires separation distances up to 70 km. In the case of a network of outdoor IMT base station transmitters, the required separation distance grows up to 120 km. It will be difficult to provide compatibility of proposed IMT systems with existing FS stations in the same geographical region where FS networks are widely deployed in both frequency bands. In the case of aggregate interference from a network of IMT base stations, the required separation distance increases the difficulty of compatibility between IMT systems and FS systems.

Study #3: This study predicted the required separation distance to prevent interference for a single IMT base station or a single UE to four representative FS systems. This study also provides an aggregate interference analysis which predicts the size of the area, surrounding a FS system, from which IMT base stations would have to be excluded to protect the FS system from interference. IMT base stations were modelled using maximum e.i.r.p. values up to 61 dBm with a 20 MHz bandwidth and 64 dBm with a 40 MHz bandwidth. For FS systems modelled on Recommendation ITU-R F.758, typical antenna gains are approximately 22 dBi and an I/N threshold of -10 dB is used as an interference criterion. The propagation model assumed a smooth spherical Earth. This model does not account for potential signal enhancements or reductions due to terrain features. A summary of the results are shown in the following table.

Required separation distance or exclusion area between FS systems and IMT

IMT station type	FS antenna coupling	F.758		Units
		System A	System B	
Base station	Main beam	157	145	km
	Back lobe	78	71	km
UE	Main beam	28	25	km
	Back lobe	8	6	km
Base station	Aggregate	165,781	133,733	km^2

1/1.1/4.1.9.3 Fixed-satellite service and the mobile service/IMT

It is worth mentioning that RR Appendix **30B** contains worldwide Plans in the 4/6 GHz and 10-11/13 GHz frequency bands. The Plans and their associated procedures are a worldwide treaty. This Appendix and its 4/6 GHz Plan are envisaged and used as a supporting backbone to the telecommunication infrastructure of many developing countries, in particular those which are located in high rain fall zones/areas of the globe.

WRC-07 revised the regulatory procedure of the above-mentioned Appendix using the approach currently applied in RR Appendices **30** and **30A**. As a consequence of that, the application of the procedure became much more rapid by administrations and the Bureau. Member States are therefore applying the procedure of Articles 6 and 7 of that Appendix more frequently than they applied before WRC-07.

Several developing countries which did not succeed in applying the procedure of RR Article **9** in coordinating the FSS in non-planned bands due to very high congestion as a result of considerable high number of submitted networks under that Article have since re-directed their applications towards RR Appendix **30B**. Several regional and sub-regional networks are now using frequency bands contained in this Appendix.

Concerning sharing studies to assess the technical feasibility of deploying IMT-Advanced systems in the 4 400-4 990 MHz frequency band, that are utilized by the FSS and other services as stipulated in the RR, similar considerations on the results of sharing studies obtained in the 3 400-4 200 MHz frequency band are applicable to the 4 500-4 800 MHz frequency band.

The sharing between IMT-Advanced and the FSS is feasible only when FSS earth stations are at known, specific locations, and deployment of IMT-Advanced is limited to the areas outside of the minimum required separation distances for each azimuth to protect these specific FSS earth stations. In this case, the FSS protection criteria should be used to determine the necessary separation distances to ensure protection of the existing and planned FSS earth stations.

When FSS earth stations are deployed in a typical ubiquitous manner or with no individual licensing, sharing between IMT-Advanced and FSS is not feasible in the same geographical area since no minimum separation distance can be guaranteed.

Deployment of IMT-Advanced would constrain future FSS earth stations from being deployed in the same area in the frequency band 4 500-4 800 MHz as shown by the studies.

1/1.1/4.1.9.4 Unwanted emissions into the frequency band 4 200-4 400 MHz

Radio altimeters are operational in the frequency band 4 200-4 400 MHz, and operational and technical characteristics and protection criteria are provided in Recommendation ITU-R M.2059. Those altimeters are an essential component of aeronautical safety of life systems, including precision approach, landing, ground proximity and collision avoidance systems.

No studies were provided regarding protection of radio altimeters from unwanted emissions from IMT operating in the frequency band 4 400-4 900 MHz.

1/1.1/4.1.10 Frequency bands within the range 4 800-5 000 MHz

1/1.1/4.1.10.1 Aeronautical mobile systems and mobile service/IMT

NOTE: See section 1/1.1/4.1.9.1 above.

1/1.1/4.1.10.2 Fixed service and mobile service (IMT)

NOTE: See section 1/1.1/4.1.9.2 above.

1/1.1/4.1.10.3 Radio astronomy service and the mobile service/IMT

The results presented in draft new Report ITU-R RA.[RAS-IMT] show that to ensure the protection of RAS stations in the frequency band 4 990-5 000 MHz for the case of in-band sharing with IMT systems, a separation distance of 1 000 km is needed between IMT macro rural base stations and an RAS antenna, and of 300 km for UE, for an assumed flat terrain profile. This indicates that in-band sharing will be very difficult, if not impossible, to achieve in practice.

1/1.1/4.1.10.3.1 Unwanted emissions in the frequency band 4 990-5 000 MHz

For the case of IMT systems operating in the adjacent frequency band 4 800-4 990 MHz, a separation distance of about 60 km is needed between IMT base stations and an RAS antenna and of one kilometre for UE, for an assumed unwanted emission level of −50 dBm/MHz, for an assumed flat terrain profile.

1/1.1/4.1.10.4 Radionavigation-satellite service and mobile service/IMT

NOTE: See section 1/1.1/4.1.2.1 above.

1/1.1/4.1.11 Frequency bands within the range 5 350-5 470 MHz

1/1.1/4.1.11.1 Earth exploration-satellite service (active) and the mobile service/RLANs

Given the RLAN parameters considered in ITU-R (e.i.r.p., bandwidth, antenna, and deployment environment) several studies were performed to assess the compatibility between the EESS (active) and potential future operations of RLANs in the 5 350-5 470 MHz frequency band under the general assumptions that the RLANs would be limited to indoor only (incidental use up to 5% was modelled without building attenuation) and an e.i.r.p. up to a maximum of 200 mW.

Study A shows, by parametric dynamic simulations, that the sharing between the EESS and RLAN in the frequency band 5 350-5 470 MHz is not feasible without some mitigation techniques which would enable the interference from RLAN to the EESS to be decreased by 10.5 to 26.5 dB, respectively for low and high density deployments.

Study B performs parametric analysis under different methodologies and concludes that RLANs cannot share the frequency band 5 350-5 470 MHz with the EESS (active) due to large negative margins (9.4 dB under optimistic assumptions, 30.4 dB under pessimistic assumptions). It further concludes that no potential mitigation techniques would be effective in filling these large negative margins and would also be enforceable/verifiable by administrations.

Study C shows that up to 43 simultaneously transmitting RLAN connections can operate within the Radarsat Constellation Mission (operating under the EESS (active) (RCM) footprint (~225 km^2)) without exceeding the interference threshold level specified in Recommendation ITU-R RS.1166. When compared to the other studies, it was shown that the expected number of simultaneously transmitting RLAN devices reported by those studies significantly exceed the number of RLAN devices that the RCM can tolerate (by a factor of 50 (or 17 dB) times in some cases). No practical and effective mitigation techniques have yet been found.

Study D shows that the rules established in adjacent bands for RLAN are insufficient to enable sharing with incumbent systems in the 5 350-5 470 MHz frequency band. Further study is required to determine if changes to these dynamic frequency selection (DFS) parameters or to see if other mitigation techniques can provide a compatible scenario. Initial studies indicate that a change to DFS detection threshold and the aggregate time for channel detection, channel closing, and channel move time could provide protection of the EESS, however further study is required to examine the ability of RLAN to implement such changes and to define the specific levels required. Studies on alternate mitigation measures have not been completed in the ITU-R and further study is required to determine their applicability.

Study E performs both a static and dynamic analysis looking at the sensitivity of the results for different outdoor usage assumptions. It also considers the effect of various combinations of mitigation techniques and carries out an analysis which places a cap on the maximum density of active RLAN networks based on maximum network activity and calculated frequency reuse distances. The results of these analyses indicate that sharing may only be feasible if additional RLAN mitigation measures are implemented. The analyses also shows that when using a combination of mitigation techniques there may be a possibility of sharing with lower power RLAN use (e.g. 50 mW or below). In addition if it is assumed that there will be more than 1% of RLANs operating outdoor with an e.i.r.p. up to a maximum of 200 mW then it appears that the only viable mitigation techniques that would be able to protect the most sensitive EESS operations in urban areas are techniques that can employ temporal and geographical sharing techniques that take account of the satellite orbits (e.g. a geo-location database).

Results of sharing studies show that with the RLAN parameters described above, sharing between RLAN and the EESS (active) systems in the 5 350-5 470 MHz frequency band would not be feasible. Sharing may only be feasible if additional RLAN mitigation measures are implemented.

Two mitigation measures (EESS post-processing and RLAN e.i.r.p. mask) were deemed to be inappropriate for further consideration with respect to sharing between the EESS (active) and RLANs. No agreement was reached on the applicability of other additional RLAN mitigation techniques. Some additional RLAN mitigation techniques to enable sharing with the EESS (active) are being studied by the ITU-R, but no conclusions can be drawn at this time.

1/1.1/4.1.11.2 Radar systems and the mobile service/RLANs

Members of ITU-R were unable to reach agreement on the applicability of specific additional RLAN mitigation techniques.

The regulatory provisions in the 5 150-5 350 MHz and 5 470-5 725 MHz frequency ranges 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. It should be noted that some of these RDS radars operate across the 5 250- 5 850 MHz frequency range.

Some additional RLAN mitigation techniques to enable sharing are being studied by the ITU-R but no conclusions can be drawn at this time.

Further study by ITU-R is required to determine if these additional mitigation techniques can be utilized to mitigate potential interference to these particular radar types.

1/1.1/4.1.12 Frequency bands within the range 5 725-5 850 MHz

Some administrations submitted contributions indicating that the study results for the 5 350-5 470 MHz frequency band are applicable to the 5 725-5 850 MHz frequency band to ensure protection of certain radars that operate across or in portions of the 5 250-5 850 MHz frequency band. Some other administrations raised concerns regarding these results because no RLAN characteristics were previously agreed for the 5 725-5 850 MHz frequency band and that the RLAN characteristics utilized for the 5 350-5 470 MHz frequency band cannot be applied similarly to the 5 725-5 850 MHz frequency band. Some administrations also highlighted that the sharing environment is significantly different between the two bands due to the ISM designation of the 5 725-5 875 MHz frequency band. There are current deployments of RLAN in the 5 725-5 850 MHz frequency band in some countries in all three ITU Regions. Therefore, agreement was not reached on the conclusions in these documents.

No other sharing/compatibility studies were provided for this frequency band.

1/1.1/4.1.13 Frequency bands within the range 5 925-6 425

1/1.1/4.1.13.1 Fixed service and the mobile service/IMT

The frequency band 5 925-6 425 MHz has been proposed as a possible candidate frequency band for IMT identification. However, this band is heavily used for point-to-point FS links. The objective is to study the sharing and compatibility between indoor IMT small cells and FS stations.

The study considers only the impact of interference from IMT indoor small cells into point-to-point FS station receivers.

The results of the studies showed that the permissible I/N = –10 dB with indoor IMT small cells operating in co-channels with point-to-point FS receivers could be reached starting from 20-200 metres distances in most directions, except for the main and first side lobes of the antenna pattern. In the main lobe direction of the antenna pattern this distance corresponds to 8-50 km, depending on the value of additional losses due to local clutter shielding, which will be present in an IMT urban environment. The likelihood of an IMT small cell lying within the main or first side lobes of a point-to-point antenna pattern hasn't been studied. These results are derived based on a single interferer and do not consider cumulative effect, which could lead to different values.

When detailed information on point-to-point links deployment is available, more detailed planning of IMT systems could be performed to reduce the separation distances mentioned above.

The calculated separation distances are going to be dependent on a number of local considerations including deployment and geographical distribution of both IMT and FS stations at a national level and may require coordination with neighbouring administrations.

1/1.1/4.1.13.2 Fixed-satellite service and mobile service/IMT

Concerning the protection of a receiving geostationary FSS space network, the studies showed that GSO FSS space networks would be subjected to excessive levels of interference from the aggregate operation of IMT-Advanced (small cell) base stations, irrespective of whether they are deployed outdoors or indoors. The e.i.r.p. limit of IMT stations to protect FSS satellites is dependent on dissemination of IMT-Advanced stations, activity factors, the actual channelization scheme and the building penetration losses. The studies show that for case when IMT-Advanced stations are limited only to indoor use (deployed 95% indoors and 5% without building attenuation) the e.i.r.p. of the IMT-Advanced station should be limited to 10-15 dBm. Under certain conditions for the 15 dBm e.i.r.p. limit, interference above the 6% ΔT/T criterion equal to several dBs could be observed for some beams with high gain antennas. For approximately 1% of beams analysed such excess equals 3-6 dB and up to 9 dB in single instances. In such cases usually only one of multiple beams of a satellite is identified as possibly affected. Other beams of the satellite covering the same region will have smaller ΔT/T increase. The limitation may be placed on the e.i.r.p. in the total bandwidth of the emission, rather than on the power spectral density. The above limits are based on the assumption that the whole of the frequency band 5 925-6 425 MHz is identified for IMT-Advanced stations. If a narrower or wider band is identified for IMT-Advanced (or used in a particular country), the power limits should be adjusted according to the following formula: Adjustment $=10\times\log(500/B)$ in dB, where B is the available bandwidth for IMT-Advanced systems, in MHz.

It was concluded that for the protection of a single receiving IMT-Advanced base station, separation distances up to many tens of km would be required between a single transmitting FSS earth station and a single outdoor IMT-Advanced receiving base station, in order to protect the IMT-Advanced station from co-frequency interference. For indoor deployed IMT-Advanced stations, a separation distance ranging from several hundreds of metres up to several km would be required. The effectiveness of frequency selective scheduling (described in draft new Report ITU-R [FSS-IMT C-BAND UPLINK], Annex 1, section 4.3) as a method to mitigate interference from a transmitting FSS Earth station into an IMT-Advanced system has been studied. For the specific case studied, the entirety of the interfering FSS carrier was contained within the bandwidth of the IMT-Advanced channel. The results indicated that the use of this mitigation technique could reduce the separation distance to around 100 metres even with the IMT-Advanced protection criteria being exceeded. It should be noted that the effectiveness of such a mitigation technique is expected to be more limited, relative to the specific case studied, when the bandwidth of the FSS carrier is larger than the bandwidth of the IMT-Advanced channel or larger than the aggregate bandwidth of the combined IMT-Advanced channels. Thus it is generally concluded that no specific separation distance is required between a FSS transmitting station and an indoor IMT-Advanced small cell.

Based on studies described in draft new Report ITU-R [FSS-IMT C-BAND UPLINK] it is concluded that sharing and compatibility between IMT-Advanced systems and FSS networks in 5 925-6 425 MHz frequency band is feasible under certain conditions. These conditions include deployment of IMT-Advanced systems only indoor and establishment of a limit on the maximum allowable e.i.r.p. for IMT-Advanced stations in this frequency range. In addition it is generally concluded that no specific separation distance is required between a FSS transmitting station and an indoor IMT-Advanced small cell.

1/1.1/4.2 Potential candidate frequency bands

The frequency bands below are considered as potential candidate frequency bands from among the suitable frequency ranges provided by the ITU-R. These frequency bands were proposed by one or more administrations and were studied by the ITU-R (see section 1/1.1/3.2). No consensus was reached on the proposed candidature of any of these frequency bands for mobile broadband, including IMT. However, the frequency bands listed below, and detailed in sections 1/1.1/3.2 and 1/1.1/4.1, were proposed as potential candidate frequency bands and received both support and opposition.

In studying agenda item 1.1, inputs were received reflecting views on certain frequency ranges/bands. These views were compiled/consolidated in Annex 1 of the Document 4-5-6-7/715. It should be emphasized that this Annex was neither examined nor approved by JTG 4-5-6-7, thus its inclusion in Document 4-5-6-7/715 is for information only.

Studies related to various frequency bands (studies initiated, carried out, not completed, completed), as well as an overview of which services were and were not studied for each band, are addressed in sections 1/1.1/3.2 and 1/1.1/4.1 above.

Frequency band 470-694/698 MHz

Frequency band 1 350-1 400 MHz

Frequency band 1 427-1 452 MHz

Frequency band 1 452-1 492 MHz

Frequency band 1 492-1 518 MHz

Frequency band 1 518-1 525 MHz

Frequency band 1 695-1 710 MHz

Frequency band 2 700-2 900 MHz

Frequency band 3 300-3 400 MHz

Frequency band 3 400-3 600 MHz

Frequency band 3 600-3 700 MHz

Frequency band 3 700-3 800 MHz

Frequency band 3 800-4 200 MHz

Frequency band 4 400-4 500 MHz

Frequency band 4 500-4 800 MHz

Frequency band 4 800-4 990 MHz

Frequency band 5 350-5 470 MHz

Frequency band 5 725-5 850 MHz

Frequency band 5 925-6 425 MHz

1/1.1/5 Method(s) to satisfy the agenda item

The following methods are considered to satisfy this agenda item and may be applied to potential candidate frequency bands. These are:

Method A – No change, which may be accompanied by reasons.

Method B – Make an allocation to the MS on a primary basis (either by a new allocation or the upgrade of an existing secondary allocation) with a view to facilitate the development of terrestrial mobile broadband applications.

> **Method B-ToA** - Make an allocation to the MS on a primary basis in the Table of Frequency Allocations.
>
> **Method B-FN** - Make an allocation to the MS on a primary basis in a footnote.

Method C - To identify the frequency band for IMT either in a new or existing footnote. This Method can be applied individually if there is already a primary mobile allocation or in conjunction with Method B.

In addition, any condition of use specific to a frequency band by the MS or IMT systems will be described under the specific frequency band under Methods B and/or C.

Other considerations - Current status of the frequency band: There is an allocation on a primary basis for the MS for a frequency band in a Region and it is identified for IMT in certain countries in that Region. Those countries which may wish to add their names to that footnote can submit proposals to WRC-15 taking into account Resolution **26 (Rev.WRC-07)** in accordance with Resolution **233 (WRC-12)**.

The frequency bands considered as potential candidate frequency bands under this agenda item together with the applicable methods identified to satisfy the agenda item are summarized in the table below:

Methods that may be applicable to the potential candidate frequency bands, taking into account existing frequency allocations contained in Article 5 of the RR

Number / Bands (MHz)	Applicable Methods				
	Method A	**Method B-ToA**	**Method B-FN**	**Method C**	**Options**
1 / 470-694/698	A	B	B	C	1/1.1/5.1
2 / 1 350-1 400	A	B	B	C	1/1.1/5.2
3 / 1 427-1 452	A			C	1/1.1/5.3
4 / 1 452-1 492	A			C	1/1.1/5.4
5 / 1 492-1 518	A			C	1/1.1/5.5
6 / 1 518-1 525	A			C	1/1.1/5.6
7 / 1 695-1 710	A	B	B	C	1/1.1/5.7
8 / 2 700-2 900	A	B	B	C	1/1.1/5.8
9 / 3 300-3 400	A	B	B	C	1/1.1/5.9
10 / 3 400-3 600	A	B	B	C	1/1.1/5.10
11 / 3 600-3 700	A	B	B	C	1/1.1/5.11
12 / 3 700-3 800	A	B	B	C	1/1.1/5.12
13 / 3 800-4 200	A	B	B	C	1/1.1/5.13
14 / 4 400-4 500	A			C	1/1.1/5.14
15 / 4 500-4 800	A			C	1/1.1/5.15
16 / 4 800-4 990	A			C	1/1.1/5.16
17 / 5 350-5 470	A				1/1.1/5.17
18 / 5 725-5 850	A				1/1.1/5.18
19 / 5 925-6 425	A			C	1/1.1/5.19

Note: In the above table, Methods B-ToA and B-FN, when identified as applicable for a frequency band, do not necessarily apply to all regions.

1/1.1/5.1 For the frequency band 470-694/698 MHz

Methods A, B, C are applicable.

The following options may be applied in the case of **Method A**:

For Method A, Option 1 - No change for Region 1. See section 1/1.1/4.1.1.1.1.3.

For Method A, Option 2 - No change for Region 2. See section 1/1.1/4.1.1.1.2.

For Method A, Option 3 - No change for Region 3.

The following options may be applied in the case of **Method B**:

For Method B-ToA, Option 1– applies to Region 1 and Region 2 in the frequency band, or portion of the band, as the case may be.

For Method B-ToA, Option 2 – applies to Region 1 in the frequency band, or portion of the band, as the case may be.

For Method B-ToA, Option 3 – applies to Region 2 in the frequency band, or portion of the band, as the case may be.

For Method B-FN, Option 4 – applies to [list countries of Region 1 and Region 2] subject to agreement obtained under RR No. **9.21**. In Region 2 this may be applied by modification of existing footnotes or by a new footnote in the frequency band, or a portion of the band, as the case may be.

The following option may be applied in the case of **Method C**:

For Method C, Option C1

RR Article **5** footnote specifying the application of RR No. **9.21** to safeguard regulatory priority of the incumbent services by requiring that administrations that choose to implement IMT in the frequency band will be obligated to seek the agreement of other affected administrations.

1/1.1/5.2 For the frequency band 1 350-1 400 MHz

Methods A, B, and C are applicable.

The following options may be applied in the case of Methods B or C, as appropriate.

Option C1a

Relevant mandatory unwanted emission levels in Resolution **750 (Rev.WRC-12)** for the frequency band 1 400-1 427 MHz consistent with DN Report ITU-R RS.[EESS-IMT 1.4 GHz] will have to be included in the Radio Regulations to ensure the protection of the EESS (passive).

Option C1b

Relevant recommended unwanted emission levels in Resolution **750 (Rev.WRC-12)** for the frequency band 1 400-1 427 MHz consistent with DN Report ITU-R RS.[EESS-IMT 1.4 GHz] will have to be included in the RR to ensure protection of the EESS (passive).

Options C1a and C1b are alternative, while the following Option(s) can be used in conjunction with either C1a or C1b.

Option C2

TBD by the proponent of the option (taking into account the information provided in section 1/1.1/6)

Option B1

RR Article **5** footnote specifying that stations of the MS operating in the frequency band 1 350-1 400 MHz shall not cause harmful interference to or claim protection from stations in the RLS.

1/1.1/5.3 For the frequency band 1 427-1 452 MHz

Methods A and C are applicable.

The following options may be applied in the case of Method C:

Option C1a

Relevant mandatory unwanted emission levels in Resolution **750 (Rev.WRC-12)** Table **1-1** for the frequency band 1 400-1 427 MHz consistent with DN Report ITU-R RS.[EESS-IMT 1.4 GHz] will have to be included in the RR to ensure the protection of the EESS (passive).

Option C1b

Relevant recommended unwanted emission levels in Resolution **750 (Rev.WRC-12)** Table **1-2** for the band 1 400-1 427 MHz will have to be revised in accordance with DN Report ITU-R RS.[EESS-IMT 1.4 GHz] to ensure protection of the EESS (passive). It should be noted that the revised values should be retained as “recommended” values.

Options C1a and C1b are alternative, while the following options can be used in conjunction with either C1a or C1b.

Option C2

RR Article **5** footnote specifying that stations in the MS operating in the frequency band 1 429-1 452 MHz shall not cause harmful interference to or claim protection from stations in the aeronautical telemetry listed in RR No. **5.342**.

Option C3

RR Article **5** footnote specifying that the frequency band 1 429-1 452 MHz can be used by stations in the MS subject to agreement obtained under RR No. **9.21** from the countries listed in RR No. **5.342**.

1/1.1/5.4 For the frequency band 1 452-1 492 MHz

Methods A and C are applicable.

The following options may be applied in the case of Method C.

Option C1

In order to facilitate the coexistence between IMT and the BSS in the frequency band 1 452-1 492 MHz, the current regulatory procedures governing the relation between the BSS and terrestrial services would be modified by inserting a pfd value of [-113 dBW/m²/MHz] in RR Article **21** with the view to provide a more stable (long-term stability) situation to IMT.

RR Appendix **5** would be modified so as to enable countries wishing to continue to apply the coordination procedure under RR No. **9.11** to do so. Therefore a pfd limit will apply to the BSS with respect to all terrestrial services except for countries wishing to continue to apply RR No. **9.11**, because of more stringent protection requirements (e.g. in order to protect telemetry systems).

Option C2

Applying the current practice of ITU to facilitate the use of IMT through bilateral/multilateral coordination with neighbouring countries since this frequency band is already allocated to the MS and to continue to have coordination between the BSS and the MS pursuant to RR Nos. **9.11** and **9.19**.

Option C3

ITU-R received a proposal to include for the frequency band 1 452-1 492 MHz a new method aiming to put new constraints on the existing BSS allocation.

In this connection it should be stated that:

- WARC-92 has made frequency allocations to the BSS (sound) and complementary terrestrial broadcasting in frequency band 1 452-1 492 MHz;
- RR No. **5.345** stipulate that the use of the frequency band 1 452-1 492 MHz by BSS is subject to Resolution **528 (WARC-92).**

Resolution **528 (Rev.WRC-03)** resolved that a competent conference should be convened, preferably not later than 1998, for the planning of the BSS (sound) in the frequency bands allocated to this service in the frequency range 1-3 GHz; and the development of procedures for the coordinated use of complementary terrestrial broadcasting.

This Resolution also resolved that in the interim period, the use of BSS systems are in accordance with the procedures contained in Sections A to C of Resolution **33 (Rev.WRC-03)**, or in RR Articles **9** to **14**, as appropriate (see *resolves* 1 and 2 of Resolution **33 (Rev.WRC-03)**).

The same Resolution also resolved that the calculation methods and the interference criteria to be employed in evaluating the interference should be based upon relevant ITU-R Recommendations agreed by the administrations concerned as a result of Resolution **703 (Rev.WARC-92)** or otherwise.

The relation between the BSS and the terrestrial service is thus currently governed by RR No. **9.11** triggered by frequency overlapping as referred to Appendix **5** to the RR.

Any modification to the regulatory regime from RR No. **9.11** to any other regime is subject to a decision to be taken by a competent conference for the planning of the BSS (sound) in the frequency bands allocated to this service in the frequency range 1-3 GHz and the development of procedures for the coordinated use of complementary terrestrial broadcasting.

In addition it should be recalled that CPM-07 received contribution CPM07-2/79 indicating that:

Quote 1

that NGSO systems operating in the frequency band 1 467-1 492 MHz should no longer be subject to Article **22.2**, but coordinated under Article **9.11A**.

Unquote l

Corrigendum 1 to Revision 1 to Document CPM07-2/134 reflects the conclusion of CPM07-2 as follows:

Quote 2

The meeting considered input Documents CPM07-2/79 and 36 (§ 2 Issue 19) from Lebanon and APT respectively, dealing with proposals regarding regulatory procedures concerning non-GSO systems in the frequency band 1 467-1 492 MHz. The Chairman of the CPM also included in the discussion the output of the SC regarding this matter (CPM07-2/2, § 2.18). After some discussion of the documents, the meeting agreed that the issue will be summarized in Chapter 6 of the CPM Report in the following manner:

It will be stated that CPM-07 received contributions CPM07-2/79 and 36, with reference to the views from the Special Committee as contained in CPM07-2/2. The views of the CPM on the matter will be as follows: "CPM concluded that this issue needs to be considered by WRC-07".

Unquote 2

In light of the foregoing and in line with the conclusion reached by CPM07-2 on a similar issue (changing regulatory regime applicable to the frequency band 1 452-1 492 MHz from that contained in the RR to a new one) the proposal aiming to put new constraints on an existing BSS allocation and change its regulatory status is outside of the Terms of Reference decided by CPM 15-1 (see Annex 10 of BR Administrative Circular CA/201).

It was recognized that in carrying out the studies in relation to any frequency band under the agenda item of any WRC, such studies shall not modify the regulatory environments and conditions in force and applicable to the incumbent service. Any contrary action would be in contradiction and contravene the principles enshrined in the RR, unless the agenda item specifically calls for any modification in the regulatory environment. It was also emphasized that the regulatory examples given under Method C for this approach are not consistent with the description of Method C.

Option C4

In order to harmonize the usage of the frequency band in all three Regions allocation to the MS in the frequency band 1 452-1 492 MHz in Region 1 needs to be modified, taking into account protection of existing mobile application.

1/1.1/5.5 For the frequency band 1 492-1 518 MHz

Methods A and C are applicable.

Under Method C the following options may be applied:

Option C1

Applying the current practice of ITU to facilitate the use of IMT through bilateral/multilateral coordination with neighbouring countries since this frequency band is already allocated to the MS in Regions 2 and 3.

Option C2

Applying additional regulatory provisions in the RR to protect the MSS systems operating above 1 518 MHz.

Option C3

RR Article **5** footnote specifying that stations in the MS operating in the frequency band 1 492-1 518 MHz shall not cause harmful interference to or claim protection from the aeronautical telemetry stations mentioned in RR No. **5.342**.

Option C4

RR Article **5** footnote specifying that the frequency band 1 492-1 518 MHz can be used by stations in the MS subject to agreement obtained under RR No. **9.21** from the countries listed in RR No. **5.342**.

1/1.1/5.6 For the frequency band 1 518-1 525 MHz

Methods A and C are applicable.

The following options may be applied in the case of Method C:

Option C1

Applying the current practice of ITU to facilitate the use of IMT through bilateral/multilateral coordination with neighbouring countries since this frequency band is already allocated to the MS in Regions 2 and 3.

Option C2

RR Article **5** footnote specifying that stations in the MS operating in the frequency band 1 518-1 525 MHz shall not cause harmful interference to or claim protection from the aeronautical telemetry stations mentioned in RR No. **5.342**.

Option C3

RR Article **5** footnote specifying that the frequency band 1 518-1 525 MHz can be used by stations in the MS subject to agreement obtained under RR No. **9.21** from the countries listed in RR No. **5.342**.

1/1.1/5.7 For the frequency band 1 695-1 710 MHz

Methods A, B, and C are applicable.

The following option may be applied in the case of Method C:

Option C1

RR Article **5** footnote limiting the use of MS allocation to terminals and stressing the need for protection of METSAT stations.

1/1.1/5.8 For the frequency band 2 700-2 900 MHz

Methods A, B and C are applicable.

The following options may be applied in the case of Methods B and C.

Option 1

Allocate the frequency band to the MS on a primary basis in a new footnote listing the countries in which the allocation applies, subject to agreement to be obtained under RR No. **9.21**, and identify the frequency band for IMT in the same footnote.

Option 2

RR Article **5** footnote specifying that stations in the MS operating in the frequency band 2 700-2 900 MHz shall not cause harmful interference to or claim protection from systems in ARNS.

1/1.1/5.9 For the frequency band 3 300-3 400 MHz

Methods A, B and C are applicable.

The following option may be applied in the case of Methods B or C, as appropriate:

Option 1

RR Article **5** footnote specifying that stations in the MS operating in the frequency band 3 300-3 400 MHz shall not cause harmful interference to or claim protection from systems in the RLS.

1/1.1/5.10 For the frequency band 3 400-3 600 MHz

In the case that Method A is applied:

No change, due to the fact that the frequency band 3 400-3 600 MHz was under agenda item 1.4 of WRC-07. After lengthy and extensive discussion, consensus emerged for Regions 1 and 3 to allocate the frequency band to the MS and/or identify for IMT in footnotes (RR Nos. **5.430A**, **5.432A**, **5.432B**, **5.433A**), as the case may be. The principles based on which consensus was reached at WRC-07 need to be maintained. Method A is therefore applied.

The following options may be applied in the case of Method B-ToA and Method B-FN

Option 1

Allocate the frequency band to the MS on a primary basis either in the Table of Frequency Allocations or in a new footnote without application of RR No. **9.21** and pfd limits to protect the FSS in the neighbouring countries.

Option 2

Allocate the frequency band to the MS on a primary basis either in the Table of Frequency Allocations or in a new footnote, together with technical and regulatory conditions in a footnote/Resolution including the application of RR Nos. **9.17**, **9.18**, **9.21**, RR Table **21-4** pfd limits, pfd limits for the MS and any additional conditions, if necessary as appropriate.

Option 3

Add new country names to existing footnotes RR Nos. **5.430A**, **5.431A** and **5.432B**.

Option 4

Allocations to the MS beyond those mentioned in footnotes RR Nos. **5.430A**, **5.431A**, **5.432B** should strictly retain four conditions (RR No. **9.21**, RR Table **21-4** pfd limits, pfd limits for the MS, RR Nos. **9.17**, **9.18**) referred to in those footnotes, i.e. no change of conditions of use as currently enforced to be made.

The following options may be applied in the case of **Method C**:

Option 1

Identify for IMT without any additional conditions. Conditions applicable to the MS in the frequency band equally apply to IMT.

Option 2

Identify for IMT, together with technical and regulatory conditions in a footnote/WRC Resolution including the application of RR Nos. **9.17**, **9.18**, **9.21**, RR Table **21-4** pfd limits for the FSS, pfd limits for the MS/IMT and any additional conditions, if necessary as appropriate.

Option 3

Add new country names to existing footnotes RR Nos. **5.430A**, **5.432B**, and **5.433A**

Option 4

Identification for IMT beyond those mentioned in footnotes RR Nos. **5.430A**, **5.432A**, **5.432B**, **5.433A** should strictly retain four conditions (RR No. **9.21**, RR Table **21-4** pfd limits, pfd limits for the MS, RR Nos. **9.17**, **9.18**) referred to in those footnotes, i.e. no change of conditions of use as currently enforced to be made.

Note: Options 1 and 2 for Method B and Options 1 and 2 for Method C may require consequential suppression/modification of existing footnotes in the frequency band 3 400-3 600 MHz.

1/1.1/5.11 For the frequency band 3 600-3 700 MHz

Method A is applicable.

Options 1 and 2 for Method B as well as Options 1 and 2 for Method C, as described in section 1/1.1/5.10, may also be applied to the frequency band 3 600-3 700 MHz, taking into account existing allocations to the MS in this frequency band.

1/1.1/5.12 For the frequency band 3 700-3 800 MHz

Method A is applicable.

Options 1 and 2 for Method B as well as Options 1 and 2 for Method C, as described in section 1/1.1/5.10, may also be applied to the frequency band 3 700-3 800 MHz, taking into account existing allocations to the MS in this band.

1/1.1/5.13 For the frequency band 3 800-4 200 MHz

Method A is applicable.

Options 1 and 2 for Method B as well as Options 1 and 2 for Method C, as described in section 1/1.1/5.10, may also be applied to the frequency band 3 800-4 200 MHz, taking into account existing allocations to the MS in this band.

1/1.1/5.14 For the frequency band 4 400-4 500 MHz

Methods A and C are applicable.

Option 1

Applying the current practice of ITU to facilitate the use of IMT through bilateral/multilateral coordination with neighbouring countries since this frequency band is already allocated to the MS in Regions 2 and 3.

1/1.1/5.15 For the frequency band 4 500-4 800 MHz

Option 1

Option 1 for Method C, as described in section 1/1.1/5.10, may be applied to the frequency band 4 500-4 800 MHz, taking into account the need to preserve the integrity of the RR Appendix **30B** and its future development, which is a worldwide treaty included in the RR, and associated existing procedures.

Option 2

Option 2 for Method C, as described in section 1/1.1/5.10, may be applied to the frequency band 4 500-4 800 MHz, taking into account the need to preserve the integrity of the RR Appendix **30B** and its future development, which is a worldwide treaty included in the RR, and associated existing procedures.

Option 3

Identify for IMT, together with technical and regulatory conditions in a footnote/Resolution providing protection to the allotments and assignments subject in RR Appendix **30B** and their future development taking into account receiving FSS earth station in RR Appendix **30B** could be located anywhere within the service area of the FSS network.

1/1.1/5.16 For the frequency band 4 800-4 990 MHz

Methods A and C are applicable.

Option 1

Applying the current practice of ITU to facilitate the use of IMT through bilateral/multilateral coordination with neighbouring countries since this frequency band is already allocated to the MS in Regions 2 and 3.

1/1.1/5.17 For the frequency band 5 350-5 470 MHz

Only Method A is applicable.

Option 1

No change due to unresolved issues:

a) Results of studies show that with the RLAN parameters utilized, sharing between RLAN and EESS (active) systems in the 5 350-5 470 MHz frequency band would not be feasible. Sharing may only be feasible if additional RLAN mitigation measures are implemented, but no agreement was reached on the applicability of additional RLAN mitigation techniques. Some additional RLAN mitigation techniques to enable sharing with the EESS (active) are being studied by the ITU-R, but no conclusions can be drawn at this time.

b) The regulatory provisions in the 5 150-5 350 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. Some additional RLAN mitigation techniques to enable sharing are being studied by the expert groups in the ITU-R but no conclusions can be drawn at this time. Further study by ITU-R is required to determine if these additional mitigation techniques can be utilized to mitigate potential interference to these particular radar types.

1/1.1/5.18 For the frequency band 5 725-5 850 MHz

Only Method A is applicable.

Option 1

No change due to unresolved issues.

Some administrations submitted contributions indicating that the study results for the 5 350-5 470 MHz frequency band are applicable to the 5 725-5 850 MHz frequency band to ensure protection of certain radars that operate across or in portions of the 5 250-5 850 MHz frequency band. Some other administrations raised concerns regarding these results because no RLAN characteristics were previously agreed for the 5 725-5 850 MHz frequency band and that the RLAN characteristics utilized for the 5 350-5 470 MHz frequency band cannot be applied similarly to the 5 725-5 850 MHz frequency band. Some administrations also highlighted that the sharing environment is significantly different between the two frequency bands due to the ISM designation of the 5 725-5 875 MHz frequency band. There are current deployments of RLAN in the 5 725-5 850 MHz frequency band in some countries in all three ITU Regions. Therefore, agreement was not reached on the conclusions in these documents.

1/1.1/5.19 For the frequency band 5 925-6 425 MHz

Methods A and C are applicable.

The following options may be applied in the case of Method C

Option C1

Add a Resolution in the identification footnote establishing a regulatory e.i.r.p. limit for IMT stations and limiting IMT deployment to indoor.

Option C2

Identify the frequency band 5 925-6 425 MHz for IMT by a footnote without any additional conditions. Conditions applicable to the MS in the frequency band equally apply to IMT.

Option C3

Modification of existing Resolutions, such as WRC Resolutions **212**, **223**, and **224**, to include additional conditions on the use of the frequency band 5 925-6 425 MHz by the MS.

Option 4

IMT system operation under the condition of not claiming protection from FSS earth stations.

1/1.1/6 Regulatory and procedural considerations

For Method A (No change)

NOC

For Method B-FN

ADD

5.A11 *Additional allocation:* [in country names], the frequency bands [aa-bb, and cc-dd MHz] are also allocated to the mobile, except aeronautical mobile, service on a primary basis. (WRC-15)

For Method C

ADD

5.B11 [In Regions/country names], the frequency bands [aa-bb and cc-dd MHz], or portions of those frequency bands, are identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [See/Subject to application of WRC Resolution and/or WRC Recommendation, which may include conditions of use, as appropriate.] (WRC-15)

For Method B-FN and C

ADD

5.C11 *Additional allocation:* [in country names], the frequency bands [aa-bb and cc-dd MHz] are also allocated to the mobile, except aeronautical mobile, service on a primary basis and are identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of these frequency bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. See [WRC Resolution and/or WRC Recommendation]. (WRC-15)

For footnote satisfying other considerations

MOD

5.313A ~~The band, or portions of the band 698-790 MHz, i~~In [add administration(s)/Region], Bangladesh, China, Korea (Rep. of), India, Japan, New Zealand, Pakistan, Papua New Guinea, Philippines and Singapore, the frequency band 698-790 MHz, or portions of that frequency band, ~~are~~ is identified for use by these administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of these frequency bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. In China, the use of IMT in this band will not start until 2015. (WRC-~~12~~15)

Note by the Secretariat: The guidelines regarding examples of modifications of Section IV – Table of Frequency Allocations of RR Article 5, either to MOD a relevant part of the Table, MOD a footnote and/or ADD a new footnote, have not been fully implemented in this section 1/1.1/6 of the draft CPM Report in order to limit the number of pages.

1/1.1/6.1 For the frequency band 470-694/698 MHz

1/1.1/6.1.1 For Method C, Option C1

ADD

5.D11 The operation of stations in the mobile service for the implementation of International Mobile Telecommunications (IMT) in the frequency band 470-694 MHz in Region 1, in 470-608 MHz and 614-698 MHz in Region 2, and in 470-698 MHz in Region 3 shall be subject to agreement obtained under No. **9.21**. (WRC-15)

1/1.1/6.2 For the frequency band 1 350-1 400 MHz

1/1.1/6.2.1 For Method B or C, Option C1a

ADD

5.E11 *Additional allocation:* in [country names], the frequency band 1 350-1 400 MHz is allocated to the mobile, except aeronautical mobile, service on a primary basis and is also identified for International Mobile Telecommunications (IMT). This identification does not preclude the use of this band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Such use is subject to the application of Resolution **750 (Rev.WRC-15)**. (WRC-15)

1/1.1/6.2.2 For Method B or C, Option C1b

The same regulatory example as in section 1/1.1/6.2.1 applies.

1/1.1/6.2.3 For Method C, Option C2

ADD

5.F11 IMT stations of the mobile service operating in the frequency band 1 350-1 400 MHz in Region 1 shall not cause harmful interference to or claim protection from stations in the radiolocation service. (WRC-15)

1/1.1/6.2.4 For Method B, Option B1

ADD

5.G11 Stations of the mobile service operating in the frequency band 1 350-1 400 MHz in Regions 2 and 3 shall not cause harmful interference to or claim protection from stations in the radiolocation service. (WRC-15)

1/1.1/6.3 For the frequency band 1 427-1 452 MHz

1/1.1/6.3.1 For Method C, Option C1a

ADD

5.H11 [In Regions/country names], the frequency band 1 427-1 452 MHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Such use is subject to the application of Resolution **750 (Rev.WRC-15)**, which includes conditions of use, as appropriate. (WRC-15)

1/1.1/6.3.2 For Method C, Option C1b

The same regulatory example as in section 1/1.1/6.3.1 applies.

1/1.1/6.3.3 For Method C, Option C2

ADD

5.I11 IMT stations in the mobile service operating in the frequency band 1 429-1 452 MHz shall not cause harmful interference to or claim protection from stations in the aeronautical telemetry listed in No. **5.342**. (WRC-15)

1/1.1/6.3.4 For Method C, Option C3

ADD

5.J11 The frequency band 1 429-1 452 MHz can be used by IMT stations in the mobile service subject to agreement obtained under No. **9.21** from the countries listed in No. **5.342**. (WRC-15)

1/1.1/6.4 For the frequency band 1 452-1 492 MHz

1/1.1/6.4.1 For Method C, Option C1

No consensus was reached on inclusion of this regulatory proposal in section 1/1.1/6.

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section V − Limits of power flux-density from space stations

MOD

TABLE **21-4** (Rev.WRC-~~12~~15)

Frequency band	Service*	Limit in dB(W/m²) for angles of arrival (δ) above the horizontal plane			Reference bandwidth
		0°-5°	5°-25°	25°-90°	
1 452-1 492 MHz[7A]	Broadcasting-satellite	[−113]	[−113]	[−113]	1 MHz

ADD

[7A] **21.16.1A** These limits do not apply over the territory of *[list of countries]*.

APPENDIX 5 (REV.WRC-12)

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-~~12~~15)

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. **9.11** GSO, non-GSO/ terrestrial	A space station in the BSS in any band shared on an equal primary basis with terrestrial services and where the BSS is not subject to a Plan, in respect of terrestrial services	620-790 MHz (see Resolution **549 (WRC-07)**) 1 452-1 492 MHz <u>(only over the territory of countries listed in **21.16.1A**)</u> 2 310-2 360 MHz (No. **5.393**) 2 535-2 655 MHz (Nos. **5.417A** and **5.418**) 17.7-17.8 GHz (Region 2) 74-76 GHz	Bandwidths overlap: The detailed conditions for the application of No. **9.11** in the bands 2 630-2 655 MHz and 2 605-2 630 MHz are provided in Resolution **539 (Rev.WRC-03)** for non-GSO BSS (sound) systems pursuant to Nos. **5.417A** and **5.418**, and in Nos. **5.417A** and **5.418** for GSO BSS (sound) networks pursuant to those provisions.	Check by using the assigned frequencies and bandwidths	

1/1.1/6.4.2 For Method C, Option C2

Note: Example of regulatory text to be provided.

1/1.1/6.4.3 For Method C, Option C3

Note: Example of regulatory text to be defined.

1/1.1/6.4.4 For Method C, Option C4

MOD

5.342 *Additional allocation:* in Armenia, Azerbaijan, Belarus, the Russian Federation, Uzbekistan, Kyrgyzstan and Ukraine, the frequency bands 1 429-1 452 MHz, 1 492-1 535 MHz, and in Bulgaria the frequency band 1 525-1 535 MHz, are also allocated to the aeronautical mobile service on a primary basis exclusively for the purposes of aeronautical telemetry within the national territory. ~~As of 1 April 2007, the use of the band 1 452-1 492 MHz is subject to agreement between the administrations concerned.~~ (WRC-~~12~~15)

ADD

5.K11 In Armenia, Azerbaijan, Belarus, the Russian Federation, Uzbekistan, Kyrgyzstan and Ukraine, the use of the frequency band 1 452-1 492 by the aeronautical mobile service for telemetry has priority over other uses by the mobile service. Usage of this frequency band by IMT stations in the mobile service in Region 1 is subject to agreement with the countries listed above obtained under No. **9.21**. (WRC-15)

1/1.1/6.5 For the frequency band 1 492-1 518 MHz

1/1.1/6.5.1 For Method C, Option C1

Note: Example of regulatory text to be defined.

1/1.1/6.5.2 For Method C, Option C2

Note: Example of regulatory text to be defined.

1/1.1/6.5.3 For Method C, Option C3

ADD

5.L11 IMT stations in the mobile service operating in the frequency band 1 492-1 518 MHz shall not cause harmful interference to or claim protection from the aeronautical telemetry stations mentioned in No. **5.342**. (WRC-15)

1/1.1/6.5.4 For Method C, Option C4

ADD

5.M11 The frequency band 1 492-1 518 MHz can be used by IMT stations in the mobile service subject to agreement obtained under No. **9.21** from the countries listed in No. **5.342**. (WRC-15)

1/1.1/6.6 For the frequency band 1 518-1 525 MHz

1/1.1/6.6.1 For Method C, Option C1

Note: example of regulatory text to be defined

1/1.1/6.6.2 For Method C, Option C2

ADD

5.N11 IMT stations in the mobile service operating in the frequency band 1 518-1 525 MHz shall not cause harmful interference to or claim protection from the aeronautical telemetry stations mentioned in No. **5.342**. (WRC-15)

1/1.1/6.6.3 For Method C, Option C3

ADD

5.O11 The frequency band 1 518-1 525 MHz can be used by IMT stations in the mobile service subject to agreement obtained under No. **9.21** from the countries listed in No. **5.342**. (WRC-15)

1/1.1/6.7 For the frequency band 1 695-1 710 MHz

1/1.1/6.7.1 For Method C, Option C1a

ADD

5.P11 The frequency band 1 695-1 710 MHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) for transmissions by user equipment. Transmissions by IMT base stations are prohibited. The use of this band by IMT shall not cause harmful interference to stations in the meteorological-satellite service. (WRC-15)

1/1.1/6.7.2 For Method C, Option C1b

ADD

5.Q11 The frequency band 1 695-1 710 MHz is identified for use by International Mobile Telecommunications (IMT) for transmissions by user equipment. Transmissions by IMT base stations are prohibited. (WRC-15)

1/1.1/6.8 For the frequency band 2 700-2 900 MHz

1/1.1/6.8.1 For Method B and C, Option C1

ADD

5.R11 *Additional allocation:* in [*Regions/country names list*] the frequency band 2 700-2 900 MHz [*or portions of that frequency band as the case may be*[9]] is also allocated to the mobile, except aeronautical mobile, service on a primary basis, subject to agreement under No. **9.21**, and is also identified for use by International Mobile Telecommunications (IMT). This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. (WRC-15)

---

[9] Note: Specific proposals may address an allocation only to portions of the frequency band, which will be specified exactly by the proponents, under certain circumstances and taking into account current allocations to the mobile service.

1/1.1/6.8.2 For Method B and C, Option C2

ADD

5.S11[10] IMT stations in the mobile service operating in the frequency band 2 700-2 900 MHz shall not cause harmful interference to or claim protection from systems in the aeronautical radionavigation service, radiolocation service, and ground-based meteorological radars operating under No. **5.423**, and maritime radionavigation service operating under No. **5.424**. (WRC-15)

1/1.1/6.9 For the frequency band 3 300-3 400 MHz

1/1.1/6.9.1 For Method C, Option C1

ADD

5.T11 IMT stations in the mobile service operating in the frequency band 3 300-3 400 MHz shall not cause harmful interference to or claim protection from systems in the radiolocation service. (WRC-15)

1/1.1/6.10 For the frequency band 3 400-3 600 MHz

Note: Modifications to the Table of Frequency Allocations will vary depending on the options chosen and to which Region those options are applied, thus only some examples of footnotes for the frequency band 3 400-3 600 MHz are provided below. These footnotes could also be used as examples to cover options for the frequency bands 3 600-3 700 MHz, 3 700-3 800 MHz and 3 800-4 200 MHz taking into account existing allocations to the MS in these bands across different Regions. Square brackets in the examples below are introduced to provide flexibility in combining different technical and regulatory conditions for specific proposals. Conditions in the example footnotes should be included in a WRC Resolution that is cross-referenced in the footnote, where justified.

1/1.1/6.10.1 For Method B, Option 1

ADD

5.U11 [In *Regions/country names*], the frequency band [3 400-3 600] MHz [*or portions of that frequency band as the case may be*[11]] is allocated to the mobile, except aeronautical mobile, service on a primary basis. (WRC-15)

1/1.1/6.10.2 For Method B, Option 2

ADD

5.V11 [In *Regions/country names*], the frequency band [3 400-3 600] MHz [*or portions of that frequency band as the case may be*[12]] is allocated to the mobile, except aeronautical mobile, service

---

[10] This option is based on the assumption that the secondary radiolocation services are upgraded from secondary to primary.

[11] Note: Specific proposals may address an allocation only to portions of the frequency band, which will be specified exactly by the proponents, under certain circumstances and taking into account current allocations to the mobile service.

[12] Note: Specific proposals may address an allocation only to portions of the frequency band, which will be specified exactly by the proponents, under certain circumstances and taking into account current allocations to the mobile service.

on a primary basis, [subject to agreement obtained under No. **9.21** with other administrations]. [At the stage of coordination the provisions of Nos. **9.17** and **9.18** also apply.] [Before an administration brings into use a (base or mobile) station of the mobile service in this band, it shall ensure that the power flux-density (pfd) produced at 3 metres above ground does not exceed −154.5 dB(W/(m^2 · 4 kHz)) for more than 20% of time at the border of the territory of any other administration. This limit may be exceeded on the territory of any country whose administration has so agreed. In order to ensure that the pfd limit at the border of the territory of any other administration is met, the calculations and verification shall be made, taking into account all relevant information, with the mutual agreement of both administrations (the administration responsible for the terrestrial station and the administration responsible for the earth station), with the assistance of the Bureau if so requested. In case of disagreement, the calculation and verification of the pfd shall be made by the Bureau, taking into account the information referred to above.] [Stations of the mobile service in the frequency band [3 400-3 600] MHz shall not claim more protection from space stations than that provided in Table **21-4** of the Radio Regulations.] (WRC-15)

1/1.1/6.10.3 For Method B, Option 3

MOD

5.431A *Different category of service*: in *[country names]*, Argentina, Brazil, Chile, Costa Rica, Cuba, French overseas departments and communities in Region 2, Dominican Republic, El Salvador, Guatemala, Mexico, Paraguay, Suriname, Uruguay and Venezuela, the band 3 400-3 500 MHz is allocated to the mobile, except aeronautical mobile, service on a primary basis, subject to agreement obtained under No. **9.21**. Stations of the mobile service in the band 3 400-3 500 MHz shall not claim more protection from space stations than that provided in Table **21-4** of the Radio Regulations (Edition of 2004). (WRC-~~12~~15)

1/1.1/6.10.4 For Method B, Option 4

ADD

5.W11 [In *Regions/country names*], the frequency band [3 400-3 600] MHz *[or portions of that frequency band as the case may be*[13]] is allocated to the mobile, except aeronautical mobile, service on a primary basis, subject to agreement obtained under No. **9.21** with other administrations. At the stage of coordination the provisions of Nos. **9.17** and **9.18** also apply. Before an administration brings into use a (base or mobile) station of the mobile service in this band, it shall ensure that the power flux-density (pfd) produced at 3 metres above ground does not exceed −154.5 dB(W/(m^2 · 4 kHz)) for more than 20% of time at the border of the territory of any other administration. This limit may be exceeded on the territory of any country whose administration has so agreed. In order to ensure that the pfd limit at the border of the territory of any other administration is met, the calculations and verification shall be made, taking into account all relevant information, with the mutual agreement of both administrations (the administration responsible for the terrestrial station and the administration responsible for the earth station), with the assistance of the Bureau if so requested. In case of disagreement, the calculation and verification of the pfd shall be made by the Bureau, taking into account the information referred to above. Stations of the mobile service in the frequency band [3 400-3 600] MHz shall not claim more protection from space stations than that provided in Table **21-4** of the Radio Regulations. (WRC-15)

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[13] Note: Specific proposals may address an allocation only to portions of the frequency band, which will be specified exactly by the proponents, under certain circumstances and taking into account current allocations to the mobile service.

1/1.1/6.10.5 For Method C, Option 1

ADD

5.X11 [In *Regions/country names*], the frequency band [3 400-3 600] MHz, or portions of that frequency band, is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. (WRC-15)

1/1.1/6.10.6 For Method C, Option 2

ADD

5.Y11 [In *Regions/country names*], the frequency band [3 400-3 600] MHz, or portions of that frequency band, is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT), [subject to agreement obtained under No. **9.21** with other administrations]. This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. [At the stage of coordination the provisions of Nos. **9.17** and **9.18** also apply]. [Before an administration brings into use a (base or mobile) station of the mobile service in this band, it shall ensure that the power flux-density (pfd) produced at 3 metres above ground does not exceed −154.5 dB(W/(m^2 · 4 kHz)) for more than 20% of time at the border of the territory of any other administration. This limit may be exceeded on the territory of any country whose administration has so agreed. In order to ensure that the pfd limit at the border of the territory of any other administration is met, the calculations and verification shall be made, taking into account all relevant information, with the mutual agreement of both administrations (the administration responsible for the terrestrial station and the administration responsible for the earth station), with the assistance of the Bureau if so requested. In case of disagreement, the calculation and verification of the pfd shall be made by the Bureau, taking into account the information referred to above.] [Stations of the mobile service in the frequency band [3 400-3 600] MHz shall not claim more protection from space stations than that provided in Table **21-4** of the Radio Regulations.] (WRC-15)

1/1.1/6.10.7 For Method C, Option 3

MOD

5.433A In [country names], Bangladesh, China, French overseas communities of Region 3, Korea (Rep. of), India, Iran (Islamic Republic of), Japan, New Zealand and Pakistan, the frequency band 3 500-3 600 MHz is identified for International Mobile Telecommunications (IMT). This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. At the stage of coordination the provisions of Nos. **9.17** and **9.18** also apply. Before an administration brings into use a (base or mobile) station of the mobile service in this band it shall ensure that the power flux-density (pfd) produced at 3 m above ground does not exceed −154.5 dB(W/(m2 · 4 kHz)) for more than 20% of time at the border of the territory of any other administration. This limit may be exceeded on the territory of any country whose administration has so agreed. In order to ensure that the pfd limit at the border of the territory of any other administration is met, the calculations and verification shall be made, taking into account all relevant information, with the mutual agreement of both administrations (the administration responsible for the terrestrial station and the administration responsible for the earth station), with the assistance of the Bureau if so requested. In case of disagreement, the calculation and verification of the pfd shall be made by the Bureau, taking into account the information referred to above. Stations of the mobile service in the frequency band 3 500-3 600 MHz shall not claim more protection from space stations than that provided in Table **21-4** of the Radio Regulations (Edition of 2004). (WRC-~~12~~15)

1/1.1/6.10.8 For Method C, Option 4

ADD

5.Z11 [In *Regions/country names*], the frequency band [3 400-3 600] MHz, or portions of that frequency band, is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT), subject to agreement obtained under No. **9.21** with other administrations. This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. At the stage of coordination the provisions of Nos. **9.17** and **9.18** also apply. Before an administration brings into use a (base or mobile) station of the mobile service in this band, it shall ensure that the power flux-density (pfd) produced at 3 metres above ground does not exceed -154.5 dB(W/(m^2 · 4 kHz)) for more than 20% of time at the border of the territory of any other administration. This limit may be exceeded on the territory of any country whose administration has so agreed. In order to ensure that the pfd limit at the border of the territory of any other administration is met, the calculations and verification shall be made, taking into account all relevant information, with the mutual agreement of both administrations (the administration responsible for the terrestrial station and the administration responsible for the earth station), with the assistance of the Bureau if so requested. In case of disagreement, the calculation and verification of the pfd shall be made by the Bureau, taking into account the information referred to above. Stations of the mobile service in the frequency band [3 400-3 600] MHz shall not claim more protection from space stations than that provided in Table **21-4** of the Radio Regulations. (WRC-15)

1/1.1/6.11 For the frequency band 3 600-3 700 MHz

The regulatory examples as in section 1/1.1/6.10 for Options 1 and 2 for Method B and Options 1 and 2 for Method C, apply taking into account existing allocations to the MS in the frequency band 3 600-3 700 MHz.

1/1.1/6.12 For the frequency band 3 700-3 800 MHz

The regulatory examples as in section 1/1.1/6.10 for Options 1 and 2 for Method B and Options 1 and 2 for Method C, apply taking into account existing allocations to the MS in the frequency band 3 700-3 800 MHz.

1/1.1/6.13 For the frequency band 3 800-4 200 MHz

The regulatory examples as in section 1/1.1/6.10 for options 1 and 2 for Method B and Options 1 and 2 for Method C apply taking into account existing allocations to the MS in the frequency band 3 800-4 200 MHz.

1/1.1/6.14 For the frequency band 4 400-4 500 MHz

1/1.1/6.14.1 For Method C, Option C1

Note: Example of regulatory text to be provided.

1/1.1/6.15 For the frequency band 4 500-4 800 MHz

Note: Only some examples of footnotes for the frequency band 4 500-4 800 MHz are provided below. Square brackets in the examples below are introduced to provide flexibility in combining different technical and regulatory conditions for specific proposals. Conditions in the example footnotes should be included in a WRC Resolution that is cross-referenced in the footnote, where justified.

1/1.1/6.15.1 For Method A

NOC for RR

1/1.1/6.15.2 For Method C, Option 1

ADD

5.AA11 [In *Regions/country names*], the frequency band [4 500-4 800] MHz, or portions of that frequency band, is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. (WRC-15)

1/1.1/6.15.3 For Method C, Option 2

ADD

5.AB11 [In *Regions/country names*], the frequency band [4 500-4 800] MHz, or portions of that frequency band, is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT), [subject to agreement obtained under No. **9.21** with other administrations]. This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. [At the stage of coordination the provisions of Nos. **9.17** and **9.18** also apply.] [Before an administration brings into use a (base or mobile) station of the mobile service in this band, it shall ensure that the power flux-density (pfd) produced at 3 metres above ground does not exceed −154.5 dB(W/(m^2 · 4 kHz)) for more than 20% of time at the border of the territory of any other administration. This limit may be exceeded on the territory of any country whose administration has so agreed. In order to ensure that the pfd limit at the border of the territory of any other administration is met, the calculations and verification shall be made, taking into account all relevant information, with the mutual agreement of both administrations (the administration responsible for the terrestrial station and the administration responsible for the earth station), with the assistance of the Bureau if so requested. In case of disagreement, the calculation and verification of the pfd shall be made by the Bureau, taking into account the information referred to above.] [Stations of the mobile service in the frequency band [4 500-4 800] MHz shall not claim more protection from space stations than that provided in Table **21-4** of the Radio Regulations.] (WRC-15)

1/1.1/6.15.4 For Method C, Option 3

ADD

5.AC11 [In *Regions/country names*], the frequency band [4 500-4 800] MHz, or portions of that frequency band, is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT), subject to agreement obtained under No. **9.21** with other administrations. This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. At the stage of coordination the provisions of Nos. **9.17** and **9.18** also apply. Before an administration brings into use a (base or mobile) station of the mobile service in this band, it shall ensure that the power flux-density (pfd) produced at 3 metres above ground does not exceed −154.5 dB(W/(m^2 · 4 kHz)) for more than 20% of time at the border of the territory of any other administration. This limit may be exceeded on the territory of any country whose administration has so agreed. In order to ensure that the pfd limit at the border of the territory of any other administration is met, the calculations and verification shall be made, taking into account all relevant information, with the mutual agreement of both administrations (the administration responsible for the terrestrial station and the administration responsible for the earth station), with the assistance of the Bureau if so requested. In case of disagreement, the calculation and verification of the pfd shall be made by the Bureau, taking into account the information referred to above. Stations of the mobile service in the frequency band [4 500-4 800] MHz shall not claim more protection from space stations than that provided in Table **21-4** of the Radio Regulations. (WRC-15)

1/1.1/6.16 For the frequency band 4 800-4 990 MHz

1/1.1/6.16.1 For Methods A and C, Option C1

Note: Example of regulatory text to be defined.

1/1.1/6.17 For the frequency band 5 350-5 470 MHz

TBD

1/1.1/6.18 For the frequency band 5 725-5 850 MHz

TBD

1/1.1/6.19 For the frequency band 5 925-6 425 MHz

1/1.1/6.19.1 For Method C, Option 1

ADD

5.AD11 The frequency band 5 925-6 425 MHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Resolution **A11** (**WRC-15**) applies. (WRC-15)

ADD

DRAFT NEW RESOLUTION [A11-5925TO6425MHz] (WRC-15)

Use of the frequency band 5 925-6 425 MHz by the mobile service for IMT systems

The World Radiocommunication Conference (Geneva, 2015),

considering

a) that this Conference has identified the frequency band 5 925-6 425 MHz for IMT;

b) that the frequency band 5 925-6 425 MHz is allocated worldwide on a primary basis to the fixed-satellite service (FSS) (Earth-to-space);

c) that the frequency band 5 925-6 425 MHz is also allocated to the mobile service on a primary basis;

d) that results of studies in ITU-R indicate that sharing in the frequency band 5 925-6 425 MHz between IMT systems and the FSS satellites is feasible under specified conditions;

e) that there is a need to specify an appropriate e.i.r.p. limit and operational restrictions for IMT systems in the mobile service in the frequency band 5 925-6 425 MHz in order to protect FSS satellite receivers,

further considering

a) that the interference from a single IMT station, 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 frequency band 5 925-6 425 MHz;

b) that such FSS satellite receivers may experience an unacceptable effect due to the aggregate interference from IMT stations, 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 IMT stations and it may not be possible for administrations to determine the location of the source of the interference and the number of IMT stations in operation simultaneously,

recognizing

a) that interference criteria of FSS satellite receivers based on $\Delta T/T$ ratio is given in Recommendation ITU-R S.1432;

b) that some administrations have extensive deployments of fixed-service systems in the band 5 925-6 425 MHz;

c) that the use of the frequency band 5 925-6 425 MHz by IMT systems will provide substantial additional capacity to address additional spectrum requirements for IMT;

d) that there is a need for administrations to ensure that IMT stations meet the required mitigation techniques, for example through equipment or standards compliance procedures;

e) that no specific separation distance is required to protect IMT stations operating indoors from FSS transmitting stations,

resolves

1 that in the frequency band 5 925-6 425 MHz, IMT stations shall be restricted to indoor use with a maximum mean e.i.r.p.[1] of [10-15][14] dBm;

2 that if the band made available for IMT systems by any administration is less than 500 MHz, the power limit in *resolves* 1 shall be reduced by the following amount: reduction $= 10 \times \log(500/B)$ in dB, where B is the available bandwidth for IMT systems, in MHz,

invites administrations

1 to adopt appropriate regulation if they intend to permit the operation of IMT stations in the frequency band 5 925-6 425 MHz;

2 to monitor whether the aggregate interference levels have exceeded, or will exceed in the future, the $\Delta T/T$ criteria at FSS satellite receivers given in Recommendation ITU-R S.1432 in order to enable a future competent Conference to take appropriate action.

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[1] 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.

[14] *[Editor’s note: The range 10-15 dBm is based on sharing studies results described in section 1/1.1/4.1.12]*

1/1.1/6.19.2 For Method C, Option 2

ADD

5.AE11 The frequency band 5 925-6 425 MHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. (WRC-15)

1/1.1/6.19.3 For Method C, Option 3

Note: Example of regulatory text to be defined.

1/1.1/6.19.4 For Method C, Option 4

ADD

5.AF11 The frequency band 5 925-6 425 MHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Resolution [**A11-5925to6425MHz]** (**WRC-15**) applies. In the frequency band 5 925-6 425 MHz, IMT stations in the mobile service shall not claim protection from earth stations in the fixed-satellite service. (WRC-15)

AGENDA ITEM 1.2

(JTG 4-5-6-7 / WP 4A, WP 5A, WP 5B, WP 5D, WP 6A (WP 3K, WP 3M))[15]

1.2 to examine the results of ITU R studies, in accordance with Resolution ***232 (WRC-12)****, on the use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 and take the appropriate measures;*

Resolution **232 (WRC-12)**: *Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 and related studies.*

1/1.2/1 Executive summary

Section 1/1.2/2 contains a general description for background information on WRC-15 agenda item 1.2 (AI 1.2) according to Resolution **232 (WRC-12).**

Section 1/1.2/3 contains a summary of technical and operational studies and relevant ITU-R Recommendations. This summary assesses:

- Spectrum requirements for the BS and the MS;
- Sharing and compatibility studies between the BS and the MS;
- Sharing and compatibility studies between the ARNS and the MS;
- Solutions for SAB/SAP.

Section 1/1.2/4 contains the analysis of the results of studies, in particular:

- The analysis of studies between the BS and the MS;
- The analysis of studies between the ARNS and the MS;
- The analysis of solutions for SAB/SAP.

Section 1/1.2/5 contains the methods to satisfy the agenda item for the following issues:

- Issue A: Option for the refinement of the lower band edge
- Issue B: Technical and regulatory conditions applicable to the MS concerning the compatibility between the MS and the BS
- Issue C: Technical and regulatory conditions applicable to the MS concerning the compatibility between the MS and the ARNS for the countries listed in RR No. **5.312**
- Issue D: Solutions for accommodating the requirements for applications ancillary to broadcasting.

Section 1/1.2/6 contains regulatory and procedural considerations for Issues A, B, C and D mentioned above.

1/1.2/2 Background

WRC-12 adopted Resolution **232 (WRC-12)** relating to the allocation of the frequency band 694-790 MHz in Region 1 to the MS except aeronautical mobile (see also RR No. **5.312A**). This frequency band is already allocated to the MS in Regions 2 and 3. The frequency band

[15] See the CPM15-1 Decision on the establishment and Terms of Reference of Joint Task Group 4-5-6-7 (Annex 10 to Administrative Circular CA/201).

694-790 MHz is also allocated to the BS on a primary basis in all three ITU Regions. In Region 1, it is also allocated to the ARNS on a primary basis in some countries under RR No. **5.312**, the LMS on a secondary basis intended for applications ancillary to broadcasting in some countries under RR No. **5.296**, the FS and the MS except aeronautical mobile on a secondary basis in several countries of Africa and the Middle East under RR No. **5.300** and the BSS under RR No. **5.311A** and in accordance with Resolution **549 (WRC-07)**.

It should be noted that the GE06 Agreement applies in all Region 1 countries (except Mongolia), and in the Islamic Republic of Iran in Region 3. Compatibility between the MS and other primary services to which the frequency band is allocated and primary services in adjacent bands (in particular the BS and the ARNS) needs to be ensured.

There is a demand by many developing countries in Region 1 to use International Mobile Telecommunications (IMT) systems in the 700 MHz frequency band in order to meet their needs, and in order to assist them to "bridge the gap" between their communication capabilities and those of developed countries considering, to a certain extent, the possibility of new technologies to provide various radiocommunication services.

The 700 MHz frequency band allows for cost effective implementation of IMT in particular for large areas with low population densities. The terrestrial BS provides a cost-efficient solution for high-quality media delivery, in particular to populations in rural areas. It is an evolving service that has adapted and continues to adapt to new consumer demands in terms of content and technology, such as three dimensional television (3DTV) and ultra-high definition television (UHDTV).

ITU-R studies have been conducted on spectrum requirements for the MS and the BS and on the channelling arrangements for the MS, adapted to the 700 MHz frequency band.

Furthermore, WRC-15 agenda item 1.2 refers to several issues:

- Issue A: Options for the refinement of the lower edge
- Issue B: Technical and regulatory conditions applicable to the MS concerning the compatibility between the MS and the BS
- Issue C: Technical and regulatory conditions applicable to the MS concerning the compatibility between the MS and the ARNS
- Issue D: Solutions for accommodating applications ancillary to broadcasting requirements.

Resolution **232 (WRC-12)** also invites the ITU-R to study solutions for accommodating applications ancillary to broadcasting requirements. These applications are deployed in a number of countries of Region 1 on a secondary basis in accordance with RR No. **5.296**.

The allocation of the frequency band 694-790 MHz in Region 1 to the MS except aeronautical mobile will be effective immediately after WRC-15 and therefore fully available for national use, as required, for mobile applications.

Taking into account the desire for harmonization across Regions, ITU-R has developed an IMT channelling arrangement based on a common baseline arrangement: 2x30 MHz frequency division duplexing (FDD) (uplink (UL): 703-733 MHz, and downlink (DL): 758-788 MHz), which is the lower duplexer of the A5 frequency arrangement in Recommendation ITU-R M.1036 and with the maximum possible utilization of the centre gap for IMT.

With regard to possible additions to the baseline frequency arrangement, no consensus was reached and two views were expressed:

View 1: Some administrations are of the view that:

ITU-R is also studying possible additions to the baseline frequency arrangement, which may be reflected in the new revision of Recommendation ITU-R M.1036.

These administrations proposed the following additions to the baseline frequency arrangement:

a) Up to 20 MHz supplemental down-link (SDL) within the centre gap (738-758 MHz);

b) 2x3 MHz FDD (UL: 733-736 MHz, DL: 788-791 MHz), which could be used for IMT applications;

c) 2x5 MHz FDD (UL: 698-703 MHz, DL: 753-758 MHz), which could be used for IMT applications subject to protection of the BS below 694 MHz in Region 1.

View 2: Some other administrations are of the view that:

These possible additions have not been studied in ITU-R and some of them are out of the scope of AI 1.2.

In general, it should be noted that another frequency arrangement related to this frequency band is already included in Recommendation ITU-R M.1036 (A5 “UL: 703-748 MHz, DL: 758-803 MHz”).

1/1.2/3 Summary of technical and operational studies and relevant ITU-R Recommendations

1/1.2/3.1 Spectrum requirements

1/1.2/3.1.1 Spectrum requirements for the broadcasting service

In 2012/13 ITU-R conducted a survey to ascertain the spectrum requirements for digital terrestrial television broadcasting (DTTB) of administrations in Region 1 and 86 responses from administrations were received.

A summary of the responses is given in the following tables.

TABLE 1/1.2/3-1

Proportion of population using terrestrial television

Population using terrestrial TV	**<25%**	**≥25 and <50%**	**≥50 and <75%**	**≥75%**	**No reply**
Number of administrations	16	10	14	25	21

TABLE 1/1.2/3-2

Number of DTTB multiplexes required in the future in the band 470-862 MHz

Number of multiplexes	**0-3**	**4-6**	**7-8**	**>8**	**Still to be determined**
Number of administrations	4	57	9	4	12

TABLE 1/1.2/3-3

Amount of spectrum required in the band 470-862 MHz for DTTB in the future

Spectrum requirement (MHz)	**<224**	**= 224**	**> 224 and < 320**	**= 320**	**>320**	**Still to be determined**
Required band IV/V 8 MHz TV channels	**Fewer than 28**	**28**	**Between 28 and 40**	**40**	**More than 40**	**–**
Number of administrations	4	39	8	16	3	16

Full details of the results of the ITU-R survey can be found in Report ITU-R BT.2302-0.

Following the allocation of the frequency bands 790-862 MHz and 694-790 MHz to the MS at WRC-07 and WRC-12 respectively, forty-seven (47) Sub-Saharan countries in Africa plus Egypt reached an agreement on the principle of harmonizing the use of the frequency band 470-694 MHz for terrestrial television broadcasting and the frequency band 694-862 MHz for the MS. The African Telecommunication Union (ATU), with the assistance of the ITU, concluded an 18-month negotiation and coordination process to complete the GE06 modification activities to satisfy all or most of each nation's broadcasting frequency requirements. These activities have been very successful with a target number of four multiplexes per site largely attained, showing that the broadcasting spectrum needs of these administrations can be covered in the UHF frequency band 470-694 MHz. These administrations have started the process of formal submission of official GE06 Plan modification notice files to the ITU BR in order that the modifications could officially take effect and be reflected in the GE06 Plan.

The result of studies carried out indicates that the lower edge of the frequency band under consideration in WRC-15 agenda item 1.2 should be set at 694 MHz.

1/1.2/3.1.2 Spectrum requirements for the mobile service

Noting that ITU-R studies on spectrum requirements for IMT were focused on the total requirements, no spectrum requirement studies were carried out for the MS in the specific frequency band 694-790 MHz for Region 1.

1/1.2/3.2 Sharing and compatibility studies between IMT and the broadcasting service

1/1.2/3.2.1 Co-channel studies

1/1.2/3.2.1.1 Mobile service base stations as an interferer into broadcast reception

A generic study showed that the cumulative effect of interference can exceed 20 dB and that a separation distance of more than 200 km is needed to meet the field-strength threshold of 23 dB(μV/m) which is equivalent to an *I*/*N* of –10 dB (95% locations, 16 dB antenna discrimination) at the lower end of the frequency band 694-790 MHz compared to 61 km for a single base station of the MS.

The results of another generic study showed that the excess of the cumulative interference from a MS network (from IMT to broadcast) over the single interferer can be up to 21 dB. This causes a corresponding increase of the separation distance of up to 274 km on land and up to 1 000 km for land/sea paths (warm), when using the same field-strength threshold for cumulative interference as for single entry interference.

A case study showed that the excess cumulative interference from the MS network over the single interferer can be up to 21 dB (using the receiving antenna).

A generic study showed that even without accumulation of the interfering field strength, a single IMT base station will need to be positioned 53 km (for land path) from the DTTB service edge, i.e. from the border of the affected administration, in order not to exceed 23 dB(μV/m). This field strength is equivalent to an *I*/*N* of –10 dB (95% locations, 16 dB antenna discrimination) at the input of the DTTB receiver at the lower end of the frequency band 694-790 MHz. Including multiple interfering base stations would increase the interfering field strength at the DTTB service edge by up to 20 dB which corresponds to a separation distance of up to 200 km based on the parameters used in this particular study, when using the same field-strength threshold for cumulative interference as for single entry interference.

A case study showed that IMT base stations in one country which are not individually subject to coordination, i.e. meeting the trigger threshold of GE06 (25 dB(μV/m)), will not interfere with the TV receivers in the neighbouring country, even if the cumulative effect of those base stations is taken into account.

1/1.2/3.2.1.2 Broadcasting service as an interferer into mobile service base stations

A generic study showed that separation distances of up to 427 km and 269 km, for high power (HP) and medium power (MP) DTTB transmitters respectively, would be required to protect the IMT base station receiver (uplink) for 99% time, a target *I*/*N* of –6 dB and with no additional discrimination by cross-polarization or receive antenna directivity. The relaxation of the protection level to 90% time, a target *I*/*N* of 0 dB and mitigation by full receive antenna polarization and/or discrimination would reduce the separation distances to 159 km for HP and 76 km for MP.

A case study showed that co-channel sharing between DTTB transmitters and an IMT uplink receiver positioned at 30 metres height, would require separation distances of the order of 200 km on land paths even with antenna cross polarization and a relaxation of the percentage of time for the interfering signal from 1 to 10%.

A generic study showed that the maximum permissible interfering field-strength threshold for the protection of IMT base stations from DTTB stations based on an *I*/*N* = –10 dB is higher than the GE06 trigger field-strength threshold of 13 dB(μV/m) (generic case, code NB).

1/1.2/3.2.2 Adjacent channel studies

1/1.2/3.2.2.1 IMT base station interference into DTTB

One study showed that the separation distances needed for different adjacent channel cases in order to protect DTTB from IMT base stations, considering the accumulative effect, would vary from 15 to 35 km.

The study of the interference situation between LTE base station downlinks and fixed roof-top digital terrestrial television (DTT) reception in the adjacent band (in the 800 MHz frequency band) in France shows that the distance between the interfering IMT base station and the fixed roof-top DTT receiving location is, in 99% of cases, below 1.3 km. This interfering situation is essentially a national matter and does not require any provision in the RR. Almost all reported interference cases observed so far were identified as the LTE base station provoking DTT receiver saturation (active systems like amplifiers or DTT television / set-top box). All these cases have been successfully resolved by the administration and operators by introduction of an LTE 800 filter (either head-end filters or user filters). Regarding the saturation effects, the situation is likely to be similar in the 800 MHz and 700 MHz frequency bands.

1/1.2/3.2.2.2 IMT user equipment interference into DTTB

1/1.2/3.2.2.2.1 Minimum coupling loss calculations

One study showed that the minimum coupling loss (MCL) technique establishes known everyday configurations for study. This study showed the television (TV) fixed reception critical distance is around 22 metres to the areas outside a house with a larger distance spread within a few dB. Using the adjacent channel selectivity (ACS) and out-of-block (OOB) / adjacent channel leakage ratio (ACLR) values provided by the ITU-R, the actual separation distance required between a user equipment (UE) and the fixed TV antenna is a lot greater. There would be no compatibility at maximum UE power in lower TV reception signal strength areas at a separation distance of 22 metres. The potential improvement in compatibility with higher TV ACS values, as found in newer TV sets, was investigated as well as additional external filter mitigation. To achieve compatibility, the calculated required UE OOB level is –56 dBm/8 MHz for 23 dBm UE power, for a 10 MHz LTE signal, and given a TV receiver plus an extra filter combined ACS of 80 dB.

A study showed that in a typical European suburban area there is a high probability, over 70% in the example provided, that the path loss between an IMT UE and a DTTB receiver using a fixed receive aerial will be within 6 dB of MCL.

One study based on a MCL method derived the level of out-of-block emissions (OOBE) required to limit the degradation in sensitivity of a DTTB receiver, with fixed roof top antenna, to 0.41 dB; this degradation corresponds to an *I*/*N* of –10 dB. The results derived a minimum coupling distance of 22 metres and suggest an OOBE limit of –56 dBm/8 MHz would be appropriate to manage the interference into a typical DVB-T2 receiver. The calculations assumed the DTT receiver ACS would be enhanced by using an external filter to give a total ACS value of 79 dB.

One study showed measurements of the performance of three independent new design TV receivers on sale in the United Kingdom, in the presence of LTE interference. The results also showed that the improved ACS values capabilities of these receivers could not be utilized unless improvements were also made to the ACLR of the UE. The studies showed the additional benefits that were possible with external TV receiving filters. Bandpass transmit filters on the UE were used to vary the OOB emissions. The achieved TV receiver ACS values were between 64 dB to 65 dB unaided and from nearly 74 dB to 80 dB with the aid of an external receiving filter. The TV receiver overload thresholds were improved from around –10 dBm to above +10 dBm with the external receive filter.

1/1.2/3.2.2.2.2 Monte Carlo simulations

A generic study on the impact of IMT UE into DTT reception at the coverage edge showed that the less favourable interference scenario from IMT/LTE uplink to DTT is found in an urban environment for smaller cell size (higher active user density). In a rural environment the probability of interference is mainly dominated by UE in-band (IB) power, and this power can only be attenuated by the DTT receiver ACS. It also showed that the total probability of interference decreases with the increase of DTT receiver ACS, and the increase of IMT UE ACLR (decrease of UE OOBE level). Furthermore, for a given DTT receiver ACS, the total probability of interference will not decrease with the increase of IMT UE ACLR (decrease of UE OOBE level) above a certain level, since it is limited by DTT receiver ACS. When considering several UE (e.g. 10) the probability of interference is mainly dominated by the UE IB power.

Another study indicated that imposing more stringent OOBE values of up to –35 dBm/8 MHz, will lead to a minimal reduction in interference probability (IP) of 0.10% at most. On the basis of this minimal reduction in IP, the adoption of stricter OOBE limits is not warranted. In view of the above results, and taking into account the potential benefits of harmonization, it is proposed that an OOBE limit of –25 dBm/8 MHz be adopted as a suitable value.

Another study indicated that in the whole DTT coverage area, for a given IMT UE transmitter blocking mask or ACLR which is based on the APT OOBE value that is recommended not to exceed –34 dBm/MHz (ACS values of 25, 38, 50 and 60 dB were taken into account) below 694 MHz, the results of the simulations for different DTT receiver ACS values show that the total interference probability (IP) is less than 1% in all cases.

Another study indicated a very low IP for its worst case (urban environment, one user with full resource block allocation, low ACS of DTT receiver) and almost zero potential of IP in the majority of scenarios and parameter combinations. It was also observed that the IP is more sensitive to the DTT ACS than to the LTE UE OOBE level, so that means that after a certain breaking point, a more stringent OOBE does not decrease the IP anymore. For example, in the urban scenario (worst case found) and with ACS values 55, 60 and 65 dB, the breaking point for OOBE is somewhere between –33 and –38 dBm/8 MHz (for the 10 MHz IMT channel).

Based on previous work testing input parameters, one study calculated the IP for a DTTB receiver ACS of 65, 70 and 75 dB and a range of UE ACLR from 48 to 79 dB. These studies were conducted using the TPC values and network configuration specified by ITU-R for studies and 10 000 000 simulations in the Monte Carlo (MC) calculations. IP results for urban, suburban and rural environments, for the ACS and ACLR ranges mentioned are presented.

Another study was carried out to calculate the probability of interference into portable outdoor DTTB reception. Its results indicate that this probability is slightly higher than it is for fixed reception, for the same parameters, and that it increases significantly with the number of active UEs. The results also indicate that the probability of interference increases by a factor of 2 if no body loss is taken into account or the UE has a higher antenna gain by 4 dB (+1 dB in total). Furthermore, the study indicates that more than 100 000 events should be used in order to get converging/reliable results.

1/1.2/3.2.2.2.3 Monte Carlo simulations with post-processing

One study based on MC statistical simulations of the probability of interference into the DTTB reception in a pixel (100x100 m^2) at the coverage edge during an observation time (TW) of one hour indicated that, while the values of IMT UE ACLR and DTT receiver ACS should be similar in order to achieve the best performance configuration with respect to interference into DTTB reception, above a certain level of ACS (e.g. 65 dB, which is the average ACS of recent DTTB receivers), a further improvement of the IMT UE ACLR above a certain level (e.g. a value higher than 67 dB) provides no significant reduction of the overall probability of interference. This leads to a range of IMT UE OOBE limit values between –40 and –44 dBm/8 MHz for a 10 MHz IMT channel. Further simulations showed that the OOBE of IMT UE operating in the frequency band 694-790 MHz should not exceed –42 dBm/8 MHz for a 10 MHz LTE channel bandwidth in the frequency band 470-694 MHz for the protection of the BS in this frequency band.

Another study used MC analysis to generate the IP which was then post-processed to give the probability of interference to a DTTB receiver occurring in a specified time window (TW). This post-processing used a number of independent events generated based on the user density and UE movement. The results of this post processing have been used to derive the OOB emissions for IMT UE required to limit interference to DTTB reception to 1%. The study concludes that to limit the interference into channel 48 and below, from IMT UE operating in the 700 MHz frequency band, DTTB receiver ACS should be in the range 70 dB to 75 dB. IMT UE out-of-band emissions should be limited to the range –47 dBm/8 MHz to –52 dBm/8 MHz (an ACLR range of 70 dB to 75 dB).

1/1.2/3.2.2.2.4 Monte Carlo simulation with time element

One MC study investigated adjacent band sharing between DTTB and IMT UE based on Δ_{RLP}, the degradation of reception location probability (RLP). This method was developed to deal with the time element of mobile transmission (e.g. movement of UE during a DTTB viewer's time frame) and to take into account RLP which is the basis of broadcast planning. The Monte Carlo methodology used to calculate Δ_{RLP} is described. The results cover a range of ACS values (55-80 dB) and ACLR values (40-80 dB) and UE density (1-10 UE/sector). It is shown that unacceptable interference from UE results, unless both improved OOBE filtering in the UE and increased ACS at the point of DTTB reception are implemented. Based on the results, an ACS of 80 dB, a set of OOBE limits for 10 MHz IMT UEs are proposed: the OOBE shall not exceed a value of –55 dBm/8 MHz for a resource block usage of 33%; a value of –49 dBm/8 MHz for a resource block usage of 50%; and a value of –46 dBm/8 MHz for a resource block usage of 100%.

1/1.2/3.2.2.2.5 Monte Carlo sensitivity studies

Another set of studies were carried out to test how the results of MC simulations varied for different input parameters. One study concluded that the number of simulations in a MC analysis needed to provide confidence in the derived IP, should use more than 100 000 trials - ideally being between 1 000 000 and 10 000 000. Another study investigated the impact of omitting the standard deviation associated with building entry loss. This study concluded that doing so would result in an underestimation of the IP of up to 50% and that such values of IP calculated without taking into account a standard deviation associated with building entry loss, should be adjusted appropriately. As the power control settings are key to determining the level of interference of IMT UE to DTTB reception, a further study was carried out to ensure settings are aligned with advice from ITU-R. Values were derived for urban, suburban and rural environments and used in studies to derive the IP.

Another set of studies were carried out to test how the results of MC simulations varied for different input parameters ("sensitivity studies"). With respect to other studies based on "standard" parameters, the probability of interference into fixed DTTB reception increased by a factor of 2 in the case that no body loss applies or the UE antenna gain is by 4 dB higher, as well as if 30% of the mobile traffic is generated from indoor and 70% is generated from outdoor. The probability will increase by a factor of 3 if 30% of the traffic is generated indoor, 35% is generated outdoor with body loss and an antenna gain of –3 dBi and the remaining 35% is generated outdoor without body loss and an antenna gain of 0 dBi. The studies also concluded that the number of active devices usually is much higher than the number of users triggered this activity, and that the probability of interference increases significantly with the number of active UEs. This set of studies indicates that more than 100 000 events should be used in order to get converging/reliable results.

1/1.2/3.2.2.2.6 Field trials

One field trial study with a particular wireless broadband access system (non-3GPP LTE system) indicated that necessary line-of-sight separation distance ranges from 180 to 995 metres for specified technical parameters in this study (depending on the OOBE limit in the range from –56 to –25 dBm/8 MHz and the frequency separation) in the frequency range until at least 112 MHz (N-14) offset, when no mitigation technique for the BS is applied. With a rejection filter at the broadcast receiver antenna's input, separation distances decrease from a range of 180 to 995 metres to a range of 38 to 713 metres for a 15 dB rejection, and to a range of 22 metres to 703 metres for a 25 dB rejection.

Considering protection ratios for a DVB-T2 system interfered with by LTE, it's shown that to keep the number of households affected by interference at a manageable level (lower than 2%), it is necessary to limit UE OOBE to a level no higher than –52 dBm/8 MHz or –56 dBm/8 MHz (better, 0.5% households affected), with a guard band not less than 9 MHz, 30..40 dB rejection filters and UE maximum power not exceeding 23 dBm.

1/1.2/3.2.2.3 Measurements

A measurement study showed that the tested DTTB receivers (ACS 62 to 65 dB) behave similarly in the presence of a continuous IMT UE signal, and behaved differently in the presence of a discontinuous (time varying) signal. The IMT UE ACLR tested was between 60 and 70 dB. Modern DVB-T2 receivers behave better in the presence of a discontinuous IMT UE signal than in the presence of a continuous IMT UE signal, while the performance of DVB-T receivers was reduced by about 20 dB. The impact of discontinuous IMT UE emissions on DTTB reception can only be efficiently mitigated by improving DTTB receivers' AGC circuits, including the overall ACS of the receivers. It was confirmed that improving the IMT UE ACLR (i.e. above around 60 dB) does not improve the protection ratio. For these reasons, when determining the IMT UE OOBE limits, only the impact of a continuous IMT UE signal on DTTB reception should be considered.

1/1.2/3.2.2.4 Results adjacent channel studies - IMT UE interference into DTTB

Studies were performed in order to obtain an OOBE limit from IMT UE into the DTTB reception below 694 MHz. These studies were performed under the assumption of 9 MHz between the upper channel edge of the DTTB and the lower channel edge of IMT uplink. The required OOBE limits for IMT UE resulting from these studies are the following:

- MCL studies indicate a value of –56.25 dBm/8 MHz for an ACS of 79.25 dB based on *I*/*N* and an IMT channel of 10 MHz;
- MC IP based studies indicate a range of –25 to –38 dBm/8 MHz for a range of ACS between 55 and 65 dB based on C/(N+I) and an IMT channel of 10 MHz;
- MC IP based studies indicate a value of –25 dBm/8 MHz for a range of ACS between 25 and 60 dB based on C/(N+I) and an IMT channel of 10 MHz;
- MC IP based studies with post-processing to account for time indicate:
  - in one study, a range of –40 to –44 dBm/8 MHz for a range of ACS between 60 and 70 dB based on C/(N+I) and an IMT channel of 10 MHz;
  - in another study, a range of –47 to –52 dBm/8 MHz for a range of ACS between 70 and 75 dB based on C/(N+I) and an IMT channel of 10 MHz;
- MC Δ_{RLP} based study with time element indicate a range of –46 to –55 dBm/8 MHz for an ACS value of 80 dB based on C/(N+I) and an IMT channel of 10 MHz;
- A field trial study indicates a range of –46 to –56 dBm/8 MHz for an ACS range of between 75 and 80 dB based on C/(N+I) and an IMT channel of 10 MHz;
- A measurement study indicates an OOBE limit of –55 dBm/8 MHz (portable indoor reception) based on *I*/*N* and an IMT channel of 10 MHz.

1/1.2/3.3 Sharing and compatibility studies between IMT and aeronautical radionavigation service

Several sharing and compatibility studies have been carried out with diverging results using different assumptions and methodologies. No agreement however could be reached as to the parameters and methodology that should be used and hence on a single conclusion. The required coordination distance between the MS and the ARNS ranges from 15 to 565 km. The results are contained in section 1/1.2/4.2.

Further material on current compatibility studies between the MS and the ARNS in the frequency band 694-790 MHz in Region 1 can be found in in Annex 23 of Document 4-5-6-7/715.

1/1.2/3.4 Solutions for SAB/SAP

RR No **5.296** allocates the frequency band 470-790 MHz to the LMS on a secondary basis for 60 countries and the frequency band 470-698 MHz for another 12 countries and limits its use to applications ancillary to broadcasting (SAB/SAP). Studies (see draft new Report ITU-R BT.[SAB_SAP]) indicate that this spectrum is intensively used by these applications.

This Report contains a summary of the studies on SAB/SAP, including the following:

- Technical parameters required for a reliable operation of SAB/SAP;
- The impact of OOBE from IMT devices in the duplex gap of the MS, showing that parts of the duplex gap may not be usable for some SAB/SAP applications;
- Service requirements for SAB/SAP at large events, including examples of the number of wireless audio links used in major events in recent years. In most cases the whole spectrum available for SAB/SAP in the 470-790 MHz range was required;
- The impact of the loss of the 700 MHz frequency band on SAB/SAP use, assuming that DTT transmitters that currently operate in this band will be moved below 694 MHz[16].

1/1.2/4 Analysis of the results of studies

1/1.2/4.1 Analysis of studies between IMT and the broadcasting service

1/1.2/4.1.1 Co-channel studies between IMT and the broadcasting service

Several sharing studies, generic and case studies, on the co-channel compatibility between IMT and DTTB were performed. Some of the generic sharing studies indicated ranges of geographic separation distances required for sharing between DTTB systems and IMT systems. The ranges of geographic separation distances differ significantly depending on different technical conditions, assumptions and methodology used in these studies. The calculated separation distances in these generic studies ranged from 53 to 1 000 km to meet the different protection criteria in each study.

Based on these ranges, the conclusion of these studies emphasized constraints on the planning, implementation and sharing of the two services regarding the use of the same or overlapping frequencies in neighbouring geographic areas.

Some other studies have shown that the excess of the cumulative interference from the MS network over the single interferer can be up to 21 dB above the value of 23 dB(μV/m), which causes a significant increase in the required separation distance when using the same GE06 field-strength threshold for cumulative interference as for single entry interference.

Another case study using existing network configurations showed an increase from 5 to 15 dB of the cumulative effect. For this case study where the cumulative interference is calculated from all IMT stations which individually comply with the GE06 trigger value, it was concluded that the protection of the BS was also ensured against cumulative interference in terms of the C/(N+I) criterion.

[16] In a case study on the Eurovision Song Contest 2011 it was demonstrated that out of 175 wireless audio links used, it would have been possible to accommodate only 77 links in the remaining spectrum (470-694 MHz) while respecting the required production quality demands.

Another generic study showed that the GE06 trigger value for the protection of the MS is sufficient to protect IMT.

1/1.2/4.1.2 Adjacent channel studies between IMT and the broadcasting service

Studies on interference from IMT base stations into DTTB receivers were performed in order to assess the requirement for compatibility between the MS and the BS in an adjacent channel situation. One study showed separation distances of several km (15 to 35 km).

An experience based on an actual implementation of IMT in the 800 MHz frequency band in one country showed that the effective separation distance is lower than 1.3 km in 99% of cases and that interference can be resolved by introducing mitigation techniques such as appropriate band rejection filters in the DTTB receiving installation. Further information can be found in Report ITU-R BT.2301. Several studies have been performed in order to derive IMT UE OOBE limits that would achieve the following objectives:

a) to manage the risk of interference between mobile use and the BS below 694 MHz;

b) to be technically feasible from the point of view of practical implementation of IMT UE in order to avoid unnecessarily stringent limits that may lead to an increase in size or in complexity of IMT radio equipment;

c) to aim to a global harmonization of IMT UE.

Compatibility studies were based on the lower duplexer of the A5 frequency arrangement in Recommendation ITU-R M.1036 (i.e. uplink in 703-733 MHz) and a maximum output power of 23 dBm.

Having in mind the objectives mentioned above, there were diverging views on the way to meet them in a balanced way. Different IMT UE OOBE values into frequency bands below 694 MHz were proposed, including:

- –25 dBm/8 MHz
- –42 dBm/8 MHz
- –56 dBm/8 MHz

It was found difficult to meet the three objectives mentioned above in a balanced way, as they received different consideration among the proponents of the studies from which the proposed OOBE limits were derived, considering the protection of the broadcasting reception and global harmonization. It should also be noted that these proposed IMT UE OOBE limits reflect that there are different technical conditions for coexistence with the BS between different parts of Region 1, taking into account the differences in broadcasting characteristics, deployments, scenarios and protection criteria for broadcasting reception.

In summary, considering the three objectives mentioned above, it was not possible to reach a consensus on a single OOBE to provide sufficient protection of the BS from IMT UE OOBE for the whole Region 1.

Some views were expressed that there are possible measures to meet both the objectives of protection of DTTB reception below 694 MHz and harmonization such as implementing different OOBE limits in the IMT UE for different IMT channel bandwidths in 3GPP specifications.

Some other views were expressed that a possible measure to meet these two objectives while using an IMT channel bandwidth greater than 10 MHz, which has a less stringent OOBE limit, is to implement this IMT channel starting from 713 MHz, therefore the emissions levels from IMT UE below 694 MHz may decrease. It was recognized that a too stringent OOBE limit may result in a more difficult or delayed implementation of IMT UE until the point of time where the technical feasibility meets the OOBE limit specifications, or could lead to no implementation of IMT UE. On the other hand, a less stringent OOBE limit may result in a need for additional measures to satisfy protection requirements of the BS operating below 694 MHz and appropriate mitigation techniques in order to avoid possible constraints that this less stringent OOBE limit might cause.

Different OOBE limits might be applied in order to meet the requirements for the protection of the broadcasting reception under certain conditions.

Supplementary information

Sensitivity studies, case studies and measurements were performed. In particular a measurement study of current TV set ACS indicated an unaided ACS between 64 and 65 dB and with an additional external filter of 74 dB to 80 dB with an IMT channel of 10 MHz. A separate field trial study also indicated ACS figures between 54 and 60 dB.

1/1.2/4.2 Analysis of the results for the compatibility studies between the mobile service and the aeronautical radionavigation service for the countries listed in RR No. 5.312

In the studies, two different interference impact scenarios from the MS to the ARNS were considered:

1) Interference from the MS to the ARNS without interference from the BS.

2) Interference from the MS to the ARNS with interference from the BS.

1/1.2/4.2.1 Results of compatibility studies of the mobile service with the aeronautical radionavigation service without interference from the broadcasting service

The results of the various studies carried out as detailed in Annex 23 to Document 4-5-6-7/715 are given below. No agreement was reached on any study.

Views of administrations with respect to the various studies are contained in Appendix 7 to Attachment 2 of the referenced document.

Based on **Study A1** the coordination distances between the MS and the ARNS shown in Table 1/1.2/4-1 below can be concluded.

TABLE 1/1.2/4-1

Coordination threshold values of MS stations with the ARNS

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)[1]
RSBN	AA8	Rural: < 1 Suburban: < 1 Urban: N/A[5]	Rural: 15/19*[2] Suburban: 17/25*[2] Urban: 5/7*[2] Mixed: 15/20*[2]
RLS 2 (type 1) (airborne receiver)	BD	Rural: < 1 Suburban:< 1 Urban: < 1	Rural: > RH[4] Suburban/urban: > RH[4] Mixed: > RH[4]
RLS 2 (type 1) (ground receiver)	BA	Rural: < 1 Suburban:< 1 Urban: N/A[5]	Rural: 31/42* Suburban: 70/112* Urban: 13/18* Mixed: 40/61*
RLS 2 (type 2) (airborne receiver)	BC	Rural: < 1 Suburban:< 1 Urban: < 1	Rural: 251 Suburban/urban: 403 Mixed: 373
RLS 2 (type 2) (ground receiver)	AA2	Rural: < 1 Suburban: < 1 Urban: N/A[5]	Rural: 45/65* Suburban: 124/167* Urban: 18/29* Mixed: 69/111*
RLS 1 (types 1 and 2) (ground receiver)	AB	Rural: < 1 Suburban: < 1 Urban: N/A[5]	Rural: 112/163* Suburban: 230/274* Urban: 53/97* Mixed: 171/212*
Other ARNS ground stations	Not applied	Rural: < 1 Suburban: < 1 Urban: N/A[5]	Rural: 112/163* Suburban: 230/274* Urban: 53/97* Mixed: 171/212*
Other ARNS airborne stations	Not applied	Rural: < 1 Suburban:< 1 Urban: < 1	Rural: > RH[4] Suburban/urban: > RH[4] Mixed: > RH[4]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area. MS base station e.i.r.p. in direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336.

Note 2: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area.

Note 3: All UE with antenna height 1.5 m use average transmit power of 2 dBm for macro rural scenario, –9 dBm for macro urban/suburban scenario and densities of UE in active mode are: rural: 0.17 UE per km^2/5 MHz, suburban/urban: 2.16 UE per km^2/5 MHz, as specified by ITU-R. Typical body loss of 4 dB was taken into account.

Note 4: RH = radio horizon (The radio horizon for 30 m and 10 000 m antenna heights are 431 km).

Note 5: Recommendation ITU-R P.1546 is not applicable for the urban case since both transmitter and receiver antenna heights are below the clutter height.

Note 6: Base station density in the mixed scenario: 0.0274 base stations/km^2/5 MHz, which is made up from: 70% rural (density of 0.7 × 0.0050 base stations/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2 × 0.0796 base stations/km^2/5 MHz = 0.0159), 10% urban (density of 0.1 × 0.0796 base stations/km^2/5 MHz = 0.0080).

Note 7: Propagation environment between MS base stations and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario where MS base station transmitters and ARNS receiver are placed in the same type of area (rural/suburban/urban).

Note 8: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.

It can be concluded that only the coordination distances between MS base stations and the ARNS need to be considered, since the coordination distances between MS UE and the ARNS in all cases are considerably smaller than the coordination distances between MS base stations and the ARNS.

Further analysing which frequencies the different ARNS systems use, it can also be concluded that only the ground stations of the RSBN system and the ground station of the RLS2 type 2 needs to be taken into account and it could be concluded that the coordination distance between the MS and the BS, and ground ARNS receivers in the 694-790 MHz frequency band vary from 15 to 111 km, depending on the scenario.

TABLE 1/1.2/4-2

Coordination distance required between the MS and the ARNS in 694-790 MHz if only RLS 2 (type 2) ground and RSBN receivers of the ARNS system are concerned

Scenario	Propagation type	Required coordination distance – Mixed environment	Required coordination distance – Rural environment	Required coordination distance – Sub-urban environment	Required coordination distance – Urban environment
MS base station to RLS 2 (Type 2)	Land path	69 km	45 km	124 km	18 km
MS base station to RLS 2 (Type 2)	Mixed: 50% sea/ 50% land path	111 km	65 km	167 km	29 km
MS base station to RSBN	Land path	15 km	15 km	17 km	5 km
MS base station to RSBN	Mixed: 50% sea/ 50% land path	20 km	19 km	25 km	7 km

General note: all below notes apply to all of the values in this table.

Note 1: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area, MS base station e.i.r.p. in the direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336.

Note 2: Base station density in the mixed scenario: 0.0274 base station/km^2/5 MHz, which is made up from: 70% rural (density of 0.7 × 0.0050 base station/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2 × 0.0796 base station/km^2/5 MHz = 0.0159), 10% urban (density of 0.1 × 0.0796 base station/km^2/5 MHz = 0.0080).

Note 3: Propagation environment between MS base stations and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario where MS base station transmitters and ARNS receiver are placed in the same type of area (rural/suburban/urban).

Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.

For the case where only RSBN ground receivers are concerned (e.g. if lower duplex pair of frequency arrangement A5 of Recommendation ITU-R M.1036 is used for the MS implementation), the distances shown in Table 1/1.2/4-3 below apply.

TABLE 1/1.2/4-3

Coordination distance required between the MS and the ARNS in 694-790 MHz if only RSBN ground receivers of the ARNS system are concerned

Scenario	Propagation type	Required coordination distance – Mixed environment	Required coordination distance – Rural environment	Required coordination distance – Sub-urban environment	Required coordination distance – Urban environment
MS base station to ARNS	Land path	15 km	15 km	17 km	5 km
MS base station to ARNS	Mixed: 50% sea/ 50% land path	20 km	19 km	25 km	7 km

General note: all below notes apply to all of the values in this table.

Note 1: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area, MS base station e.i.r.p. in the direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336 If lower duplex pair of frequency arrangement A5 of Recommendation ITU-R M.1036 is used for the MS implementation.

Note 2: Base stations density in the mixed scenario: 0.0274 base stations/km^2/5 MHz, which is made up from: 70% rural (density of 0.7 × 0.0050 base stations/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2 × 0.0796 base stations/km^2/5 MHz = 0.0159), 10% urban (density of 0.1 × 0.0796 base stations/km^2/5 MHz = 0.0080).

Note 3: Propagation environment between MS base stations and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario where MS base station transmitters and ARNS receiver are placed in the same type of area (rural/suburban/urban).

Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.

In Study A.2 and Study A.3 the interference scenario from the MS to the ARNS in the absence of interference caused by the BS is feasible when the BS stations operate in the frequency band 694-790 MHz at a large distance (more than 450 km) from ARNS stations and in this case they will not cause interference to ARNS stations.

Under the considered scenario two studies were conducted. The results of the **Study A.2** are given in Table 1/1.2/4-4.

TABLE 1/1.2/4-4

Compatibility conditions of MS stations with ARNS stations

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)
RSBN (ground receiver)	AA8	441[1]	75[2] / 90[2]*
RLS 2 (type 1) (airborne receiver)	BD	130[1]/165[1]*	441[2]
RLS 2 (type 1) (ground receiver)	BA	441[1]	185[2] / 200[2]*
RLS 2 (type 2) (airborne receiver)	BC	405[1]/445[1]*	400[2]
RLS 2 (type 2) (ground receiver)	AA2	441[1]	250[2] / 275[2]*
RLS 1 (types 1 and 2) (ground receiver)	AB	405[1]/445[1]*	350[2] / 375[2]*
Other ARNS ground stations	Not applied	405[1]/445[1]*	350[2] / 375[2]*
Other ARNS airborne stations	Not applied	405[1]/445[1]*	441[2]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on conditions that MS base stations operate with antenna height 50 m. No downtilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 2: Result based on conditions that MS base stations operate with antenna height 50 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 300 km^2) and 0.5 km (S = 100 km^2) for urban area, power of MS base stations is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. No downtilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 3: The figures given are based on the estimated distance to protect the IMT base stations from ARNS with the protection criteria of $I/N = -6$ dB.

Note 4: Propagation environment between MS base stations and ARNS receiver is rural for all deployment areas (rural, suburban, urban) in mixed scenario.

Note 5: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree were used.

The results of the **Study A.3** are given in Table 1/1.2/4-5.

The conducted studies showed that the same ARNS systems as those that were considered in the frequency band 790-862 MHz under the studies on WRC-12 agenda item 1.17 operate in the frequency band 694-790 MHz. The MS system characteristics in the frequency band 694-790 MHz are also close to the MS systems characteristics which were used in the studies on WRC-12 agenda item 1.17.

Therefore, in the frequency band 694-790 MHz, in the absence of interference from the BS, the results previously obtained (at WRC-12) for the frequency band 790-862 MHz reflected in Resolution **749 (WRC-12)** and given in Table 1/1.2/4-5 can be applied for protection of the ARNS from the MS.

TABLE 1/1.2/4-5

Compatibility conditions of MS stations with ARNS stations

ARNS station	System type code	Minimum separation distance between receiving MS base stations and ARNS stations (km)	Minimum separation distance between transmitting MS base stations and ARNS stations (km)
RSBN	AA8	50	125/175*
RLS 2 (type 1) (airborne receiver)	BD	410	432
RLS 2 (type 1) (ground receiver)	BA	50	250/275*
RLS 2 (type 2) (airborne receiver)	BC	150	432
RLS 2 (type 2) (ground receiver)	AA2	50/75*	300/325*
RLS 1 (types 1 and 2) (ground receiver)	AB	125/175*	400/450*
Other ARNS ground stations	Not applied	125/175*	400/450*
Other ARNS airborne stations	Not applied	410	432

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on conditions that MS base stations operate with antenna height 60 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 1 470 km^2) and 0.5 km (S = 490 km^2) for urban area, power of MS base stations is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. The results are not based on the updated IMT parameters specified by ITU-R, but used the results in Resolution **749 (Rev.WRC-12)**.

Note 2: Tropospheric scattering effect in propagation model Recommendation from ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree were used.

The difference in the obtained results in Table 1/1.2/4-4 and Table 1/1.2/4-5 is explained mainly by the fact that the Study A.2 option addresses base stations with an antenna height of 50 metres and an urban area of 30 square km and a suburban area of 90 square km. The Study A.3 option addresses base stations with an antenna height from 30 m to 60 m and an urban area of 490 square km and a suburban area of 1 470 square km. For example, the Moscow area is 1 081 square km, the Berlin area is 900 square km, the Helsinki area is 680 square km and the Prague area is 500 square km.

1/1.2/4.2.2 Results of compatibility studies of the mobile service with the aeronautical radionavigation service with interference from the broadcasting service

Currently the frequency band 694-790 MHz is widely used by the BS. Therefore interference to ARNS stations from MS stations was considered taking into account interference caused by existing and future stations of the BS.

In practice, in the frequency band 694-790 MHz, the most likely interference scenario is from the MS to the ARNS with interference caused by the BS when broadcasting stations operate at the distance of less than 450 km from ANRS stations. It is confirmed by a large number of BS assignments implemented in the frequency band 694-790 MHz.

Under the considered scenario three studies were conducted:

– First study (Study B.1) is based on application of protection criteria for the ARNS as the permissible aggregate threshold field strength

– Second study (Study B.2) is based on application of protection criteria for the ARNS as the permissible interference-to-noise ratio I/N = –6 dB

– Third study (Study B.3) is based on application of protection criteria for the ARNS as the permissible interference-to-noise ratio *I*/*N* = –6 dB to obtain coordination protection distances.

In the first study the permissible aggregate threshold field strength given in Table 1/1.2/4-6 is used as the protection criteria for the ARNS. It was assumed that in the territory of neighbouring countries different services can operate (in one country the BS, in another the MS and in the third the ARNS).

TABLE 1/1.2/4-6

Protection criteria for ARNS stations

ARNS type	Predetermined aggregate trigger field-strength values (dB(µV/m))
RSBN	42 at 10 m in a 3 MHz reference bandwidth
RLS 2 (Type 1) (aircraft receiver)	52[1] at 10 000 m in a 4 MHz reference bandwidth
RLS 2 (Type 1) (ground receiver)	29[1] at 10 m in a 4 MHz reference bandwidth
RLS 2 (Type 2)	73 at 10 000 m in a 3 MHz reference bandwidth
RLS 2 (Type 2) (ground receiver)	24[1,2] at 10 m in a 8 MHz reference bandwidth
RLS 1 (Type 1 and 2)	13 at 10 m in a 6 MHz reference bandwidth
Other type ARNS ground stations	13 at 10 m in a 6 MHz reference bandwidth
Other type ARNS airborne stations	52 at 10 000 m in a 4 MHz reference bandwidth

Note 1: The values provided in this table refer to the permissible aggregate co-channel interference field-strength values provided for the necessary emission bandwidth (from all services).

The first study showed that compatibility of MS stations of one country with ARNS stations of another country with the BS in the third country is feasible. With this, restrictions to MS stations from the ARNS are not as significant as was expected. In practice, the minimum distance between MS stations and the country border operating the ARNS does not exceed several tens of km. These restrictions mostly depend on implementation features of BS stations and MS networks in the neighbouring countries.

In the second study an *I*/*N* = –6 dB, given in the Table 1/1.2/4-7, was used as the protection criteria for the ARNS. It was assumed that in the territory of neighbouring countries different services can operate (in one country the BS, in another country the MS and in the third country the ARNS). However, unlike the first study, the *I*/*N* protection criterion for the ARNS allows one to estimate interference to ARNS stations from MS stations not accounting for interference from the BS even notwithstanding their real existence.

TABLE 1/1.2/4-7

Protection criteria of ARNS stations

ARNS system type	**Permissible ratio interference-to-noise*, *I*/*N* (dB)**
RSBN	–6 at 10 m in a 3 MHz reference bandwidth
RLS 1 (types 1 and 2) (ground receiver)	–6 at 10 m in a 6 MHz reference bandwidth
RLS 2 (type 1) (aircraft receiver)	–6 at 10 000 m in a 4 MHz reference bandwidth
RLS 2 (type 1) (ground receiver)	–6 at 10 m in a 4 MHz reference bandwidth
RLS 2 (type 2) (aircraft receiver)	–6 at 10 000 m in a 3 MHz reference bandwidth
RLS 2 (type 2) (ground receiver)	–6 at 10 m in a 8 MHz reference bandwidth
Other type ARNS ground stations	–6 at 10 m in a 6 MHz reference bandwidth
Other type ARNS airborne stations	–6 at 10 000 m in a 4 MHz reference bandwidth

* Values of interference-to-noise, presented in the table relate to the total permissible level of interference-to-noise (from MS) in a common frequency band. For earth stations the propagation model is used in accordance with Recommendation ITU-R P.1546-4 for 10% of time and 50% of locations.

The second study showed that compatibility of MS stations in one country with ARNS stations in the other country with operation of the BS in the third country is feasible.

The third study is based on application of protection criteria for the ARNS as the permissible I/N = –6 dB to obtain coordination distances. The approach indicated in this study allows one to estimate interference to ARNS stations from MS stations not accounting for interference from the BS even notwithstanding their real existence.

The third study showed that compatibility of MS stations in one country with ARNS stations in another country with operation of BS in a third country is feasible. The obtained separation distances between the transmitting MS and BS, and ARNS stations in the frequency band 694-790 MHz are given in Table 1/1.2/4-8.

TABLE 1/1.2/4-8

Compatibility conditions of MS stations with ARNS stations

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)
RSBN (ground receiver)	AA8	441[1]	455[2]/480[2]*
RLS 2 (type 1) (airborne receiver)	BD	130[1]/165[1]*	441[2]
RLS 2 (type 1) (ground receiver)	BA	441[1]	400[2]/425[2]*
RLS 2 (type 2) (airborne receiver)	BC	405[1]/445[1]*	441[2]
RLS 2 (type 2) (ground receiver)	AA2	441[1]	530[2]/550[2]*
RLS 1 (types 1 and 2) (ground receiver)	AB	405[1]/445[1]*	545[2]/565[2]*
Other ARNS ground stations	Not applied	405[1]/445[1]*	545[2]/565[2]*
Other ARNS airborne stations	Not applied	405[1]/445[1]*	441[2]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on conditions that MS base stations operate with antenna height 50 m. No downtilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 2: Result based on conditions that MS base stations operate with antenna height 50 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 300 km^2) and 0.5 km (S = 100 km^2) for urban area, power of MS base station is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. No downtilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 3: The figures given are based on the estimated distance to protect the IMT base stations from the ARNS with the protection criteria of I/N = –6 dB.

Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree were used.

1/1.2/4.2.3 Conclusions

Results of compatibility study A.1 show that for the ARNS stations operating in the 694-790 MHz frequency band, i.e. ground stations of the RSBN system and the ground station of the RLS2 type 2 system, the coordination distance between the MS and the BS, and ground ARNS receivers in the 694-790 MHz frequency band vary from 15 to 111 km, depending on the scenario. Coordination distances for other types for ARNS systems are contained in Table 1/1.2/4-1 above.

Results of compatibility study A.2 show that the coordination distances for ARNS stations are in the range from 90 km to 441 km, depending on scenario. Specific coordination distances for different types of ARNS systems are contained in Table 1/1.2/4-4 above.

Results of compatibility study A.3 show that coordination distances for ARNS stations are in the range from 125 km to 450 km, depending on scenario. Specific coordination distances for different types of ARNS systems are contained in Table 1/1.2/4-5 above.

Results of compatibility study B.1 show that the field strength contained in Table 1/1.2/4-6 for ARNS stations may be used as the coordination trigger, depending on the scenario. Calculation with the proposed methodology is presented in the section 4.2.2.2 of Annex 23 to Document 4-5-6-7/715.

Results of compatibility study B.2 show that the I/N value contained in the Table 1/1.2/4-7 for ARNS stations may be used as the coordination trigger, depending on the scenario. Calculation with the proposed methodology is presented in the section 4.2.3.2 of Annex 23 to Document 4-5-6-7/715.

Results of compatibility study B.3 show that coordination distances for ARNS stations are in the range from 130 to 565 km, depending on the scenario. Specific coordination distances for different types of ARNS systems are contained in Table 1/1.2/4-8 above.

1/1.2/4.3 Analysis of solutions for SAB/SAP

It should be noted that, in the frequency band 694-790 MHz, applications ancillary to broadcasting will be able to operate under a new primary mobile allocation. However the studies referred to in section 1/1.2/3.4 show that co-channel and co-location operation between SAB/SAP and IMT is not feasible and therefore an identification for and use by IMT of the 694-790 MHz frequency band under certain circumstances may imply a loss of frequencies available for SAB/SAP.

Although the envisaged channelling arrangement recommended for IMT would allow Region 1 countries to use all or a portion of the guard band and/or duplex gap in 694-790 MHz for these applications, taking into account the increasing demand for SAB/SAP and the need to maintain existing production quality, the frequency band 470-790 MHz will not be sufficient.

Some SAB/SAP applications, which can operate under certain interference conditions, could use IMT duplex gaps and guard bands. However, the duplex gaps of all spectrum currently identified for IMT below 2 GHz may not alleviate the loss of the frequency band 694-790 MHz for SAB/SAP applications. That is why suitable frequency bands below 2 GHz, in addition to bands already allocated to the MS, may need to be found for SAB/SAP. Further studies are needed to find additional bands for SAB/SAP, on a regionally harmonized basis.

To this end, it is considered preferable that the need for additional frequency bands to be used for SAB/SAP in Region 1 could be addressed by a future competent conference, as appropriate.

Recognizing that non-broadcasting production teams use the same kind of equipment as broadcasting teams and many productions are conducted exclusively by external production teams or in cooperation with broadcasting teams, adding the term “and programme making” in addition to “applications ancillary to broadcasting” into RR No. **5.296** will increase flexibility in the use of the spectrum.

1/1.2/5 Methods to satisfy the agenda item

1/1.2/5.1 Issue A: Option for the refinement of the lower edge

Method A

– Modification of RR Article **5** to insert the allocation to the mobile, except aeronautical mobile, service in the frequency band 694-790 MHz in Region 1 on a primary basis, technical and regulatory conditions apply as in one of the methods for Issue B and in the Method(s) of Issue C, to be decided by WRC-15, based on the results of the studies performed by the ITU-R.

– Modification of RR No. **5.317A** to extend the identification of IMT in Region 1 down to 694 MHz.

– Consequential modification of RR No. **5.312A** to reflect the decisions of WRC-15 for Issues B and C, as appropriate.

Note: Additional provisions related to Resolutions are addressed under Issues B and C.

Reasons: The lower edge of allocation under agenda item 1.2 is proposed to be set at 694 MHz.

1/1.2/5.2 Issue B: Technical and regulatory conditions applicable to the mobile service concerning the compatibility between the mobile service and the broadcasting service

1/1.2/5.2.1 Method B1

No change, see section 1/1.2/6.2.1.

The GE06 Agreement contains the necessary provisions to provide protection to the BS in neighbouring countries.

Administrations may take measures to provide a set of technical conditions applicable to IMT UE to protect the BS below 694 MHz, on a local, national or regional basis. Based on the results of the studies, ITU-R may develop the following Recommendation(s) to ensure their harmonization, including:

- Revision of Recommendation ITU-R M.1036 so as to include harmonized frequency arrangements for 700 MHz in Region 1.
- New ITU-R Recommendation to specify the limit of OOBE of UE in the 700 MHz frequency band, as appropriate.

View from some administrations supporting Method B1:

The protection of the BS below 694 MHz from the MS can be ensured through applying the technical and regulatory provisions of the GE06 Agreement. Case studies of interference have shown that the single-entry coordination threshold (i.e. GE06 trigger) is sufficient to protect the BS from cumulative interference. A new recommendation may be developed, as appropriate, to specify the OOBE limits of the IMT UE below 694 MHz. Accordingly, this method should be adopted in WRC-15.

View from some administrations not supporting Method B1:

This method does not provide compatibility between the MS and the BS for several reasons:

– Development of the MS or the BS in a country could be blocked by neighbouring countries due to different country interests and large separation distances as justified by ITU-R study.

– Recommendation ITU-R M.1036 does not determine the frequency plan for all possible applications in the MS and accordingly does not provide the guard band necessary for protection of the BS below 694 MHz.

– Coordination trigger of the GE06 Agreement does not take into account aggregated interference from MS IMT networks.

– This method does not define the limits for the variation of technical parameters within the MS, allowing changes in the future without decisions by a competent WRC.

1/1.2/5.2.2 Method B2

The GE06 Agreement applies.

The ITU-R has developed Recommendation(s) which specify a set of technical conditions applicable to MS stations and protection to the BS below 694 MHz based on the results of the studies.

- Revision of Recommendation ITU-R M.1036 so as to include harmonized frequency arrangements for 700 MHz in Region 1.

- New Recommendation ITU-R to specify the limit of unwanted emissions of UE in the 700 MHz frequency band in Region 1.

Method B2 may be applied by referencing the Recommendation(s) in a footnote to the allocation in the RR.

View from some administrations supporting Method B2:

Following ITU-R studies, a possible new ITU-R Recommendation may be developed which defines limits for out-of-band emissions for IMT UE. The provisions of this Recommendation can only be guaranteed by incorporating it by reference in the RR.

View from some administrations not supporting Method B2:

Some administrations are of the view that ITU-R studies show that the adjacent channel interference from IMT base stations into DTT reception can occur for distances below 1 – 3 km, as confirmed by practical experience, while distances are less than a few hundred of metres for IMT UE. Therefore, this is a national issue which does not require any provisions in the RR. If an ITU-R Recommendation is to be incorporated by mandatory reference in the RR, this cannot be modified outside a WRC. It will be also counter-productive by not reflecting any technology developments that could provide better protection to the BS.

Some other administrations are of the view that this method does not provide compatibility between the BS and the MS, because Recommendation ITU-R M.1036 does not determine frequency arrangements, for all applications of MS, which are not limited to IMT; the GE06 Agreement coordination trigger does not take into account aggregated interference from a network of MS stations; variation of limits for the MS technical parameters are not established, allowing for possible changes in future without a decision by a competent WRC.

1/1.2/5.2.3 Method B3

The GE06 Agreement applies together with additional technical conditions and regulatory mechanisms for the protection of the BS.

To this effect, a new or a revised WRC-15 Resolution is required which specifies a consistent set of technical conditions and regulatory mechanisms applicable to MS stations for protection of the BS with respect to co-channel and adjacent channel interference, based on the results of studies.

For example, this Resolution may include:

- OOBE level of UE in the frequency band below 694 MHz
- Guard band above 694 MHz
- A complementary value to the existing GE06 trigger in order to take into account cumulative interference.

View from some administrations supporting Method B3:

The method contains the minimum restrictive but necessary conditions to be set in the Radio Regulations, which will ensure sharing between the MS and the BS.

View from some administrations not supporting Method B3:

ITU-R studies show that adjacent channel interference from IMT base stations into DTT reception can occur for distances below 1-3 km, as confirmed by practical experience, while distances are less than a few hundreds of metres for IMT UE. Therefore, this is a national issue which does not require any provisions in the RR.

Also, this method does not provide any clear regulatory procedure. The application of two different triggers (GE06 trigger and the additional coordination trigger for cumulative interference) will increase the burden of administrations and BR and lead to a contradiction between the results of the two procedures. In addition, case studies of interference have shown that a single-entry coordination threshold (i.e. GE06 trigger) is sufficient to protect the BS from cumulative interference. Therefore, Method B3 should not be adopted by WRC-15.

1/1.2/5.2.4 Method B4

The GE06 Agreement applies and for the operation of the MS in relation to the protection of the BS, RR No. **9.21** shall apply.

Affected administrations are identified by application of RR No. **9.21** using trigger criteria, as contained in Annex 1 of Resolution **232 (Rev.WRC-15)** or of a possible new WRC-15 Resolution, resulting from the studies carried out by the ITU-R through Resolution **232 (WRC-12)**.

View from some administrations supporting Method B4:

The application of the procedure of RR No. **9.21** is necessary due to the following facts:

– Provision of RR No. 9.21 is applied when the sharing criteria are not clearly defined and included in the relevant coordination procedure. The protection of the BS from IMT is not ensured by applying GE06 Agreement since the triggering criteria for coordination of that agreement is only based on a single entry and does not take into account the cumulative effect of interference from IMT.

– Studies carried out by the ITU-R demonstrated that the cumulative effect of interference from the MS/IMT into a DTTB station is significantly high (up to 21 dB).

– There is no contradiction between RR No. **9.21** and the GE06 Agreement. Those assignments which do not obtain the agreement under RR No. **9.21** are not in conformity with the Radio Regulation and therefore are not eligible to enter in that Plan.

View from some administrations not supporting Method B4:

The application of the procedure of RR No. **9.21** is not relevant to this issue under agenda item 1.2 due to the following reasons:

– The protection of the BS from IMT can be ensured by applying the GE06 Agreement as shown by case study that a single-entry coordination threshold (i.e. GE06 trigger) is sufficient to protect the BS from cumulative interference.

– This will contradict with the application of the GE06 Agreement and applying two different triggers will increase the burden on administrations and BR.

– RR No. **9.21** was never used in cases where a regional agreement exists. However, it applies in cases where no other agreements prevail, such as the application of RR No. **9.21** on the MS for protecting the ARNS in countries listed in RR No. **5.312**.

– Applying RR No. **9.21** with the GE06 Agreement may lead to non-equitable access to the MS in this frequency band.

1/1.2/5.3 Issue C: Technical and regulatory conditions applicable to the mobile service concerning the compatibility between the mobile service and the aeronautical radionavigation service for the countries listed in RR No. 5.312

1/1.2/5.3.1 Method C1

RR No. **9.21** still applies to the MS in relation to the ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of the ARNS, shall use the predetermined coordination distances specified in section 1/1.2/4.2.1 above (derived from Study A.1) in accordance with a modification of Resolution **232** at WRC-15 or a possible new WRC-15 Resolution.

View from some administrations not supporting Method C1:

> Some administrations are of the view that Method C1 is not applicable, because results obtained in the Study A.1 are based on an incorrect methodology and unrealistic interference scenario. In particular, this view is proven by the fact that coordination distances calculated in Study A.1 for the case of aggregate interference for the urban scenario are shorter than distances for the case of one source of interference for the rural scenario and therefore cannot be applied to provide protection for the ARNS. Detailed explanations can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.3.2 Method C2

RR No. **9.21** still applies to the MS in relation to the ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of the ARNS, shall use the ARNS coordination trigger as specified in section 1/1.2/4.2.2 above (derived from Study B.2) in accordance with a modification of Resolution **232** at WRC-15.

View from some administrations not supporting Method C2:

> Some administrations are of the view that multiservice interference from the BS and the MS does not occur and should not be taken into account. ECC Recommendation T/R 25-08 used for the derivation of the MS field strength protection criteria, used for the justification of the multiservice interference, is not applicable to IMT. The methodology proposed is not appropriate due to the dynamic deployment of IMT networks. The I/N = –6 dB protection criterion leads to overprotection of ARNS stations. Given these comments Method C2 leads to overestimation of the coordination distances and cannot be applied to solve Issue C. Further comments on the related study can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.3.3 Method C3

RR No. **9.21** still applies to the MS in relation to the ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of the ARNS, shall use the predetermined coordination distances specified in section 1/1.2/4.2.1 above (derived from Study A.2) in accordance with a modification of Resolution **232** at WRC-15.

View from some administrations not supporting Method C3:

> Some administrations are of the view that some of the parameters used deviate from the agreed parameters provided by ITU-R WP 5D. The rural attenuation from Recommendation ITU-R P.1546 has been used also for urban and sub-urban environments. The proposed coordination distances are not the distances required for protecting ARNS; they are derived from the calculation of protection of the MS from the ARNS. No terrain database has been used as required by Recommendation ITU-R

P.1546, when determining the effect of tropospheric scattering. Given these comments Method C3 leads to overestimation of the coordination distances and cannot be applied to solve Issue C. Further comments on the related study can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.3.4 Method C4

RR No. **9.21** still applies to the MS in relation to the ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of the ARNS, shall use the predetermined coordination distances specified in section 1/1.2/4.2.1 above (derived from Study A.3) in accordance with a modification of Resolution **232 (WRC-12)** at WRC-15.

View from some administrations not supporting Method C4:

Some administrations are of the view that the results are not based on the agreed parameters provided by ITU-R WP 5D. The coordination threshold values presented in Resolution **749 (Rev.WRC-12)** were agreed upon only on the basis that all affected CEPT countries obtained coordination agreement with the relevant countries in RR No. **5.312**. No terrain database has been used as required by Recommendation ITU-R P.1546, when determining the effect of tropospheric scattering. Given these comments Method C4 leads to overestimation of the coordination distances and cannot be applied to solve Issue C. Further comments on the related study can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.3.5 Method C5

RR No. **9.21** still applies to the MS in relation to the ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of the ARNS, shall use the predetermined coordination distances specified in section 1/1.2/4.2.2 above (derived from Study B.3) in accordance with a modification of Resolution **232 (WRC-12)** at WRC-15.

View from some administrations not supporting Method C5:

Some administrations are of the view that some of the parameters used deviate from the agreed parameters provided by ITU-R WP 5D. The rural attenuation from Recommendation ITU-R P.1546 has been used also for urban and sub-urban environments. The proposed coordination distances for the receiving base stations do not correspond to the distances needed to protect the ARNS systems; they are derived from the calculation of protection of the MS from the ARNS. The $I/N = -6$ dB protection criterion leads to overprotection of ARNS stations. No terrain database has been used as required by Recommendation ITU-R P.1546, when determining the effect of tropospheric scattering. Given these comments Method C5 leads to overestimation of the coordination distances and cannot be applied to solve Issue C. Further comments on the related study can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.3.6 Method C6

RR No. **9.21** still applies to the MS in relation to the ARNS in the 694-790 MHz frequency band. The determination of affected administrations, based on RR No. **9.21** for MS stations in respect of the ARNS, shall use the ARNS coordination trigger as specified in section 1/1.2/4.2.2 above (derived from Study B.1) in accordance with a modification of Resolution **232 (WRC-12)** at WRC-15.

View from some administrations not supporting Method C6:

> Some administrations are of the view that multiservice interference from the BS and the MS does not occur and should not be taken into account. ECC Rec T/R 25-08 used for the derivation of the MS system field strength protection criterion, used for justification of the multiservice interference, is not applicable to IMT. The cumulative effect of broadcasting assignments is taken into account both in the country hosting the ARNS as well as in countries within a certain radius from the ARNS station, regardless of the fact that these assignments may not be in operation. The methodology proposed is not appropriate due to the dynamic deployment of IMT networks. Given these comments Method C6 leads to overestimation of the coordination distances and cannot be applied to solve Issue C. Further comments on the related study can be found in Appendix 7 to Attachment 2 of Annex 23 to Document 4-5-6-7/715.

1/1.2/5.4 Issue D: Solutions for accommodating applications ancillary to broadcasting requirements

1/1.2/5.4.1 Method D1

Modification of the existing upper limits of frequency bands mentioned in RR No. **5.296** for the secondary allocation to 694 MHz and extension of that use to the applications ancillary to programme-making.

To accommodate the operability of the frequency band for applications ancillary to broadcasting and programme-making, an identification of the band 694-790 MHz should be done by a new footnote.

1/1.2/5.4.2 Method D2

Modification of the existing upper limits of frequency bands mentioned in RR No. **5.296** for the secondary allocation to 694 MHz and extension of that use to the applications ancillary to programme-making.

In order to accommodate the operability of the frequency band 694-790 MHz for applications ancillary to broadcasting and programme-making, a WRC Resolution needs to address the issue taking into account the process described in Resolution ITU-R 59.

1/1.2/5.4.3 Method D3

Modification of the existing upper limits of frequency bands mentioned in RR No. **5.296** for the secondary allocation to 694 MHz and extension of that use to the applications ancillary to programme-making.

1/1.2/6 Regulatory and procedural considerations

1/1.2/6.1 Issue A: Options for the refinement of the lower edge

ARTICLE 5

Frequency allocations

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

MOD

460-890 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
...		
470-~~790~~694 BROADCASTING 5.149 5.291A 5.294 MOD 5.296 5.300 5.304 5.306 5.311A 5.312 ~~5.312A~~	**470-512** BROADCASTING Fixed Mobile 5.292 5.293	**470-585** FIXED MOBILE BROADCASTING 5.291 5.298
	512-608 BROADCASTING 5.297	**585-610** FIXED MOBILE BROADCASTING RADIONAVIGATION 5.149 5.305 5.306 5.307
	608-614 RADIO ASTRONOMY Mobile-satellite except aeronautical mobile-satellite (Earth-to-space)	**610-890** FIXED MOBILE 5.313A 5.317A BROADCASTING 5.149 5.305 5.306 5.307 5.311A 5.320
	614-698 BROADCASTING Fixed Mobile 5.293 5.309 5.311A	
694~~470~~-790 BROADCASTING MOBILE except aeronautical mobile MOD 5.312A MOD 5.317A ~~5.149 5.291A 5.294 5.296~~ 5.300 ~~5.304 5.306~~ 5.311A 5.312 ~~5.312A~~	**698-806** MOBILE 5.313B 5.317A BROADCASTING Fixed 5.293 5.309 5.311A	
790-862 FIXED MOBILE except aeronautical mobile 5.316B 5.317A BROADCASTING 5.312 5.314 5.315 5.316 5.316A 5.319	**806-890** FIXED MOBILE 5.317A BROADCASTING 5.317 5.318	
862-890 FIXED MOBILE except aeronautical mobile 5.317A BROADCASTING 5.322 5.319 5.323		

NOTE – For MOD 5.296, see Section 1/1.2/6.4 below (Issue D).

MOD

5.312A In Region 1, the use of the band 694-790 MHz by the mobile, except aeronautical mobile, service is subject to the provisions of Resolution **232 (Rev.WRC-1~~2~~5)**. See also Resolution **224 (Rev.WRC-12)**. (WRC-1~~2~~5)

MOD

5.317A Those parts of the band 698-960 MHz in Region 2 and the band 694-790 MHz in Region 1 and 790-960 MHz in Regions 1 and 3 which are allocated to the mobile service on a primary basis are identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) – see Resolutions **224 (Rev.WRC-12), 232 (Rev.WRC-15)** and **749 (Rev.WRC-12)**, as appropriate. This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. (WRC-1~~2~~5)

MOD

RESOLUTION 232 (REV.WRC-1~~2~~5)

Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 ~~and related studies~~

The World Radiocommunication Conference (Geneva, 201~~2~~5),

…

resolves

~~1 to allocate the frequency band 694-790 MHz in Region 1 to the mobile, except aeronautical mobile, service on a co-primary basis with other services to which this band is allocated on a primary basis and to identify it for IMT;~~

~~2 that the allocation in *resolves* 1 is effective immediately after WRC-15;~~

[Note: this resolves 1 hereafter is to be modified with text from one of the methods of Issue C.]

~~3~~1 that use of the frequency band 694-790 MHz by the mobile service ~~allocation in *resolves* 1~~ is subject to agreement obtained under No. **9.21** with respect to the aeronautical radionavigation service in countries listed in No. **5.312**. A methodology for identification of the affected administrations under No. **9.21** for the mobile service with respect to the aeronautical radionavigation service in countries listed in No. **5.312** in the 694-790 MHz frequency band *[text from one of the methods of Issue C]*;

~~4 that the lower edge of the allocation is subject to refinement at WRC-15, taking into account the ITU-R studies referred to in invites ITU-R below and the needs of countries inRegion 1, in particular developing countries;~~

[Note: this resolves 2 hereafter is to be deleted or to be modified with text from one of the methods of Issue B.]

[~~5~~2] that ~~WRC-15 will specify the~~ technical and regulatory conditions applicable to the mobile service in the frequency band 694-790 MHz with respect to the broadcasting service *[text from one of the methods of Issue B, if any]*~~allocation referred to in resolves 1, taking into account the ITU-R studies referred to in invites ITU-R below~~,

~~*invites ITU-R*~~

~~1 to study the spectrum requirement for the mobile service and for the broadcasting service in this frequency band, in order to determine as early as possible the options for the lower edge referred to in resolves 4;~~

~~2 to study the channelling arrangements for the mobile service, adapted to the frequency band below 790 MHz, taking into account:~~

~~– the existing arrangements in Region 1 in the bands between 790 and 862 MHz and defined in the last version of Recommendation ITU-R M.1036, in order to ensure coexistence with the networks operated in the new allocation and the operational networks in the band 790-862 MHz;~~

…

[Note: The numbering is provisional and would depend on the amount of resolves to be decided by WRC-15.]

1/1.2/6.2 Issue B: Technical and regulatory conditions applicable to the mobile service concerning the compatibility between the mobile service and the broadcasting service

1/1.2/6.2.1 For Method B1

No modifications to the RR and no new WRC Resolution or WRC Recommendation in response to Issue B.

1/1.2/6.2.2 For Method B2

ARTICLE 5

Frequency allocations

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

MOD

460-890 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
460-470	FIXED MOBILE 5.286AA Meteorological-satellite (space-to-Earth) 5.287 5.288 5.289 5.290	
470-~~790~~694 BROADCASTING 5.149 5.291A 5.294 MOD 5.296 5.300 5.304 5.306 5.311A 5.312 ~~5.312A~~	**470-512** BROADCASTING Fixed Mobile 5.292 5.293 **512-608** BROADCASTING 5.297 **608-614** RADIO ASTRONOMY Mobile-satellite except aeronautical mobile-satellite (Earth-to-space)	**470-585** FIXED MOBILE BROADCASTING 5.291 5.298 **585-610** FIXED MOBILE BROADCASTING RADIONAVIGATION 5.149 5.305 5.306 5.307
694~~470~~-790 BROADCASTING MOBILE except aeronautical mobile ADD 5.A12 ~~5.149 5.291A 5.294 5.296~~ 5.300 ~~5.304 5.306~~ 5.311A 5.312 5.312A MOD 5.317A	**614-698** BROADCASTING Fixed Mobile 5.293 5.309 5.311A **698-806** MOBILE 5.313B 5.317A BROADCASTING Fixed 5.293 5.309 5.311A	**610-890** FIXED MOBILE 5.313A 5.317A BROADCASTING
790-862 FIXED MOBILE except aeronautical mobile 5.316B 5.317A BROADCASTING 5.312 5.314 5.315 5.316 5.316A 5.319 **862-890** FIXED MOBILE except aeronautical mobile 5.317A BROADCASTING 5.322 5.319 5.323	**806-890** FIXED MOBILE 5.317A BROADCASTING 5.317 5.318	 5.149 5.305 5.306 5.307 5.311A 5.320

NOTES:

– for MOD 5.296, see Section 1/1.2/6.4 below (Issue D);

– for MOD 5.317A, see Section 1/1.2/6.1 above (Issue A).

ADD

5.A12 International Mobile Telecommunications (IMT) networks in the frequency band 694-790 MHz shall be deployed in accordance with section [the relevant section to be referenced] of Recommendation ITU-R M.1036[-5]. In addition, the unwanted emissions of the IMT user equipment shall conform to those specified in [the relevant part of] Recommendation ITU-R M.[BSMS700]. (WRC-15)

1/1.2/6.2.3 For Method B3

ARTICLE 5

Frequency allocations

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

NOC

5.312A

MOD

RESOLUTION 232 (REV.WRC-125)

Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 ~~and related studies~~

The World Radiocommunication Conference (Geneva, 20125),

…

resolves

[Note: The text under resolves 2 hereafter is to complete the resolves 2 under Issue A, depending on the outcome of WRC-15, i.e. if this Method B3 is adopted by WRC-15.]

[2] that to ensure compatibility with the broadcasting service, the use of the allocation to the mobile service in the frequency band 694-790 MHz shall be carried out under the following conditions:

– IMT stations shall not use frequencies below 703 MHz;

– out-of-band emissions of user equipment (UE) shall not exceed [xx] dBm / 8 MHz in the frequency bands below 694 MHz;

– out-of-band emissions of base stations shall not exceed [yy] dBm / 8 MHz in the frequency bands below 694 MHz;

– specifications of IMT base stations and UE shall meet the requirements of Recommendations ITU-R M.1457-11 and ITU-R M.2012-0;

– field strength from a mobile service station at the border should not exceed the values given in Annex 1, unless otherwise agreed with affected administrations,

…

invites ITU-R

…

[Note: The numbering is provisional and would depend on the amount of resolves to be decided by WRC-15.]

ANNEX 1

Field-strength limits for the protection of the terrestrial broadcasting services

Service to be protected	**Field-strength limit (dB(µV/m))(1)**	
	703-718 MHz	**718-790 MHz**
Terrestrial broadcasting	2	4

(1) The trigger field-strength values are related to an 8 MHz bandwidth and a height of 10 m above ground level.

1/1.2/6.2.4 For Method B4

MOD

RESOLUTION 232 (REV.WRC-1~~2~~5)

Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 ~~and related studies~~

The World Radiocommunication Conference (Geneva, 201~~2~~5),

…

resolves

…

[2] that to ensure compatibility with the broadcasting service, the use of the allocation to the mobile service in the frequency band 694-790 MHz in Region 1 is subject to agreement obtained under No. **9.21**. A methodology for identification of the affected administrations under No. **9.21** for the mobile service with respect to the broadcasting service in the 694-790 MHz frequency band is provided in Annex 1 to this Resolution;

[Note: The text under resolves 2 above is to complete the resolves 2 under Issue A, depending on the outcome of WRC-15, i.e., if this Method B4 is adopted by WRC-15. The numbering in provisional and would depend on the amount of resolves to be decided by WRC-15.]

ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

Criteria for identifying potentially affected administrations with respect to the broadcasting service

To identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by the mobile service in the frequency band 694-790 MHz with respect to the broadcasting service, the trigger field strength for the mobile service indicated below should be used.

These trigger values are derived from the GE06 Agreement trigger values corrected for the cumulative effect of interference, which is considered to be 20 dB.

All the examinations under the GE06 Agreement for the case of adding or modifying an assignment to the mobile service shall be repeated with these new trigger values and affected administrations shall be identified under No. **9.21**.

When submitting a notice to BR for assignments of the mobile service, notifying administrations may indicate in the notice the list of administrations with which bilateral agreement has already been reached. BR shall take this into account in determining the administrations with which coordination under No. **9.21** is required.

Trigger field strength (dB(μV/m))

694-718 MHz	718-790 MHz
3	5

1/1.2/6.3 Issue C: Technical and regulatory conditions applicable to the mobile service concerning the compatibility between the mobile service and the aeronautical radionavigation service

1/1.2/6.3.1 Main body of Resolution 232 for all Methods under Issue C (C1-C6)

MOD

RESOLUTION 232 (REV.WRC-1~~2~~5)

Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 ~~and related studies~~

The World Radiocommunication Conference (Geneva, 201~~2~~5),

…

resolves

1 to allocate the frequency band 694-790 MHz in Region 1 to the mobile, except aeronautical mobile, service on a co-primary basis with other services to which this band is allocated on a primary basis and to identify it for IMT;

2 that the allocation in *resolves* 1 is effective immediately after WRC-15;

For Method C1

3 that use of the allocation in *resolves* 1 is subject to agreement obtained under No. **9.21** with respect to the aeronautical radionavigation service in countries listed in No. **5.312**. The coordination distance for the identification of affected administrations under No. **9.21** for the mobile service with respect to the aeronautical radionavigation service in the 694-790 MHz frequency band is provided in Annex 1 to this Resolution;

or

For Method C2 and Method C6

3 that use of the allocation in *resolves* 1 is subject to agreement obtained under No. **9.21** with respect to the aeronautical radionavigation service in countries listed in No. **5.312**. A methodology for the identification of affected administrations under No. **9.21** for the mobile service with respect to ARNS in the 694-790 MHz frequency band is provided in Annex 1 to this Resolution;

or

For Method C3, Method C4 and Method C5

3 that use of the allocation in *resolves* 1 is subject to agreement obtained under No. **9.21** with respect to the aeronautical radionavigation service in countries listed in No. **5.312**. The criteria for the identification of affected administrations under No. **9.21** for the mobile service with respect to the aeronautical radionavigation service in the 694-790 MHz frequency band are provided in Annex 1 to this Resolution;

…

invites ITU-R

…

[Note: The numbering in provisional and would depend on the amount of resolves to be decided by WRC-15.]

1/1.2/6.3.2 New Annex 1 to Resolution 232 for the different Methods C1 to C6

[Note for the preparation of proposals to WRC-15: The different versions of Annex 1 provided under this section correspond to the Methods described in section **1/1.2/5.3**. *These Annexes are shown without revision marks below and, if supported, should be presented as a modification to Resolution* ***232*** *with track changes.]*

1/1.2/6.3.2.1 For Method C1

ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

The criteria for identifying potentially affected administrations in the frequency band 694-790 MHz with respect to the aeronautical radionavigation service countries listed in No. 5.312

To identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by the mobile service (MS) with respect to the aeronautical radionavigation service (ARNS) operating in countries mentioned in No. **5.312**, the coordination distances (between a base station in the MS and a potentially affected ARNS station) indicated below should be used.

When notifying, administrations may indicate in the notice sent to BR the list of administrations with which bilateral agreement has already been reached. BR shall take this into account in determining the administrations with which coordination under No. **9.21** is required.

Case where the mobile service is operated according to the frequency arrangement where the base stations transmit only in the frequency band 758-788 MHz and receive only in the frequency band 703-733 MHz

TABLE 1

Scenario	Propagation type	Required coordination distance – Mixed environment	Required coordination distance – Rural environment	Required coordination distance – Suburban environment	Required coordination distance – Urban environment
MS base station to ground ARNS station	Land path	15 km	15 km	17 km	5 km
MS base station to ground ARNS station	Mixed: 50% sea/ 50% land path	20 km	19 km	25 km	7 km

General note: All below notes apply to all of the values in this table.

Note 1: Result based on condition that MS base station operates with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area, MS base station e.i.r.p. in direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336. If lower duplex pair of frequency arrangement A5 of Recommendation ITU-R M.1036 is used for the MS implementation.

Note 2: Base stations density in the mixed scenario: 0.0274 base station/km^2/5 MHz, which is made up from: 70% rural (density of 0.7 × 0.0050 base station/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2 × 0.0796 base station/km^2/5 MHz = 0.0159), 10% urban (density of 0.1 × 0.0796 base station/km^2/5 MHz = 0.0080).

Note 3: Propagation environment between MS base stations and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario where MS base station transmitters and ARNS receiver are placed in the same type of area (rural/suburban/urban).

Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.

Case where the mobile base stations transmit within the frequency band 733-758 MHz

TABLE 2

Scenario	Propagation type	Required coordination distance – Mixed environment	Required coordination distance – Rural environment	Required coordination distance – Suburban environment	Required coordination distance – Urban environment
MS base station to ground RLS 2 (Type 2) station	Land path	69 km	45 km	124 km	18 km
MS base station to ground RLS 2 (Type 2) station	Mixed: 50% sea/ 50% land path	111 km	65 km	167 km	29 km
MS base station to ground RSBN station	Land path	15 km	15 km	17 km	5 km
MS base station to ground RSBN station	Mixed: 50% sea/ 50% land path	20 km	19 km	25 km	7 km

General note: all below notes apply to all of the values in this table.

Note 1: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area, MS base station e.i.r.p. in direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336.

Note 2: Base station density in the mixed scenario: 0.0274 base station/km^2/5 MHz, which is made up from: 70% rural (density of 0.7 × 0.0050 base station/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2 × 0.0796 base station/km^2/5 MHz = 0.0159), 10% urban (density of 0.1 × 0.0796 base station/km^2/5 MHz = 0.0080).

Note 3: Propagation environment between MS base stations, and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario where MS base station transmitters and ARNS receiver are placed in the same type of area (rural/suburban/urban).

Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.

Other cases

TABLE 3

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)[1]
RSBN	AA8	Rural: < 1 Suburban: < 1 Urban: N/A[5]	Rural: 15/19*[2] Suburban: 17/25*[2] Urban: 5/7*[2] Mixed: 15/20*[2]
RLS 2 (type 1) (airborne receiver)	BD	Rural: < 1 Suburban: < 1 Urban: < 1	Rural: > RH[4] Suburban/urban: > RH[4] Mixed: > RH[4]

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)[1]
RLS 2 (type 1) (ground receiver)	BA	Rural: < 1 Suburban: < 1 Urban: N/A[5]	Rural: 31/42* Suburban: 70/112* Urban: 13/18* Mixed: 40/61*
RLS 2 (type 2) (airborne receiver)	BC	Rural: < 1 Suburban: < 1 Urban: < 1	Rural: 251 Suburban/urban: 403 Mixed: 373
RLS 2 (type 2) (ground receiver)	AA2	Rural: < 1 Suburban: < 1 Urban: N/A[5]	Rural: 45/65* Suburban: 124/167* Urban: 18/29* Mixed: 69/111*
RLS 1 (types 1 and 2) (ground receiver)	AB	Rural: < 1 Suburban: < 1 Urban: N/A[5]	Rural: 112/163* Suburban: 230/274* Urban: 53/97* Mixed: 171/212*
Other ARNS ground stations	Not applied	Rural: < 1 Suburban: < 1 Urban: N/A[5]	Rural: 112/163* Suburban: 230/274* Urban: 53/97* Mixed: 171/212*
Other ARNS airborne stations	Not applied	Rural: < 1 Suburban: < 1 Urban: < 1	Rural: > RH[4] Suburban/urban: > RH[4] Mixed: > RH[4]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area. MS base station e.i.r.p. in direction towards the country hosting the ARNS is not more than 55 dBm in 5 MHz and 3 degrees down tilt of antenna pattern in accordance with Recommendation ITU-R F.1336.

Note 2: Result based on condition that MS base stations operate with antenna height 30 m, cell radius is 8 km for rural area, 2 km for suburban and urban area.

Note 3: All user equipment (UE) with antenna height 1.5 m use average transmit power of 2 dBm for macro rural scenario, –9 dBm for macro urban/suburban scenario and densities of UE in active mode are: rural: 0.17 UE per km^2/5 MHz, suburban/urban: 2.16 UE per km^2/5 MHz, as specified by ITU-R. Typical body loss of 4 dB was taken into account.

Note 4: RH = radio horizon (The radio horizon for 30 m and 10 000 m antenna heights are 431 km).

Note 5: Recommendation ITU-R P.1546 is not applicable for the urban case since both transmitter and receiver antenna heights are below the clutter height.

Note 6: Base station density in the mixed scenario: 0.0274 base station/km^2/5 MHz, which is made up from: 70% rural (density of 0.7 × 0.0050 base station/km^2/5 MHz = 0.0035), 20% suburban (density of 0.2 × 0.0796 base station/km^2/5 MHz = 0.0159), 10% urban (density of 0.1 × 0.0796 base station/km^2/5 MHz = 0.0080).

Note 7: Propagation environment between MS base stations, and ARNS receiver, in the same environment (rural/suburban/urban) corresponds to the deployment scenario where MS base station transmitters and ARNS receiver are placed in the same type of area (rural/suburban/urban).

Note 8: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was not taken into account.

1/1.2/6.3.2.2 For Method C2

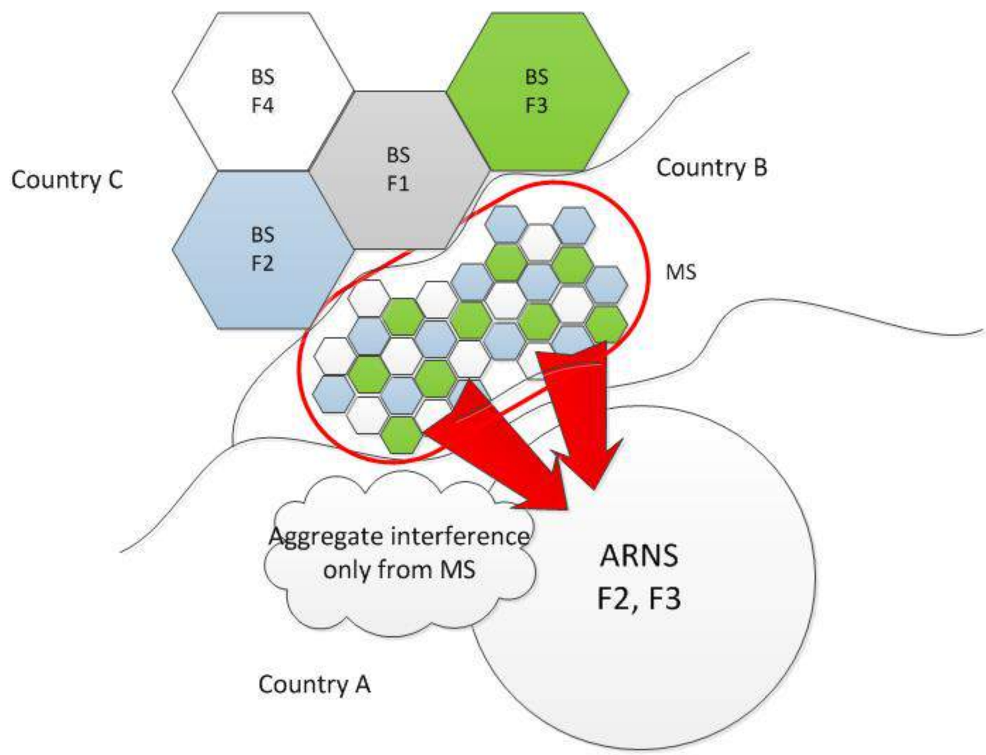
ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

Methodology for identification of the affected administrations under No. 9.21 for the mobile service in the 694-790 MHz frequency band

A protection criteria of $I/N = -6$ dB for aeronautical radionavigation service (ARNS) stations gives the possibility to estimate interference from the mobile service (MS) to the ARNS without taking into account interference caused by stations of the broadcasting service. A typical scenario of the aggregate interference impact from the MS to the ARNS is shown in Fig. 1.

FIGURE 1

Typical scenario for aggregate interference to the ARNS from the MS in the frequency band 694-790 MHz



To identify affected administrations when applying No. **9.21** for the MS with respect to the ARNS in the 694-790 MHz frequency band, the criteria specified in Table 1 should be used.

TABLE 1

Protection criteria for ARNS stations

ARNS system type	Permissible ratio "interference-to-noise"*, *I*/*N* (dB)
RSBN	−6 at 10 m in a 3 MHz reference bandwidth
RLS 1 (types 1 and 2) (ground receiver)	−6 at 10 m in a 6 MHz reference bandwidth
RLS 2 (type 1) (aircraft receiver)	−6 at 10 000 m in a 4 MHz reference bandwidth
RLS 2 (type 1) (ground receiver)	−6 at 10 m in a 4 MHz reference bandwidth
RLS 2 (type 2) (aircraft receiver)	−6 at 10 000 m in a 3 MHz reference bandwidth
RLS 2 (type 2) (ground receiver)	−6 at 10 m in a 8 MHz reference bandwidth
Other type ARNS ground stations	−6 at 10 m in a 6 MHz reference bandwidth
Other type ARNS airborne stations	−6 at 10 000 m in a 4 MHz reference bandwidth

* Values of interference-to-noise presented in the table relate to the total permissible level of interference-to-noise (from MS) in a common frequency band. For the earth stations the propagation model is used in accordance with Recommendation ITU-R P.1546-4 for 10% of time and 50% of locations.

This methodology considers that interference to ARNS stations can be caused by MS base stations as well as user equipment (UE). In case of the implementation of an FDD mode by the MS, interference would be calculated in each channel from the base station or from the UE in accordance with the scenario.

1 Consideration of mobile service base stations impact to ground and aircraft aeronautical radionavigation service stations

In applying criteria proposed in Table 1, the estimation of interference caused by newly notified MS stations to the ARNS shall be performed taking into account interference from previously notified MS stations.

Assignments of MS base stations recorded in the Master International Frequency Register (MIFR) or earlier notified for coordination under No. **9.21**, that have frequency overlap with ARNS stations, in the frequency band 694-790 MHz shall be taken into account.

Depending on the considered ARNS stations two interference scenarios are possible:

1) interference to airborne ARNS receiver;

2) interference to ground ARNS receiver.

Interference evaluation for each scenario is given below.

1.1 Mobile service base station impact to aeronautical radionavigation service aircraft receiver

The typical airborne ARNS receiver is at the altitude of 10 000 metres and can be located at any point of the service area of the associated transmitting ground station (which is notified in ITU).

The visibility zone for the airborne ARNS station is determined in accordance with the equation:

$$D_{vi} = 4.1 \times \left(\sqrt{H_{1i}} + \sqrt{H_2} \right) \quad (1)$$

where:

H_{1i}: is antenna altitude of ARNS *i*-receiver

H_2: is transmitter antenna altitude of the notified MS base station.

The height of the MS base station transmit antenna is taken from the notice. If this value is not available in the notice, the height of the MS base station transmitter antenna should be considered as 50 metres.

In consideration of the interference impact of the notified MS base station to ARNS airborne stations the following algorithm to determine the affected ARNS assignments is proposed:

1) The distance D_{ci} is determined from the notified MS base station in the direction of ARNS ground stations which are previously notified or recorded in ITU in the frequency band of a new MS base station (see Fig. 2).

2) The condition to be checked:

$$D_{ci} > R_{zi} + D_{vi} \quad (2)$$

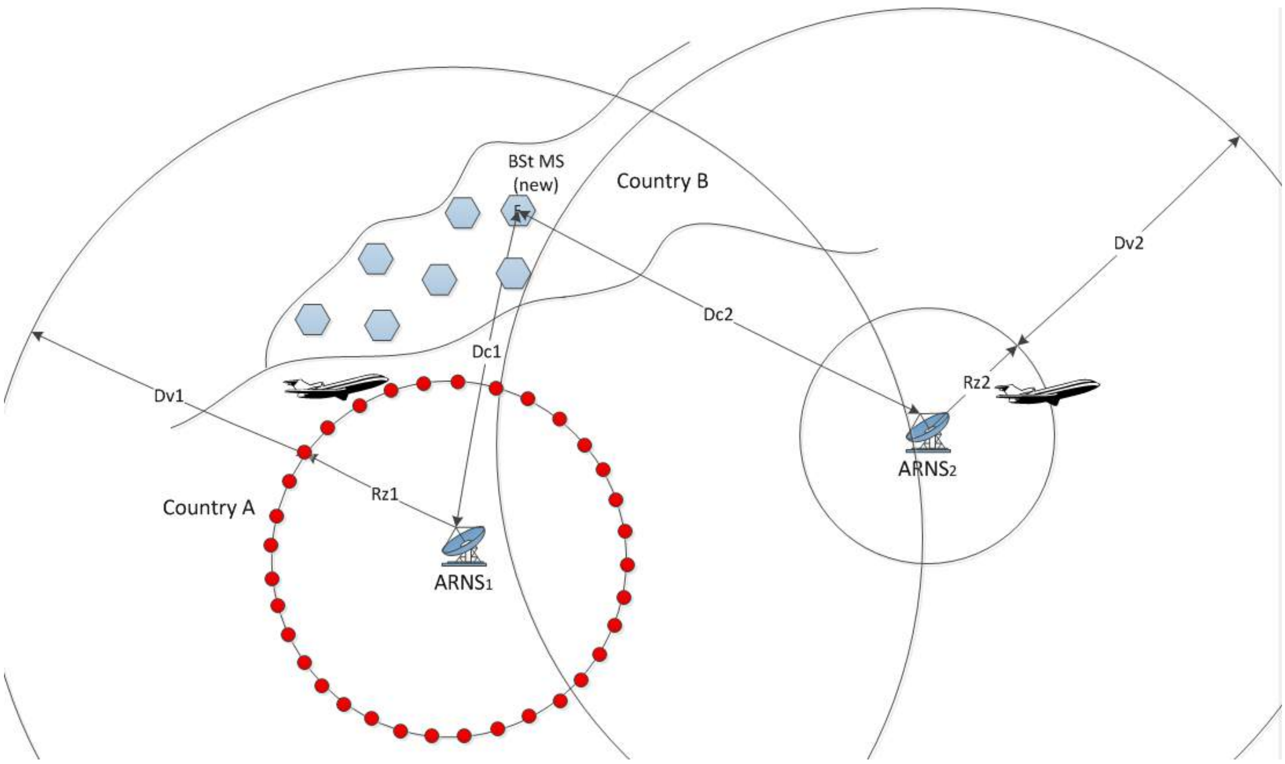
where:

R_{zi}: the service area radius of the ARNS ground *i*-th station, where the associated receiving airborne ARNS station can be located (indicated in the filing of the ARNS station).

If the requirement is met then obtaining agreement for the new MS base station under No. **9.21** with respect to the specific ARNS station is not required (Fig. 2 with respect to ARNS2 station).

FIGURE 2

How to determine affected frequency assignments of ARNS airborne receivers



3) For each ARNS *i*-th station located at the distance less than or equal to D_{vi} + R_{zi} the following is determined the MS base station assignments recorded in the MIFR or earlier notified to obtain agreement under No. **9.21** which completely or partially fall

into the line-of-sight area of the ARNS airborne receiver (these assignments are highlighted in blue in Fig. 2).

4) The interference level I_{ijk} is calculated at the *k*-th boundary point of the service area of *i*-th ARNS ground receiver (these are red points in Fig. 2) from each *j*-th interference source identified in item 3 above including the new notified MS base station assignment. The calculation is performed by application of Recommendation ITU-R P.525.

Interference level I_{ijk} is calculated taking into account the overlapping frequency band ratios, *N*– index, that takes into account interference power portion, entering the ARNS receiver, in dB:

$$N = \begin{cases} 10\log(B_I / B_W), \ B_I < B_W \\ 0, \ B_I = B_W \end{cases} \quad (3)$$

B_W: interferer’s bandwidth, MHz

B_I: bandwidth overlap of the interferer and the ARNS receiver, MHz.

It should be noted that the test points (where calculations are performed) are chosen at the boundary of the service area of *i*-th ARNS ground receiver with a defined interval (for example 1 degree) (currently used under the GE06 Agreement) (the points on the service area boundary of ARNS1 receiver are highlighted in red in Fig. 2).

5) The aggregate interference level I_{ik} is calculated at each *k*-th point of the service area of *i*-th ARNS ground receiver by application of the data obtained in item 4 above and in accordance with the equation:

$$I_{ik} = 10\log\left(\sum_{j=1}^{n} 10^{0.1 I_{ijk}}\right) \quad (4)$$

6) The aggregate interference level I_{ik} in each *k*-th boundary point is compared with the protection criteria E_{reqi} of *i*-th ARNS airborne receiver. If the condition $I_{ik} > I_{reqi}$ is met then obtaining agreement for new notified MS base station under No. **9.21** with regard to the specific *i*-th ARNS station is required. I_{reqi} calculation is based on $I/N = -6$ dB criterion. Based on N_i for certain types of ARNS system, then $I_{reqi} = N_i - 6$.

1.2 Mobile service base station impact on aeronautical radionavigation service ground-based receiver

In consideration of MS base station impact on a ground-based ARNS receiver it is required to take into account the fact that ARNS ground station antennas are directional. Therefore in the compatibility estimation MS assignments which fall in the main lobe of the ARNS station antenna pattern are taken into account. It should be noted that the parameter for the −3 dB beamwidth of the main lobe of the ARNS ground-based station’s antenna should be added to Appendix **4** as a mandatory parameter for notification. In the absence of this parameter in the notification the −3 dB beamwidth of the main lobe of the ARNS ground-based station antenna should be assumed equal to 8 degrees.

Interference outside the ARNS station antenna pattern main lobe was taken into account by adding 4 dB to the interference which will be calculated in the angle sector of the ARNS station antenna pattern main lobe.

Depending on location of the affected ARNS station, the sector radius is determined where interference sources should be taken into account. In the GE06 Agreement and Recommendation

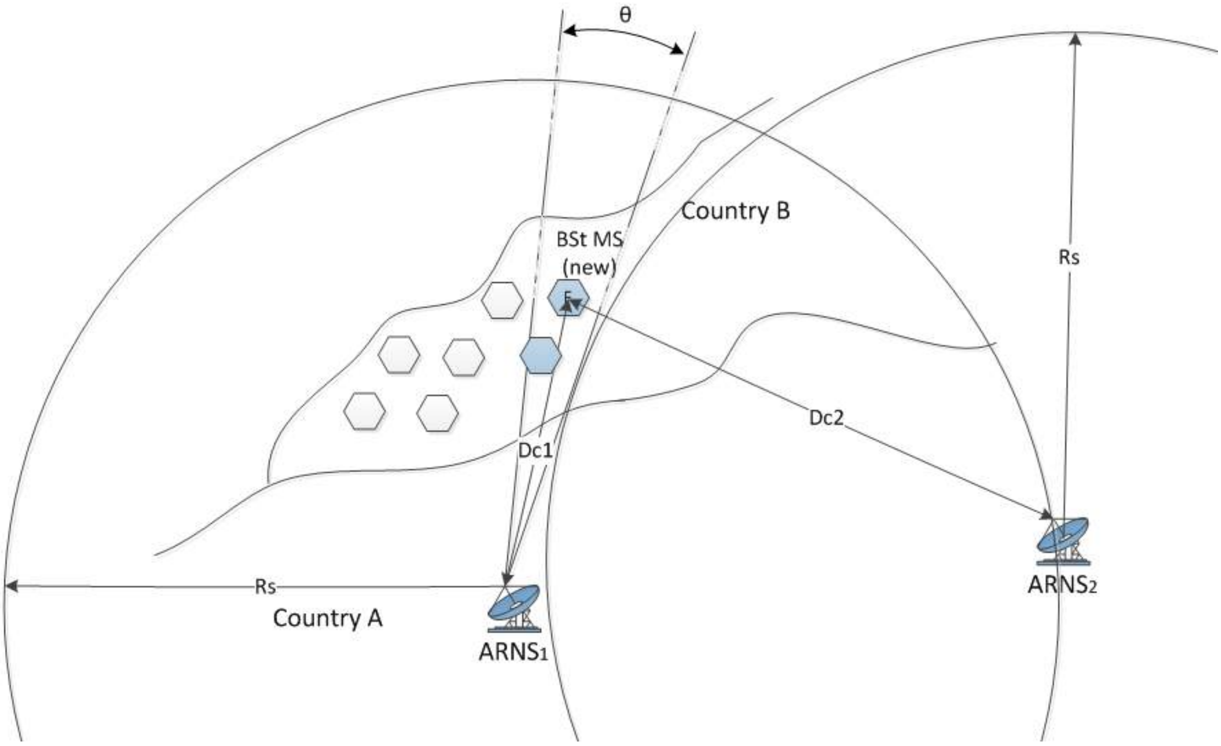
ITU-R P.1546-4 the distance of 1 000 km is taken as this sector radius. The same distance is used by BR for checking the notices for the modification of GE06 Plan with respect to ARNS stations.

However, taking into account that Recommendation ITU-R P.1546-4 is applied for different climatic areas and a wide frequency range therefore the sector radius R_s where interference sources are taken into account is limited up to distance of 600 km – for ARNS stations located above 48 degrees north latitude and up to 800 km for ARNS stations located below or on 48 degrees north latitude (the Black Sea region).

Therefore if the MS base station is located in the main beam of ARNS station antenna pattern, but at the distance R_s of more than 600 km or 800 km (as the case may be) then it is proposed not to take into account such station in the interference calculation for ARNS stations (see Fig. 3).

FIGURE 3

How to determine affected frequency assignments of ARNS ground-based receivers



Taking into account the above-mentioned while considering the interference impact of the notified MS base station to the ARNS ground-based stations the following procedure to determine the affected ARNS is applied:

1) Around the notified new MS base station towards the ARNS ground-based stations which are notified/recorded in ITU in the new MS base station frequency band the distance D_{ci} is determined (see Fig. 3).

2) The condition to be checked:

$$D_{ci} > R_s \qquad (5)$$

where:

R_s: = 600 km or = 800 km depending on the latitude of the ARNS i-th station.

If the requirement is met then obtaining agreement for the new MS base station under No. **9.21** with respect to the specific ARNS station is not required. (This relates to ARNS2 station in Fig. 3.)

3) With respect to each ARNS *i*-th station which is located nearer than $D_{ci} \leq R_s$, the MS base station assignments recorded in the MIFR or earlier notified to obtain agreement under No. **9.21** are determined which completely or partially fall into the main beam sector of ARNS ground station directed to a new notified MS base station. This sector is limited by the distance R_s (in Fig. 3 these assignments and allotments are highlighted in blue).

4) The interference level I_{ij} is calculated at the location of the *i*-th ARNS ground-based receiver (in Fig. 3 this is ARNS1) from each *j*-th MS base station assignment recorded in the MIFR or earlier notified to obtain agreement under No. **9.21** including the new notified MS base station assignment.

Interference level I_{ij} shall be calculated with account of overlapping frequency band ratio, *N*– index, that takes into account interference power portion, entering the ARNS receiver, dB:

$$N = \begin{cases} 10\log(B_I / B_W), \; B_I < B_W \\ 0, \; B_I = B_W \end{cases} \quad (6)$$

B_W: interferer's bandwidth, MHz

B_I: bandwidth overlap of the interferer and the ARNS receiver, MHz.

The calculation is performed by application of Recommendation ITU-R P.1546-4 for 10% of time and 50% of locations.

5) The aggregate interference level I_i is calculated at the *i*-th ARNS ground-based receiver location by application of the data obtained in item 4 above and in accordance with the following equation:

$$I_i = 10\log\left(\sum_{j=1}^{n} 10^{0.1 I_{ij}}\right) + 4 \quad (7)$$

6) The aggregate interference level I_i is compared with the protection criteria I_{reqi} of the *i*-th ARNS ground-based receiver. If the requirement $I_i > I_{reqi}$ is met, then obtaining agreement for the new MS base station under No. **9.21** with respect to the *i*-th ARNS station is required. I_{reqi} calculation is based on the $I/N = -6$ dB criterion. Based on N_i for certain types of ARNS system, then $I_{reqi} = N_i - 6$.

2 Consideration of mobile service user equipment impact on aeronautical radionavigation service ground-based and aircraft stations

In case of CDMA or TDD MS systems, it is expected that interference caused by MS UE to ARNS stations will not exceed the interference from MS base stations. Therefore, in these cases it is sufficient to use the methodology specified in section 1 above.

In case of frequency division duplex (FDD) MS systems, the interference caused by UE to ARNS stations will impact in other frequency bands than interference from MS base stations. Therefore in this case other approaches are required to be applied to determine the affected ARNS assignments.

In case of notifications of MS systems with FDD when a notifying administration indicates in the notice that the aggregate e.i.r.p. value of all UE operating simultaneously with the notified base station does not exceed 21 dBm per 1 MHz (this corresponds to the coordination distance of 70 km specified in Table 1 of Annex 1 to Resolution **749 (Rev.WRC-12)**) then this value should be used in the interference calculation.

Otherwise, the value of 31 dBm per 1 MHz (this corresponds to the coordination distance of 150 km specified in Table 1 of Annex 1 to Resolution **749 (Rev.WRC-12)**) can be used as the aggregate e.i.r.p. value of all UE operating simultaneously with the notified base station or to use another e.i.r.p. value as notified by the administration.

Using these aggregate values of UE (21 dBm per 1 MHz or 31 dBm per 1 MHz, as appropriate) operating with one MS base station one can determine the affected ARNS assignments by applying the methodology presented in section 1 above. However, the receiving MS base station should be considered instead of the transmitting MS base station, and the aggregate e.i.r.p. of all UE operating simultaneously with the notified MS base station should be considered instead of the e.i.r.p. of the MS base station (see above).

1/1.2/6.3.2.3 For Method C3

ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

The criteria for the identification of affected administrations under No. 9.21 for the mobile service in the 694-790 MHz frequency band

To identify affected administrations when applying the procedure for seeking agreement under No. **9.21** by the mobile service (MS) with respect to the aeronautical radionavigation service (ARNS) operating in countries mentioned in No. **5.312** the coordination distances (between a base station in the MS and a potentially affected ARNS station) indicated below should be used.

Notifying administrations may indicate in the notice sent to BR the list of administrations with which bilateral agreement has already been reached. BR shall take this into account in determining the administrations with which coordination under No. **9.21** is required.

TABLE 1

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)
RSBN (ground receiver)	AA8	441[1]	75[2]/90[2]*
RLS 2 (type 1) (airborne receiver)	BD	130[1]/165[1]*	441[2]
RLS 2 (type 1) (ground receiver)	BA	441[1]	185[2]/200[2]*
RLS 2 (type 2) (airborne receiver)	BC	405[1]/445[1]*	400[2]
RLS 2 (type 2) (ground receiver)	AA2	441[1]	250[2]/275[2]*
RLS 1 (types 1 and 2) (ground receiver)	AB	405[1]/445[1]*	350[2]/375[2]*
Other ARNS ground stations	Not applied	405[1]/445[1]*	350[2]/375[2]*
Other ARNS airborne stations	Not applied	405[1]/445[1]*	441[2]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on conditions that MS base stations operate with antenna height 50 m. No down-tilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 2: Result based on conditions that MS base stations operate with antenna height 50 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 300 km^2) and 0.5 km (S = 100 km^2) for urban area, power of MS base station is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. No down-tilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 3: The figures given are based on the estimated distance to protect the IMT base stations from the ARNS with the protection criteria of $I/N = -6$ dB.

Note 4: Propagation environment between MS base station transmitters and ARNS receiver is rural for all deployment areas (rural, suburban, urban) in mixed scenario.

Note 5: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree were used.

1/1.2/6.3.2.4 For Method C4

ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

The criteria for identification of affected administrations under No. 9.21 for the mobile service in the 694-790 MHz frequency band

To identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by the mobile service (MS) with respect to the aeronautical radionavigation service (ARNS) operating in countries mentioned in No. **5.312** the coordination distances (between a base station in the MS and a potentially affected ARNS station) indicated below should be used.

Notifying administrations may indicate in the notice sent to BR the list of administrations with which bilateral agreement has already been reached. BR shall take this into account in determining the administrations with which coordination under No. **9.21** is required.

TABLE 1

ARNS station	System type code	Minimum separation distance between receiving MS base stations and ARNS stations (km)	Minimum separation distance between transmitting MS base stations and ARNS stations (km)
RSBN	AA8	50	125/175*
RLS 2 (type 1) (airborne receiver)	BD	410	432
RLS 2 (type 1) (ground receiver)	BA	50	250/275*
RLS 2 (type 2) (airborne receiver)	BC	150	432
RLS 2 (type 2) (ground receiver)	AA2	50/75*	300/325*
RLS 1 (types 1 and 2) (ground receiver)	AB	125/175*	400/450*
Other ARNS ground stations	Not applied	125/175*	400/450*
Other ARNS airborne stations	Not applied	410	432

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on conditions that MS base stations operate with antenna height 60 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 1 470 km^2) and 0.5 km (S = 490 km^2) for urban area, power of MS base station is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. The results are not based on the updated IMT parameters specified ITU-R, but used the results in Resolution **749 (Rev.WRC-12)**.

Note 2: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree were used.

1/1.2/6.3.2.5 For Method C5

ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

The criteria for identification of affected administrations under No. 9.21 for the mobile service in the 694-790 MHz frequency band

To identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by the mobile service (MS) with respect to the aeronautical radionavigation service (ARNS) operating in countries mentioned in No. **5.312** the coordination distances (between a base station in the MS and a potentially affected ARNS station) indicated below should be used.

Notifying administrations may indicate in the notice sent to BR the list of administrations with which bilateral agreement has already been reached. BR shall take this into account in determining the administrations with which coordination under No. **9.21** is required.

TABLE 1

ARNS station	System type code	Coordination distances for the receiving MS base stations (km)[3]	Coordination distances for the transmitting MS base stations (km)
RSBN (ground receiver)	AA8	441[1]	455[2]/480[2]*
RLS 2 (type 1) (airborne receiver)	BD	130[1]/165[1]*	441[2]
RLS 2 (type 1) (ground receiver)	BA	441[1]	400[2]/425[2]*
RLS 2 (type 2) (airborne receiver)	BC	405[1]/445[1]*	441[2]
RLS 2 (type 2) (ground receiver)	AA2	441[1]	530[2]/550[2]*
RLS 1 (types 1 and 2) (ground receiver)	AB	405[1]/445[1]*	545[2]/565[2]*
Other ARNS ground stations	Not applied	405[1]/445[1]*	545[2]/565[2]*
Other ARNS airborne stations	Not applied	405[1]/445[1]*	441[2]

* 50% ≤ land path ≤ 100% / 0% ≤ land path < 50%.

Note 1: Result based on conditions that MS base stations operate with antenna height 50 m. No down-tilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 2: Result based on conditions that MS base stations operate with antenna height 50 m, cell radius is 8 km for rural area, 2 km for suburban area (S = 300 km^2) and 0.5 km (S = 100 km^2) for urban area, power of MS base station is 55 dBm in 5 MHz due orientation of main beam antenna pattern towards ARNS station. No down-tilt of the MS base station antennas has been applied. Antenna pattern only in horizontal plane from Recommendation ITU-R F.1336 has been used.

Note 3: The figures given are based on the estimated distance to protect the IMT base stations from the ARNS, with the protection criteria of $I/N = -6$ dB.

Note 4: Tropospheric scattering effect in propagation model from Recommendation ITU-R P.1546 was taken into account. Due to the lack of terrain information, terrain clearance angles of 0 degree were used.

1/1.2/6.3.2.6 For Method C6

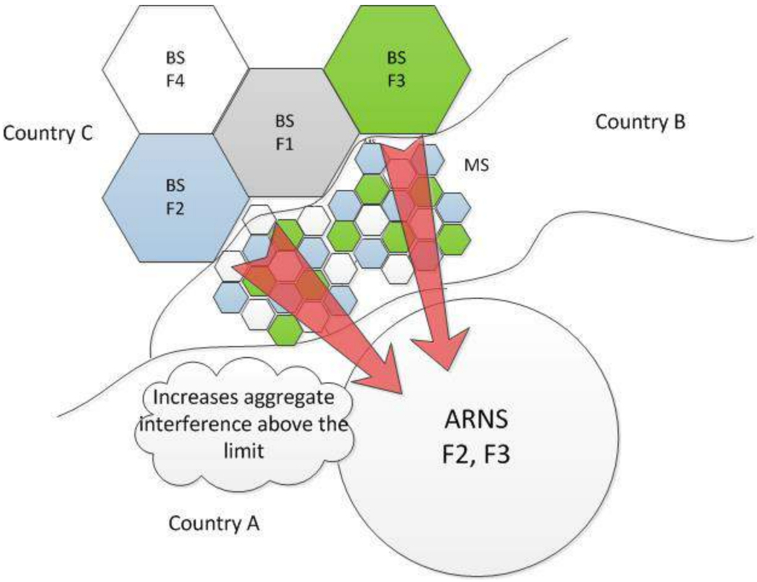
ANNEX 1 TO RESOLUTION 232 (REV.WRC-15)

Methodology for identification of affected administrations under No. 9.21 for the mobile service in the 694-790 MHz frequency band

Protection criteria of field-strength values for the aeronautical radionavigation service (ARNS) stations can be used to estimate interference from the mobile service (MS) to the ARNS by taking into account interference caused by stations of the broadcasting service (BS). A typical scenario of the aggregate interference impact from the MS to the ARNS is shown in Fig. 1.

FIGURE 1

Typical scenario for aggregate interference to the ARNS from the BS and the MS in the frequency band 694-790 MHz



To identify affected administrations when applying No. **9.21** for the MS with respect to the ARNS in the 694-790 MHz frequency band the criteria specified in Table 1 should be used.

TABLE 1

Protection criteria for ARNS stations

ARNS type	Predetermined aggregate trigger field-strength values (dB(µV/m))
RSBN	42 at 10 m in a 3 MHz reference bandwidth
RLS 2 (Type 1) (aircraft receiver)	52[1] at 10 000 m in a 4 MHz reference bandwidth
RLS 2 (Type 1) (ground receiver)	29[1] at 10 m in a 4 MHz reference bandwidth
RLS 2 (Type 2)	73 at 10 000 m in a 3 MHz reference bandwidth
RLS 2 (Type 2) (ground receiver)	24[1,2] at 10 m in a 8 MHz reference bandwidth
RLS 1 (Type 1 and 2)	13 at 10 m in a 6 MHz reference bandwidth
Other type ARNS ground stations	13 at 10 m in a 6 MHz reference bandwidth
Other type ARNS airborne stations	52 at 10 000 m in a 4 MHz reference bandwidth

Note 1: The values provided in this table refer to the permissible aggregate co-channel interference field-strength values provided for the necessary emission bandwidth (from all services).

This methodology considers that interference to ARNS stations can be caused by MS base station as well as user equipment (UE). In case of implementation of FDD mode by the MS, interference would be calculated in each channel from base station or from UE in accordance to scenario.

1 Consideration of mobile service base stations impact to ground-based and aircraft aeronautical radionavigation service stations

In applying criteria proposed in Table 1 the estimation of interference caused by newly notified MS stations to the ARNS shall be performed by taking into account interference from the previously notified MS stations and also from BS assignments, recorded in the Master International Frequency Register (MIFR) or notified under Article **11**.

The following shall be taken into account:

1) BS assignments, recorded in MIFR or notified under Article **11** which can potentially cause interference to ARNS;

2) assignments of MS base station recorded in MIFR or earlier notified for coordination under No. **9.21**, that have frequency overlap with ARNS stations, in the frequency band 694-790 MHz.

Depending on the considered ARNS stations two interference scenarios are possible:

1) interference to an airborne ARNS receiver;

2) interference to a ground-based ARNS receiver.

Interference evaluation for each scenario is given below.

1.1 Mobile service base station impact on aeronautical radionavigation service aircraft receiver

The typical airborne ARNS receiver is at the altitude of 10 000 metres and can be located at any point of service area of an associated transmitting ground station (which is recorded in ITU).

The visibility zone for the airborne ARNS station is determined in accordance with the equation:

$$D_{vi} = 4.1 \times \left(\sqrt{H_{1i}} + \sqrt{H_2}\right) \quad (1)$$

where

H_{1i}: is antenna altitude of ARNS *i*-receiver

H_2: is transmitter antenna altitude of the notifying MS base station.

The height of the MS base station transmit antenna is taken from the notice. If this value is not available in the notice, the height of the MS base station transmitter antenna should be considered as 50 metres.

In consideration of interference impact of the notified MS base station to ARNS airborne stations the following algorithm to determine the affected ARNS assignments is proposed:

1) The distance D_{ci} is determined from the notified MS base station in the direction of ARNS ground stations which are recorded in ITU in the frequency band of a new MS base station (see Fig. 2).

2) To condition to be checked:

$$D_{ci} > R_{zi} + D_{vi} \quad (2)$$

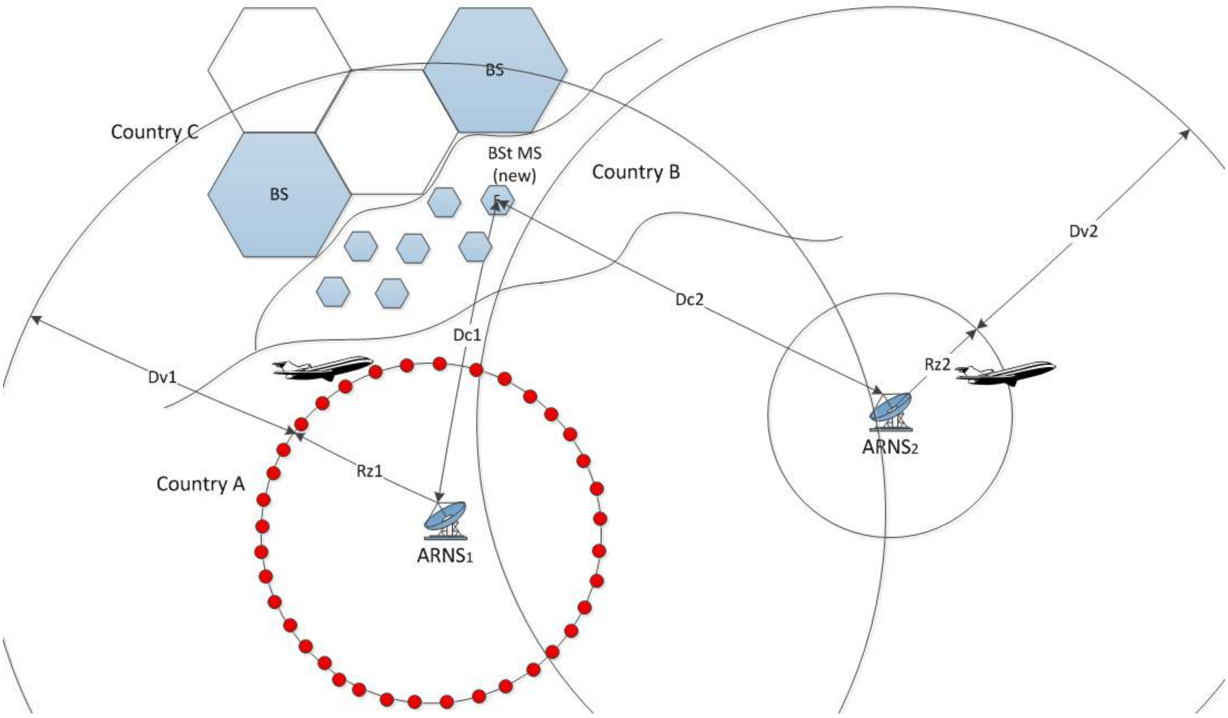
where

R_{zi}: service area radius of ARNS ground *i*-th station, where the associated receiving airborne ARNS station can be located (indicated in the notice for ARNS station).

If the requirement is met then obtaining agreement for the new MS base station under No. **9.21** with respect to the specific ARNS station is not required (Fig. 2 with respect to ARNS2 station).

FIGURE 2

How to determine affected frequency assignments of ARNS airborne receivers



3) For each ARNS *i*-th station located at the distance less than or equal to $D_{vi} + R_{zi}$ the following is determined:

a) the MS base station assignments recorded in MIFR or earlier notified to obtain agreement under No. **9.21** which completely or partially fall into the line-of-sight area of ARNS airborne receiver (these assignments are highlighted in blue in Fig. 2);

b) the broadcasting assignments, recorded in MIFR or notified under Article **11**, or which notified for inclusion in the GE06 Plan which completely or partially fall into the line-of-sight area of the ARNS airborne receiver (Fig. 2 these assignments and allotments are highlighted in blue.)

4) The field strength E_{ijk} is calculated at the *k*-th boundary point of the service area of *i*-th ARNS ground-based receiver (these are red points in Fig. 2) from each *j*-th interference source identified in item 3 above including the new notified MS base station assignment. The calculation is performed by application of Recommendation ITU-R P.525.

Field strength E_{ijk} is calculated taking into account the overlapping frequency bands ratio, *N*– index, that takes into account the interference power portion, entering the ARNS receiver, dB:

$$N = \begin{cases} 10\log(B_I / B_W), \ B_I < B_W \\ 0, \ B_I = B_W \end{cases} \quad (3)$$

B_W: interferer's bandwidth, MHz

B_I: bandwidth overlap of the interferer and the ARNS receiver, MHz.

It should be noted that the test points (where calculations are performed) are chosen at the boundary of the service area of *i*-th ARNS ground receiver at defined intervals (for example 1 degree) (currently used under the GE06 Agreement) (the points on the service area boundary of ARNS1 receiver are highlighted in red in Fig. 2).

5) The aggregate field strength E_{ik} is calculated at each *k*-th point of the service area of *i*-th ARNS ground-based receiver by application of the data obtained in section 4 above and in accordance with the equation:

$$E_{ik} = 10\log\left(\sum_{j=1}^{n} 10^{0.1E_{ijk}}\right) \quad (4)$$

6) The aggregate field strength E_{ik} at each *k*-th boundary point is compared with the protection criteria E_{reqi} of the *i*-th ARNS airborne receiver. If the condition $E_i > E_{reqi}$ is met then obtaining agreement for new notified MS base station under No. **9.21** with regard to the specific ARNS station is required.

1.2 Mobile service base station impact to aeronautical radionavigation service ground-based receiver

In consideration of MS base station impact on a ground-based ARNS receiver it is required to take into account the fact that ARNS ground-based station antennas are directional. Therefore in the compatibility estimation MS assignments and BS assignments which fall in the main lobe of the ARNS station antenna pattern are to be taken into account. It should be noted that the parameter for the −3 dB beamwidth of the main lobe of the ARNS ground-based station antenna should be added to Appendix **4** as a mandatory parameter for notification. In the absence of this parameter in the notification the −3 dB beamwidth of the main lobe of the ARNS ground-based station antenna should be assumed to be 8 degrees.

Interference outside the ARNS station antenna pattern main lobe was taken into account by adding 4 dB to the interference which will be calculated in the angle sector of the ARNS station antenna pattern main lobe.

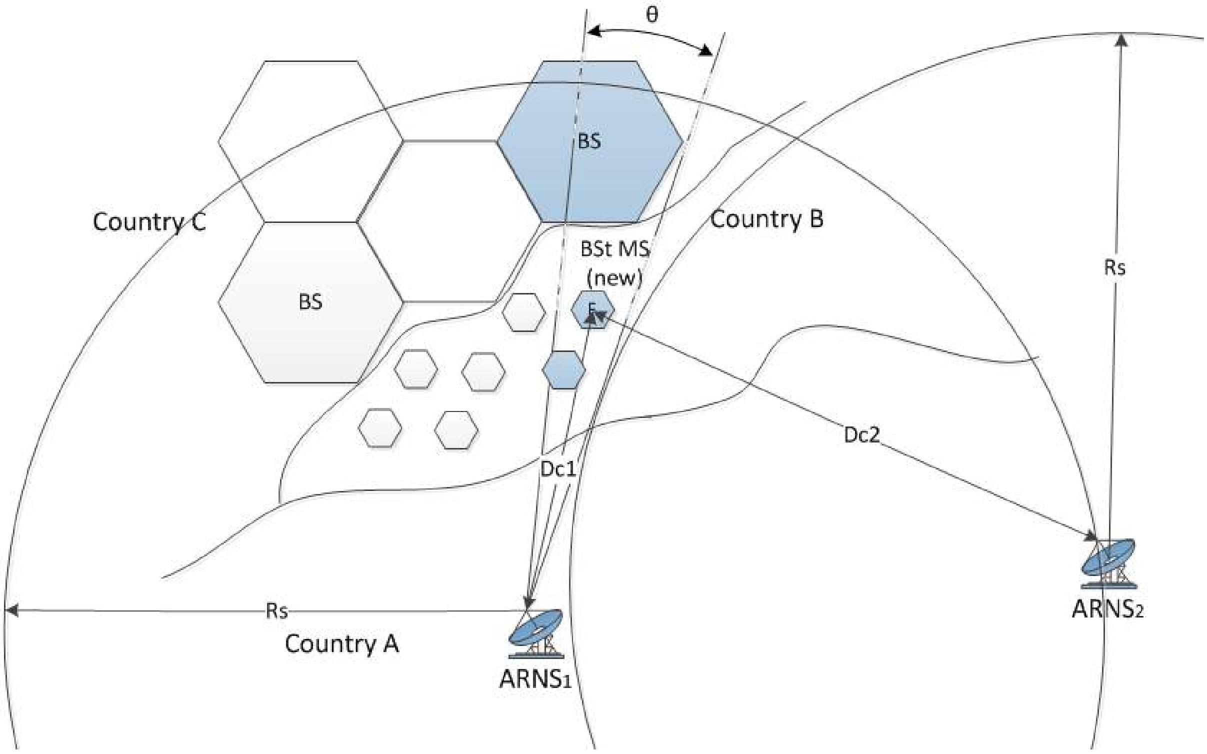
Depending on the location of the affected ARNS station the sector radius is determined where interference sources should be taken into account. In the GE06 Agreement and Recommendation ITU-R P.1546-4 the distance of 1 000 km is taken as this sector radius. The same distance is used by BR for checking the notices for the modification of the GE06 Plan with respect to ARNS stations.

However, taking into account that Recommendation ITU-R P.1546-4 is applied for different climatic areas and a wide frequency range, therefore the sector radius R_s where interference sources are taken into account is limited up to a distance of 600 km – for ARNS stations located above 48 degrees north latitude and up to 800 km for ARNS stations located below or at 48 degrees north latitude (the Black Sea region).

Therefore if the MS base station is located in the main beam of ARNS station antenna pattern, but at the distance R_s of more than 600 km or 800 km (as the case may be), then it is proposed not to take into account such stations in the interference calculation for ARNS stations (see Fig. 3).

FIGURE 3

How to determine affected frequency assignments of ground ARNS receivers



Taking into account the above-mentioned when considering the interference impact of the notified MS base station on the ARNS ground-based stations, the following procedure is applied to determine the affected ARNS:

1) Around the notified new MS base station towards the ARNS ground-based stations which are recorded in ITU in the new MS base station frequency band the distance D_{ci} is determined (see Fig. 3).

2) The condition to be checked:

$$D_{ci} > R_s \qquad (5)$$

where

R_s = 600 km or = 800 km depending on latitude of ARNS *i*-th station.

If the requirement is met then obtaining agreement for the new MS base station under No. **9.21** with respect to the specific ARNS station is not required. (This relates to ARNS2 station in Fig. 3.)

3) With respect to each ARNS *i*-th station which is located closer than $D_{ci} \leq R_s$ the MS base station assignments recorded in MIFR or earlier notified to obtain agreement under No. **9.21** and also broadcasting assignments of the GE06 Plan are determined which completely or partially fall into the main beam sector of the ARNS ground-based station

directed to a new notified MS base station. This sector is limited by the distance R_s (in Fig. 3 these assignments and allotments are highlighted in blue).

4) The field strength E_{ij} is calculated at the location of each *i*-th ARNS ground receiver (in Fig. 3 this is ARNS1) from each *j*-th MS base station assignment entered in the MIFR or earlier notified to obtain agreement under No. **9.21** and GE06 Plan assignment including the new notified MS base station assignment. The field strength E_{ij} shall be calculated taking account of the overlapping frequency band ratio, *N*– index, that takes into account interference power portion, entering the ARNS receiver, dB:

$$N = \begin{cases} 10\log(B_I / B_W), \ B_I < B_W \\ 0, \ B_I = B_W \end{cases} \quad (6)$$

B_W: interferer's bandwidth, MHz

B_I: bandwidth overlap of the interferer and the ARNS receiver, MHz.

The calculation is performed by application of Recommendation ITU-R P.1546-4 for 10% of time and 50% of locations.

5) The aggregate field strength E_i is calculated at the *i*-th ARNS ground receiver location by application of the data obtained in section 4 above and in accordance with the following equation:

$$E_i = 10\log\left(\sum_{j=1}^{n} 10^{0.1E_{ij}}\right) + 4 \quad (7)$$

6) The aggregate field strength E_i is compared with the protection criteria E_{reqi} of the *i*-th ARNS ground receiver (see Table 1). If the requirement $E_i > E_{reqi}$ is met then obtaining agreement for the new MS base station under No. **9.21** with respect to the *i*-th ARNS station is required.

2 Consideration of mobile service user equipment impact on aeronautical radionavigation service ground-based and aircraft stations

In case of CDMA or TDD MS systems, it is expected that interference caused by MS UE to ARNS stations will not exceed the interference from MS base station. Therefore, in these cases it is sufficient to use the methodology specified in section 1 above.

In case of frequency division duplex (FDD) MS systems, the interference caused by UE to ARNS stations will impact in other frequency bands than interference from MS base stations. Therefore in this case other approaches are required to be applied to determine the affected ARNS assignments.

In case of the notification of MS systems with FDD when a notifying administration indicates in the notice that the aggregate e.i.r.p. value of all UE operating simultaneously with the notified base station does not exceed 21 dBm per 1 MHz (this corresponds to the coordination distance of 70 km specified in Table 1 of Annex 1 to Resolution **749 (Rev.WRC-12)**) then this value should be used in the interference calculation.

Otherwise, the value of 31 dBm per 1 MHz (this corresponds to the coordination distance of 150 km specified in Table 1 of Annex 1 to Resolution **749 (Rev.WRC-12)**) can be used as the aggregate e.i.r.p. value of all UE operating simultaneously with the notified base station or to use another e.i.r.p. value as notified by the administration.

Using these aggregate values of UE (21 dBm per 1 MHz or 31 dBm per 1 MHz, as appropriate) operating with one MS base station one can determine the affected ARNS assignments by applying the methodology presented in Section 1 above. However, the receiving MS base station should be considered instead of a transmitting MS base station, and the aggregate e.i.r.p. of all UE operating simultaneously with the notified MS base station should be considered instead of the e.i.r.p. of the MS base station (see above).

1/1.2/6.4 Issue D: Solutions for accommodating applications ancillary to broadcasting requirements

1/1.2/6.4.1 For Method D1

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

(See No. **2.1**)

MOD

5.296 *Additional allocation:–* in Albania, Germany, Saudi Arabia, Austria, Bahrain, Belgium, Benin, Bosnia and Herzegovina, Burkina Faso, Cameroon, Congo (Rep. of the), Côte d'Ivoire, Croatia, Denmark, Djibouti, Egypt, United Arab Emirates, Spain, Estonia, Finland, France, Gabon, Ghana, Iraq, Ireland, Iceland, Israel, Italy, Jordan, Kuwait, Latvia, The Former Yugoslav Republic of Macedonia, Libya, Liechtenstein, Lithuania, Luxembourg, Mali, Malta, Morocco, Moldova, Monaco, Niger, Norway, Oman, the Netherlands, Poland, Portugal, Qatar, the Syrian Arab Republic, Slovakia, the Czech Republic, the United Kingdom, Sudan, Sweden, Switzerland, Swaziland, Chad, Togo, Tunisia and , Turkey, the band 470-790 MHz, and in Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Nigeria, South Africa, Tanzania, Zambia and Zimbabwe, the band 470-6948 MHz are is also allocated on a secondary basis to the land mobile service, intended for applications ancillary to broadcasting and programme-making. Stations of the land mobile service in the countries listed in this footnote shall not cause harmful interference to existing or planned stations operating in accordance with the Table in countries other than those listed in this footnote. (WRC-125)

Note for Secretariat: The countries names should be rearranged alphabetically at WRC-15.

ADD

5.B12 In Region 1, the band or part of the frequency band 694-790 MHz is intended for applications ancillary to broadcasting and programme-making within the land mobile service. Stations of the land mobile service providing applications ancillary to broadcasting and programme-making shall not cause harmful interference to nor claim protection from existing or planned stations operating on a primary basis in accordance with the Radio Regulations. (WRC-15)

1/1.2/6.4.2 For Method D2

ARTICLE 5

Frequency allocations

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

MOD

5.296 *Additional allocation:*~~–~~ in Albania, Germany, Saudi Arabia, Austria, Bahrain, Belgium, Benin, Bosnia and Herzegovina, Burkina Faso, Cameroon, Congo (Rep. of the), Côte d'Ivoire, Croatia, Denmark, Djibouti, Egypt, United Arab Emirates, Spain, Estonia, Finland, France, Gabon, Ghana, Iraq, Ireland, Iceland, Israel, Italy, Jordan, Kuwait, Latvia, The Former Yugoslav Republic of Macedonia, Libya, Liechtenstein, Lithuania, Luxembourg, Mali, Malta, Morocco, Moldova, Monaco, Niger, Norway, Oman, the Netherlands, Poland, Portugal, Qatar, the Syrian Arab Republic, Slovakia, the Czech Republic, the United Kingdom, Sudan, Sweden, Switzerland, Swaziland, Chad, Togo, Tunisia~~ and ~~, Turkey, ~~the band 470-790 MHz, and in~~ Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Nigeria, South Africa, Tanzania, Zambia and Zimbabwe, the band 470-694~~8~~ MHz ~~are~~ is also allocated on a secondary basis to the land mobile service, intended for applications ancillary to broadcasting and programme-making. Stations of the land mobile service in the countries listed in this footnote shall not cause harmful interference to existing or planned stations operating in accordance with the Table in countries other than those listed in this footnote. (WRC-1~~2~~5)

Note for Secretariat: The countries names should be rearranged alphabetically at WRC-15.

*Note: Depending on the outcome of WRC-15, i.e., if this Method D2 is adopted by WRC-15, only one of the options below (modification of Resolution **232** or addition of two considerings in a new WRC-15 Resolution) should to be retained.*

MOD

RESOLUTION 232 (REV.WRC-1~~2~~5)

Use of the frequency band 694-790 MHz by the mobile, except aeronautical mobile, service in Region 1 ~~and related studies~~

The World Radiocommunication Conference (Geneva, 201~~2~~5),

…

considering

aaa) that in Region 1, a number of countries have deployments of applications ancillary to broadcasting and programme-making operating on a secondary basis, which provide tools for the daily content production for the broadcast service;

bbb) that further harmonization of spectrum for applications ancillary to broadcasting and programme-making in the frequency band 694-790 MHz is subject to ITU-R studies regarding possible solutions for global/regional harmonization of frequency bands and tuning ranges for electronic news gathering (ENG) use in accordance to Resolution ITU-R 59;

or

ADD

DRAFT NEW RESOLUTION [A12-METHOD-D2] (WRC-15)

…

The World Radiocommunication Conference (Geneva, 2015),

…

considering

aaa) that in Region 1, a number of countries have deployments of applications ancillary to broadcasting and programme-making operating on a secondary basis, which provide tools for the daily content production for the broadcast service;

bbb) that further harmonization of spectrum for applications ancillary to broadcasting and programme-making in the frequency band 694-790 MHz is subject to ITU-R studies regarding possible solutions for global/regional harmonization of frequency bands and tuning ranges for electronic new gathering (ENG) use as in accordance to Resolution ITU-R 59;

…

1/1.2/6.4.3 For Method D3

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

(See No. **2.1**)

MOD

5.296 *Additional allocation:–* in Albania, Germany, Saudi Arabia, Austria, Bahrain, Belgium, Benin, Bosnia and Herzegovina, Burkina Faso, Cameroon, Congo (Rep. of the), Côte d'Ivoire, Croatia, Denmark, Djibouti, Egypt, United Arab Emirates, Spain, Estonia, Finland, France, Gabon, Ghana, Iraq, Ireland, Iceland, Israel, Italy, Jordan, Kuwait, Latvia, The Former Yugoslav Republic of Macedonia, Libya, Liechtenstein, Lithuania, Luxembourg, Mali, Malta, Morocco, Moldova, Monaco, Niger, Norway, Oman, the Netherlands, Poland, Portugal, Qatar, the Syrian Arab Republic, Slovakia, the Czech Republic, the United Kingdom, Sudan, Sweden, Switzerland, Swaziland, Chad, Togo, Tunisia ~~and~~ , Turkey, ~~the band 470-790 MHz, and in~~ Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Nigeria, South Africa, Tanzania, Zambia and Zimbabwe, the band 470-694~~8~~ MHz ~~are~~ is also allocated on a secondary basis to the land mobile service, intended for applications ancillary to broadcasting and programme-making. Stations of the land mobile service in the countries listed in this footnote shall not cause harmful interference to existing or planned stations operating in accordance with the Table in countries other than those listed in this footnote. (WRC-1~~2~~5)

Note for Secretariat: The countries names should be rearranged alphabetically at WRC-15.

AGENDA ITEM 1.3

(**WP 5A / WP 5B, WP 5C, WP 5D**, (WP 1B), (WP 4A), (WP 4B), (WP 4C), (WP 6A), (WP 7B), (WP 7C), (WP 7D))

1.3 to review and revise Resolution ***646 (Rev.WRC-12)*** *for broadband public protection and disaster relief (PPDR), in accordance with Resolution* ***648 (WRC-12)****;*

Resolution **648 (WRC-12)**: *Studies to support broadband public protection and disaster relief.*

1/1.3/1 Executive summary

For WRC-15 agenda item 1.3 there are three proposed methods. These methods can be summarized as follows:

- Method A proposes that no change will be made to Resolution **646 (Rev.WRC-12)**, other than editorial amendments to Footnote 1 of Resolution **646 (Rev.WRC-12)** and the text surrounding it, and updated references to ITU-R Reports. The broadband PPDR requirements will be addressed through ITU-R studies.
- Method B proposes that the requirements of broadband PPDR would be addressed in the revision of Resolution **646 (Rev.WRC-12)** in accordance with Resolution **648 (WRC-12)**.
- Method C also proposes revision of Resolution **646 (Rev.WRC-12)** and further proposes that all referenced frequency bands/ranges for PPDR operations from Resolution **646 (Rev.WRC-12)** be removed and be replaced with a cross reference to the latest version of Recommendation ITU-R M.2015, which will contain the recommended regionally harmonized frequency bands/ranges for PPDR operations.

1/1.3/2 Background

Resolution **646 (Rev.WRC-12)** on Public Protection and Disaster Relief (PPDR), encourages administrations, for the purpose of achieving regionally harmonized frequency bands/ranges for advanced public protection and disaster relief solutions, to consider certain identified frequency bands/ranges or parts thereof when undertaking their national planning.

The benefits resulting from the use of regionally or internationally harmonized frequency bands have been well documented in the Resolution and in many studies and reports. These benefits include, among others, achieving economies of scale and expanded equipment availability, possibly increasing competition and improved spectrum management and planning. In emergency and disaster relief situations, the benefits of harmonization also include enhanced cross-border circulation of equipment and increased potential for interoperability of communications when a country receives assistance from other nations.

Since the initial adoption of Resolution **646** in 2003, major technological developments in radiocommunications have taken place. Moreover, the use of PPDR data applications in certain countries has increased – a trend which continues to grow. New broadband mobile technologies, such as 3GPP's Long-Term Evolution (LTE), have emerged, for which today there are already practical applications, and PPDR agencies increasingly recognize the importance of video and broadband to carry out their activities more efficiently. In addition, some countries have designated new frequency bands for broadband PPDR that are currently not identified in Resolution **646 (Rev.WRC-12)**.

It has also been recognized that, during disasters, wireless video systems are rolled out more rapidly than fibre or cable networks. In various parts of the world, governments and PPDR institutions are using high-speed wireless video networks to enhance the safety of officers and increase their effectiveness in saving lives. In this context, new scenarios of applications and demand for public safety communications have emerged. WRC-15, under agenda item 1.3, will review and revise, as appropriate, Resolution **646 (Rev.WRC-12)** for broadband PPDR in accordance with Resolution **648 (WRC-12)**.

1/1.3/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Region 1

ECC Report 199, "User requirements and spectrum needs for future European broadband PPDR systems (Wide Area Networks) May 2013". (http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP199.PDF)

Region 2

Phoenix Center Policy Bulletin No. 26, "Public Safety or Commercial Use? A Cost/Benefit Framework for the D Block" March 2011 (http://www.phoenix-center.org/PolicyBulletin/PCPB26Final.pdf).

Defence Research and Development Canada, "700 MHz Spectrum Requirements for Canadian

Public Safety Interoperable Mobile Broadband Data Communications" February 2011. (http://cradpdf.drdc-rddc.gc.ca/PDFS/unc122/p535072_A1b.pdf)

Region 3

APT Report on "PPDR Applications Using IMT-Based Technologies and Networks" April 2012. (APT/AWG/REP-27)

– This report provides the technical requirements for using IMT based technologies and networks in PPDR applications. The PPDR requirements of IMT-based technologies and networks are reviewed and some methods of adapting for PPDR application using IMT-based technologies and networks are addressed.

APT Report on "Technical Requirements for Mission Critical Broadband PPDR Communications" September 2013. (APT/AWG/REP-38)

– This report provides an outline of the technical requirements of mobile wireless broadband communications systems to meet mission critical broadband PPDR requirements. It presents a high-level framework and broad rationale, along with a fundamental set of recommended operational and functional requirements that might be found useful to regional administrations for a variety of purposes.

TRPC "Public Protection and Disaster Relief (PPDR) Services and Broadband in Asia and the Pacific: A Study of Value and Opportunity Cost in the Assignment of Radio Spectrum" May 2013. (http://trpc.biz/wp-content/uploads/PPDR-_Report_June-2013_FINAL.pdf)

List of Relevant ITU-R Recommendations and Reports

Reports ITU-R M.2033[17], M.[PPDR] and ITU-R M.2291

Recommendations ITU-R M.1826, M.2009 and M.2015

1/1.3/4 Analysis of the results of studies

The documents in section 1/1.3/3, in particular ECC Report 199, APT/AWG/Report 38 Appendix 4 and Report ITU-R M.[PPDR], summarize the studies carried out on PPDR broadband spectrum requirments. These studies, providing examples from China, Israel, CEPT, UAE, and Motorola Solutions indicate a strong need for harmonized spectrum. Broadband PPDR spectrum bandwidth requirements vary to a significant extent between countries, regardless of whether the PPDR network is owned/operated by a government PPDR agency, commercial entity or a hybrid commercial/government solution. These studies indicate a need for a spectrum bandwidth of 20 MHz (e.g.10+10 MHz) or more in some countries for broadband PPDR. Some other administrations may have differing bandwidth requirements.

Region 1

In accordance with their studies, CEPT is expecting that in some countries narrowband PPDR technology will continue to play an important role in the medium term (i.e. at least in the next 10-15 years), even when future broadband technologies may be capable of meeting mission critical voice requirements.

Region 3

APT Report 27 concludes that the mobile broadband PPDR systems based on IMT have a critical role to play in effectively and efficiently satisfying local, national, and international public safety objectives. PPDR organizations need to be able to communicate among themselves as well as with the community at large, many times across jurisdictional boundaries, in order to meet modern day challenges. There are several different approaches that PPDR organizations could take in relation to using IMT technologies for their broadband wireless needs, ranging from dedicated PPDR networks to operating as virtual private networks (VPNs), on a preferential basis, on commercial IMT networks. Regardless of the approach chosen, the availability of funds to deploy such infrastructure needs to be addressed as they may involve varying levels of expenditure. The effectiveness of such expenditure in providing PPDR organizations a broadband mobile capability through the use of IMT technologies will however be undermined if the pursuit of regional harmonization of spectrum bands for PPDR applications and the relevant technology standards are not continued.

APT Report 38 encourages administrations to adopt common technology, technical features and functional capabilities, as well as harmonized spectrum arrangements as far as practicable, to maximize the potential for regional cooperation and cross-border inter-working. Further, pursuit of such harmonization is expected to lead to greater market size to the benefit of manufacturers/vendors, government agencies, and PPDR management and operational staff.

[17] Depending on the results of Report ITU-R M.[PPDR], Report ITU-R M.2033 will be suppressed and would no longer be referenced in this section.

1/1.3/5 Methods to satisfy the agenda item

1/1.3/5.1 Method A: Editorial updating to Resolution 646 (Rev.WRC-12)

Under this method, no change will be made to Resolution **646 (Rev.WRC-12)**, other than editorial amendments to Footnote 1 of Resolution **646 (Rev.WRC-12)** and the text surrounding it, and updated references to ITU-R Reports. The broadband PPDR requirements will be addressed through ITU-R studies appropriately, as indicated in Section 1/1.3/6.1.

Advantages

– This method fulfils the objectives of review and revision of Resolution **646 (Rev.WRC-12**), as stated in Resolution **648 (WRC-12)**.

– This method provides sufficient flexibility to administrations by addressing broadband PPDR requirements through ITU-R studies.

– This method maintains the approach agreed in the *resolves* part of Resolution **646 (Rev.WRC-12)** in which the requisite frequency bands/ranges are harmonized to the extent possible on the international/regional level for public protection and disaster relief applications.

Disadvantages

– This method will not fulfil the objective of Resolution **648 (WRC-12)**, which recognized that it is timely “to consider the future direction of spectrum needs of public safety and disaster management agencies” and called on WRC-15 to “take appropriate action with regard to revision of Resolution **646 (Rev.WRC-12)**”.

– There will be no guidance to administrations and manufacturers to encourage regional/ international harmonization of frequency ranges for wide area mobile broadband PPDR.

– Additional regionally harmonized frequency ranges/bands for broadband PPDR will not be included for Region 1 and Region 3 in *resolves* 2 of Resolution **646 (Rev.WRC-12)**. In addition, *invites ITU-R* 2 of Resolution **646 (Rev.WRC-12)** specifically calls on ITU-R “to conduct further appropriate technical studies in support of possible additional identification of other frequency ranges to meet the particular needs of certain countries in Region 1”. Such identification will not be done unless Resolution **646 (Rev.WRC-12)** is suitably modified as called for in Resolution **648 (WRC-12)**. In particular in Region 3, the band 746-806 MHz is included for some countries but this part of the APT 700 MHz band (698-806) is not part of the harmonized frequency range.

1/1.3/5.2 Method B: Modify Resolution 646 (Rev.WRC-12)

Under this method, requirements of broadband PPDR would be addressed in the revision of Resolution **646 (Rev.WRC-12),** as indicated in Section 1/1.3/6.2.

Considering the growing use of mobile broadband communications, including mobile video applications, additional spectrum for PPDR mobile broadband is needed, so that administrations may assign RF spectrum for broadband PPDR. Spectrum below 1 GHz is suitable for such applications, despite the current broadcasting primary status throughout Region 1. Moreover, spectrum may also be needed for broadband PPDR at frequencies above 1 GHz bands, in order to combine RF spectrum with good coverage and penetration characteristics (below 1 GHz), together with RF spectrum (above 1 GHz) that adds capacity. Common RF spectrum will enable efficient deployment and will ease coordination and harmonization between different PPDR agencies and will advance international aid during disasters and major events. In addition to the benefits of scale production, regional harmonization will improve interoperability among first responders and will drive suitable devices and standards dedicated to broadband PPDR.

Advantages

– This method satisfies agenda item 1.3 and the *resolves* part of Resolution **648 (WRC-12)** to review and revise Resolution **646 (Rev.WRC-12)** for broadband public protection and disaster relief (PPDR). The method can also fulfil *invites ITU-R* 2 of Resolution **646 (Rev.WRC-12)** that specifically calls on ITU-R "to conduct further appropriate technical studies in support of possible additional identification of other frequency ranges to meet the particular needs of certain countries in Region 1". Such identification can be done under this method by suitable modification of Resolution **646 (Rev.WRC-12)** as called for in Resolution **648 (WRC-12)**.

– This method can facilitate regional harmonization of frequency bands/ranges for broadband PPDR by identifying frequency bands/ranges that are suitable for the deployment of mobile broadband PPDR systems. As indicated in section 1/1.3/4, various studies in section 1/1.3/3, in particular ECC Report 199, APT/AWG/Report 38 and Report ITU-R M.[PPDR] indicate a strong need for harmonized spectrum to meet the needs of PPDR agencies.

– This method facilitates, through harmonized frequency bands/ ranges, the development of economies of scale for broadband PPDR equipment; and this will address the needs of developing countries for cost-effective PPDR equipment. Studies indicate that adoption of common technology, technical features and functional capabilities, as well as harmonized spectrum arrangements, can maximize the potential for regional cooperation and cross-border inter-working and lead to greater market scale to the benefit of PPDR agencies and increase the safety and security of the public.

Disadvantages

– Changes to the preferred frequency ranges may complicate the harmonization of broadband PPDR systems creating the potential for harmful interference situations to and from PPDR operations worldwide through global circulation of equipment.

– Resolution **646 (Rev.WRC-12)** already reflects the requisite preferred harmonized frequency bands/ranges for broadband PPDR applications requirements. Additional broadband PPDR requirements may be accomplished through ITU-R studies.

– Countries of Region1 planning to introduce PPDR mobile broadband services in the low end of the 700 MHz range may have to bilaterally coordinate with neighbouring countries still transmitting high power terrestrial broadcasting on Channel 48. Some countries in Region 2 have already planned and deployed broadband PPDR networks based on frequency ranges currently shown in Resolution **646 (Rev.WRC-12)**.

– Changes to these established frequency ranges may complicate the harmonization of broadband PPDR systems between administrations in cross-border regions as well as introduce issues of interoperability.

1/1.3/5.3 Method C: Modify Resolution 646 (Rev.WRC-12), excluding PPDR frequencies through non-mandatory reference to Recommendation ITU-R M.2015

Under this method, requirements of broadband PPDR would be addressed in the revision of Resolution **646 (Rev.WRC-12)** appropriately, as indicated in Section 1/1.3/6.2.

Studies carried out by ITU-R in accordance with Resolution **648 (WRC-12)** led to the development of a new ITU-R Report. This Report ITU-R M.[PPDR] addresses relevant information on PPDR;

either narrow, wide or broadband. It also contains information on the evolution of applications supported through the provision of broadband PPDR and may be subject to further revision.

Technical requirements from Report ITU-R M.[PPDR] supporting harmonization will be reflected in the revision of Resolution **646 (Rev.WRC-12)** through a non-mandatory reference to Recommendation ITU-R M.2015.

In this method all referenced frequency bands/ranges for PPDR operations from Resolution **646 (Rev.WRC-12)** will be removed and be replaced with a cross reference to the latest version of Recommendation ITU-R M.2015 which will contain the recommended regionally harmonized frequency bands/ranges for PPDR operations.

Advantages

– Satisfies the *invites ITU-R* parts of Resolutions **646 (Rev.WRC-12)** and **648 (WRC-12)** and also covers the *resolves* of Resolution **648 (WRC-12)** to review and revise Resolution **646 (Rev.WRC-12)** for broadband PPDR.

– Provides flexibility for each administration to choose related bands for their PPDR operations by keeping harmonization of common technology, technical features and functional capabilities, as well as harmonized spectrum arrangements.

– Streamlines the information needed for the future consideration of regulatory and technical details towards PPDR operation by placing relevant information in appropriate ITU-R deliverables.

Disadvantages

– Removal of the listed spectrum ranges from *resolves* 2 of Resolution **646 (Rev.WRC-12)** would raise the potential for more frequent changes in identified spectrum ranges, leading to uncertainty for PPDR equipment manufacturers, PPDR system operators and incumbent spectrum users across multiple spectrum bands. This method will remove the stability of the bands/ranges identified for PPDR as revisions to ITU-R Recommendations can be made anytime. This will discourage investment in the development of PPDR equipment for meeting the needs of PPDR agencies. This method is un-implementable as ITU-R working parties, on their own and without guidance from the Radio Regulations, cannot decide which band to develop frequency arrangements for broadband PPDR. This will therefore defeat the whole purpose of Resolution **646 (Rev.WRC-12)**.

– Resolution **648 (WRC-12)** only calls for revision of Resolution **646 (Rev.WRC-12)** to meet the needs of broadband PPDR. There is no provision in this agenda item for changing the bands/ranges for narrowband/wideband already identified in Resolution **646 (Rev.WRC-12)**. Any change to the bands/ranges contained in *resolves* 2 of Resolution **646 (Rev.WRC-12)** for PPDR applications other than broadband is outside the scope of agenda item 1.3 (WRC-15).

– This method removes the guidance to ITU-R working parties as to which frequency bands/ranges should be used to develop frequency arrangements for PPDR. It will result in the introduction of non-harmonized bands/ranges for PPDR and defeat the purpose of Resolution **646 (Rev.WRC-12)**. It isolates into a single study group important decisions on spectrum usage that would affect spectrum bands and users across multiple radiocommunication services. It could lead to identification of additional preferred frequency ranges without appropriate technical studies, creating the potential for harmful interference situations to and from PPDR operations worldwide through global circulation of equipment.

1/1.3/6 Regulatory and procedural considerations

1/1.3/6.1 For Method A: Editorial updating to Resolution 646 (Rev.WRC-12)

MOD

RESOLUTION 646 (REV.WRC-~~12~~15)

Public protection and disaster relief

The World Radiocommunication Conference (Geneva, ~~2012~~2015),

considering

…

g) that new technologies for wideband and broadband public protection and disaster relief applications are being developed in various standards organizations~~[1]~~;

…

m) that the Tampere Convention on the Provision of Telecommunications Resources for Disaster Mitigation and Relief Operations (Tampere, 1998), an international treaty deposited with the United Nations Secretary-General and related United Nations General Assembly Resolutions and Reports are also relevant in this regard[1],

…

recognizing

g) that currently some bands or parts thereof have been designated for existing public protection and disaster relief operations~~, as documented in Report ITU-R M.2033~~;[3]

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[1] ~~For example, a joint standardization programme between the European Telecommunications Standards Institute (ETSI) and the Telecommunications Industry Association (TIA), known as Project MESA (Mobility for Emergency and Safety Applications) has commenced for broadband public protection and disaster relief. Also, the Working Group on Emergency Telecommunications (WGET), convened by the United Nations Office for Humanitarian Affairs (OCHA), is an open forum to facilitate the use of telecommunications in the service of humanitarian assistance comprising United Nations entities, major non-governmental organizations, the International Committee of the Red Cross (ICRC), ITU and experts from the private sector and academia. Another~~A platform for coordination and to foster harmonized global Telecommunication for Disaster Relief (TDR) standards is the TDR Partnership Coordination Panel, which has ~~just~~ been established under the coordination of ITU with participation of international telecommunication service providers, related government departments, standards development organizations, and disaster relief organizations.

[3] 3-30, 68-88, 138-144, 148-174, 380-400 MHz (including CEPT designation of 380-385/390-395 MHz), 400-430, 440-470, 764-776, 794-806 and 806-869 MHz (including CITEL designation of 821-824/866-869 MHz).

…

noting

c) that public protection and disaster relief agencies and organizations have ~~an initial~~a set of requirements, including but not limited to interoperability, secure and reliable communications, sufficient capacity to respond to emergencies, priority access in the use of non-dedicated systems, fast response times, ability to handle multiple group calls and the ability to cover large areas as described in Report ITU-R M.~~2033~~[PPDR];

1/1.3/6.2 For Method B: Modify Resolution 646 (Rev.WRC-12)

MOD

RESOLUTION 646 (REV.WRC-~~12~~15)

Public protection and disaster relief

The World Radiocommunication Conference (Geneva, ~~2012~~2015),

considering

a) that the term "public protection radiocommunication" refers to radiocommunications used by responsible agencies and organizations dealing with maintenance of law and order, protection of life and property and emergency situations;

b) that the term "disaster relief radiocommunication" refers to radiocommunications used by agencies and organizations dealing with a serious disruption of the functioning of society, posing a significant widespread threat to human life, health, property or the environment, whether caused by accident, natural phenomena or human activity~~, and whether developing suddenly or as a result of complex, long-term processes~~;

c) the growing telecommunication and radiocommunication needs of public protection agencies and organizations, including those dealing with emergency situations and disaster relief, that are vital to the maintenance of law and order, protection of life and property, disaster relief and emergency response;

d) that many administrations wish to promote interoperability and interworking between systems used for public protection and disaster relief (PPDR), both nationally and for cross-border operations in emergency situations and for disaster relief;

e) that ~~current~~ legacy public protection and disaster relief ~~applications~~ systems are mostly narrow-band supporting voice and low data-rate applications or wideband with data rates below 1 Mbit/s, typically ~~in~~ for systems with a channel bandwidth~~s~~ between ~~of~~ 25 to 100 kHz or less;

f) that, although ~~there will continue to be~~ narrow-band and wideband systems continue to be used for meeting PPDR requirements, many PPDR agencies have stated a need for ~~future applications will be wideband (indicative data rates in the order of 384-500 kbit/s) and/or~~ broadband applications ~~(indicative~~ with data rates in the order of 1-100 Mbit/s~~)~~ for systems requiring ~~with~~ larger channel bandwidths of 5 MHz and above ~~dependent on the use of spectrally efficient technologies~~based on International Mobile Telecommunications (IMT) technologies;

g) ~~that new technologies for wideband and broadband public protection and disaster relief applications are being developed in various standards organizations[1];~~that some administrations have started using IMT technologies such as LTE and LTE-Advanced to meet the needs of their PPDR agencies for data and multimedia capabilities; and considering that Report ITU-R M.2291 provides details of the capabilities of IMT technologies for meeting broadband PPDR requirements;

h) that continuing development of new technologies and systems, such as International Mobile Telecommunications (IMT) and Intelligent Transportation Systems (ITS), may be able to support or supplement advanced public protection and disaster relief applications;

i) that disasters and emergency events require response not only from PPDR agencies but also from humanitarian agencies;

~~i~~j) that some commercial terrestrial and satellite systems are complementing the dedicated systems in support of public protection and disaster relief~~, that the use of commercial solutions will be in response to technology development and market demands and that this may affect the spectrum required for those applications and for commercial networks~~;

~~j~~k) that Resolution 36 (Rev. Guadalajara, 2010) of the Plenipotentiary Conference urges Member States to the Tampere Convention to take all practical steps for the application of the Tampere Convention and to work closely with the operational coordinator as provided for therein;

~~k~~l) that Recommendation ITU-R M.1637 offers guidance to facilitate the global circulation of radiocommunication equipment in emergency and disaster relief situations;

~~l~~m) that some administrations may have different operational needs and spectrum requirements for public protection and disaster relief applications depending on the circumstances;

n) that some administrations are of the view that additional spectrum needs to be identified to meet the growing needs of mobile broadband PPDR, including mobile multimedia applications;

o) that some administrations are of the view that common RF spectrum will enable efficient deployment and will ease coordination and harmonization between different PPDR agencies and will advance international aid during disasters and major events; and considering that, in addition to the benefits of scale production, regional harmonization will improve interoperability among first responders and will drive suitable devices and standards dedicated to broadband PPDR;

~~m~~p) that the Tampere Convention on the Provision of Telecommunications Resources for Disaster Mitigation and Relief Operations (Tampere, 1998), an international treaty deposited with

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~~[1] For example, a joint standardization programme between the European Telecommunications Standards Institute (ETSI) and the Telecommunications Industry Association (TIA), known as Project MESA (Mobility for Emergency and Safety Applications) has commenced for broadband public protection and disaster relief. Also, the Working Group on Emergency Telecommunications (WGET), convened by the United Nations Office for Humanitarian Affairs (OCHA), is an open forum to facilitate the use of telecommunications in the service of humanitarian assistance comprising United Nations entities, major non-governmental organizations, the International Committee of the Red Cross (ICRC), ITU and experts from the private sector and academia. Another platform for coordination and to foster harmonized global Telecommunication for Disaster Relief (TDR) standards is the TDR Partnership Coordination Panel, which has just been established under the coordination of ITU with participation of international telecommunication service providers, related government departments, standards development organizations, and disaster relief organizations.~~

the United Nations Secretary-General and related United Nations General Assembly Resolutions and Reports are also relevant in this regard[1],

recognizing

a) the benefits of spectrum harmonization such as:

– increased potential for interoperability;

– a broader manufacturing base and increased volume of equipment resulting in economies of scale and expanded equipment availability;

– improved spectrum management and planning; and

– enhanced cross-border coordination and circulation of equipment;

b) that the organizational distinction between public protection activities and disaster relief activities are matters for administrations to determine at the national level;

c) that national spectrum planning for public protection and disaster relief needs to have regard to cooperation and bilateral consultation with other concerned administrations, which should be facilitated by greater levels of spectrum harmonization;

d) the benefits of cooperation between countries for the provision of effective and appropriate humanitarian assistance in case of disasters, particularly in view of the special operational requirements of such activities involving multinational response;

e) the needs of countries, particularly the developing countries[2], for low-cost communication equipment;

f) that the trend is to increase the use of technologies based on Internet Protocols;that the adoption of IMT should be encouraged for broadband PPDR because of the spectral and other operating efficiencies that these technologies offer;

g) that currently some bands or parts thereof have been designated for existing public protection and disaster relief operations, as documented in Report ITU-R M.2033[3];

h) that for solving future bandwidth requirements, there are several emerging technology developments such as software-defined radio, advanced compression and networking techniques that may reduce the amount of new spectrum required to support some public protection and disaster relief applications;

ih) that in times of disasters, if most terrestrial-based networks are destroyed or impaired, amateur, satellite and other non-ground-based networks may be available to provide communication services to assist in public protection and disaster relief efforts;

[1] The Working Group on Emergency Telecommunications (WGET), convened by the United Nations Office for Humanitarian Affairs (OCHA), is an open forum to facilitate the use of telecommunications in the service of humanitarian assistance comprising United Nations entities, major non-governmental organizations, the International Committee of the Red Cross (ICRC), ITU and experts from the private sector and Academia.

[2] Taking into account, for example, the ITU-D Handbook on disaster relief.

[3] 3-30, 68-88, 138-144, 148-174, 380-400 MHz (including CEPT designation of 380-385/390-395 MHz), 400-430, 440-470, 764-776, 794-806 and 806-869 MHz (including CITEL designation of 821-824/866-869 MHz), 791-801/832-842 MHz (Qatar) and 806-824/851-869 MHz (Israel).

~~j~~i) that the amount of spectrum needed for public protection on a daily basis can differ significantly between countries, that certain amounts of spectrum are already in use in various countries for narrow-band applications, and that in response to a disaster, access to additional spectrum on a temporary basis may be required;

j) that some administrations are of the view that studies carried out by various user agencies in different countries indicate broadband PPDR spectrum bandwidth requirements vary to a significant extent between countries, regardless of whether the PPDR network is owned/operated by a government PPDR agency, commercial entity or a hybrid commercial/government solution, and considering that these studies indicate a need for a spectrum bandwidth of 20 MHz (e.g. 10 + 10 MHz) or more in some countries for broadband PPDR; and considering that some other administrations may have differing bandwidth requirements;

k) that certain amounts of spectrum are already in use in various countries for narrow-band applications, and that in response to a disaster, access to additional spectrum on a temporary basis may be required for narrow-band PPDR operations;

~~k~~l) that in order to achieve spectrum harmonization, an approach~~solution~~ based on regional frequency ranges[4] may enable administrations to benefit from harmonization while continuing to meet national planning requirements;

~~l~~m) that not all frequencies within an identified common frequency range will be available within each country;

~~m~~n) that the identification of a common frequency range within which equipment could operate may ease the interoperability and/or inter-working, with mutual cooperation and consultation, especially in national, regional and cross-border emergency situations and disaster relief activities;

~~n~~o) that when a disaster occurs, the public protection and disaster relief agencies are usually the first on the scene using their day-to-day communication systems, but that in most cases other agencies and organizations may also be involved in disaster relief operations;~~,~~

p) that some countries in Region 1 have identified certain parts of the frequency range 694 to 790 MHz for broadband PPDR deployments,

noting

a) that many administrations currently use frequency bands below 1 GHz for narrow-band public protection and disaster relief applications;

b) that applications requiring large coverage areas and providing good signal availability would generally be accommodated in lower frequency bands and that applications requiring wider bandwidths would generally be accommodated in progressively higher bands;

c) that, in lower frequency bands, e.g. below 300 MHz, it would be efficient to use the bands which are available by transition of terrestrial television broadcasting from analogue to digital;

~~c~~d) that public protection and disaster relief agencies and organizations have a~~n~~ ~~initial~~ set of requirements, including but not limited to interoperability, secure and reliable communications, sufficient capacity to respond to emergencies, priority access in the use of non-dedicated systems,

[4] In the context of this Resolution, the term "frequency range" means a range of frequencies over which a radio equipment is envisaged to be capable of operating but limited to specific frequency band(s) according to national conditions and requirements.

fast response times, ability to handle multiple group calls and the ability to cover large areas as described in Report ITU-R M.2033[*], Report ITU-R M.2291 and Report ITU-R M.[PPDR];

~~*d)* that, while harmonization may be one method of realizing the, in some countries, the use of multiple frequency bands can contribute to meeting the communication needs in disaster situations;~~

e) that many administrations have made significant investments in public protection and disaster relief systems;

f) that flexibility must be afforded to disaster relief agencies and organizations to use current and future radiocommunications, so as to facilitate their humanitarian operations~~,~~;

g) that broadband PPDR services can be realized and deployed in the frequency bands identified for IMT,

emphasizing

a) that the frequency bands identified in this Resolution are allocated to a variety of services in accordance with the relevant provisions of the Radio Regulations and are currently used intensively by the fixed, mobile, mobile satellite and broadcasting services;

b) that some administrations are of the view that only some of the frequency bands identified in this Resolution are suitable for broadband PPDR;

~~b~~c) that flexibility must be afforded to administrations:

– to determine, at national level, how much spectrum to make available for public protection and disaster relief from the bands identified in this Resolution in order to meet their particular national requirements;

– to have the ability for bands identified in this Resolution to be used by all services having allocations within those bands according to the provisions of the Radio Regulations, taking into account the existing applications and their evolution;

– to determine the need and timing of availability as well as the conditions of usage of the bands identified in this Resolution for public protection and disaster relief in order to meet specific national situations,

resolves

1 to strongly recommend administrations to use regionally harmonized bands for public protection and disaster relief to the maximum extent possible, taking into account the national and regional requirements and also having regard to any needed consultation and cooperation with other concerned countries;

Option 1

2 to encourage administrations, for the purposes of achieving regionally harmonized frequency bands/ranges for advanced public protection and disaster relief solutions, to consider the following identified frequency bands/ranges or parts thereof when undertaking their national planning:

– in Region 1: 380-470 MHz as the frequency range within which the band 380-385/390-395 MHz is a preferred core harmonized band for permanent public protection activities within certain countries of Region 1 which have given their agreement;

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[*] Note: Depending on the results of Report ITU-R M.[PPDR], Report ITU-R M.2033 will be suppressed and would no longer be referenced in this noting.

The frequency range 694-790 MHz is a preferred harmonized range for broadband public protection and disaster relief solutions in some countries in Region 1;

– in Region 2[5]: 746-806 MHz, 806-869 MHz, 4 940-4 990 MHz;

in Region 3[6]: 406.1-430 MHz, 440-470 MHz, 806-824/851-869 MHz, 4 940-4 990 MHz and 5 850-5 925 MHz;

Note: Some administrations are of the view that administration-specific frequency bands/ranges for public protection and disaster relief (PPDR) solutions should not be included in the "*resolves* 2" of Resolution **646 (Rev.WRC-12)** since the frequency bands/ranges in Resolution **646 (Rev.WRC-12)** were identified for the purpose of achieving "regionally harmonized" frequency bands/ranges for PPDR. Instead, these should be moved to "*recognizing g)*" footnote 3.

Option 2

2 to encourage administrations, for the purposes of achieving regionally harmonized frequency bands/ranges for advanced public protection and disaster relief solutions, to consider the following identified frequency bands/ranges or parts thereof when undertaking their national planning:

– 2.1 in Region 1:

i) 380-470 MHz as the frequency range within which the band 380-385/390-395 MHz is a preferred core harmonized band for permanent public protection activities within certain countries of Region 1 which have given their agreement;

ii) the band 698-713 MHz/753-768 MHz within the frequency range 694-790 MHz and the band 791-801/832-842 MHz within the frequency range 790-862 MHz are the preferred bands for broadband PPDR within certain countries of Region 1 which have given their agreement;

– 2.2 in Region 2[5]:

i) 746-806 MHz, 806-869 MHz, 4 940-4 990 MHz;

– 2.3 in Region 3[6]:

i) 406.1-430 MHz, 440-470 MHz, 806-824/851-869 MHz, 4 940-4 990 MHz and 5 850-5 925 MHz;

3 that the identification of the above frequency bands/ranges for public protection and disaster relief does not preclude the use of these bands/frequencies by any application within the services to which these bands/frequencies are allocated and does not preclude the use of nor establish priority over any other frequencies for public protection and disaster relief in accordance with the Radio Regulations;

4 to encourage administrations, in emergency and disaster relief situations, to satisfy temporary needs for frequencies in addition to what may be normally provided for in agreements with the concerned administrations;

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[5] Venezuela has identified the band 380-400 MHz for public protection and disaster relief applications.

[6] Some countries in Region 3 have also identified the bands 174-205 MHz, 380-400 MHz and 698~~746~~-806 MHz for public protection and disaster relief applications. Some administrations have concerns with changing the 746-806 MHz band to 698-806 MHz.

5 that administrations encourage public protection and disaster relief agencies and organizations to utilize both existing and new technologies, systems and solutions (satellite and terrestrial), to the extent practicable, to satisfy interoperability requirements and to further the goals of public protection and disaster relief;

6 that administrations may encourage agencies and organizations to use advanced wireless broadband PPDR radiocommunication solutionssystems/applications taking into account *considering h)* and *ij)* for providing complementary support to public protection and disaster relief;

7 to encourage administrations to facilitate cross-border circulation of radiocommunication equipment intended for use in emergency and disaster relief situations through mutual cooperation and consultation without hindering national legislation;

8 that administrations encourage public protection and disaster relief agencies and organizations to utilize relevant ITU-R Recommendations in planning spectrum use and implementing technology and systems supporting public protection and disaster relief;

9 to encourage administrations to continue to work closely with their public protection and disaster relief community to further refine the operational requirements for public protection and disaster relief activities;

10 that manufacturers should be encouraged to take this Resolution into account in future equipment designs, including the need for administrations to operate within different parts of the identified bands,

invites ITU-R

1 to continue its technical studies and to make recommendations concerning technical and operational implementation, as necessary, for advanced solutions to meet the needs of public protection and disaster relief radiocommunication applications, taking into account the capabilities, evolution and any resulting transition requirements of the existing systems, particularly those of many developing countries, for national and international operations;.

2 to conduct further appropriate technical studies in support of possible additional identification of other frequency ranges to meet the particular needs of certain countries in Region 1 which have given their agreement, especially in order to meet the radiocommunication needs of public protection and disaster relief agencies.

1/1.3/6.3 Method C: Modify Resolution 646 (Rev.WRC-12), excluding PPDR frequencies through non-mandatory reference to Recommendation ITU-R M.2015

RESOLUTION 646 (REV.WRC-1215)

Public protection and disaster relief

The World Radiocommunication Conference (Geneva, 20122015),

considering

a) that Report ITU-R M.[PPDR] provides comprehensive details of systems and applications supporting public protection and disaster relief (PPDR) operations in narrow, wide and broadband use, including but not limited to:

– requirements and demands;

– spectrum needs;

– terms and definitions;

– promotion of interoperability and interworking;

– evolution thereof, especially on broadband solutions;

– needs of developing countries;

b) that Report ITU-R M.2291 provides details of the capabilities of International Mobile Telecommunications (IMT) technologies to meet requirements of systems and applications supporting broadband PPDR operations;

a)c) that the term "public protection radiocommunication" refers to radiocommunications used by responsible agencies and organizations dealing with maintenance of law and order, protection of life and property and emergency situations;

bd) that the term "disaster relief radiocommunication" refers to radiocommunications used by agencies and organizations dealing with a serious disruption of the functioning of society, posing a significant widespread threat to human life, health, property or the environment, whether caused by accident, natural phenomena or human activity, and whether developing suddenly or as a result of complex, long-term processes;

ce) the growing telecommunication and radiocommunication needs of public protection agencies and organizations, including those dealing with emergency situations and disaster relief, that are vital to the maintenance of law and order, protection of life and property, disaster relief and emergency response;

d) that many administrations wish to promote interoperability and interworking between systems used for public protection and disaster relief, both nationally and for cross-border operations in emergency situations and for disaster relief;

ef) that current public protection and disaster relief applications systems are mostly narrow-band supporting voice and low data-rate applications, typically in channel bandwidths of 25 kHz or less;

f) that, although there will continue to be narrow-band requirements, many future applications will be wideband (indicative data rates in the order of 384-500 kbit/s) and/or broadband (indicative data rates in the order of 1-100 Mbit/s) with channel bandwidths dependent on the use of spectrally efficient technologies;

g) that new technologies for wideband and broadband public protection and disaster relief applications are being developed in various standards organizations, e.g. IMT technologies supporting higher data rates and higher capacity in comparison to traditional PPDR networks[1];

h) that continuing development of new technologies such as International Mobile Telecommunications (IMT) and Intelligent Transportation Systems (ITS) may be able to further support or supplement advanced public protection and disaster relief applications;

i) that some commercial terrestrial and satellite systems are complementing the dedicated systems in support of public protection and disaster relief, that the use of commercial solutions will be in response to technology development and market demands and that this may affect the spectrum required for those applications and for commercial networks;

j) that Resolution 36 (Rev. Guadalajara, 2010) of the Plenipotentiary Conference urges Member States Parties to the Tampere Convention to take all practical steps for the application of the Tampere Convention and to work closely with the operational coordinator as provided for therein;

k) that Recommendation ITU-R M.1637 offers guidance to facilitate the global circulation of radiocommunication equipment in emergency and disaster relief situations;

l) that some administrations may have different operational needs and spectrum requirements for public protection and disaster relief applications depending on the circumstances;

m) that the Tampere Convention on the Provision of Telecommunications Resources for Disaster Mitigation and Relief Operations (Tampere, 1998), an international treaty deposited with the United Nations Secretary-General and related United Nations General Assembly Resolutions and Reports are also relevant in this regard,

recognizing

a) the benefits of spectrum harmonization such as:

– increased potential for interoperability;

– a broader manufacturing base and increased volume of equipment resulting in economies of scale and expanded equipment availability;

– improved spectrum management and planning; and

– enhanced cross-border coordination and circulation of equipment;

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[1] For example, a joint standardization programme between the European Telecommunications Standards Institute (ETSI) and the Telecommunications Industry Association (TIA), known as Project MESA (Mobility for Emergency and Safety Applications) has commenced for broadband public protection and disaster relief. Also, the Working Group on Emergency Telecommunications (WGET), convened by the United Nations Office for Humanitarian Affairs (OCHA), is an open forum to facilitate the use of telecommunications in the service of humanitarian assistance comprising United Nations entities, major non-governmental organizations, the International Committee of the Red Cross (ICRC), ITU and experts from the private sector and academia. Another platform for coordination and to foster harmonized global Telecommunication for Disaster Relief (TDR) standards is the TDR Partnership Coordination Panel, which was established under the coordination of ITU with participation of international telecommunication service providers, related government departments, standards development organizations, and disaster relief organizations.

b) that the organizational distinction between public protection activities and disaster relief activities are matters for administrations to determine at the national level;

c) that national spectrum planning for public protection and disaster relief needs to have regard to cooperation and bilateral consultation with other concerned administrations, which should be facilitated by greater levels of spectrum harmonization;

d) the benefits of cooperation between countries for the provision of effective and appropriate humanitarian assistance in case of disasters, particularly in view of the special operational requirements of such activities involving multinational response;

e) the needs of countries, particularly the developing countries~~[2]~~, for ~~low-~~cost-efficient communication equipment;

f) that the adoption of IMT technologies for broadband PPDR should be encouraged because of the advantages and efficiencies that the standardization of these technologies offer~~that the trend is to increase the use of technologies based on Internet Protocols~~;

g) that the most recent version of Recommendation ITU-R M.2015 contains regionally harmonized frequency bands for public protection and disaster relief~~that currently some bands or parts thereof have been designated for existing public protection and disaster relief operations, as documented in Report ITU-R M.2033[3]~~;

h) that in order to achieve spectrum harmonization, a solution based on regional frequency ranges[1] may enable administrations to benefit from harmonization while continuing to meet national planning requirements;~~that for solving future bandwidth requirements, there are several emerging technology developments such as software-defined radio, advanced compression and networking techniques that may reduce the amount of new spectrum required to support some public protection and disaster relief applications;~~

i) that in times of disasters, if most terrestrial-based networks are destroyed or impaired, amateur, satellite and other non-ground-based networks may be available to provide communication services to assist in public protection and disaster relief efforts;

j) that the amount of spectrum needed for public protection on a daily basis ~~can~~ differs significantly between countries, that certain amounts of spectrum are already in use in various countries~~ for narrow-band applications~~, and that in response to a disaster, access to additional spectrum on a temporary basis may be required;

~~[2] Taking into account, for example, the ITU-D Handbook on disaster relief.~~

~~[3] 3-30, 68-88, 138-144, 148-174, 380-400 MHz (including CEPT designation of 380-385/390-395 MHz), 400-430, 440-470, 764-776, 794-806 and 806-869 MHz (including CITEL designation of 821-824/866-869 MHz).~~

[1] In the context of this Resolution, the term "frequency range" means a range of frequencies over which a radio equipment is envisaged to be capable of operating but limited to specific frequency band(s) according to national conditions and requirements. When different national PPDR networks use a common technical standard, the frequency range includes the possibility of using any number of bands that the technology can use.

~~*k)* that in order to achieve spectrum harmonization, a solution based on regional frequency ranges[4] may enable administrations to benefit from harmonization while continuing to meet national planning requirements;~~

~~l~~k) that not all frequencies within an identified common frequency range will be available within each country;

~~m~~l) that the identification of a common frequency range within which equipment could operate may ease the interoperability and/or inter-working, with mutual cooperation and consultation, especially in national, regional and cross-border emergency situations and disaster relief activities~~;~~,

~~*n)* that when a disaster occurs, the public protection and disaster relief agencies are usually the first on the scene using their day-to-day communication systems, but that in most cases other agencies and organizations may also be involved in disaster relief operations,~~

noting

a) that many administrations are currently use~~ing~~ing frequency bands below 1 GHz for narrow-band ~~public protection and disaster relief~~ systems and applications supporting PPDR and may decide to use the same range for future PPDR systems;

~~*b)* that applications requiring large coverage areas and providing good signal availability would generally be accommodated in lower frequency bands and that applications requiring wider bandwidths would generally be accommodated in progressively higher bands;~~

~~c~~b) that public protection and disaster relief agencies and organizations have an initial set of requirements, including but not limited to interoperability, secure and reliable communications, sufficient capacity to respond to emergencies, priority access in the use of non-dedicated systems, fast response times, ability to handle multiple group calls and the ability to cover large areas as described in Report ITU-R M.~~2033~~[PPDR];

~~d~~c) that, while harmonization may be one method of realizing the desired benefits, in some countries, the use of multiple frequency bands can contribute to meeting the communication needs in disaster situations;

~~e~~d) that many administrations have made significant investments in public protection and disaster relief systems;

~~f~~e) that flexibility must be afforded to disaster relief agencies and organizations to use current and future radiocommunications, so as to facilitate their humanitarian operations;~~,~~

f) that IMT technologies offer a high degree of flexibility for supporting broadband PPDR applications, and there are a number of different approaches for using IMT technologies to meet the broadband communication needs of PPDR agencies, which are outlined in Report ITU-R M.2291,

emphasizing

a) that the frequency bands identified in ~~this Resolution~~ the most recent version of Recommendation ITU-R M.2015 are allocated to a variety of services in accordance with the relevant provisions of the Radio Regulations and are currently used intensively by ~~the fixed, mobile, mobile satellite and broadcasting~~ several different services;

~~[4] In the context of this Resolution, the term "frequency range" means a range of frequencies over which a radio equipment is envisaged to be capable of operating but limited to specific frequency band(s) according to national conditions and requirements.~~

b) that flexibility must be afforded to administrations to determine:

– to determine, at national level, how much spectrum to make available for public protection and disaster relief from the bands identified in this Resolution in order to meet their particular national requirementsthe amount of spectrum to be used;

– to have the ability for bands identified in this Resolution to be used by all services having allocations within those bands according to the provisions of the Radio Regulations, taking into account the existing applications and their evolution;

– to determine the need and timing of availability as well as the conditions of usage of the bands identified in the most recent version of Recommendation ITU-R M.2015 this Resolution for public protection and disaster reliefPPDR in order to meet specific regional or national situations;

c) that not all of the frequency bands listed in the most recent version of Recommendation ITU-R M.2015 may be suitable for every type of PPDR operation (narrowband, wideband or broadband),

resolves

1 to strongly recommend administrations to use regionally harmonized bands for public protection and disaster relief to the maximum extent possible, taking into account the national and regional requirements and also having regard to any needed consultation and cooperation with other concerned countries;

2 to encourage administrations, for the purposes of achieving regionally harmonized frequency bands/ranges for advanced public protection and disaster relief solutions, to consider the following identified frequency bands/ranges or parts thereof when undertaking their national planning as listed in the most recent version of Recommendation ITU-R M.2015;:

– in Region 1: 380-470 MHz as the frequency range within which the band 380-385/390-395 MHz is a preferred core harmonized band for permanent public protection activities within certain countries of Region 1 which have given their agreement;

– in Region 2[5]: 746-806 MHz, 806-869 MHz, 4 940-4 990 MHz;

– in Region 3[6]: 406.1-430 MHz, 440-470 MHz, 806-824/851-869 MHz, 4 940-4 990 MHz and 5 850-5 925 MHz;

3 that the identification of the above frequency bands/ranges for public protection and disaster relief PPDR, as listed in the most recent version of Recommendation ITU-R M.2015, does not preclude the use of these bands/frequencies by any application within the services to which these bands/frequencies are allocated and does not preclude the use of nor establish priority over any other frequencies for PPDR public protection and disaster relief in accordance with the Radio Regulations;

4 to encourage administrations, in emergency and disaster relief situations, to satisfy temporary needs for frequencies in addition to what may be normally provided for in agreements with the concerned administrations;

[5] Venezuela has identified the band 380-400 MHz for public protection and disaster relief applications.

[6] Some countries in Region 3 have also identified the bands 380-400 MHz and 746-806 MHz for public protection and disaster relief applications.

5 that administrations encourage ~~public protection and disaster relief~~PPDR agencies and organizations to utilize both existing and new technologies/~~ and~~ solutions~~ (satellite and terrestrial)~~, to the extent practicable, to satisfy interoperability requirements and to further the goals of public protection and disaster relief;

~~6 that administrations may encourage agencies and organizations to use advanced wireless solutions taking into account *considering h)* and *i)* for providing complementary support to public protection and disaster relief;~~

~~7~~6 to encourage administrations to facilitate cross-border circulation of radiocommunication equipment intended for use in emergency and disaster relief situations through mutual cooperation and consultation without hindering national legislation;

~~8~~7 that administrations encourage public protection and disaster relief agencies and organizations to utilize relevant ITU-R Recommendations and Reports in planning spectrum use and implementing technology and systems supporting public protection and disaster relief;

~~9~~8 to encourage administrations to continue to work closely with their public protection and disaster relief community to further refine the operational requirements for public protection and disaster relief activities;

~~10~~9 that manufacturers should be encouraged to take this Resolution and related ITU-R Recommendations and Reports into account in future equipment designs, including the need for administrations to operate within different parts of the identified bands in the most recent version of Recommendation ITU-R M.2015,

invites ITU-R

1 to continue its ~~technical~~ studies and to make recommendations concerning technical and operational implementation, as necessary, for advanced solutions to meet the needs of public protection and disaster relief radiocommunication applications, taking into account the capabilities, evolution and any resulting transition requirements of the existing systems, particularly those of many developing countries, for national and international operations;

2 to conduct further appropriate technical studies in support of possible additional identification of other frequency bands/ranges, ~~to meet the particular needs of certain countries in Region 1 which have given their agreement,~~ especially in order to meet the radiocommunication needs of public protection and disaster relief agencies.

AGENDA ITEM 1.4

(**WP 5A / WP 5B, WP 5C,** (WP 3L))

1.4 to consider possible new allocation to the amateur service on a secondary basis within the band 5 250-5 450 kHz in accordance with Resolution ***649 (WRC-12)****;*

Resolution **649 (WRC-12)**: *Possible allocation to the amateur service on a secondary basis at around 5 300 kHz*

1/1.4/1 Executive summary

Two primary methods have been developed as a result of studies.

Method A proposes an allocation to the amateur service (ARS), on a secondary basis, for one or more segments of contiguous spectrum in the range 5 275 kHz to 5 450 kHz. Four sub-methods have been developed:

– Method A1 calling for an allocation to the ARS, on a secondary basis in the frequency band, 5 275-5 450 kHz.

– Method A2 calling for an allocation to the ARS, on a secondary basis in the range 5 350 to 5 450 kHz.

– Method A3 calling for an allocation to the ARS up to [xx] kHz, on a secondary basis, in the range 5 275 kHz to 5 450 kHz.

– Method A4 calling for an allocation to the ARS at several specific channels, on a secondary basis, in the range 5 275 kHz to 5 450 kHz.

Method B is for No Change to the 5 250-5 450 kHz band.

For all of the proposed methods, suppression of Resolution **649 (WRC-12)** would be a consequential change.

1/1.4/2 Background

Based on the recommendation of the 1978 CCIR Special Preparatory Meeting, WARC-79 accepted the principle that, like other high-frequency radio services, the ARS should have access to a family of frequency bands such that communications can be maintained as propagation conditions change. The ARS has access to allocations in the vicinity of 3 500 and 7 000 kHz; however, there are frequent occasions when ionospheric conditions render either or both of these allocations unsatisfactory for communications over the distances which amateur radio operators are frequently requested to cover in the course of facilitating emergency and disaster relief operations. These distances might be relatively short (less than 1000 km) when providing direct support to first responders or relatively longer (greater than 1000 km) when exchanging information, for example, with international organizations.

The frequency range 5 250-5 450 kHz is allocated to fixed and mobile (except aeronautical mobile) services in all three Regions on a primary basis. Radiolocation services are also allocated in the range 5 250 to 5 275 kHz as a secondary service in Regions 1 and 3 and primary in Region 2.

The Master International Frequency Register (MIFR) shows 13314 frequency assignments to the fixed service (FS), 2104 frequency assignments to base stations on land in the mobile service (MS), 251 frequency assignments to transmitting coast stations in the MS and 14 frequency assignments to coast maritime receiving stations in the MS. Assignments in such numbers illustrate that it is often unfeasible to deploy traditional mobile communication networks and satellite communication stations in many sparsely populated, inaccessible and remote areas of the globe including those in the Arctic and Antarctic regions. These links are typically used for different purposes including disaster relief operations. The usage of these assignments is strongly dependent on link distances, time of day, month/season, level of solar activity and real-time propagation conditions. Technologies for automatic evaluation of propagation channels have resulted in new and different operational use of these HF frequencies.

The view of some administrations is that using the MIFR to determine the number of active stations in the band significantly overestimates the spectrum occupancy by incumbent services as listings of stations that become inactive are not routinely deleted.

ARS characteristics in the frequency range 5 250 to 5 450 kHz are similar to land mobile service (LMS) with respect to antenna types, modulation, and transmission bandwidths. This range of spectrum provides propagation at times when the maximum usable frequency (MUF) is below 7 MHz and the lowest usable frequency (LUF) is above 4 MHz permitting reliable communication for radio amateurs at any time of the day.

Currently more than 50 countries e.g. Bahrain, Bangladesh, Canada, the Czech Republic, Cayman Islands, the Dominican Republic, Finland, Ireland, Norway, Sweden, the United Kingdom, the United States allow amateur use of this band, either in the full band or part of the band.

It should be noted that RR No. **1.56** specifies that *amateur service:* is *a radiocommunication service* for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.

1/1.4/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant ITU Recommendations:

ITU-R P.533, ITU-R P.372, ITU-R P.368, ITU-R F.240, ITU-R F.339, ITU-R M.1677, ITU-R M.1732, ITU-R F.1761, ITU-R F.1762, ITU-R F.1821, ITU-R M.1874 and ITU-R SM.1541

Relevant ITU Reports:

ITU-R M.2080, ITU-R M.2234, ITU-R M.[PPDR] and ITU-R M.[5 MHz COMPAT]

1/1.4/3.1 Compatibility with stations in the fixed service

Studies conducted by several administrations have led to different conclusions about the impact of the proposed secondary allocation to the ARS upon the existing primary users.

One administration analysed the potential interference to a fixed-link operating over a 1 500 km path from an amateur link of a similar path length and determined that – notwithstanding the assumed amateur secondary status and practice of listen-before-transmit – operation of the amateur link on the same frequency as the fixed link was using was generally not practical. After taking account of the few remaining occasions when the amateur link might nonetheless operate co-channel with the fixed link, the incidence of potential interference should be infrequent and generally would not preclude continued operation of the fixed link and should be resolvable on a case-by-case basis.

However, a study conducted by another administration concluded that harmful interference caused by amateur transmissions could result in unacceptable interference which could lead to loss of FS link functionality and in degradation of wanted signal reception conditions unless separation distances of, e.g., 2 000 km for single-hop links and 6 500 km for double-hop links, were observed.

1/1.4/3.2 Compatibility with stations in the mobile service

The characteristics of stations in the MS are similar to the characteristics of stations in the FS, but the use of omnidirectional whip antennas on mobile units in the MS has two results:

1) otherwise identical circuits being less reliable in the MS than the FS; and

2) equal sensitivity of mobile units to both wanted and potentially interfering signals in all directions.

Studies on these two points are not complete.

Adjacent band analysis with stations in the aeronautical mobile service (AMS) above 5 450 kHz indicates compatibility with potential ARS stations in the 5 250-5 450 kHz frequency range.

1/1.4/4 Analysis of the results of studies

Views of the feasibility of sharing between incumbent services and the ARS in the band 5 275 to 5 450 kHz vary.

Some administrations are of the view that compatibility of amateur stations with the FS and MS systems is extremely difficult and may require operational constraints on the amateur stations.

Other administrations are of the view that compatibility is feasible. One of these administrations cites that there have been few cases of interference to incumbent services by amateur stations operating in the 5 MHz range under domestic authorizations consistent with No. **4.4** of the Radio Regulations. Interaction with the incumbent services, should it occur, generally does not preclude their continued operation and such instances are normally resolvable on a case-by-case basis.

Other of these administrations report that they are unaware of any such cases of interference by amateur stations operating under similar domestic authorizations.

In the case of the frequency range 5 250 to 5 275 kHz, allocated to radiolocation service (RLS) for oceanographic applications, previous ITU-R studies have found sharing "seems to be difficult ..."[18]. For these reasons a secondary allocation to the ARS within the frequency band 5 250-5 275 kHz authorized at WRC-12 should not be considered.

If necessary, to ensure compatibility of amateur stations with the FS and the MS, operational constraints on the amateur stations additional to those already incumbent on a secondary user might be required.

1/1.4/5 Methods to satisfy the agenda item

1/1.4/5.1 Method A

An allocation to the ARS, on a secondary basis, for one or more blocks of spectrum (not necessarily contiguous) in the range 5 275 kHz to 5 450 kHz.

Advantages

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[18] § 2/1.15/3 of the Report of the Conference Preparatory Meeting to the World Radiocommunication Conference 2012.

– The requirement of the ARS for access to frequencies in the vicinity of 5 300 kHz would be met.
– The secondary status imposes an obligation on amateur stations to avoid harmful interference to the incumbent primary user.
– A wide tuning range will allow amateurs to find a frequency that is not used by primary services.

Disadvantages

– Risk of decreased throughput for automated HF systems, as fewer channels may be available.
– Unacceptable interference may be caused to the links of the FS and the MS (excluding aeronautical mobile) including operation links used in disaster situations and in relief operations.

1/1.4/5.1.1 Method A1

An allocation to the ARS, on a secondary basis in the frequency band, 5 275-5 450 kHz.

1/1.4/5.1.2 Method A2

An allocation to the ARS, on a secondary basis in the range 5 350 to 5 450 kHz

1/1.4/5.1.3 Method A3

An allocation to the ARS up to [xx] kHz, on a secondary basis, in the range 5 275 kHz to 5 450 kHz.

1/1.4/5.1.4 Method A4

An allocation to the ARS at several specific channels, on a secondary basis, in the range 5 275 kHz to 5 450 kHz.

1/1.4/5.2 Method B

No changes to Frequency Allocation Table of Radio Regulations in the frequency band 5 250-5 450 kHz

Advantages

– Unacceptable interference would not be caused to operation of the FS, the LMS, the MMS and the RLS.

Disadvantages

– ARS stations could operate in the frequency band 5 250-5 450 kHz only subject to RR No. **4.4** provisions.

1/1.4/6 Regulatory and procedural considerations

For all of the methods below, Suppression of Resolution **649 (WRC-12)** would be a consequential change.

1/1.4/6.1.1 Regulatory and procedural considerations for Method A1

ARTICLE 5

Frequency allocations

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

MOD

5 003-7 450 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
. . .		
5 250-5 275 FIXED MOBILE except aeronautical mobile Radiolocation 5.132A 5.133A	**5 250-5 275** FIXED MOBILE except aeronautical mobile RADIOLOCATION 5.132A	**5 250-5 275** FIXED MOBILE except aeronautical mobile Radiolocation 5.132A
5 275-5 450	FIXED MOBILE except aeronautical mobile <u>Amateur</u>	
. . .		

1/1.4/6.1.2 Regulatory and procedural considerations for Method A2

ARTICLE 5

Frequency allocations

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

MOD

5 003-7 450 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
. . .		
5 250-5 275 FIXED MOBILE except aeronautical mobile Radiolocation 5.132A 5.133A	**5 250-5 275** FIXED MOBILE except aeronautical mobile RADIOLOCATION 5.132A	**5 250-5 275** FIXED MOBILE except aeronautical mobile Radiolocation 5.132A
5 275-~~5 450~~5 350	FIXED MOBILE except aeronautical mobile	
~~5 275~~5 350-5 450	FIXED MOBILE except aeronautical mobile Amateur	
. . .		

1/1.4/6.1.3 Regulatory and procedural considerations for Method A3

ARTICLE 5

Frequency allocations

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

MOD

5 003-7 450 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
. . .		
5 275-~~5 450~~5 xxx	FIXED MOBILE except aeronautical mobile	
~~5 275-5 450~~5 xxx-5 yyy	FIXED MOBILE except aeronautical mobile Amateur ADD 5.A104	
~~5 275~~5 yyy-5 450	FIXED MOBILE except aeronautical mobile	
. . .		

ADD

5.A104 The maximum equivalent isotropically radiated power (e.i.r.p.) of stations in the amateur service using frequencies in the band 5 xxx-5 yyy kHz shall not exceed [xx] W. Stations in the amateur service shall not initiate transmissions before confirming the expected operating channel is not occupied by fixed or mobile services.

1/1.4/6.1.4 Regulatory and procedural considerations for Method A4

ARTICLE 5

Frequency allocations

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

MOD

5 003-7 450 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
...		
5 275-5 450	FIXED MOBILE except aeronautical mobile Amateur ADD 5.B104	
...		

ADD

5.B104 The amateur service can only operate on the frequencies 5 xxx kHz, 5 yyy kHz, … and 5 zzz kHz. The maximum equivalent isotropically radiated power (e.i.r.p.) of stations in the amateur service shall not exceed [xx] W. Stations in the amateur service shall not initiate transmissions before confirming the expected operating channel is not occupied by fixed or mobile services.

1/1.4/6.2 Regulatory and procedural considerations for Method B

ARTICLE 5

Frequency allocations

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

NOC

5 003-7 450 kHz

CHAPTER 2

Science issues

(Agenda items 1.11, 1.12, 1.13, 1.14)

CONTENTS

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AGENDA ITEM 1.11

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

1.11 to consider a primary allocation for the Earth exploration-satellite service (Earth-to-space) in the 7-8 GHz range, in accordance with Resolution ***650 (WRC-12)****;*

Resolution **650 (WRC-12)**: *Allocation for the Earth exploration-satellite service (Earth-to-space) in the 7-8 GHz range*

2/1.11/1 Executive summary

Resolution **650 (WRC-12)** invites ITU-R to conduct a study of spectrum requirements in the 7-8 GHz frequency range for EESS (Earth-to-space) telecommand operations in order to complement telemetry operations of EESS (space-to-Earth) in the 8 025-8 400 MHz frequency band and to conduct compatibility studies between EESS (Earth-to-space) systems and existing services, with priority to the frequency band 7 145-7 235 MHz, and then within other portions of the 7-8 GHz frequency range only if the frequency band 7 145-7 235 MHz is found not to be suitable. WRC-15 agenda item 1.11 calls for providing a worldwide primary allocation to the EESS (Earth-to-space) in the frequency range 7-8 GHz with priority to the frequency band 7 145-7 235 MHz.

Studies of spectrum requirements for the EESS have been made which indicates that the EESS system spectrum requirements are between 38 and 56 MHz. 38 MHz spectrum required in the case when the allocation is made in frequency bands not shared with other space services, while 56 MHz spectrum required in the case when the allocation is made in bands shared with other space services (like the frequency band 7 190-7 235 MHz).

Sharing studies between stations of the EESS (Earth-to-space) and the SRS, FS, MS and SOS in various portions of the 7-8 GHz frequency range are addressed in Reports ITU-R RS.2272, ITU-R RS.2275 and PDN Report ITU-R SA.[EESS-Space 7GHz]. These studies show that sharing would be feasible in the frequency band 7 190-7 250 MHz, covering therefore the spectrum requirements identified.

Three methods have been proposed to satisfy this agenda item. Methods A and B propose a new primary allocation to the EESS in the frequency band 7 190-7 250 MHz with different conditions establishing protection of currently allocated services. For Method A, three options are considered. The third method, Method C, with the proposal of no change to the Radio Regulations was also included. All these methods support the suppression of Resolution **650 (WRC-12)**.

2/1.11/2 Background

A sizable number of future EESS missions will require to uplink to the spacecraft a large amount of data for operations plans and dynamic spacecraft software modifications.

The spectrum that globally would be required on the Earth-to-space link for these telecommanding functions cannot be accommodated in the only EESS (Earth-to-space) allocation that is currently available in RR Article **5** for telecommanding, i.e. the 2 025-2 110 MHz frequency band. This 2 025-2 110 MHz frequency band is of fundamental importance, since there are already more than 1 100 satellite networks filed with the ITU and many new satellite networks are expected to enter into this frequency band, also including many microsatellites, nanosatellites and picosatellites. It would be extremely difficult, if not impossible, to coordinate satellites with such large spectrum requirements within this frequency band.

An EESS (Earth-to-space) allocation in the 7-8 GHz frequency range would allow alleviating the problems posed by this new type of EESS mission. The TT&C (Telemetry, Tracking and Control) function could be implemented by pairing this new allocation with the already existing EESS (space-to-Earth) allocation in the frequency band 8 025-8 400 MHz. This may also eventually lead to a simplified on-board architecture and operational concept for some future EESS missions.

2/1.11/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Existing relevant ITU-R Recommendations: ITU-R SA.609, ITU-R SA.1157-1, ITU-R SA.514-3, ITU-R F.758-5, ITU-R F.1245, ITU-R SA.363-5, ITU-R S.465-6.

Relevant ITU-R Reports: ITU-R SA.2272, ITU-R SA.2275, PDNRep ITU-R SA.[EESS-SPACE-7GHz], WDPDNRep ITU-R S.[FSS 7/8 GHz Compatibility].

The ITU-R has developed various studies on sharing and compatibility studies in the 7 145-7 250 MHz frequency band. The studies have examined the compatibility between a transmitting EESS earth station and stations in the FS, SOS and SRS. Sharing of EESS systems with SRS and SOS systems was evaluated using the static and dynamic simulation methods and the results have been reported. The ITU-R has also developed Report ITU-R SA.2272 on the spectrum requirements for EEES operations in the 7-8 GHz frequency range.

Sharing with FS systems was evaluated using methods of RR Appendix **7** to determine separation distances under certain circumstances such as flat terrain and an obstacle of up to 50 m in height located 5 km from the transmitting EESS earth station. The separation distances calculated using the static analysis, the time-invariant gain (TIG) and time-variant gain (TVG) methods were compared and addressed in Report ITU-R SA.2275.

Similar frequency bands are being considered under WRC-15 agenda items 1.9.1 (for the FSS) and 1.11 (for the EESS), and the conditions of compatibility between potential stations of both services have been studied. WDPDN Report ITU-R S.[FSS 7/8 GHz Compatibility] examines the impact of such EESS (Earth-to-space) earth stations into new potential FSS earth stations.

2/1.11/4 Analysis of the results of studies

2/1.11/4.1 Earth exploration-satellite service spectrum requirements in the 7-8 GHz frequency range

Report ITU-R SA.2272 deals with the spectrum requirements for future EESS missions operating under a potential new EESS uplink allocation in the 7-8 GHz frequency range. In order to estimate the number of missions that could use this new EESS uplink allocation in the 7-8 GHz frequency range, a query in the ITU Space Network Systems was made and 130 EESS missions were found to have a downlink in 8 025-8 400 MHz. Under the assumption that within 10-15 years there will be an increase of approximately 25% in the number of EESS missions using the frequency band 8 025-8 400 MHz for data downlink and that approximately 50% of these satellites could be using the new EESS (Earth-to-space) allocation, the estimated number of EESS missions with an uplink in 7-8 GHz frequency range in 10-15 years would be 81, each with an average uplink bandwidth of 1.4 MHz.

According to this analysis, most Earth exploration-satellites use very similar (polar) orbits and the ground stations are co-located at high latitudes (e.g. Kiruna (Sweden), Poker Flat (Alaska), Prince Albert (Canada), Troll (Antarctica)). For the hypothetical case where the EESS uplink band is being used for support of EESS missions only, the bandwidth requirement is 38 MHz. However, considering that the EESS would probably be sharing the whole or part of the allocated band with other space services, the bandwidth requirement for EESS (Earth-to-space) increases to approximately 56 MHz. The upper edge of the new frequency allocation, the frequency band 7 235-7 250 MHz, would be used for some EESS satellites that may have difficulties sharing with some SRS and/or SOS missions as a function of their orbital characteristics.

2/1.11/4.2 Earth exploration-satellite service sharing with the fixed service

Report ITU-R SA.2275 provides the results of sharing assessments between the EESS (Earth-to-space) and the FS, which apply to the whole frequency range 7-8 GHz. The TIG and TVG methodologies described in RR Appendix **7** were applied to assess the coordination area around EESS earth stations where coordination would be required with FS assignments. However, the TVG gives a more realistic coordination distance for this particular case, as the TIG methodology overestimates the coordination distances for non GSO satellites, particularly on low Earth orbits such as polar orbits often used for Earth observation. The TVG contour, relevant when dealing with earth stations tracking non-GSO satellites as EESS satellites leads to a maximum coordination distance of 74 km for an EESS earth station located in Kiruna in Sweden, 103 km for an EESS earth station located in Villafranca in Spain and 156 km for a station located in Kourou in French Guiana, and this considering that the FS station is pointing directly towards the EESS earth station.

This coordination distance drops rapidly down to 3 km when the FS station does not point directly towards the EESS earth station, which would likely be the case when dealing with cross border coordination. The 3 km distance is obtained for offset angles greater than 50°. For 80% of FS stations, the coordination distance would be lower than 5 km. For 90% of the FS stations, it would be lower than 10 km.

It should also be noted that these findings take into account a flat terrain but that, when taking into account actual terrain elevation, on a site-by-site basis, the coordination distance would be much more reduced. Examples of such calculations are provided in Report ITU-R SA.2275.

The actual coordination distance calculated using TVG methodology will depend on the location of the EESS earth station, its characteristics and the orbit of the EESS satellite it is tracking.

It should be pointed out that a number of SRS earth stations operating today in the frequency band 7 145-7 235 MHz have been successfully coordinated with the fixed service, although they use a much higher emission power than EESS earth stations, leading to larger coordination areas.

Similarly to what is happening for these SRS earth stations, for each individual EESS satellite mission and earth station a specific uplink licence will have to be obtained from the relevant administration. This implies that the compatibility with the FS systems operating within the coordination area will always have to be analysed (in a few cases this could involve the neighbouring administrations). Only when and if the administration(s) will have verified that there will be no impact to the FS systems the individual licences for operating the uplinks will be given. In other words the FS systems will always be fully protected.

For the sharing compatibility in the other direction, no harmful interference is expected in the EESS satellite receivers based on the studies presented here and the number of FS links deployed in the whole frequency range 7.1-8.5 GHz.

Given the relatively small separation distance requirements, coordination of FS stations and EESS earth stations becomes a national matter for all currently known locations. To this effect, a separation distance between the location of the EESS earth station and the border of neighbouring administrations might be included in the RR, as a replacement for coordination. In addition, existing provisions within RR Article **21** ensure that FS systems will not be constrained beyond that with which they currently operate in the 7 145-7 250 MHz frequency band in regards to other co-primary services.

No change is being proposed on the sharing criteria that are currently applied to sharing between the FS and the SRS in the 7 145-7 235 MHz frequency band, and no additional constraints will be placed on the use of FS systems in in this band or other bands under this agenda item.

2/1.11/4.3 Earth exploration-satellite service sharing with the mobile service

Within the frequency range 7-8 GHz, the frequency band above 7 125 MHz is not currently used by MS systems and therefore no study was performed with regard to MS stations. However if the MS systems would use this band in the future, it is considered that the separation distances derived for the protection provided to the FS systems would be sufficient for the protection of the MS systems.

2/1.11/4.4 Earth exploration-satellite service sharing with the space research service (deep-space)

The protection of SRS deep-space uplinks in the frequency band 7 145-7 190 MHz is critical to the success of the deep-space missions. This is especially important as almost all current and future SRS deep-space missions rely on this band as their lifeline for routine and emergency operations. Interference to the uplink of these missions should be minimized during their routine operations, but must be avoided completely during their near-Earth operations.

Based on the analysis in PDN Report ITU-R SA.[EESS-SPACE-7GHz], SRS (deep space) spacecraft receivers in the 7 145-7 190 MHz frequency band are compliant with the applicable ITU criterion when the spacecraft is in deep space (i.e. at distances greater than 2 million km from the Earth). However, interference levels may be above the ITU criterion of deep space missions during their near-Earth operations, such as launch and early orbit operation phases, flybys, and sample returns.

Additionally, the interference from SRS deep space uplinks into EESS satellite receivers would be well above the applicable ITU criterion in case of co-frequency operations and either geographically co-located or nearby earth station operations.

Finally, the interference levels from SRS deep space uplinks could damage the satellite receiver for certain EESS missions.

Therefore, this analysis suggests that the coexistence of EESS and deep-space SRS uplinks would not be practical within the same operational frequency band. The frequency band 7 145-7 190 MHz band should hence not be considered for future EESS Earth-to-space links.

2/1.11/4.5 Earth exploration-satellite service sharing with the space research service (near-Earth)

The analysis in PDN Report ITU-R SA.[EESS-SPACE-7GHz], indicates that interference levels from EESS uplinks into near-Earth SRS satellite receivers in the frequency band 7 190-7 235 MHz are compliant with the applicable ITU criterion and that this type of operation is compatible without the need of any special mitigation techniques.

On the other hand, in some cases for co-frequency operations, in particular when the earth stations are either geographically co-located or nearby, the interference levels from near-Earth SRS uplinks into EESS satellites would exceed the applicable ITU criterion. This could put some limitations in the selection of individual frequency assignments or earth station locations for EESS (Earth-to-space) within the frequency band 7 190-7 235 MHz.

However, it should be noted that a similar situation currently exists for near-Earth SRS uplinks of different missions and that these missions are successfully coordinated among space agencies in the frame of the applicable RR procedures (i.e. RR No. **9.3**). Therefore, there should be compatibility between SRS (Earth-to space) and EESS (Earth-to space) systems in the 7 190-7 235 MHz frequency band if frequency and earth station coordination takes place.

It is noted that no change is being proposed on the sharing criteria that are currently applied to sharing among the SRS and no additional constraints beyond those currently applied to the SRS would need to be placed on the EESS in this frequency band.

2/1.11/4.6 Earth exploration-satellite service sharing with the space operation service

In the Russian Federation, the frequency bands 7 100-7 155 MHz and 7 190-7 235 MHz are also allocated by RR No. **5.459** to the SOS (Earth -to-space) on a primary basis, subject to agreement obtained under RR No. **9.21**. The PDN Report ITU-R SA.[EESS-SPACE-7GHz], contains the analysis of three studies that have been conducted independently to assess the interference from the proposed EESS system uplink into the SOS system uplink.

Two studies using the applicable SOS protection criteria contained in Recommendation ITU-R SA.363-5 conclude that the EESS and the SOS systems are compatible.

The third study indicates potential harmful interference under certain conditions. This study was based on the protection ratio C/I given in the applicable Recommendation ITU-R SA.363-5, however a more stringent percentage of time than the associated percentage contained in that Recommendation was used.

It can therefore be concluded that on the basis of the protection criteria contained in the applicable Recommendation ITU-R SA.363-5, EESS and SOS systems are compatible.

2/1.11/5 Methods to satisfy the agenda item

2/1.11/5.1 Method A

This method proposes to add a global primary allocation to the EESS in the frequency band 7 190-7 250 MHz in the Table of Frequency Allocations in RR Article **5**.

Additionally, Table 7b in RR Appendix **7** is modified to include the EESS allocation, Table **21-2** in RR Article **21** is modified to extend the frequency range 7 145-7 235 MHz to 7 145-7 250 MHz, and Table **21-3** in RR Article **21** is modified to extend the frequency range 7 190-7 235 MHz to 7 190-7 250 MHz.

Resolution **650 (WRC-12)** would be consequentially suppressed.

With respect to additional regulatory provisions, three options are considered:

Option 1

– Addition of a new provision in the Table of Frequency Allocations in RR Article **5** to limit the use of the frequency band 7 190-7 250 MHz to non-geostationary EESS systems.

Option 2

– Modification of RR footnote No. **5.460** in order to:
  – indicate that geostationary EESS systems shall not claim protection from existing and future stations of the FS and the MS, and that No. **5.43A** does not apply.

Option 3

– Modification of RR No. **5.460** in the Table of Frequency Allocation in RR Article **5** in order to:

- indicate that geostationary EESS systems shall not claim protection from existing and future stations of the FS and the MS, and that No. **5.43A** does not apply.
- restrict the usage of the frequency band 7 190-7 250 MHz to the operation of the EESS spacecraft, because the aim for the Resolution **650 (WRC-12)** is to obtain a new allocation in the frequency range 7-8 GHz for the TT&C operations.

Advantages

– A new EESS (Earth-to-space) allocation of 60 MHz would be usable by various EESS missions.

– A new EESS (Earth-to-space) allocation would provide a needed companion band to the telemetry operations of EESS (space-to-Earth) in the 8 025-8 400 MHz frequency band.

– The EESS systems that may have difficulties in sharing with SRS and/or SOS systems as a function of their orbital characteristics could be accommodated in the 7 235-7 250 MHz frequency band not allocated to the SRS and the SOS.

– The operation and development of the FS systems in the frequency band 7 190-7 250 MHz would not be constrained due to the very low number of EESS earth stations in the world and their remote locations far away from the border of neighbouring countries.

– This method does not impose unnecessary additional coordination burden (RR No. **9.11A**) on the EESS developers, on the administrations and ITU BR.

Disadvantages

– The additional limits indicated in RR Table **21-2**, in particular provisions RR No. **21.3** and No. **21.5**, will apply to the FS and the MS in the frequency band 7 235-7 250 MHz, which were not addressed in the ITU studies.

– The SOS and the EESS will have different regulatory status. The addition of the EESS allocation could increase the coordination burden on the country in which the band is additionally allocated to the SOS through RR No. **5.459**.

– The inclusion of EESS geostationary systems under options 2 and 3 has not been addressed by any ITU-R study made in preparation for this agenda item.

2/1.11/5.2 Method B

This method proposes to add a global primary allocation to the EESS in the frequency band 7 190-7 250 MHz into the Table of Frequency Allocations in RR Article **5** and to include a provision with regard to this allocation under which:

– such allocation is limited to non-geostationary-satellite systems;

– for operation of EESS systems in the frequency band 7 190-7 235 MHz coordination shall be applied with regard to SOS systems under RR No. **9.11A**;

– space stations in the EESS (Earth-to-space) shall not claim protection from SRS earth stations in the frequency band 7 190-7 235 MHz;

– space stations in the EESS (Earth-to-space) shall not claim protection from existing and future stations in the FS and the MS in the frequency band 7 235-7 250 MHz.

Additionally, Table 7b in RR Appendix **7** is modified to include the EESS allocation, and Table **21-3** in RR Article **21** is modified to extend the frequency range 7 190-7 235 MHz to 7 190-7 250 MHz.

Note: Table **21-2** in RR Article **21** is not modified with this Method B.

Resolution **650 (WRC-12)** would be consequentially suppressed.

Advantages

– A new EESS (Earth-to-space) allocation of 60 MHz would be usable by the various EESS missions.

– A new EESS (Earth-to-space) allocation would provide the needed companion frequency band to the telemetry operations of EESS (space-to-Earth) allocation in the 8 025-8 400 MHz frequency band.

– The EESS systems that may have difficulties in sharing with SRS and/or SOS systems as a function of their orbital characteristics could be accommodated in the 7 235-7 250 MHz frequency band not allocated to the SRS and the SOS.

– The operation and development of the FS systems in the frequency band 7 190-7 250 MHz would not be constrained due to the very low number of EESS earth stations in the world and their remote locations far away from the border of neighbouring countries.

– The regulatory conditions on the FS in the frequency band 7 235- 7 250 MHz will not be changed since the provisions of RR No. **21.3** and No. **21.5** applicable to the FS in the 7 190-7 235 MHz frequency band will not be extended to 7 250 MHz.

Disadvantages

– The request for coordination under RR No. **9.11A** is not justified by the ITU-R sharing studies results based on the SOS protection criteria contained in the applicable Recommendation ITU-R SA.363-5, that show compatibility with the incumbent services. It would put unnecessary burden on the EESS developers, ITU BR and on the administrations.

– The request for a footnote making EESS (Earth-to-space) secondary relative to the SRS is not necessary. The ITU-R studies have indicated that potential interference cases can be resolved by coordination of EESS and SRS systems under the applicable provisions of the Radio Regulations.

– The request for a footnote making EESS (Earth-to-space) secondary relative to the FS and the MS in the frequency band 7 235-7 250 MHz is not justified by any ITU-R study result. These studies have confirmed compatibility between systems of the EESS and the terrestrial services.

– This Method does not fully satisfy the requirements of agenda item 1.11 as it makes the EESS allocation secondary relative to the FS, MS and SRS.

2/1.11/5.3 Method C

No change in the RR Article **5** and suppression of Resolution **650 (WRC-12)**.

There would be no allocation to the EESS (Earth-to-space) in the frequency band 7 190-7 250 MHz.

Advantages

None.

Disadvantages

– The demand for the EESS spectrum, as identified in the studies presented in Report ITU-R SA.2272, will not be met.

– The congestion currently observed in 2 GHz frequency band will not be relieved.

– This method is not based on any ITU-R study results.

2/1.11/6 Regulatory and procedural considerations

2/1.11/6.1 Method A

ARTICLE 5

Frequency allocations

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

Option 1 for MOD of Table of Frequency Allocations, MOD No. 5.460 and ADD No. 5.A111

MOD

5 570-7 250 MHz *(end)*

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
7 145-~~7 235~~7 190	FIXED MOBILE SPACE RESEARCH (deep space) (Earth-to-space) ~~5.460~~ 5.458 5.459	
~~7 145~~7 190-7 235	EARTH EXPLORATION-SATELLITE (Earth-to-space) ADD 5.A111 FIXED MOBILE SPACE RESEARCH (Earth-to-space) MOD 5.460 5.458 5.459	
7 235-7 250	EARTH EXPLORATION-SATELLITE (Earth-to-space) ADD 5.A111 FIXED MOBILE 5.458	

MOD

5.460 ~~The use of the band 7 145-7 190 MHz by the space research service (Earth-to-space) is restricted to deep space; n~~No emissions to spacecraft operating in deep space shall be effected in the frequency band 7 190-7 235 MHz. Geostationary satellites in the space research service operating in the frequency band 7 190-7 235 MHz shall not claim protection from existing and future stations of the fixed and mobile services and No. **5.43A** does not apply. (WRC-~~03~~15)

Reasons: To provide a new allocation to the EESS (Earth-to-space) in the frequency band 7 190-7 250 MHz. The TT&C function could be implemented by pairing this new allocation with the already existing EESS (space-to-Earth) allocation in the frequency band 8 025-8 400 MHz. Deletion of first sentence as consequential changes. Addition of words “spacecraft operating” to be more precise.

ADD

5.A111 The use of the frequency band 7 190-7 250 MHz by systems of the Earth exploration-satellite service (Earth-to-space) is limited to non-geostationary satellite systems. (WRC-15)

Reasons: To limit the new allocation to non-geostationary satellites because no studies have been performed regarding possible geostationary EESS satellites.

Option 2 for MOD of Table of Frequency Allocations and MOD No. 5.460

MOD

5 570-7 250 MHz *(end)*

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
7 145-~~7 235~~7 190	FIXED MOBILE SPACE RESEARCH (deep space) (Earth-to-space) ~~5.460~~ 5.458 5.459	
~~7 145~~7 190-7 235	EARTH EXPLORATION-SATELLITE (Earth-to-space) FIXED MOBILE SPACE RESEARCH (Earth-to-space) ~~5.460~~ 5.458 5.459 MOD 5.460	
7 235-7 250	EARTH EXPLORATION-SATELLITE (Earth-to-space) MOD 5.460 FIXED MOBILE 5.458	

MOD

5.460 ~~The use of the band 7 145-7 190 MHz by the space research service (Earth-to-space) is restricted to deep space; n~~No emissions to spacecraft operating in deep space shall be effected in the frequency band 7 190-7 235 MHz. Geostationary satellites in the space research service operating in the frequency band 7 190-7 235 MHz and geostationary satellites in the Earth exploration-satellite service in the frequency band 7 190-7 250 MHz, shall not claim protection from existing and future stations of the fixed and mobile services and No. **5.43A** does not apply. (WRC-~~03~~15)

Reasons: To provide a new allocation to the EESS (Earth-to-space) in the frequency band 7 190-7 250 MHz. The TT&C function could be implemented by pairing this new allocation with the already existing EESS (space-to-Earth) allocation in the frequency band 8 025-8 400 MHz. Deletion of first sentence as consequential changes. Addition of words “spacecraft operating” to be more precise.

Option 3 for MOD of Table of Frequency Allocations and MOD No. 5.460

MOD

5 570-7 250 MHz *(end)*

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
7 145-7 2357 190	FIXED MOBILE SPACE RESEARCH (deep space) (Earth-to-space) 5.460 5.458 5.459	
7 1457 190-7 235	EARTH EXPLORATION-SATELLITE (Earth-to-space) FIXED MOBILE SPACE RESEARCH (Earth-to-space) 5.460 5.458 5.459 MOD 5.460	
7 235-7 250	EARTH EXPLORATION-SATELLITE (Earth-to-space) MOD 5.460 FIXED MOBILE 5.458	

MOD

5.460 The use of the band 7 145-7 190 MHz by the space research service (Earth-to-space) is restricted to deep space; nNo emissions to spacecraft operating in deep space shall be effected in the frequency band 7 190-7 235 MHz. Geostationary satellites in the space research service operating in the frequency band 7 190-7 235 MHz and geostationary satellites in the Earth exploration-satellite service in the frequency band 7 190-7 250 MHz, shall not claim protection from existing and future stations of the fixed and mobile services and No. **5.43A** does not apply. The usage of the frequency band 7 190-7 250 MHz by Earth exploration-satellite service shall be limited to the operation of the spacecraft. (WRC-0315)

Reasons: To provide a new allocation to the EESS (Earth-to-space) in the frequency band 7 190-7 250 MHz. The TT&C function could be implemented by pairing this new allocation with the already existing EESS (space-to-Earth) allocation in the frequency band 8 025-8 400 MHz. Deletion of first sentence as consequential changes. Addition of words “spacecraft operating” to be more precise.

It restricts the usage of the frequency band 7 190-7 250 MHz to the operation of the EESS spacecraft, because the aim for the Resolution **650 (WRC-12)** is to obtain a new allocation in the frequency range 7-8 GHz for the TT&C operations and no studies regarding other purpose except for TT&C function have been performed. If there is no restriction, this new allocation may be used for other purpose (e.g. data dissemination).

Options 1, 2 and 3

SUP

RESOLUTION 650 (WRC-12)

Allocation for the Earth exploration-satellite service (Earth-to-space) in the 7-8 GHz range

Reasons: This Resolution is no longer necessary.

MOD

APPENDIX 7 (Rev.WRC-~~12~~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

Options 1, 2 and 3

MOD

TABLE 7b (Rev.WRC-15~~12~~)

Parameters required for the determination of coordination distance for a transmitting earth station

Transmitting space radiocommunication service designation		**Fixed-satellite, mobile-satellite**	**Aero-nautical mobile-satellite (R) service**	**Aero-nautical mobile-satellite (R) service**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**		**Earth exploration-satellite, ~~S~~space operation, space research**		**Fixed-satellite, mobile-satellite, meteorological-satellite**		**Fixed-satellite**		**Fixed-satellite**		**Fixed-satellite**	**Fixed-satellite** [3]	**Fixed-satellite**	**Fixed-satellite** [3]
Frequency bands (GHz)		2.655-2.690	5.030-5.091	5.030-5.091	5.091-5.150	5.091-5.150	5.725-5.850	5.725-7.075		7.100-7.250~~235~~ [5]		7.900-8.400		10.7-11.7		12.5-14.8		13.75-14.3	15.43-15.65	17.7-18.4	19.3-19.7
Receiving terrestrial service designations		Fixed, mobile	Aeronautical radio-navigation	Aeronautical mobile (R)	Aeronautical radio-navigation	Aeronautical mobile (R)	Radiolocation	Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Radiolocation radionavigation (land only)	Aeronautical radionavigation	Fixed, mobile	Fixed, mobile
Method to be used		§ 2.1	§ 2.1, § 2.2	§ 2.1, § 2.2			§ 2.1	§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1, § 2.2	§ 2.2
Modulation at terrestrial station [1]		A						A	N	A	N	A	N	A	N	A	N	–		N	N
Terrestrial station interference parameters and criteria	p_0 (%)	0.01						0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01		0.005	0.005
	n	2						2	2	2	2	2	2	2	2	2	2	1		2	2
	p (%)	0.005						0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.01		0.0025	0.0025
	N_L (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
	M_s (dB)	26 [2]						33	37	33	37	33	37	33	40	33	40	1		25	25
	W (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
Terrestrial station parameters	G_x (dBi) [4]	49 [2]	6	10	6	6		46	46	46	46	46	46	50	50	52	52	36		48	48
	T_e (K)	500 [2]						750	750	750	750	750	750	1 500	1 100	1 500	1 100	2 636		1 100	1 100
Reference bandwidth	B (Hz)	4×10^3	150×10^3	37.5×10^3	150×10^3	10^6		4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	10^7		10^6	10^6
Permissible interference power	$P_r(p)$ (dBW) in B	−140	−160	−157	−160	−143		−131	−103	−131	−103	−131	−103	−128	−98	−128	−98	−131		–113	–113

1 A: analogue modulation; N: digital modulation.

2 The parameters for the terrestrial station associated with transhorizon systems have been used. Line-of-sight radio-relay parameters associated with the frequency band 5 725-7 075 MHz may also be used to determine a supplementary contour with the exception that G_x = 37 dBi.

3 Feeder links of non-geostationary-satellite systems in the mobile-satellite service.

4 Feeder losses are not included.

5 Actual frequency bands are 7 190-7 250 MHz for the Earth exploration-satellite service, 7 100-7 155 MHz and 7 190-7 235 MHz for the space operation service and 7 145-7 235 MHz for the space research service. (WRC-15)

Reasons: Consequential changes as a result of including the new allocation to the EESS (Earth-to-space) in Appendix 7, Table 7b (Parameters required for the determination of coordination distance for a transmitting earth station).

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section II − Power limits for terrestrial stations

Options 1, 2 and 3

MOD

TABLE **21-2** (Rev.WRC-15~~12~~)

Frequency band	Service	Limit as specified in Nos.
1 427-1 429 MHz 1 610-1 645.5 MHz (No. **5.359**) 1 646.5-1 660 MHz (No. **5.359**) 1 980-2 010 MHz 2 010-2 025 MHz (Region 2) 2 025-2 110 MHz 2 200-2 290 MHz 2 655-2 670 MHz[5] (Regions 2 and 3) 2 670-2 690 MHz[5] (Regions 2 and 3) 5 670-5 725 MHz (Nos. **5.453** and **5.455**) 5 725-5 755 MHz[5] (Region 1 countries listed in Nos. **5.453** and **5.455**) 5 755-5 850 MHz[5] (Region 1 countries listed in Nos. **5.453**, **5.455** and **5.456**) 5 850-7 075 MHz 7 145-~~7 235~~7 250 MHz* 7 900-8 400 MHz	Earth exploration-satellite Fixed-satellite Meteorological-satellite Mobile-satellite Space research Space operation ~~Earth exploration-satellite~~ ~~Mobile-satellite~~	**21.2**, **21.3**, **21.4** and **21.5**

Reasons: Consequential changes as a result of considering the new allocation to the EESS (Earth-to-space) the 7 190-7 250 MHz frequency band.

* For this frequency band only the limits of Nos. **21.3** and **21.5** apply.

Section III − Power limits for earth stations

Options 1, 2 and 3

MOD

TABLE **21-3** (Rev.WRC-15~~12~~)

Frequency band		**Services**
2 025-2 110 MHz		~~Fixed-satellite~~ Earth exploration-satellite Fixed-satellite Meteorological-satellite Mobile-satellite Space operation Space research
5 670-5 725 MHz	(for the countries listed in No. **5.454** with respect to the countries listed in Nos. **5.453** and **5.455**)	
5 725-5 755 MHz[6]	(for Region 1 with respect to the countries listed in Nos. **5.453** and **5.455**)	
5 755-5 850 MHz[6]	(for Region 1 with respect to the countries listed in Nos. **5.453**, **5.455** and **5.456**)	
5 850-7 075 MHz		
7 190-~~7 235~~7 250 MHz		
7 900-8 400 MHz		
10.7-11.7 GHz[6]	(for Region 1)	
12.5-12.75 GHz[6]	(for Region 1 with respect to the countries listed in No. **5.494**)	
12.7-12.75 GHz[6]	(for Region 2)	
12.75-13.25 GHz		
14.0-14.25 GHz	(with respect to the countries listed in No. **5.505**)	
14.25-14.3 GHz	(with respect to the countries listed in Nos. **5.505**, **5.508** and **5.509**)	
14.3-14.4 GHz[6]	(for Regions 1 and 3)	
14.4-14.8 GHz		

Reasons: Consequential changes as a result of considering the new allocation to the Earth exploration-satellite service (Earth-to-space) the 7 190-7 250 MHz frequency band.

[6] **21.12.1** The equality of right to operate when a band of frequencies is allocated in different Regions to different services of the same category is established in No. **4.8**. Therefore any limits concerning inter-Regional interference which may appear in ITU-R Recommendations should, as far as practicable, be observed by administrations.

2/1.11/6.2 Method B

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

(See No. **2.1**)

MOD

5 570-7 250 MHz *(end)*

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
7 145-7 2357 190	FIXED MOBILE SPACE RESEARCH (deep space) (Earth-to-space) 5.460 5.458 5.459	
7 1457 190-7 235	EARTH EXPLORATION-SATELLITE (Earth-to-space) ADD 5.B111 FIXED MOBILE SPACE RESEARCH (Earth-to-space) MOD 5.460 5.458 5.459	
7 235-7 250	EARTH EXPLORATION-SATELLITE (Earth-to-space) ADD 5.B111 FIXED MOBILE 5.458	

MOD

5.460 The use of the band 7 145-7 190 MHz by the space research service (Earth-to-space) is restricted to deep space; nNo emissions to spacecraft operating in deep space shall be effected in the frequency band 7 190-7 235 MHz. Geostationary satellites in the space research service operating in the frequency band 7 190-7 235 MHz shall not claim protection from existing and future stations of the fixed and mobile services and No. **5.43A** does not apply. (WRC-0315)

Reasons: To provide a new allocation to the EESS (Earth-to-space) in the frequency band 7 190-7 250 MHz. The TT&C function could be implemented by pairing this new allocation with the already existing EESS (space-to-Earth) allocation in the frequency band 8 025-8 400 MHz. Deletion of first sentence as consequential changes.

ADD

5.B111 The use of the frequency band 7 190-7 250 MHz by the Earth exploration-satellite service (Earth-to-space) shall be limited to non-geostationary-satellite systems. The use of the frequency band 7 190-7 235 MHz by the Earth exploration-satellite service (Earth-to-space) is subject to coordination under No. **9.11A** with space operation service systems operating in accordance with No. **5.459**. Space stations in the Earth exploration-satellite service (Earth-to-space) shall not claim protection from emissions of space research service (Earth-to-space) stations in the frequency band 7 190-7 235 MHz. Space stations in the Earth exploration-satellite service (Earth-to-space) shall not claim protection from existing and future stations in the fixed and mobile services operating in the frequency band 7 235-7 250 MHz. (WRC-15)

Reasons: To limit the new allocation to non-geostationary satellites because no studies have been performed regarding possible geostationary EESS satellites. To ensure operation of SRS earth stations in case of nearby location and co-frequency operations as potential interference was indicated in the EESS space station receiver.

SUP

RESOLUTION 650 (WRC-12)

Allocation for the Earth exploration-satellite service (Earth-to-space) in the 7-8 GHz range

Reasons: This Resolution is no longer necessary.

MOD

APPENDIX 7 (Rev.WRC-~~12~~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 7b (Rev.WRC-15~~12~~)

Parameters required for the determination of coordination distance for a transmitting earth station

Transmitting space radiocommunication service designation		**Fixed-satellite, mobile-satellite**	**Aero-nautical mobile-satellite (R) service**	**Aero-nautical mobile-satellite (R) service**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**		**Earth exploration-satellite, ~~S~~space operation, space research**		**Fixed-satellite, mobile-satellite, meteorological-satellite**		**Fixed-satellite**		**Fixed-satellite**		**Fixed-satellite**	**Fixed-satellite** [3]	**Fixed-satellite**	**Fixed-satellite** [3]
Frequency bands (GHz)		2.655-2.690	5.030-5.091	5.030-5.091	5.091-5.150	5.091-5.150	5.725-5.850	5.725-7.075		7.100-7.250~~235~~ [5]		7.900-8.400		10.7-11.7		12.5-14.8		13.75-14.3	15.43-15.65	17.7-18.4	19.3-19.7
Receiving terrestrial service designations		Fixed, mobile	Aeronautical radio-navigation	Aeronautical mobile (R)	Aeronautical radio-navigation	Aeronautical mobile (R)	Radiolocation	Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Radiolocation radionavigation (land only)	Aeronautical radionavigation	Fixed, mobile	Fixed, mobile
Method to be used		§ 2.1	§ 2.1, § 2.2	§ 2.1, § 2.2			§ 2.1	§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1, § 2.2	§ 2.2
Modulation at terrestrial station [1]		A						A	N	A	N	A	N	A	N	A	N	–		N	N
Terrestrial station interference parameters and criteria	p_0 (%)	0.01						0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01		0.005	0.005
	n	2						2	2	2	2	2	2	2	2	2	2	1		2	2
	p (%)	0.005						0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.01		0.0025	0.0025
	N_L (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
	M_s (dB)	26 [2]						33	37	33	37	33	37	33	40	33	40	1		25	25
	W (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
Terrestrial station parameters	G_x (dBi) [4]	49 [2]	6	10	6	6		46	46	46	46	46	46	50	50	52	52	36		48	48
	T_e (K)	500 [2]						750	750	750	750	750	750	1 500	1 100	1 500	1 100	2 636		1 100	1 100
Reference bandwidth	B (Hz)	4×10^3	150×10^3	37.5×10^3	150×10^3	10^6		4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	10^7		10^6	10^6
Permissible interference power	$P_r(p)$ (dBW) in B	−140	−160	−157	−160	−143		−131	−103	−131	−103	−131	−103	−128	−98	−128	−98	−131		−113	−113

1 A: analogue modulation; N: digital modulation.

2 The parameters for the terrestrial station associated with transhorizon systems have been used. Line-of-sight radio-relay parameters associated with the frequency band 5 725-7 075 MHz may also be used to determine a supplementary contour with the exception that $G_x = 37$ dBi.

3 Feeder links of non-geostationary-satellite systems in the mobile-satellite service.

4 Feeder losses are not included.

5 Actual frequency bands are 7 190-7 250 MHz for the Earth exploration-satellite service, 7 100-7 155 MHz and 7 190-7 235 MHz for the space operation service and 7 145-7 235 MHz for the space research service. (WRC-15)

Reasons: Consequential changes as a result of including the new allocation to the Earth exploration-satellite service (Earth-to-space) in Appendix 7, Table 7b (Parameters required for the determination of coordination distance for a transmitting earth station).

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section II − Power limits for terrestrial stations

NOC

TABLE **21-2** (Rev.WRC-12)

Section III − Power limits for earth stations

MOD

TABLE **21-3** (Rev.WRC-15~~12~~)

Frequency band		Services
2 025-2 110 MHz		~~Fixed-satellite~~
5 670-5 725 MHz	(for the countries listed in No. **5.454** with respect to the countries listed in Nos. **5.453** and **5.455**)	Earth-exploration-satellite Fixed-satellite
5 725-5 755 MHz[6]	(for Region 1 with respect to the countries listed in Nos. **5.453** and **5.455**)	Meteorological-satellite Mobile-satellite Space operation
5 755-5 850 MHz[6]	(for Region 1 with respect to the countries listed in Nos. **5.453**, **5.455** and **5.456**)	Space research
5 850-7 075 MHz		
7 190-~~7 235~~7 250 MHz		
7 900-8 400 MHz		
10.7-11.7 GHz[6]	(for Region 1)	
12.5-12.75 GHz[6]	(for Region 1 with respect to the countries listed in No. **5.494**)	
12.7-12.75 GHz[6]	(for Region 2)	
12.75-13.25 GHz		
14.0-14.25 GHz	(with respect to the countries listed in No. **5.505**)	
14.25-14.3 GHz	(with respect to the countries listed in Nos. **5.505**, **5.508** and **5.509**)	
14.3-14.4 GHz[6]	(for Regions 1 and 3)	
14.4-14.8 GHz		

Reasons: Consequential changes as a result of considering the new allocation to the EESS (Earth-to-space) the 7 190-7 250 MHz frequency band.

[6] **21.12.1** The equality of right to operate when a band of frequencies is allocated in different Regions to different services of the same category is established in No. **4.8**. Therefore any limits concerning inter-Regional interference which may appear in ITU-R Recommendations should, as far as practicable, be observed by administrations.

2/1.11/6.3 Method C

NOC

ARTICLE 5

Frequency allocations

SUP

RESOLUTION 650 (WRC-12)

Allocation for the Earth exploration-satellite service (Earth-to-space) in the 7-8 GHz range

Reasons: This Resolution is no longer necessary.

AGENDA ITEM 1.12

(WP 7C / WP 7B, WP 7D, WP 5A, WP 5B, WP 5C)

1.12 to consider an extension of the current worldwide allocation to the Earth exploration-satellite (active) service in the frequency band 9 300-9 900 MHz by up to 600 MHz within the frequency bands 8 700-9 300 MHz and/or 9 900-10 500 MHz, in accordance with ***Resolution 651 (WRC-12)****;*

Resolution **651 (WRC-12):** *Possible extension of the current worldwide allocation to the Earth exploration-satellite (active) service in the frequency band 9 300-9 900 MHz by up to 600 MHz within the frequency bands 8 700-9 300 MHz and/or 9 900-10 500 MHz*

2/1.12/1 Executive summary

In accordance with Resolution **651 (WRC-12)**, ITU-R has performed studies of possible extension of the current worldwide allocation to the EESS (active) within the frequency bands 8 700-9 300 MHz and/or 9 900-10 500 MHz, taking into account compatibility studies with stations of incumbent services.

Report ITU-R RS.2274 shows that an EESS additional spectrum requirement is for consecutive 600 MHz. Sharing studies were performed for all incumbent services and were based on characteristics of future wideband EESS synthetic-aperture radars (SAR) as described in Recommendation ITU-R RS.2043.

The results of sharing studies with the RDS are contained in PDN Report ITU-R RS.[EESS-9GHz_RDS]. The results of sharing studies with the FS, MS, ARS, and ARSS are contained in PDN Report ITU-R RS.[EESS-9 GHz_FS/MS/AS]. The results of compatibility studies related to unwanted emissions into the SRS, RAS, EESS (passive), and SRS (passive) are contained in DN Report ITU-R RS.[EESS-9GHz_OOBE].

The following methods to satisfy the agenda item have been developed:

- Method A - Primary EESS (active) allocation in the frequency band 9 900-10 500 MHz.
- Method B - Primary EESS (active) allocation in the frequency bands 9 200-9 300 MHz and 9 900-10 400 MHz.

These methods would impose that systems operating in the new EESS (active) allocation shall not cause harmful interference to, nor claim protection from radars operating in the radio determination service. In addition, the extension frequency band shall only be used by EESS (active) systems requiring a bandwidth of more than 600 MHz. The protection of stations of the RAS in adjacent frequency bands is addressed in PDN Recommendation ITU-R RS.[EESS 9GHZ-RAS-MITIGATION].

2/1.12/2 Background

The growing demand for higher resolution radar images to satisfy global environmental monitoring raises the need to further increase the bandwidth used for linear FM chirp radar transmission of the next generation of EESS SAR.

Resolution **651 (WRC-12)** invites ITU-R to conduct and complete compatibility studies addressing EESS (active) and existing services in the frequency bands 8 700-9 300 MHz and 9 900-10 500 MHz, and unwanted emissions from stations operating in the EESS (active) in these frequency bands into stations operating in the frequency bands 8 400-8 500 MHz and 10.6-10.7 GHz.

During the study cycle for WRC-07, studies were performed by ITU-R under WRC-07 agenda item 1.3 to investigate the conditions for the extension of EESS (active) allocation by 200 MHz above or below the former allocation 9 500-9 800 MHz (prior to WRC-07). Based on the results and conclusions in Report ITU-R RS.2094, WRC-07 decided to extend the allocation to the frequency band 9 300-9 900 MHz. This was possible because the overall sharing conditions were found to be acceptable if certain conditions are obeyed. These conditions are regulated by RR Nos. **5.475A**, **5.476A**, **5.477**, **5.478**, **5.478A**, and No. **5.478B** to protect other radio service in countries mentioned in these footnotes.

Space-borne radars operating in the EESS (active) in this frequency band have demonstrated their important contributions to a large number of scientific and geoinformation applications, which is also recognized in Resolution **673 (Rev.WRC-12**).

2/1.12/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The existing relevant ITU-R Recommendations: ITU-R RS.1029, ITU-R RS.1166, ITU-R RS.1280, ITU-R RS.1859, ITU-R RS.1861, ITU-R RS.1883, ITU-R RS.2017, ITU-R RS.2043, ITU-R SA.509, ITU-R SA.609, ITU-R SA.1157, ITU-R RA.769, ITU-R RA.1513, ITU-R RA.1631, ITU-R M.629, ITU-R M.1041, ITU-R M.1044, ITU-R M.1372, ITU-R M.1461, ITU-R M.1583, ITU-R M.1732, ITU-R M.1796, ITU-R M.1824, ITU-R M.1851, ITU-R F.758, ITU-R F.1108, ITU-R F.1245, ITU-R F.1336.

The relevant ITU-R Reports: ITU-R M.2050, ITU-R M.2076, ITU-R M.2081, ITU-R M.2128, ITU-R RS.2094, ITU-R RS.2178, ITU-R RS.2274.

New relevant ITU-R Recommendations and Reports: Recommendation ITU-R RS.2043, PDNRec ITU-R RS.[EESS9GHz-SRS-Mitigation], ITU-R RS.[EESS 9GHz-RAS-Mitigation], Reports ITU-R RS.2274, DNRep. RS.[EESS-9GHz_OOBE], PDNRep ITU-R RS.[EESS-9GHz_RDS], ITU-R RS.[EESS-9 GHz_FS/MS/AS].

2/1.12/3.1 Estimated spectrum requirements

The studies on EESS (active) spectrum requirements in the frequency range around 9 GHz are summarized in Report ITU-R RS.2274 – “Spectrum requirements for spaceborne synthetic aperture radar applications planned in an extended allocation to the Earth exploration-satellite service around 9 600 MHz". The amount of estimated spectrum requirements for EESS (active) systems around 9 GHz is a contiguous 1 200 MHz.

2/1.12/3.2 Possible frequency bands for extension of the Earth exploration-satellite (active) service allocation

The ITU-R has examined feasibility of allocation of the frequency bands 8 700-9 300 MHz and 9 900-10 500 MHz for the EESS (active) in all or portions of these frequency bands and carried out sharing studies with respect to incumbent services.

2/1.12/4 Analysis of the results of studies

2/1.12/4.1 Sharing studies with incumbent services

2/1.12/4.1.1 Sharing between EESS SAR and systems operating in the radiodetermination service

The frequency range 8 700-10 500 MHz is used by many different types of radars: airborne radars, shipborne radars, and beacon/ground-based radars. It is important to note that Report ITU-R RS.2094 provides results, which demonstrate the compatibility between spaceborne SAR systems and radars operating in the frequency bands 9 300-9 500 MHz and 9 800-10 000 MHz with radar system characteristics described in Recommendation ITU-R M.1796 (2007 version), and that EESS (active) systems have been operating in the frequency band 9 300-9 900 MHz with no report of interference. Radar systems, characterized in Recommendation ITU-R M.1796, that operate on frequencies anywhere within the frequency band of 9 300-10 000 MHz are assumed to be compatible with EESS (active) systems.

ITU-R has reviewed the proposed SAR characteristics in Recommendation ITU-R RS.2043 and the SAR characteristics in Report ITU-R RS.2094, and determined that those characteristics are similar with similar effect on radar receivers. It was, therefore, not necessary to repeat these studies performed in the frequency bands 9 300-9 500 MHz and 9 800-10 000 MHz. The studies under WRC-15 agenda item 1.12 focused on radars, identified in Recommendation ITU-R M.1796-2, operating in the frequency bands 8 700-9 300 MHz and 10 000-10 500 MHz, which were not considered in previous studies.

Recommendation ITU-R RS.1280 is about the selection of active spaceborne sensor emission characteristics to mitigate the potential for interference to terrestrial radars operating in frequency bands 1-10 GHz. Sensor transmitter power, antenna gain pattern, pulse width, pulse repetition frequency, and chirp bandwidth (if frequency modulation is used) are all possible characteristics that can be adjusted during the design of the spaceborne sensor to improve compatibility with terrestrial radars.

In the frequency band 9 000-9 200 MHz, airport surface detection equipment radars, operating in the ARNS, are used to aid air traffic controllers in preventing collisions on the airport surface and reducing runway incursions. These safety of life critical systems require special measures to ensure their freedom from harmful interference in accordance with RR Nos. **1.59** and **4.10**.

The aggregate average I/N of –6 dB should be used as the required protection level for radiodetermination radars from all interference sources, including the proposed SAR. However, the effect of pulsed interference on incumbent systems is difficult to quantify and the interference level is strongly dependent on receiver-processor design and mode of system operation. In general, some radar features can help suppress low effective duty-cycle pulsed interference (of the order of 1%[19] in the radar receiver). Techniques for suppression of low-duty-cycle pulsed interference are described in Recommendation ITU-R M.1372.

Test results provided in Report ITU-R M.2081 show that some radars can tolerate high peak I/N low-duty cycle pulsed interference like those produced by SAR systems or other radars systems, but the report should not be considered as a replacement for the interference protection criteria in Recommendation ITU-R M.1796.

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[19] As shown in Report ITU-R M.2081 values of up to 2.5% have also been observed for maritime radars.

The results of those peak interference measurements are also summarized in the CPM Report developed under WRC-07 agenda item 1.3 as follows:

> "The test and analysis results show representative radionavigation and radiolocation radars do not suffer any degradation to their performance from representative EESS (active) waveforms at an I/N of +40 dB for shipborne systems, I/N of +54 dB for airborne systems, I/N of +50 dB for ground-based systems, and an I/N of +28 dB for ground-based meteorological radars."

This shows that the improvement through radar processing gain could be significant.

It should be noted that the test measurements for some ARNS radars did not take into account the required probability of detection. Since the effects of pulsed linear chirp SARs into RDS system receivers are difficult to quantify and are dependent on receiver/processor design and mode of operation, and further, due to the safety critical aspects of ARNS radars in the frequency band 9 000-9 200 MHz, more radar performance measurements are required to adequately model these systems.

The method provided in Recommendation ITU-R RS.1280 should be used to assess the SAR pulsed interference to the RDS radars. In the case of no available measured data and to comply with the safety aspect requirements, this Recommendation recommends using a 0 dB value for the radar processing gain.

2/1.12/4.1.1.1 Sharing of the Earth exploration-satellite (active) service with the radiolocation service

The sharing studies focused on RLS radars G20 and A12 in the frequency band 8 700-9 300 MHz, and RLS radars G4, A4 and S2 in the frequency band 9 900-10 500 MHz described in Recommendation ITU-R M.1796-2.

2/1.12/4.1.1.1.1 Effect of radiolocation systems on the new generation of EESS SAR

In the frequency bands 8 700-9 300 MHz and 10 000-10 500 MHz, the simulations results show that in any case the impact of radiolocation systems into the new generation of SAR is more than 13 dB below the interference protection criterion.

2/1.12/4.1.1.1.2 Effect of EESS SAR on radiolocation systems in the frequency band 8 700-9 300 MHz

Dynamic simulation results have shown that in case of main-beam to main-beam coupling the peak I/N can reach values as high as 60 dB. However, these values are obtained for very low percentages of time in the order of 0.00001% over 11 days.

The radiolocation systems identified by ITU-R for sharing studies (system A12 and G20), which operate in the frequency band below 9 300 MHz, operate also in the current allocation in the frequency band 9 300-9 900 MHz. Therefore for comparison, simulations have also been performed with SAR-2 (EESS systems already using the current EESS frequency band 9 300-9 900 MHz) and results show that the I/N values obtained for SAR-4 are similar to the I/N values obtained for SAR-2. No interference has been reported so far for either radar A12 or G20. Therefore, some administrations expect that no interference will be observed after the extension of the allocation to the EESS (active).

2/1.12/4.1.1.1.3 Effect of EESS SAR on radiolocation systems in the frequency band 10.0-10.5 GHz

ITU-R studies show that all considered radiolocation radars would be affected with interference levels that significantly exceed the specified I/N threshold value of I/N = -6 dB in the worst case radar location and when the radar is pointing toward EESS SAR with the maximum possible gain and when SAR conducts measurements into the radar location point at times when the distance between SAR and the radar would be minimal. Probable excess would be between 29.3 dB and 74.6 dB. This study shows that threshold maybe exceeded in any moment when SAR is over the radio horizon. The value of exceedance will depend on the location of the radar and measurement points.

The results of the dynamic study presented in PDN Report ITU-R RS.[EESS9GHz_RDS] and summarized in Table 2/1.12/4-1 are showing the probability of such event to occur.

TABLE 2/1.12/4-1

Summary of studies results in the frequency band 10-10.5 GHz

	10-10.5 GHz
Service affected	RLS
Maximum I/N $_{average}$	68.6 dB-PG
% of time that maximum average I/N occurs over 11 days	0.00001 x N
% of time that I/N_{av}-PG= -6dB is exceeded over 11 days	0.005 x N
% of time that I/N_{av}= -6dB is exceeded over 11 days	Much lower than 0.005 x N (depending on PG)
PG : radar receiver processing gain in dB (the effect of pulsed interference is difficult to quantify and is strongly dependent on radar receiver-processor design and mode of system operation. In general, numerous features of radars can be expected to help suppress low duty-cycle pulsed interference. Techniques for suppression of low-duty-cycle pulsed interference are contained in Recommendation ITU R M.1372 (see also Recommendation ITU-R M.1461 and Report ITU-R M.2081). Report ITU-R RS.2094 show that such processing gain can be significant). **N** : number of wideband SAR (SAR-4) systems operating in the considered frequency band	

2/1.12/4.1.1.2 Sharing between the Earth exploration-satellite (active) service and the radionavigation service

The RNS comprises allocations particularly dedicated to the MRNS and the ARNS.

2/1.12/4.1.1.2.1 Frequency band 9 000-9 200 MHz

There is lack of ITU guidance on how much processing gain the radars that operate in the frequency band 9 000-9 200 MHz can achieve and, due to the safety critical aspects of ARNS radars in the 9 000-9 200 MHz frequency band it is difficult to ensure the protection of those systems based on the sharing studies in PDN Report ITU-R RS.[EESS-9GHz_RDS]. Therefore this frequency band is no longer considered for the extension of EESS (active) allocation.

2/1.12/4.1.1.2.2 Frequency band 9 200-9 300 MHz

The frequency band 9 200-9 500 MHz is used for the global maritime distress and safety system (GMDSS) in most countries which needs to be protected in accordance with RR Nos. **1.59** and **4.10**.

Systems used in the MRNS in the frequency band 9 200-9 300 MHz are also operated in the current EESS (active) allocation in the frequency band 9 300-9 500 MHz without any reported interference. ITU-R studies show that the sharing conditions remain similar for any SAR chirp transmission bandwidth between 600 and 1 200 MHz in the frequency band 9 200-9 300 MHz and that they are similar to the sharing conditions of SAR systems operating at lower chirp bandwidth in the frequency band 9 300-9 900 MHz.

2/1.12/4.1.1.2.3 Frequency band 9 900-10 000 MHz

RR No. **5.478** additionally allocates to the RNS in some countries the frequency band 9 900-10 000 MHz. As mentioned in section 2/1.12/4.1.1 above, the current studies are focused on radars, identified in Recommendation ITU-R M.1796-2 and operating above 10 GHz, which were not considered in previous studies (Report ITU-R RS.2094).

2/1.12/4.1.1.2.4 Effect of radionavigation systems on the new generation of EESS SAR

In the frequency bands 8 700-9 300 MHz, the simulation results presented in PDN Report ITU-R RS.[EESS-9GHz_RDS] show that the impact of RNS systems into the new generation of SAR (called SAR-4 in the studies) is more than 46 dB below the interference protection criteria.

2/1.12/4.1.1.2.5 Effect of EESS SAR on maritime radionavigation systems in the frequency band 9 200-9 300 MHz

Report ITU-R M.2081 includes test results between specific RNS and RLS systems and EESS systems in the frequency band 8 500-10 000 MHz. The results of studies with a MRNS radar in the frequency band 9 200-9 500 MHz show that it is compatible with EESS systems represented by the test waveforms at peak I/N level of 40 dB. Other test results documented in Recommendation ITU-R M.1796 confirm these results for maritime radars. The simulation results contained in PDN Report ITU-R RS.[EESS-9GHz_RDS] show that the peak I/N would never exceed 37 dB in such radars.

2/1.12/4.1.1.3 Summary of studies with the radio determination service

Since the frequency band 9 000-9 200 MHz is not retained as candidate band, the frequency band 8 700-9 000 MHz is no longer considered as it would not allow contiguous extension to the current EESS (active) allocation.

ITU-R studies show that in the frequency band 10-10.5 GHz all considered radiolocation radars would be affected with interference levels that significantly exceed the specified I/N threshold value of I/N = -6 dB in the worst case radar location and when the radar is pointing toward EESS SAR with the maximum possible gain and when SAR conducts measurements into the radar location point at times when the distance between SAR and the radar would be minimal. Probable excess would be between 29.3 dB and 74.6 dB. This study shows that threshold maybe exceeded in any moment when SAR is over the radio horizon. The value of exceedance will depend on the location of the radar and measurement points.

Table 2/1.12/4-2 summarizes the overall results of the effects of EESS SAR systems into RDS radar receivers. The percentage of time given in this table is based on the dynamic analyses and its assumptions provided in PDN Report ITU-R RS.[EESS-9GHz_RDS].

In case of multiple SAR systems (number N) operating in the frequency bands 9 200-9 300 MHz and/or 10-10.5 GHz, the probabilities calculated in the studies have to be multiplied by N to obtain the aggregate probability as the probabilities corresponding to each SAR system are statistically uncorrelated.

TABLE 2/1.12/4-2

Summary of studies results

<table>
<tr><th></th><th>9 200-9 300 MHz</th><th>9.3-10 GHz</th><th>10-10.5 GHz</th></tr>
<tr><td>Services affected</td><td>RNS</td><td>RNS/RLS</td><td>RLS</td></tr>
<tr><td>Maximum $I/N_{average}$</td><td>26.8 dB-PG</td><td rowspan="4">Sharing condition already studied before WRC-12 and conclusions still applicable to SAR systems with chirp bandwidth between 600MHz and 1.2 GHz</td><td>68.6 dB-PG</td></tr>
<tr><td>% of time that maximum I/N average occurs (over 11 days)</td><td>0.00001 x N</td><td>0.00001 x N</td></tr>
<tr><td>% of time that I/N_{av}-PG= -6dB is exceeded (over 11 days)</td><td>0.00004 x N</td><td>0.005 x N</td></tr>
<tr><td>% of time that I/N_{av}= -6dB is exceeded (over 11 days)</td><td>Never</td><td>Much lower than 0.005 x N (depending on PG)</td></tr>
<tr><td colspan="4">PG : radar receiver processing gain in dB (the effect of pulsed interference is difficult to quantify and is strongly dependent on radar receiver-processor design and mode of system operation. In general, numerous features of radars can be expected to help suppress low duty-cycle pulsed interference. Techniques for suppression of low-duty-cycle pulsed interference are contained in Recommendation ITU R M.1372 (see also Recommendation ITU-R M.1461 and Report ITU-R M.2081). Report ITU-R RS.2094 shows that such processing gain can be significant).
N : number of wideband SAR satellite systems operating in the considered frequency band</td></tr>
</table>

2/1.12/4.1.2 Sharing between EESS SAR and systems in the fixed service

The conditions for sharing with the FS have already been determined for the frequency band 9 800-9 900 MHz resulting in RR Nos. **5.477** and **5.478B.** Sharing studies have been performed with the FS allocated in the frequency bands 8 700-8 750 MHz and 10-10.5 GHz (see PDN Report ITU-R RS.[EESS-9 GHz FS/MS/AS]).

2/1.12/4.1.2.1 Effect of EESS SAR on systems operating in the fixed service

The studies basically confirm the results obtained in Report ITU-R RS.2094, showing that stations of the FS would be protected with large margins from 16 to 20 dB. Only when the FS station is pointing towards high elevation angles (higher than 35°) and the azimuth pointing angle is around 90° or 270° the fractional degradation performance criterion of 10% would be exceeded, due to main-beam to main-beam coupling possibilities. However, statistics provided to the ITU-R by several administrations for the frequency ranges around 8 GHz and 10/11 GHz indicate that the elevation angle for those frequency bands would not exceed 24°.

ITU-R is still determining an appropriate pfd limit that would protect FS stations. A value needs to be agreed prior to WRC-15.

2/1.12/4.1.2.2 Effect of fixed service stations on systems in the Earth exploration-satellite (active) service

Study results show that the SAR receiver protection criterion would be met with a margin between 8 and 13 dB depending on the frequency band, when considering a deployment of several thousands of FS links. The margin obtained is lower than the margin obtained in Report ITU-R RS.2094 due to the larger number of FS links considered, the SAR mode of operation, as well as the SAR characteristics.

2/1.12/4.1.2.3 Conclusion on compatibility between stations of the fixed service and EESS SAR

Sharing between the EESS (active) and the FS is feasible.

2/1.12/4.1.3 Sharing between EESS SAR and systems operating in the mobile service

The MS is allocated in the frequency bands 8 650-8 750 MHz and 10.0-10.5 GHz and through RR Nos. **5.468** and **5.469** as well as Nos. **5.480** and **5.481** in the upper and lower extension frequency band, respectively. The only usage identified of these frequency bands by the MS is with regard to ENG/OB in the frequency band 10-10.5 GHz.

2/1.12/4.1.3.1 Effect of EESS SAR on systems operating in the mobile service

The studies show that the protection criterion for electronic news gathering/outside broadcasting (ENG/OB), which is limited to a long-term criterion, would be met, due to the low percentage of activity of the SAR system. An additional short-term protection criterion was also considered, and would be also met with margins in the order of 22 dB, even when considering the worst case azimuth and elevation angles up to 40°.

2/1.12/4.1.3.2 Effect of systems operating in the mobile service on EESS SAR

Study results show that the SAR receiver protection criterion would be met with a margin of 16 dB when considering a deployment of several hundreds of ENG/OB transmitting at full power.

2/1.12/4.1.3.3 Conclusion on compatibility between systems in the mobile service and EESS SAR

Sharing between the EESS (active) and the MS is feasible.

2/1.12/4.1.4 Sharing between EESS SAR and stations operating in the amateur and amateur-satellite services

The ARS is allocated in the frequency band 10.0-10.5 GHz and the ARSS in the frequency band 10.45-10.5 GHz. Both services are allocated on a secondary basis.

With regard to the ARS, the study of effect of EESS (active) emissions into amateur station receivers indicates that the interference may exceed an I/N of –6 or –10 dB, but for a very limited period of time in the order of 10 times 4 seconds over 11 days, which in total represents 0.004% of the time.

The study of the impact of amateur transmitters into the SAR receivers shows a margin of 24 dB.

With regard to the ARSS, the study of the influence of an EESS (active) sensor into an amateur-satellite receiving earth station indicates that the interference may exceed an *I/N* of –6 or –10 dB, but for a very limited period of time representing 0.0015% of the total simulation time of 11 days, which represents two periods of about six seconds every five to six days. The studies of the impact of the EESS (active) sensor into the amateur-satellite receiver, as well as of the amateur-satellite transmitter or the amateur earth station transmitter into the SAR receiver indicate very large margins.

2/1.12/4.2 Compatibility studies related to unwanted emissions

2/1.12/4.2.1 Studies on unwanted emissions into stations of the space research service

A total of 15 earth stations are operating in the frequency band 8 400-8 450 MHz under the SRS (deep space) worldwide. There are also earth stations operating in the frequency band 8 450-8 500 MHz under the SRS (near-Earth) in some countries.

Besides sharing with radio services potentially affected by an extension, studies are completed to investigate the compatibility conditions of unwanted emissions from wideband EESS systems into nearby SRS systems in the adjacent frequency band 8 400-8 500 MHz.

Recommendation ITU-R SA.1157 gives the protection criterion of deep space SRS earth stations at –221 dB (W/Hz) for the 8 400-8 450 MHz frequency band. Recommendation ITU-R SA.609 gives the protection criterion of near-Earth SRS earth stations at –216 dB (W/Hz) in the frequency range 1-20 GHz.

Dynamic analyses show that unwanted emissions need to be attenuated by about 77 dB for routine operations of deep space SRS missions, and 31 dB for all operations of near-Earth SRS missions in order to protect SRS systems. Additional 44 dB of attenuation to EESS (active) OOBE is needed to protect SRS (deep space) missions during the critical events.

In addition, unwanted emissions from EESS (active) systems can exceed the SRS receiver damage threshold by:

a) 71 dB if the extension is in the frequency band 8 700-9 300 MHz;

b) 9 dB if the extension is in the frequency bands 9 000-9 300 MHz and the 9 900 MHz-10.2 GHz; and

c) 2 dB if the extension is the frequency band 9.9-10.5 GHz.

Thus, as shown above, damage to the SRS receivers is a serious concern if the additional 600 MHz frequency band is in the entire frequency band 8 700-9 300 MHz.

The attenuation needed to protect SRS (deep space) operations and to protect the SRS receivers from damages should be computed based on the OOB characteristics of actual EESS (active) hardware and not on the theoretical OOB characteristics.

Mitigation techniques have been proposed to avoid any harmful interference to the SRS receivers, particularly during critical events, or to reduce the risk of damaging or saturating the receivers. They are defined in PDN Recommendation ITU-R RS.[EESS9GHz-SRS-Mitigation]. If it is not possible to apply these techniques then sufficient, operational coordination, as described in the same Recommendation, would have to be applied.

2/1.12/4.2.2 Studies on unwanted emissions into stations of the radio astronomy service

There are RAS stations operating in the frequency band 10.6-10.7 GHz in some countries. Threshold levels of interference detrimental to the RAS are given in Recommendation ITU-R RA.769. The threshold for harmful interference in the frequency band 10.6-10.7 GHz with an antenna gain of 0 dBi is the spectral pfd of –240 dB (W/(m² Hz)) for 2 000 s integration time. Recommendation ITU-R RA.1513 recommends a criterion of 2% be used for data loss to radio astronomy observations of the RAS due to interference from any one network for evaluation of interference.

The percentage of data loss was assessed for cases when a SAR-4 system illuminates a RAS observatory whenever a satellite is in visibility of the RAS station. The percentage of data loss, under technically feasible attenuation conditions rejecting unwanted emissions in the order of 30 to 40 dB, may exceed the 2% criterion in the first worst case situation; but it would never and under any circumstances exceed 2.7%.

Reducing the data loss to 2%, as required by Recommendation ITU-R RA.1513, would make it necessary to attenuate the unwanted emissions by 63 dB with regard to the peak envelope power of the SAR pulse. If this would be impossible, particularly in the case of an extension into frequencies above the current allocation, additional mitigation techniques would become necessary. One of these possible mitigation techniques would consist in limiting the number of image acquisitions of areas where RAS observatories performing observations in the 10.6-10.7 GHz frequency band are located.

Accidental damage to the RAS receiver can be avoided, if an area of up to 28.1 km (vertical) by 9.6 km (horizontal) centred on the RAS station is excluded from illumination, or if the RAS station avoids pointing towards the satellite, or to four angular sectors while the satellite is visible.

The method to avoid damage is described in PDN Recommendation ITU-R RS.[EESS9GHz-RAS-Mitigation]. It should be noted that the application of this Recommendation will also solve the problem of the exceedance of the 2% of data loss to radio astronomy observations.

Study results are provided in DN Report ITU-R RS.[EESS-9GHz_OOBE].

2/1.12/4.2.3 Studies on unwanted emissions into stations of the Earth exploration-satellite (passive) and space research (passive) services

The SRS (passive) and the EESS (passive) are also allocated in the frequency band 10.6-10.7 GHz. As SRS (passive) systems are sensors used around other planets, no interference to stations of the SRS (passive) would be possible from space borne SARs, thus, no study required.

Microwave radiometers and microwave radiometer imagers are operating in meteorological satellites under the EESS (passive) in this frequency band in some countries. Recommendation ITU-R RS.2017 provides performance and interference criteria for satellite passive remote sensing. The permissible interference power received by an EESS (passive) sensor is −166 dBW in the reference bandwidth of 100 MHz in the frequency band 10.6-10.7 GHz.

The effect of unwanted emissions of SAR systems using high resolution spotlight mode, which are operated for very small fractions of time, into EESS (passive) sensors used in the frequency band 10.6-10.7 GHz has been analysed. Due to the attenuation of unwanted emissions, as well as the difference in orbital characteristics of SAR systems compared to EESS (passive) systems, no effect is expected in EESS (passive) sensors and no specific regulatory conditions would be required.

Study results are provided in DN Report ITU-R RS.[EESS-9GHz_OOBE].

2/1.12/5 Methods to satisfy the agenda item

2/1.12/5.1 Method A: Primary Earth exploration-satellite (active) service allocation in the frequency band 9 900-10 500 MHz

2/1.12/5.1.1 Method A1: Add a primary allocation to the Earth exploration-satellite (active) service in the frequency band 9 900-10 500 MHz

This method would impose that EESS (active) shall not cause harmful interference to, nor claim protection from the RLS allocated in the frequency band 9 900-10 500 MHz. In addition, the extension frequency band shall only be used by EESS (active) systems requiring a bandwidth greater than 600 MHz that cannot be accommodated in the frequency band 9 300-9 900 MHz. The protection of RAS stations in the frequency band 10.6-10.7 GHz will be ensured through ITU-R Recommendation incorporated by reference in the RR.

Advantages

– Resolution for spaceborne radars with synthetic aperture will be higher to satisfy global monitoring of environment and increase of mapping system resistance to interference and weather condition changes.

– Provides additional 600 MHz primary allocation for the EESS (active) to be used by EESS (active) systems that need a bandwidth wider than the bandwidth available within the existing allocation in the frequency band 9 300-9 900 MHz.

– Provides an explicit requirement for protection of RLS stations by a footnote like the current RR No. **5.476A**.

Disadvantages

– None

2/1.12/5.1.2 Method A2: Add a primary Earth exploration-satellite (active) service allocation in the frequency band 9 900-10 500 MHz subject to inclusion of technical and regulatory constraints into the Radio Regulations

Make a primary EESS (active) allocation in the frequency band 9 900-10 500 MHz subject to inclusion of technical and regulatory constraints into the RR to ensure protection for the RLS and the FS having allocations in this frequency band. The protection of FS stations is to be ensured through a provision in the RR with a pfd-limit. The protection of RAS stations in the frequency band 10.6-10.7 GHz will be ensured through ITU-R Recommendation incorporated by reference in the RR.

In addition, the extension frequency band shall only be used by EESS (active) systems requiring a bandwidth greater than 600 MHz that cannot be accommodated in the frequency band 9 300-9 900 MHz.

Advantages

– Resolution for spaceborne radars with synthetic aperture will be higher to satisfy global monitoring of environment and increase of mapping system resistance to interference and weather condition changes.

– Provides additional 600 MHz primary allocation for the EESS (active) to be used by EESS (active) systems that need a bandwidth wider than the bandwidth available within the existing allocation in the frequency band 9 300-9 900 MHz.

– Provides an explicit requirement for protection of RLS stations by a footnote like the current RR No. **5.476A**.

– It specifies provisions for the protection of FS stations.

Disadvantages

– Depending on the value of the pfd limit for the protection of FS stations may put undue constraints on EESS SARs.

2/1.12/5.2 Method B: Primary Earth exploration-satellite (active) service allocation in the frequency bands 9 200-9 300 MHz and 9 900-10 400 MHz

Add a primary allocation to the EESS (active) in the frequency bands 9 200-9 300 MHz and 9 900-10 400 MHz. This method would impose that systems of the EESS (active) shall not cause harmful interference to, nor claim protection from the RDS systems using allocations in the frequency bands 9 200-9 300 MHz and 9 900-10 400 MHz. In addition, the extension frequency band shall only be used by EESS (active) systems requiring a bandwidth greater than 600 MHz that cannot be accommodated in the frequency band 9 300-9 900 MHz. The protection of RAS stations in the frequency band 10.6-10.7 GHz will be ensured through ITU-R Recommendation incorporated by reference in the RR.

Advantages

– Resolution for spaceborne radars with synthetic aperture will be higher to satisfy global monitoring of environment and increase of mapping system resistance to interference and weather condition changes.

– Provides additional 600 MHz primary allocation for the EESS (active) to be used by EESS (active) systems that need a bandwidth wider than the bandwidth available within the existing allocation in the frequency band 9 300-9 900 MHz.

– Provides an explicit requirement for protection of RLS and RNS stations by a footnote like the current RR No. **5.476A**.

Disadvantages

– None

2/1.12/6 Regulatory and procedural considerations

2/1.12/6.1 Method A - Primary Earth exploration-satellite (active) service allocation in the frequency band 9 900-10 500 MHz

2/1.12/6.1.1 Method A1: Add a primary allocation to the Earth exploration-satellite (active) service in the frequency band 9 900-10 500 MHz

ARTICLE 5

Frequency allocations

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

MOD

8 500-10 000 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
9 900-10 000	EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 RADIOLOCATION Fixed 5.477 5.478 5.479 ADD 5.B112 ADD 5.C112	

Reasons: Provides an additional 600 MHz allocation to the EESS (active) for high resolution SARs as requested by Resolution **651 (WRC-12)** and justified in Report ITU-R RS.2274.

MOD

10-11.7 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
10-10.45 EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 FIXED MOBILE RADIOLOCATION Amateur 5.479 ADD 5.B112 ADD 5.C112	**10-10.45** EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 RADIOLOCATION Amateur 5.479 5.480 ADD 5.B112 ADD 5.C112	**10-10.45** EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 FIXED MOBILE RADIOLOCATION Amateur 5.479 ADD 5.B112 ADD 5.C112
10.45-10.5	EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 RADIOLOCATION Amateur Amateur-satellite 5.481 ADD 5.B112 ADD 5.C112	
…		

Reasons: Provides an additional 600 MHz allocation to the EESS (active) for high resolution SARs as requested by Resolution **651 (WRC-12)** and justified in Report ITU-R RS.2274.

ADD

5.A112 The use of the frequency band 9 900-10 500 MHz by the Earth exploration-satellite (active) service is limited to systems requiring a necessary bandwidth greater than 600 MHz that cannot be fully accommodated within the 9 300-9 900 MHz frequency band. (WRC-15)

Reasons: To limit the number of systems as well as the duration of transmission of SAR systems in the extension frequency band.

ADD

5.B112 In the frequency band 9 900-10 500 MHz, stations in the Earth exploration-satellite (active) service shall not cause harmful interference to, nor claim protection from, stations of the radiolocation service. (WRC-15)

Reasons: The EESS (active) primary allocation is made secondary with regard to the RLS allocation in this frequency band, to ensure protection of stations of this service from harmful interference.

ADD

5.C112 Space stations operating in the Earth exploration-satellite (active) service shall comply with Recommendation ITU-R RS.[EESS9GHz-RAS-Mitigation]. (WRC-15)

Reasons: It ensures protection of RAS stations in the frequency band 10.6-10.7 GHz.

SUP

RESOLUTION 651 (WRC-12)

Possible extension of the current worldwide allocation to the Earth exploration-satellite (active) service in the frequency band 9 300-9 900 MHz by up to 600 MHz within the frequency bands 8 700-9 300 MHz and/or 9 900-10 500 MHz

Reasons: The extension by 600 MHz has been approved by WRC-15.

2/1.12/6.1.2 Method A2: Add a primary Earth exploration-satellite (active) service allocation in the frequency band 9 900-10 500 MHz subject to inclusion of technical and regulatory constraints into the Radio Regulations

ARTICLE 5

Frequency allocations

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

MOD

8 500-10 000 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
9 900-10 000	EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 RADIOLOCATION Fixed 5.477 5.478 5.479 ADD 5.B112 ADD 5.C112 ADD 5.D112	

Reasons: Provides an additional 600 MHz allocation to the EESS (active) for high resolution SARs as requested by Resolution **651 (WRC-12)** and justified in Report ITU-R RS.2274.

MOD

10-11.7 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
10-10.45 EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 FIXED MOBILE RADIOLOCATION Amateur 5.479 ADD 5.B112 ADD 5.C112 ADD 5.D112	**10-10.45** EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 RADIOLOCATION Amateur 5.479 5.480 ADD 5.B112 ADD 5.C112 ADD 5.D112	**10-10.45** EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 FIXED MOBILE RADIOLOCATION Amateur 5.479 ADD 5.B112 ADD 5.C112 ADD 5.D112
10.45-10.5	EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 RADIOLOCATION Amateur Amateur-satellite 5.481 ADD 5.B112 ADD 5.C112 ADD 5.D112	
…		

Reasons: Provides an additional 600 MHz allocation to the EESS (active) for high resolution SARs as requested by Resolution **651 (WRC-12)** and justified in Report ITU-R RS.2274.

ADD

5.A112 The use of the frequency band 9 900-10 500 MHz by the Earth exploration-satellite (active) service is limited to systems requiring a necessary bandwidth greater than 600 MHz that cannot be fully accommodated within the 9 300-9 900 MHz frequency band. (WRC-15)

Reasons: To limit the number of systems as well as the duration of transmission of SAR systems in the extension frequency band.

ADD

5.B112 In the frequency band 9 900-10 500 MHz, stations in the Earth exploration-satellite (active) service shall not cause harmful interference to, nor claim protection from, stations of the radiolocation service. (WRC-15)

Reasons: The EESS (active) primary allocation is made secondary with regard to the RDS allocations in these frequency bands, to ensure protection of systems of these services from harmful interference.

ADD

5.C112 Space stations operating in the Earth exploration-satellite (active) service shall comply with Recommendation ITU-R RS.[EESS9GHz-RAS-Mitigation]. (WRC-15)

Reasons: It ensures protection of RAS stations in the frequency band 10.6-10.7 GHz.

ADD

5.D112 In order to protect the systems of the fixed service the power flux-density values produced on the surface of the Earth by a space station of the Earth exploration-satellite (active) service shall not exceed xxx(*) dB(W/m^2) in any 1 MHz of the frequency band 9 900-10 500 MHz for any angle of arrival, assuming free-space propagation conditions. (WRC-15)

Note: (*) value has to be defined prior to WRC-15.

Reasons: It ensures protection of FS stations in the frequency band 9 900-10 500 MHz.

SUP

RESOLUTION 651 (WRC-12)

Possible extension of the current worldwide allocation to the Earth exploration-satellite (active) service in the frequency band 9 300-9 900 MHz by up to 600 MHz within the frequency bands 8 700-9 300 MHz and/or 9 900-10 500 MHz

Reasons: The extension by 600 MHz has been approved by WRC-15.

2/1.12/6.2 Method B - Primary Earth exploration-satellite (active) service allocations in the frequency bands 9 200-9 300 MHz and 9 900-10 400 MHz

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

(See No. **2.1**)

MOD

8 500-10 000 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…		
9 200-9 300	EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 RADIOLOCATION MARITIME RADIONAVIGATION 5.472 5.473 5.474 ADD 5.B112 ADD 5.D112 ADD 5.E112	
…		
9 900-10 000	EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 RADIOLOCATION Fixed 5.477 5.478 5.479 ADD 5.C112 ADD 5.D112	

Reasons: Provides an additional 600 MHz allocation to the EESS (active) for high resolution SARs as requested by Resolution 651 (WRC-12) and justified in Report ITU-R RS.2274.

MOD

10-11.7 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
10-10.4~~5~~ EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 FIXED MOBILE RADIOLOCATION Amateur 5.479 ADD 5.C112 ADD 5.D112	**10-10.4~~5~~** EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 RADIOLOCATION Amateur 5.479 5.480 ADD 5.C112 ADD 5.D112	**10-10.4~~5~~** EARTH EXPLORATION-SATELLITE (active) ADD 5.A112 FIXED MOBILE RADIOLOCATION Amateur 5.479 ADD 5.C112 ADD 5.D112
~~10~~-10.4-10.45 FIXED MOBILE RADIOLOCATION Amateur ~~5.479~~	**~~10~~10.4-10.45** RADIOLOCATION Amateur ~~5.479~~ 5.480	**~~10~~10.4-10.45** FIXED MOBILE RADIOLOCATION Amateur ~~5.479~~
…		

Reasons: Provides an additional 600 MHz allocation to the EESS (active) for high resolution SARs as requested by Resolution 651 (WRC-12) and justified in Report ITU-R RS.2274.

ADD

5.A112 The use of the frequency bands 9 200-9 300 MHz and 9 900-10 400 MHz by the Earth exploration-satellite (active) service is limited to systems requiring a necessary bandwidth greater than 600 MHz that cannot be fully accommodated within the 9 300-9 900 MHz frequency band. (WRC-15)

Reasons: To limit the number of systems as well as the duration of transmission of SAR systems in the extension frequency band.

ADD

5.B112 In the frequency band 9 200-9 300 MHz, stations in the Earth exploration-satellite (active) service shall not cause harmful interference to, nor claim protection from, stations of the radionavigation and radiolocation services. (WRC-15)

ADD

5.C112 In the frequency band 9 900-10 400 MHz, stations in the Earth exploration-satellite (active) service shall not cause harmful interference to, nor claim protection from, stations of the radiolocation service. (WRC-15)

Reasons: The EESS (active) primary allocation is made secondary with regard to the RDS allocations in these frequency bands, to ensure protection of stations of these services from harmful interference.

ADD

5.D112 Space stations operating in the Earth exploration-satellite (active) service shall comply with Recommendation ITU-R RS.[EESS9GHz-RAS-Mitigation]. (WRC-15)

Reasons: It ensures protection of RAS stations in the frequency band 10.6-10.7 GHz.

ADD

5.E112 Space stations operating in the Earth exploration-satellite (active) service shall comply with Recommendation ITU-R RS.[EESS9GHz-SRS-Mitigation]. (WRC-15)

Reasons: It ensures protection of SRS systems in the frequency band 8 400-8 500 MHz.

SUP

RESOLUTION 651 (WRC-12)

Possible extension of the current worldwide allocation to the Earth exploration-satellite (active) service in the frequency band 9 300-9 900 MHz by up to 600 MHz within the frequency bands 8 700-9 300 MHz and/or 9 900-10 500 MHz

Reasons: The extension by 600 MHz has been approved by WRC-15.

AGENDA ITEM 1.13

(WP 7B / WP 5A, WP 5C)

1.13 to review No. ***5.268*** *with a view to examining the possibility for increasing the 5 km distance limitation and allowing space research service (space-to-space) use for proximity operations by space vehicles communicating with an orbiting manned space vehicle, in accordance with Resolution* ***652 (WRC-12)****;*

Resolution **652 (WRC-12)**: *Use of the band 410-420 MHz by the space research service (space-to-space)*

2/1.13/1 Executive summary

Resolution **652 (WRC-12)** calls for studies between SRS (space-to-space) systems communicating in proximity with orbiting manned space vehicles and systems operating in the fixed and mobile (except aeronautical mobile) services in the band 410-420 MHz. WRC-15 is called to review RR No. **5.268** with a view to examine the possibility for increasing the 5 km distance limitation and allowing space research service (space-to-space) use for proximity operations by space vehicles communicating with an orbiting manned space vehicle.

Sharing studies between stations of the SRS (space-to-space) and stations of the FS and MS in the band 410-420 MHz have been completed. These studies found that the protection criteria specified in RR No. **5.268** can be met without a distance limitation on SRS use of proximity operations.

Taking into account the results of sharing studies, one method has been proposed to satisfy this agenda item. This method proposes relevant modifications to RR No. **5.268** to remove the 5 km distance limitation and not solely limit the use of the frequency band for extra-vehicular activities. Taking into account that studies required by Resolution **652 (WRC-12)** have been completed this resolution should be suppressed.

2/1.13/2 Background

The band 410-420 MHz is used today for communications by astronauts conducting extra-vehicular activities (EVA) operations in the immediate vicinity of the International Space Station. Use of this frequency band for proximity operations by vehicles approaching the International Space Station or other manned space vehicles would be advantageous as the propagation and physical properties of this frequency range enable favourable coverage performance in the highly multipath environment of the International Space Station. The 5 km limit was agreed during WARC-92 when the envisioned use of the band was limited to free floating astronauts working in the rear vicinity of a manned space vehicle. The addition of power flux-density (pfd) limits by WRC-97 provided a primary allocation for SRS (space-to-space) uses as specified in RR No. **5.268** while ensuring the protection of systems operating in the FS and MS. Vehicles approaching the International Space Station, whether manned or robotic, need to communicate over a longer distance to provide safe operations during docking manoeuvres. It is therefore necessary to modify RR No. **5.268** to remove the 5 km limitation and EVA use limitation while maintaining the current pfd limits.

2/1.13/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Existing relevant ITU-R Reports and Recommendations: Report ITU-R SA.2162.

New relevant ITU-R Report: ITU-R SA.2271.

The ITU-R has developed Report ITU-R SA.2271 on sharing and compatibility studies between space research proximity operations links and FS and MS links in the 410-420 MHz frequency band. The report describes technical parameters and operational characteristics of SRS systems employed for proximity operations and provides a compatibility analysis between SRS communication links and links of the FS and MS. The results of this analysis show that the pfd produced by transmitters of space vehicles communicating with an orbiting manned space vehicle at the surface of the Earth do not exceed limits specified in RR No. **5.268** at distances much greater than 5 km.

2/1.13/4 Analysis of the results of studies

The studies show that the pfd limits specified in RR No. **5.268** can be met by SRS (space-to-space) systems communicating in proximity with orbiting manned space vehicles at distances beyond 5 km that ensures protection of systems operating in the FS and MS, independent of distance from, or the source of, space-to-space communications in the SRS.

2/1.13/5 Method(s) to satisfy the agenda item

One method is proposed to satisfy this agenda item.

The proposed method is to modify RR No. **5.268** to remove the 5 km distance limitation and not solely limit the use of the frequency band 410-420 MHz for extra-vehicular activities. Also Resolution **652 (WRC-12)** should be consequentially suppressed.

Advantages:

– This method would allow vehicles approaching a manned space vehicle (e.g. the International Space Station), whether manned or robotic, to communicate over longer distances to ensure safe operations and docking manoeuvres.

– This method will allow for further development of space facilities to allow for increased support of many of the planned and envisioned space activities.

– This method will ensure protection of FS and MS systems.

Disadvantages:

– None.

2/1.13/6 Regulatory and procedural considerations

ARTICLE 5

Frequency allocations

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

MOD

410-460 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
410-420	FIXED MOBILE except aeronautical mobile SPACE RESEARCH (space-to-space) MOD 5.268	

MOD

5.268 Use of the frequency band 410-420 MHz by the space research service is limited to space-to-space communications with ~~within 5 km of~~ an orbiting, manned space vehicle. The power flux-density at the surface of the Earth produced by emissions from ~~extra-vehicular activities~~ transmitting stations of the space research service (space-to-space) in the frequency band 410-420 MHz shall not exceed –153 dB(W/m^2) for 0° ≤ δ ≤ 5°, –153 + 0.077 (δ – 5) dB(W/m^2) for 5° ≤ δ ≤ 70° and –148 dB(W/m^2) for 70° ≤ δ ≤ 90°, where δ is the angle of arrival of the radio-frequency wave and the reference bandwidth is 4 kHz. ~~No. **4.10** does not apply to extra-vehicular activities.~~ In this frequency band stations of the space research (space-to-space) service shall not claim protection from, nor constrain the use and development of, stations of the fixed and mobile services. No. **4.10** does not apply. (WRC-15~~97~~)

SUP

RESOLUTION 652 (WRC-12)

Use of the band 410-420 MHz by the space research service (space-to-space)

AGENDA ITEM 1.14

(**WP 7A/WP 6A**, (WP 6B))

1.14 to consider the feasibility of achieving a continuous reference time-scale, whether by the modification of coordinated universal time (UTC) or some other method, and take appropriate action, in accordance with Resolution ***653 (WRC-12)****;*

Resolution **653 (WRC-12):** *Future of the Coordinated Universal Time time-scale.*

2/1.14/1 Executive summary

Resolution **653 (WRC-12)** invites ITU-R to conduct necessary studies on the feasibility of achieving a continuous reference time-scale for dissemination by radiocommunication systems and issues related to possible implementation of a continuous reference time-scale (including technical and operation factors).

Coordinated Universal Time (UTC) is the international standard reference time-scale for all practical timekeeping in the modern world. The UTC time-scale is maintained by the International Bureau of Weights and Measures (BIPM). UTC and its use are defined in Recommendation ITU-R TF.460-6, which is incorporated by reference in the Radio Regulations. According to this Recommendation “The UTC is adjusted by insertion or deletion of seconds (positive or negative leap-seconds) to ensure approximate agreement with UT1”[20]. Adjustment of UTC is made whenever the difference between UTC and UT1 approaches the value of 0.9 second. A positive or negative leap-second should be the last second of a UTC month, but first preference should be given to the end of December and June, and second preference to the end of March and September. As UT1 is based on measurements the adjustments in UTC occur at irregular intervals and require manual intervention in systems using UTC for operation and synchronization.

Various aspects of the current situation and the advantages and disadvantages of introducing a continuous time-scale were analysed in ITU-R studies under WRC-15 agenda item 1.14.

Three methods are proposed to satisfy the agenda item:

- Remove the leap second insertion or deletion from the definition of UTC in order to provide a continuous time-scale and either retain the name UTC or adopt a new name.
- Keep the current definition of UTC, disseminate UTC time-scale and also disseminate continuous time-scale on an equal basis.
- Keep the current definition of UTC and enable the recovery of the International Atomic Time (TAI)[21] from the current implementation of UTC or use a continuous system time-scale.

2/1.14/2 Background

UTC was originally approved by the International Radio Consultative Committee (CCIR) in Recommendation 374 of 1963 as the basis for the coordinated broadcast of standard frequency

[20] UT1 is the Universal Time based on the rotation of the Earth. This is the mean solar time of the prime meridian obtained from direct astronomical observations corrected taking into account the effects of small movements of the Earth relative to the axis of rotation (polar variations).

[21] Definition of TAI is provided in Recommendation ITU-R TF.460-6.

and time signals on allocated frequencies. At that time, frequency offsets and time steps in UTC were inserted as needed in broadcast time signals to closely match UTC with the observed rotational speed of the Earth. CCIR approved in 1970 a modified version of Recommendation 374 introducing one-second adjustments in UTC, which provides the basis for its current definition. These adjustments entered into force on 1 January1972. Later CCIR Recommendation 374 was converted into Recommendation ITU-R TF.460. Recommendation ITU-R TF.460-6, which is incorporated by reference in the Radio Regulations, provides the definition of UTC and its use. The UTC time-scale is maintained by the International Bureau of Weights and Measures (BIPM) from data provided by timing laboratories throughout the world that operate atomic clocks and data from the International Earth Rotation and Reference Systems Service (IERS) that determines the rotation angle of the Earth. It is based on the second of the International System of Units (SI). UTC is a critical part of the international infrastructure that requires accurate timing information.

A significant amount of telecommunication and information systems rely on UTC for synchronization since the introduction of leap seconds more than forty years ago. It should be highlighted that several of these systems are in use for safeguarding and rescue of human life.

In 2000 some administrations expressed concerns about the implementation of the leap second and proposed to carry out studies on the future of the UTC time-scale. The relevant studies were conducted by ITU-R during the 2003-2007 and 2007-2012 study cycles. Proposals were made to revise Recommendation ITU-R TF.460-6 by eliminating the leap second from the definition of UTC in order to achieve a continuous time-scale.

However, as there were conflicting views on the draft revision of Recommendation ITU-R TF.460-6, the draft was sent to the Radiocommunication Assembly 2012 (RA-12) with a description of the difficulties encountered during the studies. RA-12 considered this draft that prompted extensive discussion during which a large number of administrations indicated they needed more time and information to form an opinion.

As a result, RA-12 agreed to return this draft to ITU-R for further study of other technical options in addition to those already considered. Moreover, it was noted that these additional studies should take account of broader implications and include consultations with appropriate external organizations. Further, RA-12 decided to raise this matter in its Report to WRC-12, with a view to WRC-12 considering the development of an agenda item on this topic for WRC-15. As a result WRC-15 agenda item 1.14 was adopted and ITU-R is invited to carry out the relevant studies in accordance with Resolution **653 (WRC-12)**.

2/1.14/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Recommendations: ITU-R TF.460-6, ITU-R TF.486-2, ITU-R TF.535-2, ITU-R TF.686-2, ITU-R TF.1876.

New relevant ITU-R Report: WDPDN Report TF.[ITU/BIPM Workshop on Future UTC].

One of the original purposes of leap seconds was to make UTC an approximation to UT1 for celestial navigation. UTC time signals are disseminated to users by different systems of radiocommunication services. Since UT1, which is based on the rotation of the Earth, is not uniform due to the slowing down of the Earth rotation and at the same time UTC is based on TAI where the duration of the second is constant. The original purpose of leap seconds was to make UTC an approximation to UT1 by inserting or deleting a second when the divergence between UT1 and UTC is more than 0.9 s. Taking into account that celestial navigation is rarely used today and that the difference between UTC and UT1 is readily available with greater precision than the disseminated UTC values, it was proposed to revise Recommendation ITU-R TF.460-6 and make UTC a continuous time-scale by eliminating insertion or deletion of leap seconds.

Leap seconds since their introduction were inserted 25 times. During 2003-2012 study cycles ITU-R invited the involved parties (administrations, agencies and institutions) to share their experience related to leap seconds insertion in December 2005 and December 2008.

Three surveys were conducted on this issue: one through the BR Director letter (2005) initiated by a note during relevant ITU-R studies to the involved parties and two by questionnaires submitted to the ITU-R Sector Members were published in Administrative Circulars(CACE/516 in 2010 and CACE/539 in 2011). The latest CACE/539 posed the following questions to the ITU Member States:

- Do you support maintaining the current arrangement of linking UT1 and UTC (to provide an approximate celestial time reference by the use of a stepped atomic time-scale)?
- Would you support the revision of Recommendation ITU-R TF.460-6 to provide a continuous time-scale?

The ITU-R received replies from 16 different Member States. The reasons generally given in favour of the elimination of the leap seconds were:

- Use of leap seconds is not suitable for new technologies.
- The value of the predicted difference DUT1=UT1-UTC is readily available from multiple sources at higher accuracy than is currently provided in radio broadcasts.
- Documented problems exist with the introduction of leap seconds including ambiguity about the date.

The reasons given for not modifying the current definition of UTC and retaining the concept of the leap seconds were:

- Historical justifications like not breaking the link between UTC and the Earth rotation.
- Not experiencing significant difficulties with the introduction of leap seconds.
- Insufficient evidence of any other technical problems.

As decided by WRC-12, Resolution **653 (WRC-12)** was brought to the attention of IMO, ICAO, CGPM, CCTF, BIPM, IERS, IUGG, URSI, ISO, WMO and IAU and their views and/or positions (if any) were considered by ITU-R and reflected in the relevant parts of this report.

2/1.14/4 Analysis of the results of studies

The main issues studied under WRC-15 agenda item 1.14 and conclusions related to these issues are provided in the following subsections.

2/1.14/4.1 Reported incidents

ITU-R was informed that introduction of leap seconds in December 1998, December 2005 and December 2008 created some difficulties including some irregularities in the dissemination of the leap second. In addition some administrations informed ITU-R about difficulties encountered in 2012 as the inevitable reliance on human factor in the implementation of the leap second in digital systems entails a risk.

Among the events that happened during the introduction of the leap second the following ones were widely publicized:

- multiple network servers failed because of the leap second with economic implications for the companies;
- a major internet service avoided potential disruption caused by the leap second by gradually adding milliseconds to its system clocks over the course of the day rather than adding an entire second at one time;
- the application A-GPS (Assisted Global Positioning System) showed on July 1st an error in position by approximately 500 m roughly corresponding to the distance travelled by the Earth in 1 s. A simple update of the A-GPS software on July 1st solved the problem;
- some GPS receiving equipment reportedly experienced temporary failures.

It should be noted that impacts of the leap second in regions of the East where it occurs during working hours can be more significant if it occurs on days other than 1 January and Sundays.

NASA Jet Propulsion Laboratory estimated the cost of implementation of the 30 June 2012 leap second event at about four work months.

2/1.14/4.2 Negative impact of suppressing the leap second in UTC on systems

In the event of transition to a continuous time-scale access to UT1 or to an approximation would be continued. The growing offset between UT1 and UTC should be distributed and a process for correction implemented in systems that require it.

As the difference between UT1and UTC will be higher than the current limit of 0.9 s specified in Recommendation ITU-R TF.460-6 consequences caused by software failures or human factors could be greater.

Backward compatibility will not be ensured in cases where current equipment (for example, some earth stations of non-GSO satellite systems, some observatories and some radio-navigation systems) will not operate without update or replacement. This problem arises because these systems would no longer be able to use UTC as an approximation of UT1 since they are not designed to use a value of DUT1 larger than 0.9 s. The message structure transmitted by the systems usually has finite register capacity. Since the DUT1 correction value is continuously increasing, it will not be registered correctly. Therefore it will be necessary to change or update the software and possibly the hardware which will lead to costs.

It will be necessary to modify some legal and technical documents on both the international and national levels where they refer to the UTC time-scale as currently defined.

Currently the GLONASS radionavigation-satellite system implements leap seconds in its system time, this is done simultaneously with the UTC time-scale which is currently defined in Recommendation ITU-R TF.460-6. For 30 years of operation a large number of equipment has been designed for insertion of leap seconds. In addition some equipment such as the spaceborne receivers cannot be updated during its operational life. The design lifetime of these spacecraft is more than 10 years and the GLONASS system will need to keep the existing system time with leap second to ensure operation for the existing equipment.

For the purpose of celestial navigation ephemeris tables will need to take into account the fact that UTC will not be an adequate approximation of UT1 anymore.

2/1.14/4.3 Positive impact of suppressing the leap second in UTC on systems

Some systems requiring highly precise time and frequency applications and synchronization such as space geodesy, satellite launching, GNSSs, telecommunications and electric power distribution networks have requested continuous time-scales. The adoption of a continuous reference time-scale will discourage the use of different system times as a reference time.

Some GNSSs do not apply leap seconds to their individual system times in order to avoid potential disruption.

Suppression of leap seconds avoids a costly insertion and testing of equipment process, reduces the risk of operator error and increases the reliability of systems that depend upon time. For example, some systems such as time stamping will not need to be taken out of service several hours before and after the event to prevent operational mishaps.

2/1.14/4.4 Requirements for access to UT1 and impact on civil time

The predicted values of UT1-UTC that give continued access to time based on the Earth's rotation angle, UT1, are provided by IERS. This service will continue to provide this information even in event of the suppression of the leap second in UTC. Some communities such as astronomers, geodesists or navigators will have continued access to UT1.

This information is currently available through the IERS bulletin service.

Discontinuing the insertion of leap second will mean a civil time-scale would deviate from UT1. However due to the elliptical orbit of the Earth around the Sun and the angle between the Earth's equator and the plane of its orbit, the apparent solar time can differ already by some ±16 minutes from the mean solar time. Furthermore in most countries clock time may differ from mean solar time by up to one hour because of time zones and Daylight Saving Time. In some cases an entire country uses a single time zone although its territory covers many, so the difference between solar and civil time can be even greater. These conventions are considered acceptable and should remain so as it is expected that UT1 - UTC should be on the order of 1 min in the first hundred years. One study predicts a deviation of about 25 minutes in 500 years.

Views of administrations differ as to whether this will have any noticeable effect on humankind in the next centuries.

2/1.14/4.5 Considerations on retaining the name of UTC if a modified definition is adopted

The term "Coordinated" in the name "Coordinated Universal Time (UTC)" refers to the fact that this time-scale is "coordinated" among national timing agencies.

Some administrations consider that the term "Universal" in the name refers to the fact that the UTC time-scale is the same everywhere on Earth and that in this context use of the term "Universal" does not imply "solar" time. Other administrations consider that the term Universal Time in the name UTC does imply solar time and that the name should be changed if the insertion of leap seconds in UTC is ended.

UTC has been in existence since 1961 with corrections in the form of rate offsets and time steps. In 1972, when the current definition of UTC was adopted in favour of one-second steps, the name of the time-scale was not changed.

Some administrations indicate that a new name should be adopted in order to avoid confusion. They also note that ISO TC 37 has stated that retaining the name UTC with a new definition would result in polysemy, i.e. having multiple meanings and therefore being ambiguous. They consider that contravenes the principles of standards making.

Other administrations indicate that if leap seconds are eliminated from UTC, the name UTC should be retained to avoid confusion in particular since the term UTC has legal implications in many countries. They consider retaining the name as consistent with metrological standards and accepted practice.

2/1.14/4.6 Considerations for achieving a continuous reference time-scale

One possible approach would be to broadcast a continuous atomic time-scale as a reference along with the current UTC. This could be a solution for systems requiring a continuous time-scale and for systems requiring UTC as it is currently defined.

It should be noted however that the feasibility of disseminating two reference time-scales in parallel still needs to be assessed. It would be critical to distinguish between the two reference time-scales in a truly fail-safe manner in order to avoid confusion. This will require the modification of application software and hardware in order to differentiate between the two time-scales and may be cumbersome.

It should be noted that a continuous reference time-scale can be computed currently making use of the difference between TAI and UTC.

2/1.14/5 Methods to satisfy the agenda item

2/1.14/5.1 Method A

2/1.14/5.1.1 Method A1

A continuous reference time-scale is feasible and it can be achieved by stopping the insertion of leap seconds in UTC. To allow for an adequate period of time for those legacy systems reliant on the use of leap seconds to adapt to the change in UTC, the application of the suppression of leap second adjustments to UTC will be effective no less than five years after the date of entry into force of the Final Acts of the WRC-15.

For applications requiring knowledge of UT1 the difference between UT1 and UTC will continue to be provided by IERS with a much higher precision than that available from present broadcast UTC.

The name of UTC will be retained.

Advantages

UTC without leap seconds will represent a continuous reference time-scale and will encourage the use of only one continuous reference time-scale making it truly universal. This will avoid the proliferation of other time-scales that may cause serious confusion, and contribute to the interoperability between systems.

Suppression of the use of leap seconds in UTC eliminates software, protocols, and coordination necessary to accommodate leap seconds in systems.

As the definition of UTC was changed in the past and the name UTC was kept unchanged, some administrations consider that the continued use of the name “Coordinated Universal Time” will avoid confusion and maintain consistency, as UTC will continue to be “universally” used and “coordinated” worldwide.

Disadvantages

The time difference between UTC without further insertion or deletion of leap seconds and UT1 will increase beyond the current limit of 0.9 s.

Some legacy systems currently relying on the use of leap seconds in UTC will not be able to adapt to the new definition of UTC without manual intervention to insert corrections regularly. For example data formats that assume that UT1-UTC will never be greater than one second will need to be changed to comply with the increasing difference between UT1 and UTC.

For legacy systems relying on the use of leap seconds in UTC it will be necessary to change or update the software and in some cases also the hardware operating these systems (backward compatibility is not ensured) which will lead to costs. Failure of these systems and some new systems relying on UT1 caused by inadequate software or human factors could increase.

Keeping the name UTC for the revised time-scale would result in apparent polysemy (ambiguity). It could become unclear whether the term UTC refers to the old definition with leap seconds or the new definition without further insertion of leap seconds.

Some administrations consider that the name Coordinated Universal Time should not be retained for a time-scale without leap seconds that would no longer be aligned closely with Universal Time.

Some technical documents will need to be amended to reflect the change in the definition of UTC.

A view was expressed that deletion of reference in RR No**. 1.14** to Recommendation ITU-R TF.460-6 in the example of Method A1will create confusion in the definition of UTC.

2/1.14/5.1.2 Method A2

This method is similar to Method A1 but it is proposed to change the name of UTC.

Advantages

The same as for Method A1. In addition changing the name of the revised time-scale avoids the apparent polysemy, which would result from Method A1. Changing the name of the revised time-scale ensures that it is always clear which time-scale is being referred to.

As UTC would no longer be aligned closely with UT1, some administrations consider that changing the name of the revised time-scale avoids a nomenclature/consistency problem.

Disadvantages

Similar to those described in Method A1 except polysemy. It will also be necessary to modify official documents when they refer to the UTC time-scale.

2/1.14/5.2 Method B

Retain UTC as currently defined and introduce a continuous reference atomic time-scale based on TAI with an offset to be broadcasted on an equal basis.

Advantages

Provided the broadcasting of UTC is unchanged, the backward compatibility principle is ensured for existing equipment without updates and replacements including non-radio equipment such as celestial navigation. Furthermore no change is required in technical documents for equipment in using UTC.

Users may choose between UTC time-scale and the continuous reference time-scale appropriate for their applications subject to regulatory considerations.

This method will discourage the use of continuous system times (such as some GNSS times) as a reference time-scale for systems requiring a continuous time-scale.

Disadvantages

The need for adjustment of UTC by the insertion or deletion of leap seconds is continued with all the associated risks and consequences.

In order to disseminate and receive the two reference time-scales on an equal basis, the system of standard frequency and time signals must be modified, systems will need to find a viable means to interface with other systems that select opposite time. This will lead to cost. The dissemination of two “standard” time-scales would bring a risk of confusion, and it would be critical for the two scales to be differentiated in a truly fail-safe manner.

If civil time were defined on the basis of a different one of the two disseminated reference time-scales in different countries there would be consequences in particular for activities requiring international time coordination.

2/1.14/5.3 Method C

2/1.14/5.3.1 Method C1

No change in definition of UTC as specified in Recommendation ITU-R TF.460-6, which will remain the only time-scale which is broadcast in order to avoid any confusion.

Under this method Recommendation ITU-R TF.460-6 would be amended to make clear that use of TAI is an acceptable alternative for those requiring a continuous time-scale and that it can be derived from UTC using a difference figure, which is also being broadcasted.

Advantages

The proposed method does not affect radiocommunication systems and documentation that are using the existing definition of UTC specified in Recommendation ITU-R TF.460-6.

The backward compatibility principle is ensured for existing equipment without update and replacement including non-radio equipment such as celestial navigation.

Systems that require a continuous time-scale can obtain their time from broadcasted UTC by making use of the disseminated difference between TAI and UTC.

Disadvantages

The need for adjustment of UTC by the insertion or deletion of leap seconds is continued with all the associated risks and consequences.

2/1.14/5.3.2 Method C2

This method is similar to Method C1 except for Recommendation ITU-R TF.460-6, which would be amended to include additional definitions, corrections and/or materials with respect to the feasibility of using continuous system time-scales for radiocommunication systems.

Advantages

The same as for Method C1.

Disadvantages

Similar to those described in Method C1. In addition the use of multiple system time-scales would create confusion.

2/1.14/6 Regulatory and procedural considerations

2/1.14/6.1 Method A

2/1.14/6.1.1 Method A1

ARTICLE 1

Terms and definitions

MOD

Section I – General terms

1.14 *Coordinated Universal Time (UTC):* Time scale, based on the second (SI) and maintained by the Bureau International des Poids et Mesures (BIPM), that forms the basis for the coordinated dissemination of standard frequencies and time signals~~, as defined in Recommendation ITU-R TF.460-6~~. (WRC-~~03~~15)

~~For most practical purposes associated with the Radio Regulations, UTC is equivalent to mean solar time at the prime meridian (0° longitude), formerly expressed in GMT.~~

Reasons: To remove the incorporation by reference of Recommendation ITU-R TF.460-6, which defines the use of leap seconds in UTC, add a reference to the international organization responsible for the maintenance of the UTC time-scale, and remove the equivalence between UTC and the mean solar time at the prime meridian.

ARTICLE 2

Nomenclature

Section II – Dates and times

MOD

2.5 Whenever a date is used in connection with Coordinated Universal Time (UTC), this date ~~shall be~~ is that ~~of~~ at the prime meridian ~~at the appropriate time~~, the prime meridian corresponding to zero degrees geographical longitude.

MOD

2.6 Whenever a specified time is used in international radiocommunication activities, UTC shall be applied, ~~unless otherwise indicated,~~ and it shall be presented as a four-digit group (0000-2359). The abbreviation UTC shall be used in all languages.

Reasons: Consequential changes resulting from the MOD to RR No. **1.14**.

MOD

CHAPTER X

Provisions for entry into force of the Radio Regulations (WRC-15~~2~~)

MOD

ARTICLE 59

Entry into force and provisional application of the Radio Regulations (WRC-15~~2~~)

MOD

59.1 These Regulations, which complement the provisions of the Constitution and Convention of the International Telecommunication Union, and as revised and contained in the Final Acts of WRC-95, WRC-97, WRC-2000, WRC-03, WRC-07,~~ and~~ WRC-12 and WRC-15, shall be applied, pursuant to Article 54 of the Constitution, on the following basis. (WRC-15~~2~~)

ADD

59.A114 The other provisions of these Regulations, as revised by WRC-15, shall enter into force on 1 January 2017, with the following exceptions: (WRC-15)

ADD

59.B114 – the revised provisions for which other effective dates of application are stipulated in Resolution:

[A114-UTC] (WRC-15) (WRC-15)

ADD

RESOLUTION [A114-UTC] (WRC-15)

Provisional application of certain provisions of the Radio Regulations as revised by WRC-15 and abrogation of certain Resolutions and Recommendations

The World Radiocommunication Conference (Geneva, 2015),

considering

a) that this Conference has, in accordance with its terms of reference adopted a partial revision to the Radio Regulations, which will enter into force on 1 January 2017;

b) that some of the provisions, as amended by this Conference, need to apply provisionally before that date;

c) that some of the provisions, as amended by this Conference, need to apply after that date;

d) that, as a general rule, new and revised Resolutions and Recommendations enter into force at the time of the signing of the Final Acts of a Conference;

e) that, as a general rule, Resolutions and Recommendations which a WRC has decided to suppress are abrogated at the time of the signing of the Final Acts of a Conference,

resolves

1 that, as of 1 January [TBD by WRC-15], Nos. **1.14**, **2.5** and **2.6**, as revised or established by WRC-15, shall apply.

Reasons: To ensure sufficient time for legacy systems to update hardware and/or software to accommodate the elimination of leap seconds from UTC.

SUP

RESOLUTION 653 (WRC-12)

Future of the Coordinated Universal Time time-scale

Reasons: No need for Resolution **653 (WRC-12)**.

2/1.14/6.1.2 Method A2

The same modifications as for Method A1 to be used except that "UTC" should be replaced by a different reference time-scale name/abbreviation.

2/1.14/6.2 Method B

No changes to the Radio Regulations. The current definition of UTC is retained. Recommendation ITU-R TF.460-6 would be amended to make clear that a continuous time-scale would be disseminated on an equal basis.

SUP

RESOLUTION 653 (WRC-12)

Future of the Coordinated Universal Time time-scale

Reasons: No need for Resolution **653 (WRC-12)**.

2/1.14/6.3 Method C

2/1.14/6.3.1 Methods C1 and C2

ARTICLE 1

Terms and definitions

Section I – General terms

MOD

1.14 *Coordinated Universal Time (UTC):* Time-scale, based on the second (SI), as defined in the most recent version of Recommendation ITU-R TF.460-6. (WRC-0315)

For most practical purposes associated with the Radio Regulations, UTC is equivalent to mean solar time at the prime meridian (0° longitude), formerly expressed in GMT.

Reasons: To reference the most recent version of Recommendation ITU-R TF.460 that still maintains the current definition of UTC but may also contain an additional time-scale definition (e.g. a continuous time-scale) or data that would allow to retrieve continuous time and requirements for transmitted time signals.

SUP

RESOLUTION 653 (WRC-12)

Future of the Coordinated Universal Time time-scale

Reasons: No need for Resolution **653 (WRC-12)**.

CHAPTER 3

Aeronautical, Maritime and Radiolocation issues

(Agenda items 1.5, 1.15, 1.16, 1.17, 1.18)

CONTENTS

Page

AGENDA ITEM 1.5

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

*1.5 to consider the use of frequency bands allocated to the fixed-satellite service not subject to Appendices **30**, **30A** and **30B** for the control and non-payload communications of unmanned aircraft systems (UAS) in non-segregated airspaces, in accordance with Resolution **153 (WRC-12)**;*

Resolution **153 (WRC-12)**: *To consider the use of frequency bands allocated to the fixed-satellite service not subject to Appendices **30**, **30A** and **30B** for the control and non-payload communications of unmanned aircraft systems in non-segregated airspaces*

3/1.5/1 Executive summary

Report ITU-R M.2171 identified the spectrum requirements for unmanned aircraft (UA) command and non-payload communication (CNPC) that would be needed to support flight through non-segregated airspace. Those requirements identified the need for both line of sight (LOS) and beyond line of sight (BLOS) spectrum. While the LOS requirements were addressed at the last World Radiocommunication Conference held in 2012 the BLOS requirements were only partially addressed.

Agenda item 1.5 was therefore established to investigate whether fixed-satellite service (FSS) networks, not subject to Appendix **30**, **30A** and **30B** could be used to provide additional capacity for UA CNPC links.

Two methods to address the agenda item are proposed. One method (Method A) is proposed that is intended through a footnote and associated resolution to identify the conditions under which systems operating in the FSS could provide UA CNPC links.

A no change method (Method B) is also proposed on the basis of concerns about the ability of FSS to provide a safety service. There are technical, operational and regulatory obstacles for the use of FSS for UAS CNPC links. Moreover, existing allocations for AMS(R)S as well as AMSS and MSS, under certain conditions could satisfy the requirements for UAS CNPC in the frequency bands of these services.

3/1.5/2 Background

In the context of this agenda item, an unmanned aircraft system (UAS) consist of a geostationary satellite operated in FSS frequency bands, an UA with an Earth stations on-board to interconnect the communication link between this UA and associated remote Earth station, called "unmanned aircraft control station" (UACS). UA are aircraft that do not carry a human pilot but that are piloted remotely, i.e. through a reliable communication link from outside the aircraft. UAS operations up to now have been limited to segregated airspace using FSS links under RR No. **4.4**. However, it is planned to expand UAS deployment outside of segregated airspace.

There are a variety of existing and envisioned applications of UAS in the fields of economy, public safety and science. Further details on UAS applications in non-segregated airspace can be found in Report ITU-R M.2171. The operation of UA outside segregated airspace requires addressing the same issues as manned aircraft, namely safe and efficient integration into the air traffic control system.

3/1.5/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

3/1.5/3.1 Summary of technical and operational studies

Based on the Report ITU-R M.2171, the maximum amount of spectrum required for UAS CNPC links is 56 MHz for the satellite component assuming regional beams with suitable antenna discrimination. However this estimation could rise to 169 MHz when using small aperture antenna with limited discrimination in lower frequency bands.

Studies carried out in response to Resolution **153 (WRC-12)** have considered the bidirectional links between an unmanned aircraft earth station and associated FSS space station (Earth-to-space and space-to-Earth) as well as the FSS space station and the UACS (E-to-s and s-to-E). They have been developed in co-operation with ICAO.

At the same time ICAO has been working on the aeronautical operational, institutional and technical requirements. Due to the different time frames ICAO has not been able to provide the technical performance characteristics in terms of availability, reliability and continuity against which FSS links and or systems can be judged. However what ICAO have provided are 7 conditions that would have to be met as listed below noting that any solution would also have to take into account ICAO’s strategic objective that aeronautical systems should operate in spectrum allocated to an appropriate aeronautical safety service.

The conditions identified by ICAO are:

1 “That the technical and regulatory actions should be limited to the case of UAS using satellites, as studied, and not set a precedent that puts other aeronautical safety services at risk

2 That all frequency bands which carry aeronautical safety communications need to be clearly identified in the Radio Regulations

3 That the assignments and use of the relevant frequency bands have to be consistent with article **4.10** of the Radio Regulations which recognizes that safety services require special measures to ensure their freedom from harmful interference

4 Knowledge that any assignment operating in those frequency bands:

a) is in conformity with technical criteria of the Radio Regulations;

b) has been successfully co-ordinated, including cases where co-ordination was not completed but the ITU examination of probability of harmful interference resulted in a favorable finding, or any caveats placed on that assignment have been addressed and resolved such that the assignment is able to satisfy the requirements to provide BLOS communications for UAS; and has been recorded in the International Master Frequency Register

5 That interference to systems is reported in a transparent manner and addressed in the appropriate time-scale

6 That realistic worst case condition with inclusion of a safety margin can be applied during compatibility studies

7 That any operational considerations for UAS will be handled in ICAO and not in the ITU”

Preliminary draft new Report ITU-R M.[UAS-FSS] details the studies that have been carried to identify the performance capability of FSS networks as well as the radio regulatory issues that would have to be addressed for an FSS link to be capable of supporting a UA CNPC link.

3/1.5/3.2 Relevant ITU-R recommendations and reports

ITU-R Recommendations, relevant for studies under WRC-15 agenda item 1.5, as appropriate, are: ITU-R F.758-5, ITU-R F.1494, ITU-R F.1495, ITU-R F.1565, ITU-R M.1180, ITU-R M.1233, ITU-R M.1372, ITU-R M.1643, ITU-R M.1644, ITU-R M.1730, ITU-R M.2008, ITU-R SF.1650, ITU-R S.524-9, ITU-R SF.1006, ITU-R S.1432.

ITU-R Reports, relevant for the studies under WRC-15 agenda item 1.5 are:

– ITU-R M.2171, ITU-R M.2233.

New ITU-R Reports developed for this topic are:

– PDN Report ITU-R M.[UAS-FSS].

3/1.5/4 Analysis of the results of studies

No agreement was reached on this section. Texts are expected to be developed in accordance with Resolution ITU-R 2-6.

3/1.5/5 Methods to satisfy the agenda item

3/1.5/5.1 Method A: Use of the fixed satellite service

To enable the use of the FSS for UAS CNPC applications operated in accordance with ICAO standards and procedures, through a footnote and associated Resolution. The intention being that compliance with the Resolution would ensure that all required technical, operational, and regulatory conditions are met. This Method will permit FSS links supporting UAS CNPC to operate without adverse effects to existing and future FSS networks.

The footnote would only be applied to frequency bands allocated to the FSS not subject to RR Appendix **30**, **30A**, or **30B** in the frequency ranges 10.95-14.5 GHz, 17.8-20.2 GHz and 27.5-30 GHz, as appropriate, for which studies have been conducted.

Advantages

– A worldwide large capacity provided by existing and planned satellite systems would be accessible for UA CNPC applications in non-segregated airspace.

– The growing demand for UA applications worldwide as described in Report ITU-R M.2171 could be served immediately.

– The variety of satellite networks available offers opportunities to use different frequency bands and satellite networks to enhance the overall reliability.

– The provisions of this method minimize the impact on the regulatory, technical and operational framework in which the FSS networks currently operate, while ensuring compliance with RR No. **4.10**.

– This method does not require re-coordination and re-notification of existing frequency assignments under provision of RR Articles **9** and **11**.

– Studies provided a clear definition of the interference environment vis-à-vis incumbent services which allows administrations to determine whether frequency bands allocated to the FSS which can be used for the provision of UAS CNPC links.

– Studies provided a comprehensive list of mitigation techniques available for UAS CNPC links which can be used to overcome any foreseen and unforeseen changes in the interference environment.

– Protection from interference is guaranteed for FSS assignments which are coordinated under RR No. **11.32** or RR No. **11.42**. Interference cases for unforeseen or unpredicted cases, particularly for FSS assignments notified under RR No. **11.41**, can be efficiently tackled through appropriate mitigation techniques.

– Since the assignment is recorded in the MIFR, it creates no additional burden to or from other FSS networks.

Disadvantages

– This method is not in accordance with the definition of FSS.

– Operation of the earth station on board an aircraft when communicating with FSS satellites requires assumption that such earth station will operate within the FSS associated parameters and will not cause more interference and will not claim more protection than a typical FSS earth station located in the surface of the Earth.

– Potential interference into frequency assignments examined under RR No. **11.32A** or recorded under RR No. **11.41** caused by frequency assignments recorded under RR No. **11.41** will require UAS CNPC links to implement appropriate interference mitigation techniques. Use of the assignment recorded under RR No. **11.41** would put serious uncertainty about the occurrence of interference from the networks which have not completed coordination procedures. Until such time when this interference is removed under RR No. **11.42** the operation of UAS will be fully at risk.

– The operation of UA which is an aeronautical mobile earth station to communicate with FSS has regulatory obstacles yet to be resolved.

– UAS CNPC links need to implement appropriate interference mitigation techniques which requires that all FSS networks that will potentially be used for this purpose need to implement these mitigation techniques. Such course of action would add technical, operational and cost burden to all FSS to be operated for UAS CNPC.

– The service performance and availability required for UAS CNPC has not yet been established. Such availability is fundamental element before making any decision with regard to the acceptance of this Method.

– The interference environment for UA which is considered an aeronautical mobile earth station vis-à-vis the other incumbent services have not yet been studied as such environment is different from those related to FSS earth station.

– Occurrence of interference from those FSS links used for this purpose is a matter to be carefully considered due to the fact that such interference resulting from technical and operational conditions would adversely affect the safe operation of UAS CNPC links.

– Conditions of operation of UAS CNPC which should be clearly mentioned in the resolution are currently missing which contribute to the inconsistency with the objectives of the footnote and the operation of UAS CNPC.

– If it is understood that these earth stations operate within the envelope of the FSS in case that interference is received from other networks due to the modifications of characteristics of CNPC earth stations would create an uncertain environment which puts the operation of UAS in danger.

– No agreement reached on the studies provided and claimed that the interference environment vis-à-vis incumbent services which allows administrations to determine whether frequency bands allocated to the FSS can be used for the provision of UAS CNPC links.

– There is no certainty about the potential interference which may be caused either as a result of operational and technical or non-coordinated interference that could be caused to UAS CNPC.

– Implementation of this Method would lead to the necessity of application of RR No. **4.10** provision to all identified frequency bands.

– The impact of cumulative interference from FSS, even those which have coordinated assignment (RR No. **11.31**, RR No. **11.32**) on the FSS network or transponder intended to be used for UAS CNPC have not been studied. Such cumulative interference could have adverse impact on the safety requirements as provided in Res. 153.

– No agreement was reached in the ITU-R on any of the mitigation technique. Studies provided a comprehensive list of mitigation techniques available for UAS CNPC links which can be used to overcome any foreseen and unforeseen changes in the interference environment. The reason was given in the relevant disadvantage mentioned above.

– There is no guarantee of protection from interference for FSS assignments which are coordinated under RR No. **11.32** or RR No. **11.42**.

– Burden to or from other FSS networks to UAS CNPC application using the assignment recorded in the MIFR depends on the status and condition under which the UAS CNPC is recorded.

3/1.5/5.2 Method B: No change to the Radio Regulation (NOC)

Reasons for No Change:

There are considerable technical, operational and regulatory obstacles for the use of FSS for UAS CNPC links. Moreover, existing allocations for AMS(R)S as well as AMSS and MSS, under certain conditions could satisfy the requirements for UAS CNPC in the frequency bands of these services.

Advantages

– Retention of equal-in-rights conditions for operation of FSS systems.

– Incumbent terrestrial services and FSS space stations will not suffer from potential harmful interference caused by the mobile use of FSS.

– No operational impact on incumbent services due to the need of protection of CNPC links operated in FSS in particular on existing FSS applications.

– Application of RR No. **4.10** for the frequency bands under consideration, protection of safety services required for safe operation of UAS in non-segregated airspace.

– No additional regulatory consideration regarding protection against interference or more interference created by UAS CNPC links, requiring these new services to respect the current FSS interference sharing conditions and protection criteria.

Disadvantages

– The agenda item is not satisfied.

– Does not provide the opportunity to use FSS for UA CNPC links between the earth station on board an UA and an FSS space station in non-segregated airspace.

– Limits the number of frequency band available for UAS CNPC and hence the opportunity for deploying redundant systems.

– No explicit recognition in the Radio Regulations of the UAS CNPC links operation.

– UAS CNPC links in non-segregated airspace may operate in the frequency bands allocated to FSS only on national level without international recognition and without international harmonization of spectrum, and based on application of RR No. **4.4**.

Note

An additional method proposing allocations to AMS(R)S in the relevant frequency bands was also proposed. However based on legal advice that the scope of the agenda item did not include the possibility to consider additional allocations, this method was considered to be outside the scope of the agenda item and is therefore not included in this section of the CPM text.

3/1.5/6 Regulatory and procedural considerations

3/1.5/6.1 Method A: Use of the fixed satellite service

Example update to Table of Allocations

ARTICLE 5

Frequency allocations

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

MOD

14-15.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
14-14.25	FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B 5.484A 5.506 5.506B ADD 5.A15 RADIONAVIGATION 5.504 Mobile-satellite (Earth-to-space) 5.504B 5.504C 5.506A Space research 5.504A 5.505	

The footnote in the example above could be applied to those frequency bands allocated to the FSS and not subject to RR Appendix **30**, **30A**, or **30B** for which studies have been conducted in the frequency ranges 10.95-14.5 GHz, 17.8-20.2 GHz and 27.5-30 GHz.

ADD

5.A15 [TBD]

ADD

DRAFT RESOLUTION [FSS-UA-CNPC] (WRC-15)

Provision related to earth stations on board unmanned aircraft which operate with geostationary satellites in the fixed-satellite service for the control and non-payload communications of unmanned aircraft systems in non-segregated airspaces

The World Radiocommunication Conference (Geneva, 2015),

considering

a) that worldwide use of unmanned aircraft systems (UAS) is expected to increase significantly in the near future;

b) that unmanned aircraft (UA) need to operate seamlessly with piloted aircraft in non-segregated airspace;

c) that the operation of UAS in non-segregated airspace requires reliable communication links, in particular to relay the air traffic control communications and for the remote pilot to control the flight;

d) that there is a demand for the control of unmanned aircraft systems (UAS) via satellite communication networks to relay control and non-payload communications (CNPC) beyond the horizon while operating in non-segregated airspace as shown in Annex 2;

e) that there is a need to provide internationally harmonized use of spectrum for UA CNPC application;

f) that the use of fixed-satellite service (FSS) frequency assignments by UAS CNPC links should take into account their Article **11** notification status,

considering further

a) that there is a need to limit the number of communication equipment on board a UA;

b) that, as a dedicated satellite system for UAS is not likely to be implemented, it is necessary to take into account the existing and future satellite systems to accommodate the growth of the use of UAS;

c) that there are various technical methods that may be used to increase the reliability of digital communication links, e.g. modulation, coding, redundancy, etc., that can be used to ensure safe operations of UAS in non-segregated airspace;

d) that for UAS communications used for the control of UA, relay of air traffic control (ATC) voice communications, and sense and avoid, relate to the safe operation of UAS and have certain technical, operational, and regulatory requirements;

e) that the requirements in *considering further d)* can be specified for UAS use of FSS networks,

noting

a) that Report ITU-R M.2171 provides information on the vast number of applications for unmanned aircraft which need the access to non-segregated airspaces;

b) that Recommendation **724 (WRC-07)** notes that FSS is not, intrinsically, a safety service,

recognizing

a) that appropriate technical, operational and regulatory provisions can be taken in the ITU-R such that UAS CNPC links operate safely;

b) that the UAS CNPC links shall be operated in accordance with procedures established by the International Civil Aviation Organization (ICAO),

resolves

1 that UA control and non-payload communication shall operate under the regulatory and operational provisions contained in Annex 1;

2 that earth stations on unmanned aircraft can communicate with a space station operating in the fixed-satellite service;

3 that the operation of an earth station on an unmanned aircraft when communicating with stations of the fixed-satellite service meet the sharing environment and regulatory provisions applicable to FSS, thus not creating more interference than the notified FSS assignments under the UAS CNPC links would operate, and not requesting more protection from interference than the associated notified FSS assignment;

4 that the FSS stations operating in frequency bands supporting these CNPC links shall conform to the applicable technical provisions of the Radio Regulations,

encourages concerned administrations

to cooperate with administrations which license UA CNPC while seeking agreement under the above-mentioned provisions,

instructs the Secretary-General

to bring this Resolution to the attention of the ICAO.

ANNEX 1 TO RESOLUTION [FSS-UA-CNPC] (WRC-15)

Regulatory and operational provisions for UA CNPC links operating through satellite systems operated in the FSS frequency bands

1 It is anticipated that ICAO will develop associated standards and recommended practices (SARPs), taking into account the above.

2 Conformity with the Radio Regulations is ensured by application of Articles **9** and **11**. In the course of this action, the BR always checks the consistency of any frequency assignment with the relevant technical and regulatory provisions contained in the RR, thus any UAS CNPC link will operate under the protection provided by the registered FSS frequency assignments.

3 FSS frequencies used for UAS will use frequency assignments that are "successfully coordinated". Satellite operators and administrations are required to carry out coordination of their FSS frequency assignments in accordance with the provisions contained in Article **9** of the Radio Regulations. The application of such provisions ensures that FSS frequency assignments can operate free from harmful interference caused by and to other systems. The efficiency of those rules

is proven by the fact that FSS frequency assignments have been successfully operated for many years.

4 When the coordination process is completed, the BR will be notified (according to the provisions of Article **11**) by the administration proposing the new system and the frequency assignments will be recorded in the MIFR. If a frequency assignment is recorded in the MIFR under No. **11.41**, such an assignment is still entitled to protect and be protected against frequency assignments of other networks with which coordination has been successfully completed. The FSS operator then has to make sure that the outstanding coordination issues are examined to determine if UAS CNPC operations can take place within the ICAO SARPs requirements. This would be done for example by determining whether the affected network with which coordination has not been achieved is actually in operation and if so what the operational parameters are (e.g. orbital location and filed power levels) to ensure that any resultant impact would be acceptable.

5 Predicting interference risks, planning solutions for potential interference scenarios, adopting measures to solve the interference issues and reporting on the interference cases, are elements which are well known to FSS operators and which should be included in the specific agreements between FSS operators and UAS operators with guidance from Aviation Authorities (some of which could be included in SARPs).

6 Innovative ways to detect and prosecute the interference cases are being developed nowadays at international level, in order to gain further experience and contribute to harmonized and transparent reporting mechanisms of interference cases.

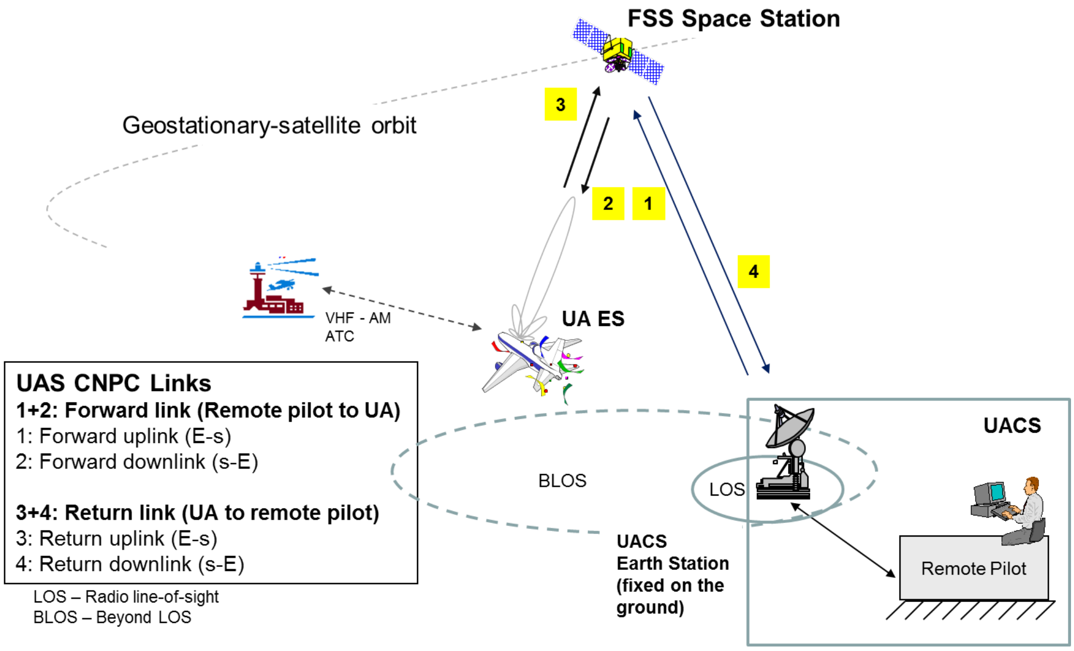
7 ITU and ICAO will carry out their mutual responsibilities in a cooperative manner. It is important that the respective roles of ICAO and ITU be fully understood to ensure appropriate separation of regulatory needs to be addressed in the Radio Regulations and operational issues to be addressed by ICAO processes. In this context, ITU will develop the typical conditions for operation of CNPC links, and then, ICAO will develop further operational conditions to ensure safe operation.

ANNEX 2 TO RESOLUTION [FSS-UA-CNPC] (WRC-15)

UA CNPC links

FIGURE 1

Typical BLoS CNPC links in an unmanned aircraft system



The forward and return (UAS) links via an FSS network

3/1.5/6.2 Method B: No change to the Radio Regulations

No need to make any changes to the Radio Regulations.

AGENDA ITEM 1.15

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

1.15 to consider spectrum demands for on-board communication stations in the maritime mobile service in accordance with Resolution ***358 (WRC-12)****;*

Resolution **358 (WRC-12)**: *Consideration of improvement and expansion of on-board communication stations in the maritime mobile service in the UHF bands*

3/1.15/1 Executive summary

The use of UHF frequencies for on-board communications is considered very important, without these, critical functions of the ship in restricted waters could not effectively take place. These functions include anchoring, berthing, control of firefighting/damage control parties, security patrols, terrorism threats etc. Whilst these are of significant concern to those operating the ship the consequences of failure affect not only the seafarer but have significant implication for the immediate environment the ship is operating in.

Only six frequencies, in the frequency range 450-470 MHz, are currently identified in RR No. **5.287** for on-board communication stations using 25 kHz channels spacing. These frequencies are 457.525 MHz, 457.550 MHz, 457.575 MHz, 467.525 MHz, 467.550 MHz and 467.575 MHz. Where needed, equipment designed for 12.5 kHz channel spacing using also the additional frequencies 457.5375 MHz, 457.5625 MHz, 467.5375 MHz and 467.5625 MHz may be introduced for on-board communications.

The use of these frequencies in territorial waters may be subject to the national regulations of the administration concerned. The characteristics of the equipment used shall conform to those specified in Recommendation ITU-R M.1174-2.

A worldwide survey indicates that in several geographical areas, communications by UHF of a ship were either prevented on some channels by traffic from other vessels or shore operations or were severely interfered.

– It should also be noted that several administrations actively use these frequencies for land mobile communications. In accordance with RR No. **5.286AA** the frequency band 450-470 MHz is identified for use by administrations wishing to implement International Mobile Telecommunication (IMT).

One method has been identified to satisfy this agenda item.

No new frequency bands are proposed for on board communication, but in order to have a more efficient usage of the existing frequencies it is proposed to introduce the possibility of using digital modulation and to encourage the use of continuous tone coded squelch systems (CTCSS) and digital coded squelch (DCS) as a way to mitigate the impression of congestion to the user.

This is intended to be achieved with a revision of Recommendation ITU-R M.1174-2 during the study period. Amendments to RR No. **5.287** are proposed to reflect these changes.

3/1.15/2 Background

RR No. **5.287** says that in the maritime mobile service (MMS) six frequencies in UHF frequency band may be used by on-board communication stations:

5.287 *In the maritime mobile service, the frequencies 457.525, 457.550, 457.575, 467.525, 467.550 and 467.575 MHz may be used by on-board communication stations. Where needed, equipment designed for 12.5 kHz channel spacing using also the additional frequencies 457.5375, 457.5625, 467.5375 and 467.5625 MHz may be introduced for on-board communications. The use of these frequencies in territorial waters may be subject to the national regulations of the administration concerned. The characteristics of the equipment used shall conform to those specified in Recommendation ITU-R M.1174-2.* *(WRC-07)*

It should be noted that some administrations use these frequencies for land mobile service (LMS). In accordance with RR No. **5.286AA** the frequency band 450-470 MHz is identified for use by administrations wishing to implement IMT.

3/1.15/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Recommendations ITU-R M.478, ITU-R M.1036, ITU-R M.1174, ITU-R M.1184, ITU-R M.1450, ITU-R M.1732, ITU-R M.1808, ITU-R M.1823, ITU-R M.1824.

Reports ITU-R M.2039, ITU-R M.2110, ITU-R M.2116.

3/1.15/4 Analysis of the results of studies

A more efficient usage of the existing on-board frequencies could be achieved with the systematic utilization of 12.5 kHz and 6.25 kHz channel spacing for spectrums identified in the RR for on-board communications. The use of 12.5 or 6.25 kHz channels with digital technologies can provide up to 4 times the capacity compared with traditional 25 kHz system.

The MMS is part of the mobile service. Analogue and different digital modulations are already in use for the land mobile applications successfully; this is used as an example to show compatibility.

Within the study (Report ITU-R M.2110) of CDMA450 (IMT) it is recognized that the mobile service is heavily operating in the frequency range 450-470 MHz and CDMA450 (IMT) has to provide appropriate filtering to ensure compatibility with analogue and digital communication systems in this frequency band.

For certain countries the frequency range 420-460 MHz is allocated to the aeronautical radio navigation service on a secondary basis, therefore they cannot claim protection against the mobile service in this frequency band. The frequency band 460-470 MHz is in certain countries allocated for Meteorological-satellite systems (space-to-Earth) on a primary basis. In the relevant frequency band 467.50- 467.60 MHz for MMS no assignment or application for a satellite was noted in the ITU database, therefore the compatibility can be assumed.

The frequencies indicated in provision RR No. **5.287** are part of the spectrum of licenced conventional radio systems, mobiles and handheld portables operating in PMR frequency range 30 to 1 000 MHz. At present a transition from analogue to digital technology for land mobile radio applications can be observed. Both systems are operating side by side on the same frequencies. Operational experience shows that the interference between the different technologies is comparable to that between analogue systems. Compatibility studies for land mobile applications to other services had already been published.

With respect to on-board communication stations in the MMS the restriction to analogue technology should be abrogated. Basically this kind of radio communication is restricted to on-board use of a vessel. For both communication technologies, analogue as well as digital, on board larger vessels infrastructure plans for the arrangement of antennas and repeaters is required.

When using the same amount of infrastructure of repeaters and antennas digital technology works as robustly and stable as analogue systems but provides better communication quality.

Conventional analogue and digital two-way radio operates in UHF ranges that include spectrums for on-board communications. Studies on analogue and digital two-way radio systems show that:

– Analogue and digital technologies are working very robustly, and advantages of digital system are recognized.

– Repeaters can be seen within UHF on-board communication system in large vessels. The implementation of repeater stations together with distributed antennas could help to utilize digital systems without propagation issue.

– With the same infrastructure, digital technology can work as robustly and stable as analogue systems but provides additional useful features as well as better communication quality;

– Interference between analogue systems is the same situation as between analogue and digital system. That means that the coexistence issue is not different among analogue vs analogue, analogue vs digital and digital vs digital systems.

– DIM and DMR are two major digital technologies for two-way voice/data radio, DMR system is a two-slot TDMA while dPMR is a FDMA system. Both standards use 4-FSK modulation variants (DMR using 9 600 bps in 12.5 kHz channels and dPMR uses 4 800 bps in 6.25 kHz channels) and voice digitally coded with error correction at 3 600 bps.

– CTCSS, DCS and listen before talk (LBT) could be a way to mitigate the congestion.

Modifications to provisions of RR No. **5.287** and Recommendation ITU-R M.1174-2 are needed to introduce additional channel arrangement with channel numbering as well as digital technology for on-board communication stations in the maritime mobile service.

Mariners should be informed about the usage of these frequencies. This information should be delivered by the member states having contiguous sea areas under their jurisdiction.

3/1.15/5 Method(s) to satisfy the agenda item

The identification of new spectrum for on-board communications in UHF is not justified and therefore not necessary.

However the importance of on-board communications to safe ship operations is fully recognized, together with the congestion in some geographical area.

A more efficient usage of the existing frequencies could be achieved with the systematic utilization of 12.5 kHz and 6.25 kHz channel spacing for all the channels identified in the RR for on-board communications. The numbering of these channels should be clearly harmonized worldwide.

The implementation of digital technology will open the possibility for additional operational features and a number of different standards are available.

For analogue technology the use of CTCSS and DCS could be used as a way to mitigate the impression of congestion to the user.

For digital technology the use of DCS or an operational equivalent system could be used as a way to mitigate the impression of congestion to the user. The LBT technology should be used.

To achieve this, amendments to provision RR No. **5.287** are necessary, in accordance with the Recommendation ITU-R M.1174 which has been revised. Provision is made for 25 kHz, 12.5 kHz and 6.25 kHz channel spacing.

To achieve a higher degree of flexibility for the use of systems, it is proposed to indicate the frequencies in RR No. **5.287** as two frequency bands.

3/1.15/6 Regulatory and procedural considerations

ARTICLE 5

Frequency allocations

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

MOD

5.287 Use of the frequency bands 457.5125-457.5875 MHz and 467.5125-467.5875 MHz byIn the maritime mobile service, is limited to the frequencies 457.525 MHz, 457.550 MHz, 457.575 MHz, 467.525 MHz, 467.550 MHz and 467.575 MHz may be used by on-board communication stations. Where needed, equipment designed for 12.5 kHz channel spacing using also the additional frequencies 457.5375 MHz, 457.5625 MHz, 467.5375 MHz and 467.5625 MHz may be introduced for on-board communications. The use of these frequencies in territorial waters may be subject to the national regulations of the administration concerned.

The characteristics of the equipment and the channellingused arrangement shall be in conformity with to those specified in Recommendation ITU-R M.1174-23. The use of these frequency bands in territorial waters may also be subject to the national regulations of the administration concerned. (WRC-0715)

SUP

RESOLUTION 358 (WRC-12)

Consideration of improvement and expansion of on-board communication stations in the maritime mobile service in the UHF bands

AGENDA ITEM 1.16

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

1.16 to consider regulatory provisions and spectrum allocations to enable possible new Automatic Identification System (AIS) technology applications and possible new applications to improve maritime radiocommunication in accordance with Resolution ***360 (WRC-12)****;*

Resolution **360 (WRC-12)**: *Consideration of regulatory provisions and spectrum allocations for enhanced Automatic Identification System technology applications and for enhanced maritime radiocommunication*

3/1.16/1 Executive summary

The goal of this agenda item is to consider potential new and enhanced applications of the automatic identification system (AIS) technology for improvement of the maritime radiocommunication. New applications using AIS technology are intended to improve the safety of navigation and applications depending on information that is to be exchanged between ships, and between ships and shore. Due to the importance of AIS it has to be ensured that these applications will not degrade the current AIS operations and other existing services. New applications for improved maritime data exchange are envisaged within maritime mobile service (MMS) allocations.

According to the complexity four issues have been identified to develop methods to satisfy the agenda item. For each of these issues one or two methods to satisfy the agenda item have been developed. The issues are complementary to each other.

Issue A: Application specific messages

– Method A1 identifies the channels 2027 and 2028 of RR Appendix **18** for the application specific message (ASM) not necessary for the safety of navigation and ensure protection of AIS1, AIS2, 2027 and 2028 by not allowing ships to transmit on channels 2078, 2019, 2079 and 2020.
– Method A2 identifies alternate channels 87 and 88 for the ASM channels and ensures the protection of AIS 1 and AIS 2 by power limitation on channels 2078, 2019, 2079 and 2020.

Issue B: New applications for the maritime radiocommunication – terrestrial component

– Method B1 identifies the channels 24, 84, 25, 85 for the terrestrial component of the VDES.
– Method B2 identifies the possibility to use the channels 24, 84, 25, 85, 26, 86 for the terrestrial component of the VDES.

Issue C: New applications for the maritime radiocommunication – satellite component

– Method C1 identifies a secondary allocation for the maritime mobile-satellite service (MMSS) (Earth-to-space) on the VDES channels 1024, 1084, 1025, 1085, 1026, 1086, 2027 and 2028. It also identifies a secondary allocation for the MMSS (space-to-Earth) on the VDES channels 2024, 2084, 2025, 2085, 2026, 2086. To ensure protection of mobile and fixed services, it’s proposed that a new pfd mask be introduced in Annex 1 to RR Appendix **5**. To ensure protection of the nearest frequency band allocated to the radio astronomy service (RAS) a modification of RR No. **5.208B** is proposed.

– Method C2 identifies the frequency band 148-150 MHz (Earth-to-space) for the VDES satellite uplink, which is currently allocated to the mobile satellite service. It also identifies the frequency band 137-138 MHz (space-to-Earth) for the VDES satellite downlink, which is currently allocated to the mobile satellite service. No additional allocations or RR changes are required.

Issue D: VDES regional solution

– Method D provides a regional VDES solution, utilizing channels 80, 21, 81, 22, 82, 23 and 83.

The suppression of Resolution **360 (Rev.WRC-12)** is also part of the described methods.

3/1.16/2 Background

3/1.16/2.1 In regards to *resolves* 1 of Resolution 360 (WRC-12)

Carriage of the shipborne AIS is mandatory for safety of navigation under Chapter V of the International Convention for the Safety of Life at Sea (SOLAS) and has become well accepted by the maritime community. It is also being used by ships not subject to the SOLAS Convention.

AIS is used in the ship movement service for safety of navigation. It enables the identification of stations using this system, provides information about a ship and its cargo. It provides a means for ships to exchange ship data, including identification, position, course and speed, with other nearby ships and coast stations.

The outcome of the maritime agenda item from WRC-12 was as follows:

– Identification of channels 75 and 76 of RR Appendix **18** for AIS and secondary allocation to the MSS (Earth-to-space) for these frequency bands in order to improve satellite detection of AIS Message 27 (long-range AIS broadcast).

– Improvement of the communication environment for port operations and ship movement including VHF data transmission capability, including identification of six channels (24, 25, 26, and 84, 85, 86) for worldwide use as potential data exchange systems. In addition a number of others channels have been identified for regional usage (see RR Appendix **18**).

AIS is supported by a terrestrial based VHF component as well as being detectable by satellite, but its effectiveness is unacceptably limited where VHF data link (VDL) loading is high. The need for separate dedicated channels was recognized by WRC-12 and two additional channels were designated. This new designation solves the problem for satellite detection.

AIS VDL loading remains an issue to an increasing degree in many parts of the world due to the proliferation of AIS applications, message types, services and equipment types plus the unanticipated increase in user volume.

In order to protect the integrity of the AIS VDL, it is considered beneficial to move ASM to two of the four channels identified for data exchange in RR Appendix **18** by WRC-12. The AIS VDL is designed mainly for safety of navigation, and assists with vessel collision avoidance. The ship’s position is continuously transmitted on the VDL and the other vessels in close proximity to the ship have the highest probability of reception. This ensures that, even during high VDL loading, the ship will receive all position reports from the other closest vessels but fewer position reports from the more distant vessels.

When the AIS VDL is used for data communications, it performs poorly with higher loads of VDL message traffic resulting in higher loss of AIS messages, and a higher number of retransmissions. This situation culminates with the breakdown of data communications on the AIS VDL.

An increasing number of ASM will also reduce the available time slots for the intended AIS messages. With increasing demand for maritime VHF data communications, AIS will become more heavily used which will lead to an overloading of the existing AIS1 and AIS2 channels.

The decision of WRC-12 to assign new channels of the RR Appendix **18** to digital communication makes the implementation and use of new digital communication means possible. The establishment of the maritime AIS technology, the VHF data exchange and certain satellite communication components on these new frequencies offers potential enhancements to VHF maritime safety communications on a global basis to satisfy the increasing need for maritime radiocommunications for enhanced maritime safety.

Taking into account the channels identified by WRC-12 as described above, new digitalized channels could be used with modulation techniques described in Recommendation ITU-R M.1842, and could be used for future VHF digital data, and ship-to-shore data exchange.

Where a number of the 25 kHz channels are combined, a typical scheme might have a 100 kHz bandwidth, allowing a much higher data throughput than a single 25 kHz channel. The use of the six VHF data channels plus two further channels (which have been identified for "possible testing of future AIS applications") for an international scheme to be known as VDES.

3/1.16/2.2 In regards to *resolves* 2 of Resolution 360 (WRC-12)

"Increased traffic, the need to adapt to technological changes in the maritime sector (e.g. professional mariners demanding greater access to electronic navigation information), climate change impacts such as fluctuating water levels and the extension of shipping seasons, are expected to place increasing demands on Coast Guard programs.[22]"

Traditional communication methods (i.e. voice) have been shown to be inadequate for the transfer of the information required to improve the safety of navigation particularly in adverse conditions. More information (such as weather, ice charts, status of aids to navigation, water levels and rapid changes of port status) are required in real-time to improve operational decisions on land and on ship that will lead to safer and more efficient voyages.

Shore authorities have also demonstrated interest in increasing the quantity of information retrieved from ships in real-time (such as voyage information, passenger manifest and pre-arrival reports) in a more efficient way to transmit and process these information as digital information. Similar projects with similar requirements have been initiated around the world such as the Mona Lisa and Mona Lisa2 projects[23] and the EfficienSea project[24]. As a result of these additional requirements on maritime communications, the channels identified by WRC-12 would be used by maritime authorities across the world to respond to increased data transfer and improve maritime safety and efficiency in the growing maritime environment.

Increasing use of satellite networks has resulted in the development of new applications which can support and enhance safety and navigation.

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[22] Canadian Coast Guard Business Plan 2011-2014

[23] http://www.sjofartsverket.se/en/MONALISA/

[24] http://www.efficiensea.org/

3/1.16/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Studies were conducted into the development of new applications for improved maritime data exchange envisage within MMS and MMSS allocations.

The main ideas that drive the VDES concept are:

– Protection of the integrity of the AIS VDL.

AIS 1 and AIS 2 should be reserved for "Navigation Safety/Collision Avoidance" purposes (as a SOLAS requirement) and therefore the ASM and other "non-critical communications" should be moved to new channels of RR Appendix **18** to avoid deleterious loading of the AIS VDL. This problem increases as more different types of equipment using AIS technology are developed, more vessels are equipped and more AIS applications are developed and implemented.

– Increased visibility (capability to see more ships on the AIS VDL on high loading).

AIS 1 and AIS 2 can support more load (future expansion) without a reduction in range if "non-critical communications" are moved to the new channels.

– Improved communications capacity.

The new channels provide opportunity for more capacity, efficiency and a more robust communications system to support new application.

– Efficient use of the spectrum for communications (vs. Navigation).

9.6 kbps Gaussian minimum shift keying (GMSK) modulation and a special network protocol were chosen for AIS as a "safety of navigation system". However, for "communications" purposes, Recommendation ITU-R M.1842 provides more efficient system options; for example, where a multi-slot AIS binary message can be reduced to 1-slot. In addition, the network protocol can be designed specifically for communications so that an ASM can be transmitted with much better confidence of reception.

In February 2014 a VDES channel sounding campaign was conducted by the United Kingdom and Australia. The study examined radio propagation conditions for channels under consideration for ship-to-shore and shore-to-ship VDE and ASM communications. System components and deployment were consistent with real world maritime use in the context of the IMO Maritime Service Portfolio area categories. The results of this campaign is available in the Report ITU-R M.[Channel sounding].

As this agenda item addresses both the terrestrial and satellite components, some channels have been considered for communications between the satellite and the ship.

3/1.16/3.1 AIS channel overloading

3/1.16/3.1.1 Study on VHF data link loading

The Report ITU-R M.2287 includes studies by Administrations on AIS VDL channel loading which indicates that increased loading in high traffic areas is nearing or has already exceeded the critical limiting factor of 50%.

To address the concern of the AIS channel overloading there are a number of channels (27, 28, 87, 88) identified by WRC-12. In accordance with Note *z)* of RR Appendix **18**, these channels may be used for possible testing of future AIS applications without causing harmful interference to, or claiming protection from, existing applications and stations operating in the fixed and mobile services.

One option being considered is to take the upper legs of channels 27 and 28 (channels 2027 and 2028) as ASM channels based on the fact that these channels are close to the existing AIS 1 and AIS 2 channels.

Another proposed option is to identify channels 87 and 88 as ASM channels based on the Note *z)* of the RR Appendix **18**.

The analysis of Master International Frequency Register showed that the designations of channels 87 and 88 as additional ASM channels will provide the following positive aspects:

1) The existing frequency assignments to the Fixed, Land Mobile and Maritime Mobile services will be affected to a lesser extent.

2) The existing duplex channels 27 and 28 to the Maritime Mobile service will be kept.

3) Potential use of channels 27 and 28 in accordance with Notes *t), u), v)* of RR Appendix **18**.

3/1.16/3.1.2 AIS and ASM blocking

The Report ITU-R M.[AIS PROTECT] provided a technical analysis which shows the potential harmful interference effects to AIS, i.e., receiver blocking, from the simplex shipborne use of the upper legs of four duplex channels as designated by WRC-12 in RR Appendix **18**.

RR Appendix **18** is structured in two sections with a 4.6 MHz separation between the lower section (156.025 MHz to 157.425 MHz) and the upper section (160.625 MHz to 162.025 MHz). This arrangement permits the implementation of duplex channels in which ships stations transmit on the lower section and shore stations transmit on the upper section. Because of this arrangement, prior to WRC-12, ships voice radios have been designed to transmit only in the lower section of the RR Appendix **18** frequency band, which provides sufficient frequency separation to prevent (by filtering) AIS receiver blocking.

Since AIS 1 and AIS 2 are very close in frequency to channels 2078, 2019, 2079 and 2020 which are located in the upper section, the use of these channels for radio communications by ships will block the AIS receiver, consequentially causing the AIS to be unable to update the location of other ships nearby, resulting in a navigation safety hazard and possible collision. The proposed new ASM channels 161.950 MHz (channel 2027) and 162.000 MHz (channel 2028) are adjacent to AIS 1 and AIS 2 and allocated 25 kHz closer than existing AIS 1 and AIS 2 to interfering channels 2078, 2019, 2079, 2020.

The use of these 4 channels by ships will block the ASM channels.

It may be solved by a different approach, either choosing other ASM channels or returning of usage of 2078, 2019, 2079, 2020 as duplex pairs with Note *m)* as was before WRC-12 or forbidding of transmission from the ships on these channels. Not allowing transmission from the ships seems inefficient in respect to spectrum usage by ship stations.

3/1.16/3.2 New applications for enhanced maritime radiocommunication

VDES considers both WRC-15 agenda item 1.16 and WRC-12 revisions to RR Appendix **18**, including both terrestrial and satellite components, which address the need to protect the integrity of the AIS VDL by moving AIS applications and ASM to other channels and the designation of some of the duplex channels previously designated for public correspondence for digitally modulated emissions in accordance with Recommendation ITU-R M.1842 (which describes various VHF data systems which could be used for terrestrial component of VDES). The VDES integrates the functions of AIS, ASM and VDE and includes the channels used for these functions.

The Report ITU-R M.[VDES-SELECT] makes the analysis among the various channel which have been studied. Table 3/1.16/3-1 "VDES Communications including AIS, ASM and VDE" provides a summary of the technical assignment of various VHF channels for communication including protocol and types of messages to meet the functionalities required by user needs.

TABLE 3/1.16/3-1

VHF data exchange system communications including AIS, ASM, and VDE

	VHF Data Communications (including ASM and VDE)		**AIS**	
Sub-group	**Data communications for ASM**	**Data communications for VDE**	**AIS for safety of navigation**	**AIS long range**
Radio channels	• Channels ASM1 and ASM2 (from RR App. **18**) • Worldwide dedicated channels (WRC-15 target)	• *VDE 1 (channels from RR App. 18)*	• AIS-1 & AIS-2 (simplex)	• Channels 75 and 76 (simplex)
Functionality	• Marine safety information • Marine security information • Short Safety related Messages (SSRMs) • General purpose information communication	• General purpose data exchange • Robust high speed data exchange • VDE satellite communications	• Safety of navigation • Maritime locating devices	• Satellite detection of AIS • Possible support of future SAR
Message types for AIS protocol	• IMO SN.1/ Circ.289 international application specific messages • Regional application specific messages • Base Station		• Vessel identification • Vessel dynamic data • Vessel static data • Voyage related data • Aids to Navigation • Base Station	• Satellite detection of AIS • Possible support of future SAR
Sub functionality	• Area warnings and advice • Meteorological and hydrographic data • Traffic management • Ship-shore data exchange • Channel management	• High message payload • Satellite communications	• Ship to ship collision avoidance • VTS • Tracking of ships • Locating in SAR • VDL control (by Base Station)	• Detection of vessels by coastal states beyond range of coastal AIS base stations

Additionally it is noted that more channels are available in some Regions, see RR Appendix **18** Notes *w)*, *x)*, *y)*. An example of the possible utilization of these channels is given in Table 3/1.16/3-2.

TABLE 3/1.16/3-2

VHF data exchange – Table of regional frequencies (MHz)

<table>
<tr><td></td><td colspan="7">Regional VDE (Regions 1 and 3)</td></tr>
<tr><td>Ship transmit</td><td>1080
157.025</td><td>1021
157.050</td><td>1081
157.075</td><td>1022
157.100</td><td>1082
157.125</td><td>1023
157.150</td><td>1083
157.175</td></tr>
<tr><td>Ship received</td><td>2080
161.625</td><td>2021
161.650</td><td>2081
161.675</td><td>2022
161.700</td><td>2082
161.725</td><td>2023
161.750</td><td>2083
161.775</td></tr>
<tr><td rowspan="2"></td><td colspan="4">Can be used separately and/or as 50 kHz channel(s) or as one 100 kHz channel</td><td></td><td colspan="2">Can be used separately or as one 50 kHz channel</td></tr>
<tr><td colspan="7">NOTE – The VHF channels shown above are a contiguous set in RR Appendix 18. They comprise a contiguous frequency block, and thus are amenable to protection by a single selective filter in the receiver.</td></tr>
</table>

The regional frequencies could be used by different types of VDES which are designed for regional or national applications.

3/1.16/3.3 Study for terrestrial component of VHF data exchange system

The Report ITU-R M.[VDES-SELECT] demonstrate that the channel plan A for the terrestrial component of VDES is the only workable one among the three which have been studied.

The Report ITU-R M.[Channel sounding] has studied the proposed channel plan A for the terrestrial component. The propagation conditions of the radio waves between ship and shore have been characterised in line-of-sight and non-line-of-sight conditions. Observed channel effects were consistent with theoretical expectation and may be managed via several waveform design approaches. Results show that spectrum currently being considered for the terrestrial component of VDES and ASM use from channel plan A is well suited to the purpose.

Current identification in accordance with RR Appendix **18** for transmitting in VHF maritime mobile bands allows for this purpose channels with bandwidth 25 kHz. New applications to provide appropriate performance for data exchange need wider channels. Separate VHF channels can be merged as 50 kHz channel(s) or 100 kHz channel. They comprise a contiguous frequency block, and thus are amenable to protection by a single selective filter in the receiver.

3/1.16/3.4 Study on possible frequencies for satellite component of VHF data exchange system

The satellite component of VDES includes:

– Satellite detection of the AIS VDL on AIS1 and AIS2 which includes all AIS equipment classes and AIS-equipped devices

– Long range detection by satellite of AIS message 27 on channels 75 and 76 in accordance with WRC-12 designations.

– Reception of ASM1 (SAT Up1) and ASM2 (SAT Up2) for reception of AIS ASM.

– Reception of SAT Up3 (which is in the lower legs of channels 24, 84, 25, 85, 26 and 86) which is the uplink from ships to satellite.

– Transmission of SAT downlink which is the downlink from satellite to ships in the upper legs of channels 24, 84, 25, 85, 26 and 86.

These VHF applications could be introduced under the mobile satellite service in the frequency bands allocated to this service for Earth-to-space and space-to-Earth directions.

3/1.16/3.4.1 Frequency already allocated for MSS

An analysis of RR Article **5** shows that close to the 160 MHz the following frequency bands are already allocated to MSS:

– 137-138 MHz (space-to-Earth)

– 148-150 MHz (Earth-to-space)

– 156.7625-156.7875 MHz (Earth-to-space)

– 156.8125-156.8375 MHz (Earth-to-space)

– 161.9625-161.9875 MHz (Earth-to-space)

– 162.0125-162.0375 MHz (Earth-to-space).

In accordance with Note *p)* and *s)* of RR Appendix **18**, the last four listed allocations to MSS are already used for the reception of AIS by satellite (156.775 MHz, 156.825 MHz) as well as for AIS exploiting satellite component (161.975 MHz, 162.025 MHz) therefore two MSS allocations 137-138 MHz (space-to-Earth) and 148-150 MHz (Earth-to-space) could be considered for introduction of new applications for maritime radio communications in VHF.

The frequency bands 137-138 MHz (space-to-Earth) and 148-150 MHz (Earth-to-space) was allocated to MSS under condition that only NGSO MSS systems could be introduced in these frequency bands (see RR Nos. **5.208** and **5.209**). At the same time the VDES concept also considers only the use of NGSO (LEO) satellites. These existing MSS allocations may give a possibility to introduce satellite component of VHF data exchange system. It is noted that all regulatory and technical provisions for MSS in the frequency bands 137-138 MHz (space-to- Earth) and 148-150 MHz (Earth-to-space) are already established in the RR and therefore no additional studies in these frequency bands are required.

These two frequency bands were not part of the 3 channel plans which are compared and assessed in the Report ITU-R M.[VDES-SELECT].

3/1.16/3.4.2 Possible new frequency allocation for MSS

The satellite component could be considered in the frequency band 156-162 MHz which is covered by RR Appendix **18**. In this case new MSS allocation in all or part of the frequency band 156-162 MHz in addition to the MSS allocations introduced by WRC-12 could be considered.

When introducing new maritime applications in the frequency band 156-162 MHz protection in adjacent band and protection of mobile and fixed service in the same band should be guaranteed.

In order to determine conditions for possible new MMSS allocation of all or parts of the frequency band 156-162 MHz compatibility studies between satellite component of VHF data exchange system (uplink and downlink) and mobile as well as fixed stations are required.

Moreover adjacent frequency band compatibility between the MSS in the frequency band 156-162 MHz and the RAS in the frequency band 150.05-153 MHz needs to be performed. Report ITU-R SM.2091 which proposes compatibility analysis between mobile-satellite service (MSS) (space-to-Earth) systems operating in the frequency band 137-138 MHz and RAS systems operating in the frequency band 150.05-153.0 MHz, may be used for similar calculations.

3/1.16/3.4.2.1 Compatibility for MSS downlink in 160 MHz

3/1.16/3.4.2.1.1 MSS downlink and mobile service (Primary basis, all Regions)

Based on the typical characteristics for stations of the mobile service (MS) in the frequency band 138-174 MHz from Recommendation ITU-R M.1808, the required level of power flux-density to provide protection of the MS was calculated.

It was shown that a pfd mask should be more appropriate than a fixed pfd level. It was concluded that the following pfd mask should be used to protect MS as primary service:

$$pfd(\theta°)_{((dBW/m^2 \cdot 4\,kHz))} = \begin{cases} -149 + 0.16 * \theta^\circ & 0^\circ \le \theta < 45^\circ; \\ -142 + 0.53 * (\theta^\circ - 45^\circ) & 45^\circ \le \theta < 60^\circ; \\ -134 + 0.1 * (\theta^\circ - 60^\circ) & 60^\circ \le \theta \le 90^\circ. \end{cases}$$

where θ is the angle of arrival of the incident wave above the horizontal plane (degrees).

3/1.16/3.4.2.1.2 MSS downlink and fixed service (primary basis, all Regions)

Based on characteristics of FS stations in the frequency band 148.0-149.9 MHz (contained in RR Appendix **7**) and in the frequency band 150.5-168.7 MHz (data provided to ITU-R) the required level of power flux density to provide protection of FS was calculated.

It was shown that a pfd mask should be more appropriate than a pfd fixed level. It was concluded that the following pfd mask should be used to protect FS as primary service:

$$pfd(\theta°)_{((dBW/m^2 \cdot 4\,kHz))} = \begin{cases} -149 + 0.16 * \theta^\circ & 0^\circ \le \theta < 45^\circ; \\ -142 + 0.53 * (\theta^\circ - 45^\circ) & 45^\circ \le \theta < 60^\circ; \\ -134 + 0.1 * (\theta^\circ - 60^\circ) & 60^\circ \le \theta \le 90^\circ. \end{cases}$$

where θ is the angle of arrival of the incident wave above the horizontal plane (degrees).

3/1.16/3.4.2.1.3 MSS downlink in the frequency band 156-162 MHz and radio astronomy service in the frequency band 150.05-153 MHz (primary basis, Region 1)

Unwanted emissions of MSS space stations operating in all or parts of the frequency band 156-162 MHz should not create interference to RAS stations in the frequency band 150.05-153 MHz. RR provisions currently guarantee protection for RAS stations operating in the frequency band 150.05-153 MHz from unwanted emission of MSS stations operating in the frequency band 137-138 MHz. In accordance with Resolution **739 (Rev.WRC-07)** for MSS stations operating in the frequency band 137-138 unwanted emissions in the frequency band 150.05-153 MHz for single dish and continuum observations should not exceed epfd value *-238 dB(W/m*^{2}*)/2.95MHz* (see Resolution **739 (Rev.WRC-07)** Annex 1 Table 1-2).

For any new MSS downlink allocations in VHF frequency band, the same requirements for unwanted emissions of MSS stations as mentioned above should be considered due to the same frequency difference between MSS and RAS allocations. This could be done by relevant amendment of Table 1-2 in Annex 1 of Resolution **739 (Rev.WRC-07)** and RR No. **5.208B**.

3/1.16/3.4.2.2 Compatibility for MSS uplink in 160 MHz

The Report ITU-R M.2084 describes satellite detection of AIS as one means of accomplishing long range ship detection. The report addresses its technical feasibility, examines satellite capacity under various conditions and examines possible methods for improving satellite capacity around 161 MHz. Moreover, Report ITU-R M.2169 addresses further studies which were not completed in the previous report.

3/1.16/3.4.2.3 Use of Non-GSO satellite systems to enhance maritime safety

The Report ITU-R M.[MAR.MSS] describes the use of a non-geostationary satellite system to provide reliable communications in regions where traditional terrestrial maritime radio communication is not feasible, and where geostationary satellite networks may not be able to provide reliable coverage.

This Report does not identify any regulatory changes required at this stage, but highlights that the introduction of these systems may require modifications to the Radio Regulations in due course.

3/1.16/3.5 Relevant ITU-R Reports and Recommendations

Recommendations ITU-R M.1084, ITU-R M.1371, ITU-R M.1808 and ITU-R M.1842.

Reports ITU-R M.2084, ITU-R SM.2091, ITU-R M.2169, ITU-R M.2231 and ITU-R M.2287.

Working documents towards PDN ITU-R Recommendations and Reports:

– Recommendation/Report ITU-R M.[VDES].
– Reports ITU-R M.[MAR.MSS], ITU-R M.[AIS.PROTECTION], ITU-R M.[VDES-SELECT] and ITU-R M.[Channel sounding].

3/1.16/4 Analysis of the results of studies

3/1.16/4.1 AIS overloading

3/1.16/4.1.1 Study on VHF data link loading

Results of studies are as follows:

– AIS VDL channel loading studies have concluded that channel loading levels in some high traffic areas have already exceeded the critical level of 50% and many more are expected to exceed this level in the foreseeable future. An identified solution to this problem is the designation of RR Appendix **18** channels for ASM.

3/1.16/4.1.2 AIS blocking

– Studies for AIS Channel protection indicated that since AIS 1 and AIS 2 are in close proximity to channels 2078, 2019, 2079 and 2020, the use of these four channels for maritime radio communications may block the ship's AIS receiver, consequentially causing the ship's AIS safety of navigation capabilities to be negatively impacted. An identified solution to this problem is modification of the provisions of channels 2078, 2019, 2079 and 2020 in RR Appendix **18** to indicate those channels are not available for transmitting from ships.

3/1.16/4.1.3 ASM blocking

– The solution mentioned in the paragraph above in order to avoid the blocking of AIS1 and AIS2, will also ensure the protection of ASM1 and ASM 2 on channels 2027 and 2028, if these channels would be identified for this purpose.
– If ASM1 and ASM2 would be decided to be on channels 87 and 88, as in Method A2, additional measures are necessary to protect the AIS channels due to potential the blockage of these channels caused by ships station transmission on nearby channels.

3/1.16/4.2 Study of review (re-identification) of channels for terrestrial component of VHF data exchange system

– Adjacent VHF channels can be merged as 50 kHz channel(s) or 100 kHz channel. They comprise a contiguous frequency block, and thus are amenable to protection by a single selective filter in the receiver.

– Studies for sharing the RR Appendix **18** channels proposed for the VDES terrestrial component between maritime terrestrial and non-maritime terrestrial services have indicated that coordination levels that are already in use are sufficient to permit sharing by these services.

In accordance with the outcomes of WRC-12, channels 24, 84, 25, 85, 26 and 86 in RR Appendix **18** are designated for global harmonized VDE applications which will be part of the VDES. In accordance with the outcomes of WRC-12, channels 80, 21, 81, 22, 82, 23 and 83 in RR Appendix **18** are designated for regional or national VDE applications which will be part of a regional VDES. Studies on the evaluation of three alternative channel plans A, B and C for VDES are documented in the Report ITU-R M.[VDES-SELECT]. This report concludes that based on an agreed set of criteria in an agreed set of scenarios channel plan A is the most suitable of the studied alternatives.

3/1.16/4.3 Study on possible frequencies for satellite component of VHF data exchange system

– Frequencies already allocated for MSS (137-138 MHz) will not require additional studies and any regulatory actions to introduce VDES satellite component.

These frequency bands are already allocated for MSS and were not part of the 3 channel plans which have been considered in the Report ITU-R M.[VDES-SELECT].

– Sharing frequencies in the frequency band 156-162 MHz for the VDES satellite component between satellite downlink and terrestrial services shows that compatibility could be feasible if pfd levels will be established in order to protect primary services:

To protect MS and FS stations, the following mask is defined:

$$pfd(\theta^\circ)_{((dBW/m^2 \cdot 4\,kHz))} = \begin{cases} -149 + 0.16 * \theta^\circ & 0^\circ \le \theta < 45^\circ; \\ -142 + 0.53 * (\theta^\circ - 45^\circ) & 45^\circ \le \theta < 60^\circ; \\ -134 + 0.1 * (\theta^\circ - 60^\circ) & 60^\circ \le \theta \le 90^\circ. \end{cases}$$

where θ is the angle of arrival of the incident wave above the horizontal plane (degrees).

In addition to protect RA stations operating in the frequency band 150.05-153 MHz in Region 1 from unwanted emissions of MSS space stations operating in all or parts of the frequency band 156-162 MHz epfd thresholds – 238 dB(W/m^2)/2.95 MHz should be guaranteed.

3/1.16/5 Methods to satisfy the agenda item

3/1.16/5.1 Issue A – Application specific message designation

3/1.16/5.1.1 Method A1

Channels 27 and 28 of RR Appendix **18** will be split into four simplex channels, channels 1027, 1028, 2027 and 2028. Channels 2027 and 2028 will be identified for the ASM application. To prevent blocking of the reception of the channels AIS1, AIS 2, 2027 and 2028, the transmission from ship on channels 2078, 2019, 2079 and 2020 will not be permitted. This will be achieved through a transitional period and an effective implementation date.

3/1.16/5.1.2 Method A2

RR Appendix **18** simplex channels 87 and 88 will be assigned for ASM applications with an effective date.

To prevent the potential blocking of the reception of the channels AIS1, AIS2 appropriate regulatory measures to restrict power limit for the transmission from ship on channels 2078, 2079, 2019, 2020 should be applied.

3/1.16/5.2 Issue B – New applications for maritime radiocommunication – terrestrial component

3/1.16/5.2.1 Method B1

In order to introduce the terrestrial component of the VDES, it is proposed to identify the duplex channels 24, 84, 25 and 85 of RR Appendix **18** for this purpose. It is further proposed that the merging of these channels will permit a better data rate for the VDE terrestrial component. This is achieved through a new Note *AAA)* in the RR Appendix **18**.

3/1.16/5.2.2 Method B2

Channels 24, 84, 25, 85, 26 and 86 in RR Appendix **18** could be used for global harmonized VDE testing and experiments, including terrestrial component and satellite component.

3/1.16/5.3 Issue C – New application for maritime radiocommunication – satellite component

3/1.16/5.3.1 Method C1

The Method proposes a new secondary allocation for the maritime mobile-satellite service (Earth-to-space) for frequency band 161.9375-161.9625 MHz (channel 2027) and frequency band 161.9875-162.0125 MHz (channel 2028) for improved ASM communications capacity and coverage.

The Method proposes a new secondary allocation for the maritime mobile-satellite service (Earth-to-space), for frequency band 157.1875-157.3375 MHz (channels 1024, 1084, 1025, 1085, 1026 and 1086).

The Method proposes a new secondary allocation for the maritime mobile-satellite service (space-to-Earth) for frequency band 161.7875-161.9375 MHz (channels 2024, 2084, 2025, 2085, 2026 and 2086), for improved VDE communications 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,** proposing a pfd mask.

The Method proposes to modify provision RR 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-07)** would be revised to include MMSS in the frequency band 161.7875-161.9375 MHz.

The Method proposes to use an ITU-R Recommendation describing the concept and characteristics of VDES.

3/1.16/5.3.2 Method C2

It is proposed to use the frequency band 148-150 MHz (Earth-to-space) for the purpose of the VDES satellite uplink (improvement of VDE communications capacity and coverage, ASM communications capacity and coverage) as the frequency band already allocated for MSS.

It is proposed to use the frequency band 137-138 MHz (space-to-Earth) for the purpose of the VDES satellite downlink as the band already is allocated for MSS.

These frequency bands are restricted to NGSO systems in accordance with provisions of RR No. **5.209**.

Furthermore, for the frequency band 137-138 MHz, Resolution **739 (Rev. WRC-07)** applies (see RR No. **5.208B**).

No additional allocations and RR changes are required to MSS for this method.

3/1.16/5.4 Issue D – VDES regional solution – Method D

Channels 80, 21, 81, 22, 82, 23 and 83 are available in some Regions as follows (see Table 3/1.16/3-2 in section 3/1.16/3.2):

- Channels 80, 21, 81 and 22 can be used using multiple 25 kHz contiguous channels for both ship and coast station transmission as regional use.
- Channel 82 can be used for both ship and coast station transmission as regional use.
- Channels 23 and 83 can be used using multiple 25 kHz contiguous channels for both ship and coast station transmission as regional use

3/1.16/6 Regulatory and procedural considerations

3/1.16/6.1 Example of a regulatory presentation of method A1 + B1+ C1

ARTICLE 5

Frequency allocations

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

MOD

148-223 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…/…		
156.8375-~~161.9625~~157.1875 FIXED MOBILE except aeronautical mobile 5.226	**156.8375-~~161.9625~~157.1875** FIXED MOBILE 5.226	
~~156.8375-161.9625~~157.1875-157.3375 FIXED MOBILE except aeronautical mobile Maritime mobile-satellite (Earth-to-space) 5.226 ADD 5.226A	**~~156.8375-161.9625~~157.1875-157.3375** FIXED MOBILE Maritime mobile-satellite (Earth-to-space) 5.226 ADD 5.226A	
~~156.8375-161.9625~~157.3375-161.7875 FIXED MOBILE except aeronautical mobile 5.226	**~~156.8375-161.9625~~157.3375-161.7875** FIXED MOBILE 5.226	
~~156.8375-161.9625~~161.7875-161.9375 FIXED MOBILE except aeronautical mobile Maritime mobile-satellite (space-to-Earth) MOD 5.208B 5.226 ADD 5.226B	**~~156.8375-161.9625~~161.7875-161.9375** FIXED MOBILE Maritime mobile-satellite (space-to-Earth) 5.226 ADD 5.226B	
~~156.8375~~161.9375-161.9625 FIXED MOBILE except aeronautical mobile Maritime mobile-satellite (Earth-to-space) 5.226 ADD 5.226A	**~~156.8375~~161.9375-161.9625** FIXED MOBILE Maritime mobile-satellite (Earth-to-space) 5.226 ADD 5.226A	

148-223 MHz *(end)*

Allocation to services		
Region 1	**Region 2**	**Region 3**
161.9625-161.9875 FIXED MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.228F 5.226 5.228A 5.228B	**161.9625-161.9875** AERONAUTICAL MOBILE (OR) MARITIME MOBILE MOBILE-SATELITE (Earth-to-space) 5.228C 5.228D	**161.9625-161.9875** MARITIME MOBILE Aeronautical mobile (OR) 5.228E Mobile-satellite (Earth-to-space) 5.228F 5.226
161.9875-162.0125 FIXED MOBILE except aeronautical mobile Maritime mobile-satellite (Earth-to-space) 5.226 ADD 5.226A 5.229	**161.9875-162.0125** FIXED MOBILE Maritime mobile-satellite (Earth-to-space) 5.226 ADD 5.226A	
162.0125-162.0375 FIXED MOBILE except aeronautical mobile Mobile-satellite (Earth-to-space) 5.228F 5.226 5.228A 5.228B 5.229	**162.0125-162.0375** AERONAUTICAL MOBILE (OR) MARITIME MOBILE MOBILE-SATELITE (Earth-to-space) 5.228C 5.228D	**162.0125-162.0375** MARITIME MOBILE Aeronautical mobile (OR) 5.228E Mobile-satellite (Earth-to-space) 5.228F 5.226
…/…		

ADD

5.226A The use of the frequency bands 157.1875-157.3375 MHz, 161.9375-161.9625 MHz and 161.9875-162.0125 MHz by the maritime mobile-satellite (Earth-to-space) service is limited to the systems which operate in accordance with Appendix **18**. (WRC-15)

ADD

5.226B The use of the frequency band 161.7875-161.9375 MHz by the maritime mobile-satellite (space-to-Earth) service is limited to the systems which operate in accordance with Appendix **18**. (WRC-15)

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 Recommendation ITU-R M.[VDES].

MOD

5.208B* In the bands:

137-138 MHz,
387-390 MHz,
161.7875-161.9375 MHz,
400.15-401 MHz,
1 452-1 492 MHz,
1 525-1610 MHz,
1 613.8-1 626.5 MHz,
2 655-2 690 MHz,
21.4-22 GHz,

Resolution **739 (Rev.WRC-~~07~~15)** applies. (WRC-~~07~~15)

* This provision was previously numbered as No. **5.347A**. It was renumbered to preserve the sequential order.

MOD

RESOLUTION 739 (REV.WRC-~~07~~15)

Compatibility between the radio astronomy service and the active space services in certain adjacent and nearby frequency bands

…

ANNEX 1 TO RESOLUTION 739 (REV.WRC-07)

Unwanted emission threshold levels

TABLE 1-2

epfd thresholds[(1)] 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[(2)]	Reference bandwidth	epfd[(2)]	Reference bandwidth	epfd[(2)]	Reference bandwidth	
	(MHz)	(MHz)	(dB(W/m^2))	(MHz)	(dB(W/m^2))	(kHz)	(dB(W/m^2))	(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-15
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)[(3)]	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

MOD

APPENDIX 5 (REV.WRC-12~~2~~5)

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-12~~2~~5)

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^2·4 kHz)) at the Earth's surface:

$$PFD(\theta°)_{((dBW/m^2\cdot 4\,kHz))} = \begin{cases} -149 + 0.16 * \theta^\circ & 0^\circ \le \theta < 45^\circ; \\ -142 + 0.53 * (\theta^\circ - 45^\circ) & 45^\circ \le \theta < 60^\circ; \\ -134 + 0.1 * (\theta^\circ - 60^\circ) & 60^\circ \le \theta \le 90^\circ. \end{cases}$$

where θ 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 this new defined mask.

* These provisions apply only to the MSS.

MOD

APPENDIX 18 (REV.WRC-~~12~~15)

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	
15	*g)*	156.750	156.750	x	x		
75	*n), s)*	156.775	156.775		x		
16	*f)*	156.800	156.800	DISTRESS, SAFETY AND CALLING			
76	*n), s)*	156.825	156.825		x		
17	*g)*	156.850	156.850	x	x		
77		156.875		x			
18	*m)*	156.900	161.500		x	x	x
78	*t), u), v)*	156.925	161.525		x	x	x
1078		156.925	156.925		x		
2078	*t), u), v)*	~~161.525~~	161.525		x		
19	*t), u), v)*	156.950	161.550		x	x	x
1019		156.950	156.950		x		
2019	*t), u), v)*	~~161.550~~	161.550		x		
79	*t), u), v)*	156.975	161.575		x	x	x
1079		156.975	156.975		x		
2079	*t), u), v)*	~~161.575~~	161.575		x		
20	*t), u), v)*	157.000	161.600		x	x	x
1020		157.000	157.000		x		
2020	*t), u), v)*	~~161.600~~	161.600		x		
80	*w), y)*	157.025	161.625		x	x	x
21	*w), y)*	157.050	161.650		x	x	x
81	*w), y)*	157.075	161.675		x	x	x
22	*w), y)*	157.100	161.700		x	x	x
82	*w), x), y)*	157.125	161.725		x	x	x
23	*w), x), y)*	157.150	161.750		x	x	x
83	*w), x), y)*	157.175	161.775		x	x	x
24	*w), ww), x), ~~y)~~ AAA)*	157.200	161.800		x	x	x
1024	*BBB)*	157.200					
2024	*CCC)*	161.800	161.800	x			
84	*w), ww), x), ~~y)~~ AAA)*	157.225	161.825		x	x	x
1084	*BBB)*	157.225					
2084	*CCC)*	161.825	161.825	x			

25	*w), ww), x), ~~y)~~ AAA)*	157.250	161.850		x	x	x
1025	*BBB)*	157.250					
2025	*CCC)*	161.850	161.850	x			
85	*w), ww), x), ~~y)~~ AAA)*	157.275	161.875		x	x	x
1085	*BBB)*	157.275					
2085	*CCC)*	161.875	161.875	x			
26	*w), ww), x), ~~y)~~*	157.300	161.900		x	x	x
1026	*BBB)*	157.300					
2026	*CCC)*	161.900	161.900	x			
86	*w), ww), x), ~~y)~~*	157.325	161.925		x	x	x
1086	*BBB)*	157.325					
2086	*CCC)*	161.925	161.925	x			
27	*z)*	157.350	161.950			x	x
1027	*z)*	157.350					
2027	*z)*	161.950	161.950				
87	~~*z)*~~	157.375	157.375		x		
28	*z)*	157.400	162.000			x	x
1028	*z)*	157.400					
2028	*z)*	162.000	162.000				
88	~~*z)*~~	157.425	157.425		x		
AIS 1	*f), l), p)*	161.975	161.975				
AIS 2	*f), l), p)*	162.025	162.025				

Reasons:

Introduction of the VDES in the Appendix 18 as follow:

ASM 1 (161.950) and ASM 2 (162.000) are non-navigation ASM.

VDE 1 lower legs (channels 1024, 1084, 1025 and 1085) are ship-shore VDE.

VDE 1 upper legs (channels 2024, 2084, 2025 and 2085) are shore-ship and ship-ship VDE.

SAT up1 (161.950) and SAT up 2 (162.000) are used for receiving ASM by satellite.

SAT up3 (channels 1024, 1084, 1025, 1085, 1026 and 1086) is a ship-satellite VDE uplink.

SAT Downlink (channels 2024, 2084, 2025, 2085, 2026 and 2086) is the satellite-ship VDE downlink.

Notes referring to the Table

General notes

NOC

Notes *a)* to *e)*

Specific notes

NOC

Notes *f)* to *s)*

MOD

t) Until 1 January 2017, IIn Regions 1 and 3, the existing duplex channels 78, 19, 79 and 20 can continue to be assigned. These channels may be operated as single-frequency channels, subject to coordination with affected administrations. From that date, these channels shall only be assigned as single-frequency channels. However, existing duplex channel assignments may be preserved for coast stations and retained for vessels, subject to coordination with affected administrations. Channels 2078, 2019, 2079 and 2020 are not available for transmitting from ships. (WRC-1215)

u) In Region 2, these channels may be operated as single-frequency channels, subject to coordination with affected administrations. Channels 2078, 2019, 2079 and 2020 are not available for transmitting from ships. (WRC-1215)

v) After 1 January 2017, in the Netherlands, these channels may continue to be operated as duplex frequency channels, subject to coordination with affected administrations. Channels 2078, 2019, 2079 and 2020 are not available for transmitting from ships. (WRC-1215)

Reasons: The split of the channels 78, 19, 79, 20 and the use of the upper legs of these channels could block the AIS equipment. Therefore it is proposed that channels 2078, 2019, 2079 and 2020 will not be available for transmitting from ships.

w) In Regions 1 and 3:

Until 1 January 2017, the frequency bands 157.025-157.325 MHz and 161.625-161.925 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23, 83, 24, 84, 25, 85, 26, 86) may be used for new technologies, subject to coordination with affected administrations. Stations using these channels or frequency bands for new technologies shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article **5**.

From 1 January 2017, the frequency bands 157.025-157.325175 MHz and 161.625-161.925775 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23, 83, 24, 84, 25, 85, 26, 86) are identified for the utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842. These frequency bands could 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.

The frequency bands 157.200-157.325 MHz and 161.800-161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26, 86) are identified for the utilization of the VHF Data Exchange System (VDES) described in the most recent version of Recommendation ITU-R M.[VDES]. (WRC-1215)

NOC

Note *ww)*

ADD

AAA) From 1 January 2019 the channels 24, 84, 25 and 85 may be merged in order to form a unique duplex channel with a bandwidth of 100 kHz in order to operate the VDES described in the most recent version of Recommendation ITU-R M.[VDES]. (WRC-15)

Reasons: The merge of these channels will permitted a better data rate for the VDE terrestrial.

ADD

BBB) From 1 January 2019 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.[VDES]. (WRC-15)

Reasons: The channels are identified for the satellite uplink of the VDES.

ADD

CCC) From 1 January 2019 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.[VDES] in which this combination is denominated as SAT downlink. (WRC-15)

Reasons: The channels are identified for the satellite downlink of the VDES.

NOC

Notes *x)* and *y)*

MOD

z) Until 1 January 2019, ~~These~~ these channels may be used for possible testing of future AIS applications without causing harmful interference to, or claiming protection from, existing applications and stations operating in the fixed and mobile services. ~~(WRC-12)~~

From 1 January 2019, these channels are split into two simplex channels. The upper legs, 2027 and 2028 respectively designated as ASM 1 and ASM 2 are used for non-navigation ASM (application specific messages) as described in the most recent version of Recommendation ITU-R M.[VDES].

The channels 2027 and 2028 are also allocated to the maritime mobile-satellite service (Earth-to-space) for the reception of ASM messages from ships as described in the most recent version of Recommendation ITU-R M.[VDES] in which they are denominated respectively as SAT up1 and SAT up2. (WRC-15)

Reasons: **I**dentification of two channels dedicated to the ASM applications non necessary for the security of the navigation in order to secure the VDL of the channels AIS1 and AIS2.

SUP

RESOLUTION 360 (WRC-12)

Consideration of regulatory provisions and spectrum allocations for enhanced Automatic Identification System technology applications and for enhanced maritime radiocommunication

Reasons: It is proposes to suppress Resolution **360 (WRC-12)** 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-15 Conference.

3/1.16/6.2 Example for Method A2

MOD

APPENDIX 18 (REV.WRC-~~12~~15)

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 corres-pondence
		From ship stations	From coast stations		Single frequency	Two frequency	
15	*g)*	156.750	156.750	x	x		
75	*n), s)*	156.775	156.775		x		
16	*f)*	156.800	156.800	DISTRESS, SAFETY AND CALLING			
76	*n), s)*	156.825	156.825		x		
17	*g)*	156.850	156.850	x	x		
77		156.875		x			
18	*m)*	156.900	161.500		x	x	x
78	*t), u), v)*	156.925	161.525		x	x	x
1078		156.925	156.925		x		
2078	*ZZZZ)*	161.525	161.525		x		
19	*t), u), v)*	156.950	161.550		x	x	x
1019		156.950	156.950		x		
2019	*ZZZZ)*	161.550	161.550		x		
79	*t), u), v)*	156.975	161.575		x	x	x
1079		156.975	156.975		x		
2079	*ZZZZ)*	161.575	161.575		x		
20	*t), u), v)*	157.000	161.600		x	x	x
1020		157.000	157.000		x		
2020	*ZZZZ)*	161.600	161.600		x		
…	...	…	…	…	…	…	…
27	*z)*	157.350	161.950			x	x
87	*z), ZZZ)*	157.375	157.375		x		
28	*z)*	157.400	162.000			x	x
88	*z), ZZZ)*	157.425	157.425		x		
AIS 1	*f), l), p)*	161.975	161.975				
AIS 2	*f), l), p)*	162.025	162.025				

…/…

ADD

ZZZ) From 1 January 2019, these channels may be used for ASM application. These channels could be continuously used for simplex voice applications subject to coordinating with ASM application, and not claiming protection.

Reasons: The existing duplex channel 27 and 28 will be kept as a duplex for MMS. The existing simplex channels will be identified for ASM.

ADD

ZZZZ) While using these channels (2078, 2079, 2019, 2020) all precautions should be taken to avoid harmful interference to channels AIS1 and AIS2, by limiting the output power to 1 W. (WRC-15)

Reasons: The following channels (2078, 2079, 2019, 2020) will be kept for voice transmission in MMS. This approach is in similar to measures to protect 16 channel (footnote *n)*) App.**18**).

3/1.16/6.3 Example of a regulatory presentation of method A1 + B2

MOD

APPENDIX 18 (REV.WRC-~~12~~15)

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 corres-pondence
		From ship stations	From coast stations		Single frequency	Two frequency	
…		…	…				
80	*w), y)*	157.025	161.625		x	x	x
21	*w), y)*	157.050	161.650		x	x	x
81	*w), y)*	157.075	161.675		x	x	x
22	*w), y)*	157.100	161.700		x	x	x
82	*w), x), y)*	157.125	161.725		x	x	x
23	*w), x), y)*	157.150	161.750		x	x	x
83	*w), x), y)*	157.175	161.775		x	x	x
24	*w), ww), x), y), dddd)*	157.200	161.800		x	x	x
84	*w), ww), x), y), dddd)*	157.225	161.825		x	x	x
25	*w), ww), x), y), dddd)*	157.250	161.850		x	x	x
85	*w), ww), x), y), dddd)*	157.275	161.875		x	x	x
26	*w), ww), x), y), dddd)*	157.300	161.900		x	x	x

86	*w), ww), x), y), dddd)*	157.325	161.925		x	x	x
27	*z,), dd)*	157.350	161.950			x	x
1027		157.350	157.350		x		
2027	*ddd)*	161.950	161.950		x		
87	*z)*	157.375	157.375		x		
28	*dd), z)*	157.400	162.000			x	x
1028		157.400	157.400		x		
2028	*ddd)*	162.00	162.000		x		
88	*z)*	157.425	157.425		x		
AIS 1	*f), l), p)*	161.975	161.975				
AIS 2	*f), l), p)*	162.025	162.025				

…/…

MOD

w) In Regions 1 and 3 except China:

Until 1 January 2017, the frequency bands 157.025-157.325 MHz and 161.625-161.925 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23, 83, 24, 84, 25, 85, 26, 86) may be used for new technologies, or VDE terrestrial component testing and experiment, subject to coordination with affected administrations. Stations using these channels or frequency bands for new technologies shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article **5**.

From 1 January 2017, the frequency bands 157.025-157.325 MHz and 161.625-161.925 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23, 83, 24, 84, 25, 85, 26, 86) are identified for the utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842. These frequency bands could 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-~~12~~15)

x) From 1 January 2017, in Angola, Botswana, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Democratic Republic of the Congo, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, the frequency bands 157.125-157.325 and 161.725-161.925 MHz (corresponding to channels: 82, 23, 83, 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions.

From 1 January 2017, in China, the frequency bands 157.150-157.325 and 161.750-161.925 MHz (corresponding to channels: 23, 83, 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions. The channels 23 and 83 are designated for national VDE in accordance with the most recent version of Recommendation ITU-R M.1842. (WRC-~~12~~15)

ADD

dd) Until 1 January 2019, the duplex channels 27 and 28 may be operated as single-frequency channels, subject to coordination with affected administrations. From that date, these channels shall only be assigned as single-frequency channels.

ddd) From 1 January 2019, these channels may be used for ASM application. These channels could be continuously used for simplex voice applications subject to coordinating with ASM application, and not claiming protection.

dddd) From 1 January 2019, the frequency bands 157.200-157.325 and 161.800-161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions in accordance with the most recent version of Recommendation ITU-R M.1842.

3/1.16/6.4 Example for Method C2

NOC to RR Article **5**.

3/1.16/6.5 Example for Method D

MOD

APPENDIX 18 (REV.WRC-~~12~~15)

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 corres-pondence
		From ship stations	From coast stations		Single frequency	Two frequency	
…	…	…	…	…	…	…	…
80	*w), y), xx)*	157.025	161.625		x	x	x
1080	*w), y), xx)*	157.025	157.025	x	x		
2080	*w), y), xx)*	161.625	161.625	x	x		
21	*w), y), xx)*	157.050	161.650		x	x	x
1021	*w), y), xx)*	157.050	157.050	x	x		
2021	*w), y), xx)*	161.650	161.650	x	x		
81	*w), y), xx)*	157.075	161.675		x	x	x
1081	*w), y), xx)*	157.075	157.075	x	x		
2081	*w), y), xx)*	161.675	161.675	x	x		
22	*w), y), xx)*	157.100	161.700		x	x	x
1022	*w), y), xx)*	157.100	157.100	x	x		
2022	*w), y), xx)*	161.700	161.700	x	x		
82	*w), x), y)*	157.125	161.725		x	x	x
1082	*w), x), y)*	157.125	157.125	x	x		
2082	*w), x), y)*	161.725	161.725	x	x		
23	*w), x), y), xxx)*	157.150	161.750		x	x	x
1023	*w), x), y), xxx)*	157.150	157.150	x	x		
2023	*w), x), y), xxx)*	161.750	161.750	x	x		
83	*w), x), y), xxx)*	157.175	161.775		x	x	x
1083	*w), x), y), xxx)*	157.175	157.175	x	x		

Channel designator	Notes	Transmitting frequencies (MHz)		Inter-ship	Port operations and ship movement		Public corres-pondence
		From ship stations	From coast stations		Single frequency	Two frequency	
2083	*w), x), y), xxx)*	161.775	161.775	x	x		
…	…	…	…	…	…	…	…

Notes referring to the Table

…/…

Specific notes

…/…

ADD

xx) Assignable for wideband digital system operation using multiple 25 kHz contiguous channels.

ADD

xxx) Assignable for 50 kHz bandwidth digital system operation using two 25 kHz contiguous channels.

Reasons: The channels are identified for regional use of the VDES.

AGENDA ITEM 1.17

(**WP 5B / WP 4A, WP 4C, WP 5A, WP 5C, WP 7B, WP 7C, WP 7D**,
(WP 1B), (WP 3K), (WP 6A))

*1.17 to consider possible spectrum requirements and regulatory actions, including appropriate aeronautical allocations, to support wireless avionics intra-communications (WAIC), in accordance with Resolution **423 (WRC-12)**;*

Resolution **423 (WRC-12)**: *Consideration of regulatory actions, including allocations, to support Wireless Avionics Intra-Communications*

3/1.17/1 Executive summary

The 2012 World Radiocommunication Conference (WRC-12) approved agenda item 1.17 to conduct sharing and compatibility studies to determine appropriate frequency bands for wireless avionics intra-communications (WAIC) systems. According to Resolution **423 (WRC-12)** the frequency bands to be initially reviewed are limited to those frequency bands containing allocations to the aeronautical mobile (R) service (AM(R)S), aeronautical mobile service (AMS) and aeronautical radionavigation service (ARNS) below 15.7 GHz. In addition, frequency bands above 15.7 GHz can be studied if spectrum requirements cannot be met in frequency bands allocated to the aeronautical services below 15.7 GHz.

Agenda item 1.17 considers the spectrum requirements and regulatory actions to support WAIC systems. WAIC systems are described in Report ITU-R M.2283. WAIC systems utilize radio communications between two or more stations on-board a single aircraft supporting the safe operation of the aircraft. The Report concludes that 145 MHz of radio frequency spectrum is necessary to support the requirements for WAIC systems.

In accordance with Resolution **423 (WRC-12**), an initial assessment was conducted that analyses potential compatibility between proposed WAIC systems and systems operating under an allocation to an incumbent service. It considers all aeronautical bands in the frequency range 960 MHz-15.7 GHz containing either an AM(R)S, AMS, ARNS allocation.

Studies were conducted analysing potential compatibility between proposed WAIC systems and systems operating under an allocation to an incumbent service in the frequency bands 2 700-2 900 MHz, 4 200-4 400 MHz, 5 350-5 460 MHz, 22.5-22.55 GHz, and 23.55-23.6 GHz. Of the frequency bands below 15.7 GHz studied, only the frequency band 4 200-4 400 MHz shows that sharing is feasible.

Two methods to address the agenda item are proposed. Method A adds a new allocation to the AM(R)S reserved exclusively for WAIC systems in the frequency band 4 200-4 400 MHz with three options for an accompanying Resolution. Method B provides the same regulatory changes as Method A, except it proposes an ITU-R Recommendation incorporated by reference.

3/1.17/2 Background

The civil aviation industry is continually developing future generations of aircraft. Each subsequent generation is designed to enhance efficiency and reliability while maintaining current required levels of safety. WAIC systems will offer aircraft designers and operators opportunities to improve flight safety and operational efficiency with the goal of reducing costs to airlines and passengers. WAIC systems could improve an aircraft's performance over its lifetime through more cost-effective flight operations, reduction in maintenance costs, enhancement of aircraft systems that maintain or increase the level of safety, and environmental benefits. WAIC systems are also envisioned to provide new functionalities to aircraft manufacturers and operators.

Manufacturers are provided additional installation options for previously wired systems, while operators are afforded more opportunities to monitor aircraft systems. A major WAIC system application is wireless sensing. It is expected that existing and future aircraft will be equipped with such wireless sensors. These sensors could be located throughout the aircraft and will be used to monitor the health of the aircraft structure and its critical systems, and to communicate this information. WAIC systems are also intended to support data, voice and safety related video surveillance applications such as taxiing cameras and may also include communications systems used by the crew for safe operation of the aircraft. WAIC systems can provide additional opportunities to monitor more components and systems without significantly increasing the aircraft's weight.

WAIC systems will only be used for safety-related aircraft applications, providing communications within a single aircraft. While WAIC system transmissions may not be limited to the interior of the aircraft structure, they will not provide communications between an aircraft and the ground, another aircraft or satellite. Because WAIC systems carry aeronautical safety related content they are classified as an application of the AM(R)S.

The total radio frequency spectrum required for all types of WAIC application categories is 145 MHz. To reflect the diverging conditions and requirements, different categories of WAIC systems are defined. These are based on the two criteria "data rate requirements" and "transmit antenna location on the aircraft", i.e. internal or external to the aircraft structure. For determining bandwidth requirements, low rate and high rate systems are separately considered due to differing technical requirements and technological restrictions their implementation may face.

Given the fact that both the radio altimeter and WAIC systems are aeronautical applications and are also regulated by aviation certification authorities as well as ICAO, additional efforts, including development of standards and certification guidance material within the aviation community could contribute in ensuring the safe operation of WAIC and radio altimeter systems.

Further information on WAIC system technical and operational characteristics can be found in the Report ITU-R M.2283.

3/1.17/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Existing relevant ITU-R Recommendations:

Recommendation ITU-R P.525.

Existing relevant ITU-R Reports:

Report ITU-R M.2283.

New relevant ITU-R Recommendations: WDPDN Recommendation ITU-R M.[WAIC]; WDPDN Recommendation ITU-R M.[WAIC CONDITIONS].

New relevant ITU-R Reports: PDN Report ITU-R M.[WAIC_SHARING_4 200-4 400 MHz]; PDN Report ITU-R M.[WAIC BANDS]; WDPDN Report ITU-R M.[WAIC_SHARING_22/23 GHz].

3/1.17/4 Analysis of the results of studies

3/1.17/4.1 Analysis of the frequency bands below 15.7 GHz

PDN Report M.[WAIC_BANDS] contains the results of assessments and studies of the frequency bands between 960 MHz and 15.7 GHz considered under WRC-15 agenda item 1.17. Frequency bands below 960 MHz were assessed and do not support the implementation of WAIC systems as antenna sizes are too large given the space available on-board aircraft.

The current frequency bands allocated to the AM(R)S; 960-1 164 MHz, 5 030-5 091 MHz and 5 091-5 150 MHz were found to not be appropriate to accommodate WAIC systems, considering the numerous existing and planned applications in these frequency bands.

Out of the frequency bands assessed, the frequency bands 2 700-2 900 MHz, 4 200-4 400 MHz, 5 350-5 460 MHz were considered for further study. Results of the studies for the frequency bands 2 700-2 900 MHz and 5 350-5 460 MHz show that sharing between WAIC systems and existing systems is not feasible. Therefore, these frequency bands were not considered to be a candidate for WAIC systems.

Studies contained in PDN Report ITU-R M.[WAIC_SHARING_4 200-4 400 MHz] show compatibility between WAIC systems and incumbent systems in the frequency band 4 200-4 400 MHz, provided that suitable measures for outside applications such as the use of directional antennas and reduced transmit power are undertaken.

In addressing this agenda item it was proposed that an adjacent band study should be carried out with FSS VSAT's operating below 4 200 MHz. However, based on the low WAIC power level it was agreed that an adjacent band study would not be required as the separation distance were expected to be in the range of 50-100 m.

3/1.17/4.2 Analysis of the frequency bands above 15.7 GHz

Compatibility studies between WAIC systems and systems operating in the FS and the AMS in the frequency bands 22.5-22.55 GHz and 23.55-23.6 GHz show that WAIC systems are compatible with EESS (passive) and RAS systems, in the adjacent frequency bands 22.21-22.5 GHz and 23.6-24 GHz. However, additional work has yet to be conducted to show compatibility with the incumbent FS.

3/1.17/5 Method(s) to satisfy the agenda item

There are 2 Methods to satisfy the agenda item:

3/1.17/5.1 Method A

Adds a primary AM(R)S allocation to the frequency band 4 200-4 400 MHz. Relevant footnotes are modified and new footnotes are added to limit the use to WAIC systems, maintain the status of passive sensing in the EESS and SRS, and maintain the use of the ARNS. A new Resolution is proposed in Method A. The method contains three different options for this new Resolution **[A117-WAIC] (WRC-15)** in order to satisfy the agenda item.

Advantages (For Options 1, 2, 3)

– Provides a primary AM(R)S allocation limited to WAIC systems.

– Ensures mandatory protection of the ARNS reserved exclusively for radio altimeters.

– Provides worldwide harmonized frequency spectrum for WAIC systems.

– Provides the required wideband spectrum for implementation of WAIC systems.

Disadvantages (for Options 1 and 2)

– None.

Disadvantages (for Option 3)

– May require a specific WRC agenda item in order to modify Resolution **[A117-WAIC] (WRC-15)** referred to in Option 3.

– Defining in a Resolution the maximum e.i.r.p. level an aircraft is allowed to radiate may unnecessarily restrict the design and improvements of WAIC systems.

3/1.17/5.2 Method B

This method is based on Method A option 3. However instead of referencing a WRC Resolution in a footnote it uses an ITU-R Recommendation incorporated by reference through the same footnote.

Advantages

– Provides a primary AM(R)S allocation limited to WAIC systems.

– Provides worldwide harmonized frequency spectrum for WAIC systems.

– Provides the required wideband spectrum for implementation of WAIC systems.

– Provides the ability to update the recommendation incorporated by reference without a need for a specific WRC agenda item.

– Ensures protection of the ARNS reserved exclusively for radio altimeters as described in Recommendation ITU-R M.2059 since the quantified conditions based on the results of the sharing studies would be mandatory.

Disadvantages

– Should WRC-15 not decide to incorporate the ITU-R Recommendation in the Radio Regulations, the mandatory protection of radio altimeter would not be appropriately achieved under this method.

– Defining the maximum e.i.r.p. level an aircraft is allowed to radiate as described in *recommends* 4 of WDPDN Recommendation ITU-R M.[WAIC CONDITIONS] may unnecessarily restrict the design and improvements of WAIC systems.

3/1.17/6 Regulatory and procedural considerations

3/1.17/6.1 Method A

ARTICLE 5

Frequency allocations

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

MOD

2 700-4 800 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…/…		
4 200-4 400	AERONAUTICAL MOBILE (R) ADD 5.A117 AERONAUTICAL RADIONAVIGATION MOD 5.438 5.439 5.440 ADD 5.B117	
…/…		

MOD

5.438 Use of the band 4 200-4 400 MHz by the aeronautical radionavigation service is reserved exclusively for radio altimeters installed on board aircraft and for the associated transponders on the ground. ~~However, passive sensing in the Earth exploration-satellite and space research services may be authorized in this band on a secondary basis (no protection is provided by the radio altimeters).~~

ADD

5.A117 Use of the frequency band 4 200-4 400 MHz by stations in the aeronautical mobile (R) service is reserved exclusively for wireless avionics intra-communication systems that operate in accordance with recognized international aeronautical standards. Such use shall be in accordance with Resolution **[A117-WAIC] (WRC-15)**.

Reasons: This footnote makes reference to the following Resolution **[A117-WAIC] (WRC-15)**. See also below the alternative text option for ADD 5.A117.

ADD

5.A117 Use of the frequency band 4 200-4 400 MHz by stations in the aeronautical mobile (R) service is reserved exclusively for wireless avionics intra-communication systems that operate in accordance with recognized international aeronautical standards. These systems shall not cause harmful interference to, nor claim protection from, the aeronautical radionavigation service. Wireless Avionics Intra-Communications (WAIC) is defined as radiocommunication between two or more aircraft stations located on a single aircraft, supporting the safe operation of the aircraft. No. **43.1** shall not apply.

Reasons: This alternative text for ADD 5.A117 may not require the following Resolution **[A117-WAIC] (WRC-15)**.

ADD

5.B117 Passive sensing in the Earth exploration-satellite and space research services may be authorized in the frequency band 4 200-4 400 MHz on a secondary basis.

SUP

RESOLUTION 423 (WRC-12)

Consideration of regulatory actions, including allocations, to support Wireless Avionics Intra-Communications

3/1.17/6.1.1 Method A Option 1 for Resolution [A.117-WAIC] (WRC-15):

Option 1 provides relevant regulatory provisions to satisfy the agenda item.

ADD

RESOLUTION [A117-WAIC-OPTION-1] (WRC-15)

Conditions for the use of Wireless Avionics Intra-Communications

The World Radiocommunication Conference (Geneva, 2015),

considering

a) that aircraft are being designed to enhance efficiency, reliability and safety, as well as to be more environmentally friendly;

b) that Wireless Avionics Intra-Communications (WAIC) systems provide radiocommunications between two or more points integrated into or installed on a single aircraft;

c) that WAIC systems do not provide radiocommunications between an aircraft and the ground, another aircraft or satellite;

d) that WAIC systems must operate in a manner that ensures the safe operation of an aircraft;

e) that WAIC systems will operate during all phases of flight, including on the ground;

f) that aircraft equipped with WAIC systems will be operated worldwide and will cross national borders;

g) that WAIC systems operating inside an aircraft will receive the benefits of fuselage attenuation to facilitate sharing with other services;

h) that Recommendation ITU-R M.[WAIC] provides technical characteristics and operational objectives for WAIC systems,

recognizing

a) that Annex 10 to the Convention on International Civil Aviation contains Standards and Recommended Practices (SARPs) for aeronautical radionavigation and radiocommunication systems used by international civil aviation,

resolves

1 that WAIC is radiocommunication between two or more aircraft stations located on a single aircraft, supporting the safe operation of the aircraft;

2 that the aeronautical mobile (route) service systems operating in the frequency band 4 200-4 400 MHz shall not cause harmful interference to, nor claim protection from, aeronautical radionavigation service systems in this band;

3 that the aeronautical mobile (route) service systems operating in the frequency band 4 200-4 400 MHz shall meet SARPs requirements published in Annex 10 to the Convention on International Civil Aviation;

4 that No. **43.1** shall not apply for aeronautical mobile (route) service allocations in the frequency bands identified in Article **5** for WAIC systems,

instructs the Secretary-General

to bring this Resolution to the attention of ICAO.

3/1.17/6.1.2 Method A Option 2 for Resolution [A117-WAIC] (WRC-15):

Option 2 provides an additional *considering i)*.

ADD

RESOLUTION [A117-WAIC-OPTION-2] (WRC-15)

Conditions for the use of Wireless Avionics Intra-Communications

The World Radiocommunication Conference (Geneva, 2015),

considering

{Note: considering a) to h) identical with Option 1}

i) that under some limited circumstances, operational measures might be considered to ensure compatibility between WAIC systems operating in the band 4 200-4 400 MHz and nearby FSS systems operating below 4 200 MHz,

recognizing

{Note: recognizing a) identical with Option 1}

resolves

{Note: resolves 1 to 4 identical with Option 1}

instructs the Secretary-General

{Note: instructs the Secretary-General identical with Option 1}.

3/1.17/6.1.3 Method A Option 3 for Resolution [A117-WAIC] (WRC-15):

Option 3 provides relevant regulatory provisions to satisfy the agenda item by the addition of a *resolves* to the Resolution given in Option 1, moreover two *considerings* and one *recognizing* are also added.

ADD

RESOLUTION [A117-WAIC-OPTION-3] (WRC-15)

Conditions for the use of Wireless Avionics Intra-Communications

The World Radiocommunication Conference (Geneva, 2015),

considering

a) that the frequency band 4 200-4 400 MHz is allocated to the aeronautical radionavigation service (ARNS) on a primary basis, limited to radio altimeters, and in one country, to the fixed service on a secondary basis, according to No. **5.439**;

b) that in the frequency band 4 200-4 400 MHz the Earth exploration-satellite (passive) and space research services may be authorized in the frequency band on a secondary basis, according to No. **5.438**;

c) that the future generations of aircraft are being designed to enhance efficiency, reliability and safety, as well as to be more environmentally friendly;

d) that Wireless Avionics Intra-Communications (WAIC) systems provide radiocommunications between two or more points integrated into or installed on a single aircraft;

e) that WAIC systems do not provide radiocommunications between an aircraft and the ground, another aircraft or satellite;

f) that WAIC systems must operate in a manner that ensures the safe operation of an aircraft;

g) that WAIC systems will operate during all phases of flight, including on the ground;

h) that aircraft equipped with WAIC systems will be operated worldwide and will cross national borders;

i) that WAIC systems operating inside an aircraft will receive the benefits of fuselage attenuation to facilitate sharing with other services;

j) that Recommendation ITU-R M.[WAIC] provides technical characteristics and operational objectives for WAIC systems,

recognizing

that Annex 10 to the Convention on International Civil Aviation contains Standards and Recommended Practices (SARPs) for aeronautical radionavigation and radiocommunication systems used by international civil aviation,

resolves

1 that WAIC is defined as radiocommunication between two or more aircraft stations located on a single aircraft, supporting the safe operation of the aircraft;

2 that the aeronautical mobile (R) service (AM(R)S) systems operating in the frequency band 4 200-4 400 MHz shall meet Standards and Recommended Practices (SARPs) requirements published in Annex 10 to the Convention on International Civil Aviation;

3 that the AM(R)S systems operating in the band 4 200-4 400 MHz shall not cause harmful interference to, nor claim protection from aeronautical radionavigation service systems in this band;

4 that in order to not cause harmful interference to the incumbent services, the aggregate equivalent isotropically radiated power (e.i.r.p.) for outside WAIC systems in the AM(R)S shall be limited to the values presented in the following table:

Angle with vertical axis of the aircraft, θ (degrees)	**Aggregate e.i.r.p. limits (dBm)**
$0 \leq \theta < 70$	−20
$70 \leq \theta < 78$	−15
$78 \leq \theta < 86$	−2
$86 \leq \theta < 120$	3
$120 \leq \theta \leq 180$	20

where θ is the rotationally symmetrical angle of the direction considered with the vertical axis referred to the aircraft. θ = 0 in the vertical (zenith) direction;

5 that No. **43.1** does not apply for aeronautical mobile (R) service allocation in frequency bands identified in Article **5** for WAIC systems,

instructs the Director of the Radiocommunication Bureau

to report to the next WRC on implementation of this Resolution,

instructs the Secretary-General

to bring this Resolution to the attention of ICAO.

3/1.17/6.2 Method B

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations

(See No. **2.1**)

MOD

2 700-4 800 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
…/…		
4 200-4 400	AERONAUTICAL MOBILE (R) ADD 5.C117 AERONAUTICAL RADIONAVIGATION MOD 5.438 5.439 5.440 ADD 5.B117	
…/…		

MOD

5.438 Use of the band 4 200-4 400 MHz by the aeronautical radionavigation service is reserved exclusively for radio altimeters installed on board aircraft and for the associated transponders on the ground.~~ However, passive sensing in the Earth exploration-satellite and space research services may be authorized in this band on a secondary basis (no protection is provided by the radio altimeters).~~

ADD

5.C117 Use of the frequency band 4 200-4 400 MHz by stations in the aeronautical mobile (R) service is reserved exclusively for wireless avionics intra-communication systems that operate in accordance with recognized international aeronautical standards. Such use shall be in accordance with Recommendation ITU-R M.[WAIC CONDITIONS].

Reasons: To reserve the use of the proposed new AM(R)S allocation in the frequency band 4 200-4 400 MHz exclusively for WAIC systems in accordance with Recommendation ITU-R M.[WAIC CONDITIONS] to be incorporated by reference in the RR. See also below the alternative text option for ADD 5.C117.

ADD

5.C117 Use of the frequency band 4 200-4 400 MHz by stations in the aeronautical mobile (R) service is reserved exclusively for wireless avionics intra-communication systems that operate in accordance with recognized international aeronautical standards. These systems shall not cause harmful interference to, nor claim protection from, the aeronautical radionavigation service. Wireless Avionics Intra-Communications (WAIC) is defined as radiocommunication between two or more aircraft stations located on a single aircraft, supporting the safe operation of the aircraft. Such use shall be in accordance with Recommendation ITU-R M.[WAIC CONDITIONS]. No. **43.1** shall not apply.

Reasons: Same purposes as in the first text option above and, in addition, to provide other restriction of use with respect to ARNS, define WAIC and exclude application of RR No. **43.1**.

ADD

5.B117 Passive sensing in the Earth exploration-satellite and space research services may be authorized in the frequency band 4 200-4 400 MHz on a secondary basis.

SUP

RESOLUTION 423 (WRC-12)

Consideration of regulatory actions, including allocations, to support Wireless Avionics Intra-Communications

AGENDA ITEM 1.18

(**WP 5B** for *invites ITU-R i) and ii)* and **WP 5A** for *invites ITU-R iii)* / **WP 1B**, **WP 7B**, **WP 7C**, **WP 7D**, (WP 3M))

1.18 to consider a primary allocation to the radiolocation service for automotive applications in the 77.5-78.0 GHz frequency band in accordance with Resolution ***654 (WRC-12)****;*

Resolution **654 (WRC-12)**: *Allocation of the band 77.5-78 GHz to the radiolocation service to support automotive short-range high-resolution radar operations*

3/1.18/1 Executive summary

The 2012 World Radiocommunication Conference (WRC-12) approved agenda item 1.18 to consider a primary allocation in the frequency band 77.5-78.0 GHz to the radiolocation service (RLS) for automotive applications in accordance with Resolution **654 (WRC-12)**. Resolution 654 invites ITU-R to conduct the appropriate technical, operational and regulatory studies including sharing and compatibility studies taking into account incumbent services and existing uses of the frequency band 77.5-78.0 GHz.

The incumbent services in the frequency band are amateur service (ARS) and amateur satellite service (ARSS) (primary) and radio astronomy service (RAS) and space research service (SRS) (secondary). The sharing studies between the automotive radars and systems operating under allocations to the incumbent services are given in Report ITU-R M.[AUTOMOTIVE RADARS]. Automotive radars, operating in the frequency range 76-81 GHz, were taken as the representative of RLS for the purpose of the studies. Systems characteristics of automotive radars, used in the sharing studies, are given in Recommendation ITU-R M.2057.

Two methods are proposed to satisfy the agenda item 1.18. Both provide a primary allocation to the RLS in frequency band 77.5-78 GHz on a worldwide basis, which can be used by automotive applications. While Method A limits the use of the new allocation to automotive radars, Method B gives an unrestricted allocation which supports the use of automotive radars.

3/1.18/2 Background

Portions of the frequency band 76-81 GHz are allocated to the RAS, ARS, ARSS and RLS on a primary or secondary basis and to the SRS (space-to-Earth) on a secondary basis. At frequencies above 30 GHz, radio propagation decreases more rapidly with distance than at lower frequencies and antennas that can narrowly focus transmitted energy are practical and of modest size. While the limited range of such transmissions might appear to be a major disadvantage for many applications, it does allow the reuse of frequencies over very short distances and, thereby enables a higher concentration of transmitters to be located in a geographical area than is possible at lower frequencies.

The attenuation of the transmissions, however, varies depending on the water vapour content of the atmosphere and other atmospheric factors.

There has been significant growth in the use of automobile radar systems, and these systems are expected to become relatively commonplace within a few years because of consumer demand for increased vehicle safety. Studies have shown that the use of collision avoidance technology can prevent or lessen the severity of a significant number of traffic accidents. In certain parts of the world, automotive radars have successfully operated in this portion of the spectrum, particularly the frequency band 76-77 GHz, for many years without mitigation methods or deactivation methods and without increased reports of interference to other services.

The ITU Council, in adopting Resolution 1318 (Council 2010), stated that information and communication technologies (ICTs), including intelligent transport systems, provide mechanisms for human and vehicle safety; and invited members of the union to take practical steps to further national and domestic policies, programs and/or educational initiatives in the use of ICTs to improve global road safety.

3/1.18/2.1 Regulatory status of the RLS in the frequency band 76-81 GHz

Currently, the RLS is allocated globally on primary basis in the frequency bands 76-77.5 GHz, and 78-81 GHz. Obtaining a possible global primary radiolocation allocation in the frequency band 77.5-78 GHz provides for a harmonized, contiguous band for radiolocation service, including collision avoidance related automotive radar applications in the frequency band 76-81 GHz. It should be noted that RR No. **5.149** urges administrations to take all practicable steps to protect the radio astronomy service from harmful interference in the band. A primary allocation to the RLS in the frequency band 77.5-78 GHz would establish regulatory priority over the RAS and SRS (space-to-Earth) , which are allocated on a secondary basis. Means to ensure that the provisions of RR No. **5.149** are not diminished may need to be considered.

3/1.18/3 Summary and the analysis of the results of the technical and operational studies relating to the possible methods of satisfying the agenda item, including a list of relevant ITU-R Recommendations

Results of the sharing studies for are given in PDN Report ITU-R M.[AUTOMOTIVE RADARS]. The following studies are considered in this Report:

Sharing studies with the amateur and amateur satellite service

Two different methodologies were used in the sharing studies between automotive radar and ARS and ARSS stations:

a) Geometric analysis methodology:

The conclusions of this study indicate that:

- The operation of the ARS in the mountain top scenario is not expected to be significantly constrained by the RLS.
- It is still possible to operate the radio amateur stations in the building top scenario with a careful choice of the building, where the amateur receiver has to be installed.

Therefore, the study indicates that the allocation of the frequency band 77.5-78 GHz to the RLS is not expected to impose severe constraints on the ARS.

b) Minimum coupling loss methodology:

The conclusions of this study indicate that:

The calculations show that the distances over which interference could be expected are small and are all less than 200 metres for the scenarios considered for both ARS and ARSS stations. In the light of the calculations given in PDN Report ITU-R M.[AUTOMOTIVE RADARS], it can be concluded that the interference probability from automotive radars to ARS and ARSS stations is very low.

Sharing studies with the radio astronomy service

Studies included a theoretical assessment of the necessary separation distances to protect RAS as a function of the density of transmitting automotive radar devices and two case studies: Kitt Peak in the USA which included actual measurements and Plateau de Bure in France.

– The following conclusions can be drawn from the conducted studies mentioned above:
– The shape and dimension of the coordination area largely depends on the features of terrain surrounding the RAS site. In principle terrain shape and terrain occupation should be considered.
– Choice of the location may considerably improve the protection of systems operating in the RAS.
– The magnitude of the interference issue could be manageable provided that RAS sites are adequately shielded by terrain relief.

Areas of concern remain and will have to be further analysed and dealt with by administrations.

Based on the above, potential cases of interference would be expected to be localized and could best be resolved by the concerned administration.

Sharing studies with the SRS (space-to-Earth)

No SRS (space-to-Earth) systems have been identified to date in the frequency range 76 GHz to 81 GHz and therefore no sharing studies were performed.

List of relevant ITU-R recommendations

Following recommendations are considered relevant for the studies:

Recommendations ITU-R M.1732, ITU-R RA.769, ITU-R RA.1031, ITU-R RA.1272, ITU-R M.2057, ITU-R P.676, ITU-R P.837, ITU-R SA.1157, ITU-R RA.1513, ITU-R P.452, ITU-R P.833, ITU-R P.620, ITU-R P.526 and ITU-R F.749.

3/1.18/4 Analysis of the results of studies relating to the possible methods of satisfying the agenda item

The analysis of the results of studies is provided in Section 3/1.18/3.

3/1.18/5 Method(s) to satisfy the agenda item

3/1.18/5.1 Method A

Add a primary allocation to the RLS on a worldwide basis, limited to automotive applications, between 77.5 GHz and 78 GHz.

Advantages

– provides worldwide harmonization for safety and collision avoidance related automotive radar applications in the frequency band 76-81 GHz, which, if implemented, will very likely result in reduced traffic fatalities and injuries on the road;
– provides a broader manufacturing base and increased volume of equipment (globalization of markets) resulting in economies of scale and expanded equipment availability;
– the nature of these short range automotive radars along with the propagation characteristics of the frequency band 76-81 GHz will facilitate sharing with incumbent services.

Disadvantages

– in some areas, mitigation methods such as appropriate emission power limits and antenna height limits may be needed to avoid potential interference to the RAS operating in the frequency band 77.5-78 GHz. It should however be noted that there are already primary allocations to the RLS in the frequency bands 76-77.5 GHz and 78-81 GHz.

– the limitation to the automotive applications may impede the usage of short range high resolution radars for other applications and thus result in a less flexible spectrum usage.

3/1.18/5.2 Method B

Add a primary allocation to the RLS on a worldwide basis, supporting automotive radar operations, between 77.5 GHz and 78 GHz.

Some administrations are of the view that this method by expanding the use of the frequency band to applications other than short-range automotive radars may be beyond the scope of the agenda item.

However, some other administrations are of the view that this method is within the scope of the agenda item.

Advantages

– provides worldwide harmonization for radiolocation in the frequency band 76-81 GHz that would enable short-range high-resolution radar applications, including the safety and collision avoidance related automotive radar applications, which, if implemented, will very likely result in reduced traffic fatalities and injuries on the road. It should also be noted that there are already primary allocations without any restriction on the RLS in the frequency bands 76-77.5 GHz and 78-81 GHz;

– provides a broader manufacturing base and increased volume of equipment (globalization of markets) resulting in economies of scale and expanded equipment availability;

– the nature of these short-range radars along with the propagation characteristics of the frequency band 76-81 GHz will facilitate sharing with incumbent services;

– would not limit the future development of short-range high-resolution radar to automotive applications.

Disadvantages

– in some areas, mitigation methods such as appropriate emission power limits and antenna height limits may be needed to avoid potential interference to the RAS operating in the frequency band 77.5-78 GHz;

– to date, the only sharing studies with the incumbent services have been with short-range automotive radars and the technical parameters associated with those radars.

3/1.18/6 Regulatory and procedural considerations

3/1.18/6.1 Method A

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**
…		
76-77.5	RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.149	
77.5-78	AMATEUR AMATEUR-SATELLITE RADIOLOCATION ADD 5.A118 Radio astronomy Space research (space-to-Earth) 5.149	
78-79	RADIOLOCATION Amateur Amateur-satellite Radio astronomy Space research (space-to-Earth) 5.149 5.560	
79-81	RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.149	

ADD

5.A118

Option 1:

The use of the 77.5-78 GHz frequency band by the radiolocation service is limited to automotive applications. The characteristics of the automotive radars are given in Recommendation ITU-R M.2057.

Option 2:

The use of the 77.5-78 GHz frequency band by the radiolocation service is limited to automotive applications.

SUP

RESOLUTION 654 (WRC-12)

Allocation of the band 77.5-78 GHz to the radiolocation service to support automotive short-range high-resolution radar operations

3/1.18/6.2 Method B

The regulatory approach under this Method is to add a primary allocation to RLS in the Table of Frequency Allocations of RR Article **5**. The other consequential action under this method would be to suppress Resolution **654 (WRC-12)**.

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**
…		
76-77.5	RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.149	
77.5-78	AMATEUR AMATEUR-SATELLITE <u>RADIOLOCATION</u> Radio astronomy Space research (space-to-Earth) 5.149	
78-79	RADIOLOCATION Amateur Amateur-satellite Radio astronomy Space research (space-to-Earth) 5.149 5.560	

SUP

RESOLUTION 654 (WRC-12)

Allocation of the band 77.5-78 GHz to the radiolocation service to support automotive short-range high-resolution radar operations

CHAPTER 4

Satellite services

(Agenda items 1.6, 1.7, 1.8, 1.9.1, 1.9.2, 1.10)

CONTENTS

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SUB-CHAPTER 4.1

Fixed-satellite service

(Agenda items 1.6, 1.7, 1.8, 1.9.1)

AGENDA ITEM 1.6

1.6 to consider possible additional primary allocations:

1.6.1 to the fixed-satellite service (Earth-to-space and space-to-Earth) of 250 MHz in the range between 10 GHz and 17 GHz in Region 1;

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

1.6.2 to the fixed-satellite service (Earth-to-space) of 250 MHz in Region 2 and 300 MHz in Region 3 within the range 13-17 GHz;

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

*and review the regulatory provisions on the current allocations to the fixed-satellite service within each range, taking into account the results of ITU-R studies, in accordance with Resolutions **151 (WRC-12)** and **152 (WRC-12)**, respectively;*

Resolution **151 (WRC-12)**: *Additional primary allocations to the fixed-satellite service in frequency bands between 10 and 17 GHz in Region 1*

Resolution **152 (WRC-12)**: *Additional primary allocations to the fixed-satellite service in the Earth-to-space direction in frequency bands between 13-17 GHz in Region 2 and Region 3*

4.1/1.6.1 Resolution 151 (WRC-12)

4.1/1.6.1/1 Executive summary

ITU-R has undertaken studies of possible bands for new primary allocations to the fixed-satellite service (FSS) in the Earth-to-space and space-to-Earth directions within the frequency range 10-17 GHz in ITU Region 1. Studies were performed in 11 different sub-bands from 10 to 17 GHz, and the analysis of the results of the studies and the methods to satisfy the agenda item can be found in section 4.1/1.6.1/4 and section 4.1/1.6.1/5, respectively. It should be noted that the studies performed and the methods considered only address geostationary (GSO) FSS.

4.1/1.6.1/2 Background

The existing unplanned FSS bands in the 10-15 GHz range are used extensively for a myriad of applications such as very small aperture terminal (VSAT) services, video distribution, broadband networks, internet services, satellite news gathering and backhaul links. Growth in demand for these applications has triggered a rapid rise in the demand for spectrum. Moreover, as satellite traffic is typically symmetrical in a large variety of applications, i.e. similar amounts of Earth-to-space (uplink) and space-to-Earth (downlink) traffic are transmitted.

WRC-12 adopted WRC-15 agenda item 1.6.1 to consider additional primary allocations to the FSS in the range 10-17 GHz in Region 1 (Earth-to-space and space-to-Earth) and a review of regulatory provisions for existing FSS allocations, taking into account ITU-R studies in accordance with Resolution **151 (WRC-12)**.

4.1/1.6.1/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The main elements required for the decision under WRC-15 agenda item 1.6.1 are the established technical characteristics and operational parameters of GSO FSS systems (Earth-to-space and space-to-Earth) which could operate in the 10-17 GHz band, and also sharing studies of GSO FSS (Earth-to-space and space-to-Earth) with other radio services.

Relevant ITU-R documents:

The preliminary draft new (PDN) Report ITU-R S.[R1.FSS] and PDN Report ITU-R S.[FSS.DEPLOYMENT] and also the relevant ITU-R Recommendations and ITU-R Reports are indicated in the abovementioned PDN Reports which could be used in the studies performed in accordance with Resolution **151 (WRC-12)**.

4.1/1.6.1/3.1 Overview of current unplanned FSS allocations in Region 1

In Region 1, there are equal allocations between uplink and downlink spectrum, however there is a difference of 250 and 300 MHz of unplanned FSS spectrum when compared with Regions 2 and 3, respectively, as shown in Table 4.1/1.6.1/3-1.

TABLE 4.1/1.6.1/3-1

The current unplanned FSS bands in 10-15 GHz range in Region 1

Frequency bands (GHz)	Bandwidth (MHz)
Earth-to-space direction (uplink)	
13.75-14.5	750
Total spectrum in the uplink	**750**
space-to-Earth direction (downlink)	
10.95-11.2	250
11.45-11.7	250
12.5-12.75	250
Total spectrum in the downlink	**750**
Region 2 spectrum in the downlink	**1 000**
Region 3 spectrum in the downlink	**1 050**
Spectrum difference from other ITU Regions	**250/300**

4.1/1.6.1/3.2 Frequency bands examined

ITU-R has examined frequency bands in the 10-17 GHz range for their suitability in addressing the shortage in the uplink and downlink spectrum in Region 1 when compared with Region 2 and Region 3 FSS allocations.

Detailed study results on these bands are contained in PDN Report ITU-R S.[R1.FSS].

4.1/1.6.1/4 Analysis of the results of studies

Studies were performed in 11 different sub-bands from 10 to 17 GHz.

4.1/1.6.1/4.1 10.0-10.5 GHz band

Consideration is given to this band for possible primary allocations to FSS space-to-Earth operations. The band 10-10.45 GHz is allocated to the fixed service (FS) and mobile service (MS) on a primary basis in Region 1. The frequency band 10.45-10.5 GHz is also allocated to the FS and MS in some countries of Region 1 through RR No. **5.481**. The band 10-10.5 GHz is allocated to the radiolocation service (RLS) on a primary basis in Region 1.

4.1/1.6.1/4.1.1 FSS (space-to-Earth) sharing with the FS

The frequency band 10.0-10.5 GHz is used by digital wireless access systems of FS point-to-multipoint (PMP) links. Technical characteristics of digital PMP links of FS systems in the frequency band 10.0-10.68 GHz and the protection criteria are provided in Recommendation ITU-R F.758. The antenna patterns of the FS stations are described in Recommendations ITU-R F.1245 and ITU-R F.1336.

Statistical analysis showed a high probability of exceeding the permissible long-term aggregate interference level $I_{ag}/N = -10$ dB for terminal stations of PMP digital links of FS systems from the FSS (space-to-Earth) links with a spectral density e.i.r.p. equal to 40 dBW/MHz towards the horizon or with elevation angle lower than 5°. Thus, the achievement of compatibility of the proposed FSS (space-to-Earth) with FS terminal stations in the band 10.0-10.5 GHz is not feasible without use of additional mitigation techniques such as a power flux-density (pfd) mask like that developed to protect terrestrial stations in the band 10.7-11.7 GHz, i.e. RR Article **21** Table **21-4**.

For instance, when the e.i.r.p. spectral density of FSS space station is decreased by 6 dB (to 34 dBW/MHz, i.e. 2 dB lower than the RR Article **21** Table **21-4** value), the probability of exceeding the permissible long-term aggregate interference level of terminal stations of PMP FS links would be no more than about 1% (for FS station elevation angle no more than 5°).

Compatibility of the proposed FSS (space-to-Earth) with PMP links of FS systems in the frequency band 10.0-10.5 GHz is possible with the use of additional mitigation techniques like a pfd mask.

4.1/1.6.1/4.1.2 FSS (space-to-Earth) sharing with the MS

No ITU-R studies have been conducted to date.

4.1/1.6.1/4.1.3 FSS (space-to-Earth) sharing with the RLS

See section 4.1/1.6.1/4.2.3.

4.1/1.6.1/4.1.4 FSS (space-to-Earth) sharing with the radio astronomy service (RAS) operating in the adjacent frequency band

FSS emissions in the frequency band 10.0-10.5 GHz may cause interference to RAS receivers operating in the frequency band 10.6-10.68 GHz. The analysis of out-of-band (OOB) emissions in the RAS frequency band (10.6-10.68 GHz) from the main emissions of a single FSS space station with maximum pfd level of -122 dB(W/(m$^2 \cdot$ MHz)) showed that to protect RAS stations (Continuum observations) for which Recommendation ITU-R RA.769 (see Table 1, Annex 1) specifies the allowed level of interference pfd of -180 dB(W/(m$^2 \cdot$ MHz)), the emissions from a FSS space station in the RAS frequency band should be suppressed by 58 dB. With the typical OOB emission of FSS space station in the adjacent band suppressed by 35 dB, to protect RAS stations (Continuum observations) OOB emissions from FSS space stations should be additionally suppressed by 23 dB.

It should be noted, however, that the sharing between the current FSS (space-to-Earth) in the band 10.7-10.95 GHz (RR Appendix **30B**) and RAS in the adjacent band 10.6-10.68 GHz is achieved without additional constraints* to OOB emissions from FSS space stations.

Note (*): See Annex 3 to RR Appendix **30B** – Under the assumed free space propagation conditions the pfd (space-to-Earth) created at any spot of the Earth surface offered by a new assignment or allocation should not exceed −114.0 dB(W/(m^2 · MHz)) in the frequency bands 10.70-10.95 GHz and 11.20-11.45 GHz.

This pfd value of FSS space stations is 8 dB higher than the maximum pfd level of the proposed FSS (space-to-Earth) of −122 dB(W/(m^2 · MHz)).

Therefore, if considering a minimum frequency separation of 100 MHz with a possible new FSS allocation in the band 10-10.5 GHz, no compatibility issue is expected with RAS.

4.1/1.6.1/4.1.5 Summary of studies for the band 10.0-10.5 GHz

With additional spectrum allocation to GSO FSS (space-to-Earth) on a primary basis in Region 1 in the frequency band 10.0-10.5 GHz, the compatibility of the proposed GSO FSS (space-to-Earth) with RLS and FS in the common frequency band will be difficult to achieve with respect to the required interference protection levels without the use of additional mitigation techniques.

4.1/1.6.1/4.2 10.5-10.6 GHz band

Consideration is given to this band for possible primary allocations to FSS space-to-Earth operations. The band 10.5-10.6 GHz is allocated to the FS and MS on a primary basis in Region 1. In the portion of the band 10.55-10.6 GHz, the aeronautical mobile service (AMS) is not permitted.

4.1/1.6.1/4.2.1 FSS (space-to-Earth) sharing with the FS

The frequency band 10.5-10.6 GHz is used by FS digital wireless systems PMP. The results of compatibility studies of FSS (space-to-Earth) links and FS links PMP in the frequency band 10.0-10.5 GHz (see section 4.1/1.6.1/4.1.1) are applicable to the frequency band 10.5-10.6 GHz.

Compatibility of the proposed FSS (space-to-Earth) with PMP links of FS systems in the frequency band 10.5-10.6 GHz would be difficult to achieve with respect to the required interference protection levels without the use of additional mitigation techniques. Compatibility could be reached by means of reduction of e.i.r.p. spectral density of FSS space station.

4.1/1.6.1/4.2.2 FSS (space-to-Earth) sharing with the MS

No ITU-R studies have been conducted to date.

4.1/1.6.1/4.2.3 FSS (space-to-Earth) sharing with the RLS

When implementing FSS (space-to-Earth) with a maximum pfd level at the RLS station of −122 dB(W/(m^2 · MHz)) (e.i.r.p spectral density of 40 dBW/MHz,) in the frequency band 10.5-10.6 GHz, the allowed pfd level of −146 dB(W/(m^2 · MHz)) specified by Recommendation ITU-R M.1796 to protect RLS stations will be exceeded by 24 dB.

A decrease of the maximum FSS (space-to-Earth) pfd level by 24 dB is required to respect the level of protection for RLS stations.

4.1/1.6.1/4.2.4 FSS (space-to-Earth) sharing with the RAS operating in the adjacent frequency band

The studies as contained in the section 4.1/1.6.1/4.1.4 concerning the sharing between FSS (space-to-Earth) in the band of 10.0-10.5 GHz and RAS are applicable to the 10.5-10.6 GHz band.

4.1/1.6.1/4.2.5 Summary of studies for the band 10.5-10.6 GHz

With additional spectrum allocation to GSO FSS (space-to-Earth) on a primary basis in Region 1 in the frequency band 10.5-10.6 GHz the compatibility of the proposed GSO FSS (space-to-Earth) with RLS and FS allocated in the shared frequency band and with RAS in adjacent frequency band

10.6-10.68 GHz will be difficult to achieve with respect to the required interference protection levels without the use of additional mitigation techniques.

4.1/1.6.1/4.3 10.6-10.68 GHz band

Consideration is given to this band for possible primary allocations to FSS (space-to-Earth) operations. In Region 1, the band 10.6-10.68 GHz is allocated to the Earth exploration-satellite service (EESS) (passive), FS, MS (except aeronautical mobile), RAS, and space research service (SRS) (passive) on a primary basis. RR Nos. **5.149**, **5.482** and **5.482A** apply.

4.1/1.6.1/4.3.1 FSS (Earth-to-space and space-to-Earth) sharing with the EESS (passive)

The compatibility analyses with the EESS (passive) are based on technical characteristics derived from Recommendation ITU-R RS.1861.

Compatibility analysis performed between the FSS (space-to-Earth) and EESS (passive) indicated that sharing between the two services in the 10.6-10.68 GHz band is not feasible.

In addition to this study dedicated to a possible FSS (space-to-Earth) allocation, an FSS (Earth-to-space) allocation will create harmful interference to the operation of EESS (passive) sensors within the 10.6-10.68 GHz band.

4.1/1.6.1/4.3.2 FSS (space-to-Earth) sharing with the FS

The frequency band 10.6-10.68 GHz is used by FS systems with restrictions according to RR No. **5.482**. Technical characteristics of digital PMP and point-to-point (PP) links of FS systems in the frequency band 10.6-10.68 GHz and the protection criteria are provided in Recommendation ITU-R F.758. The antenna patterns of the FS stations are described in Recommendations ITU-R F.1245 and ITU-R F.1336.

Statistical analysis showed a high probability of exceeding the permissible long-term aggregate interference level $I_{ag}/N = -10$ dB for stations of PP digital links of FS systems from the FSS (space-to-Earth) links. Thus, compatibility of the proposed FSS (space-to-Earth) with FS stations of PP links in the band 10.6-10.68 GHz is not achieved with respect to the interference protection level without the use of additional mitigation techniques.

For instance, when the e.i.r.p. spectral density of FSS space station is decreased by 6 dB (to 34 dBW/MHz), the probability of exceeding the permissible long-term aggregate interference level of FS stations of PP links would be no more than about 0.9% (for FS station elevation angle no more than 5°). With this restriction one may use FSS earth stations with antenna diameter of more than 1.2 m.

The results of compatibility studies of FSS (space-to-Earth) links and PMP links of FS in the band 10.0-10.5 GHz (see section 4.1/1.6.1/4.1.1) are applicable to the frequency band 10.6-10.68 GHz.

Without the use of additional mitigation techniques, compatibility of the proposed FSS (space-to-Earth) with PP links of FS systems in the frequency band 10.6-10.68 GHz is not achieved since the interference protection level would not be respected. Compatibility could be reached by means of reduction of e.i.r.p. spectral density of the FSS space station.

4.1/1.6.1/4.3.3 FSS (space-to-Earth) sharing with the MS

No ITU-R studies have been conducted to date.

4.1/1.6.1/4.3.4 FSS (space-to-Earth) sharing with the RAS

The frequency band 10.6-10.7 GHz is used by RAS stations for monitoring sources of continuous spectrum and VLBI observations. In accordance with Recommendation ITU-R RA.769 the threshold interference pfd level is −240 dB(W/(m^2 · Hz)) for continuum observations and −193 dB(W/(m^2 · Hz)) for VLBI observations.

The pfd limits for GSO FSS (space-to-Earth) in the frequency band 10.7-11.7 GHz are also given in RR Article **21** Table **21-4** at level –150/–140 dB(W/(m^2 · Hz)).

Summary: The proposed FSS (space-to-Earth) does not provide compatibility with RAS in the frequency band 10.6-10.68 GHz.

4.1/1.6.1/4.3.5 Summary of studies for the band 10.6-10.68 GHz

With additional allocation of spectrum to GSO FSS (space-to-Earth) on a primary basis in the band 10.6-10.68 GHz in Region 1, compatibility of the proposed GSO FSS (space-to-Earth) with passive services (EESS, SRS) and RAS, allocated in the shared frequency band, is not achieved as the interference protection level is not respected.

Compatibility of proposed FSS (space-to-Earth) and FS in the shared frequency band 10.6-10.68 GHz is not achieved without the use of additional mitigation techniques.

4.1/1.6.1/4.4 13.25-13.4 GHz band

Consideration is given to this band for possible primary allocations to FSS Earth-to-space and space-to-Earth operations. The band 13.25-13.4 GHz is allocated to the EESS (active), aeronautical radionavigation service (ARNS) and SRS (active) on a primary basis. RR Nos. **5.497**, **5.498A** and **5.499** apply.

4.1/1.6.1/4.4.1 FSS (Earth-to-space) sharing with the EESS (active)

With regard to sharing between EESS (active) and FSS (Earth-to-space), nine studies have been performed to date.

Three of the studies indicate that the EESS (active) protection criteria is always met for all kinds of sensors considered, assuming the current FSS frequency reuse factor (FRF) per satellite of 1.2. However, the FSS FRF per GSO location may be higher than 1.2. In addition, it is to be noted that EESS (active) altimeters and one type of precipitation radar have lower margins of compatibility from 3 to 6 dB below the protection criteria, than scatterometers, and that these studies have been performed on a worldwide basis without consideration of measurement area of interest.

Another study indicates that FSS (Earth-to-space) with EESS (active) are compatible subject to some FSS (Earth-to-space) parameters restriction, using the same hypothesis as previously stated. According to the results of these studies, compatibility is achieved for all transmission types of FSS (Earth-to-space) earth stations with antenna diameters from 0.6m to 9 m with a maximum peak envelope power spectral density less than or equal to −50.8 dBW/Hz.

The last study provides a parametric analysis varying the FSS GSO FRF from 1.2 to 5. The parametric studies also examined varying the FSS deployment transmission types by percentage of transmissions. In addition, an assessment of the simplifying assumption of using a single continuously transmitting earth station in place of a TDMA network was done, showing that this simplifying assumption underestimates the amount of interference seen by the JASON-3 sensor by 3.4 dB considering a 100% VSAT TDMA deployment and a 0% wideband and PP deployment. Therefore, when considering a frequency reuse factor of 1.5, studies examining the random data availability criteria in Recommendation ITU-R RS. 1166-4 shows compatibilities between FSS (Earth-to-space) and EESS (active).

The results of dynamic analyses examining the compatibility between FSS (Earth-to-space) and EESS (active) in the 13.25-13.75 GHz band were based on a simplifying assumption for the representation of FSS TDMA networks and may underrepresent the interference that would be caused to EESS (active) sensors by FSS stations if an allocation to the FSS (Earth-to-space) is made in that band. The antenna size limitation and the regulatory obligation to coordinate each FSS earth station individually, should limit the total number of FSS earth stations that will be operated under TDMA technology.

Considering a linear extrapolation of the current trend, for the FRF implemented on new FSS satellites, it is expected to have an average FRF of 1.5 per satellite for the next 30 years. A FRF of 5 may be observed for high throughput satellite (HTS) at certain GSO orbital locations.When considering compatibility between EESS (active) and FSS (Earth-to-space), using the systematic data availability criteria of Recommendation ITU-R RS.1166-4, two of the studies show that, when examining specific measurement areas of interest (sea/land/wet areas) for EESS (active) altimetry, compatibility is not achieved. A single earth station uplink of median transmit power can corrupt the sensor measurements of a specific measurement area of interest. In one of the studies it was shown that the sharing criteria is not met for regions of the Earth extending from the equator to ±10 degrees latitude (VSAT) to ±45 degrees latitude (wideband). A specific mitigation technique to address sharing has not yet been identified. One study performed dynamic simulations of the FSS (Earth-to-space) with EESS active precipitation radar, and showed the protection criteria for Precipitation Measurement Radar 2 (PMR2) were not satisfied, exceeding the interference threshold by 10 dB.

4.1/1.6.1/4.4.2 FSS (space-to-Earth) sharing with the EESS (active)

The static analysis of interference from the FSS (space-to-Earth) space stations to EESS space stations active sensors is performed using two interference scenarios: Scenario 1 considers the variant of interference impact on the back lobes of the EESS space station antenna pattern, and Scenario 2 considers the option when the interfering signal is reflected from the earth surface and falls into the antenna main lobe of the EESS active sensor also known as backscatter.

The analysis showed the availability of positive margin for allowable interference protection criterion in both scenarios for all types of the considered EESS (active) sensors. The margin of protection criterion is from 16 to 21 dB (for Scenario 1) and 3 to 41 dB (for Scenario 2).

Dynamic analysis of interference from EESS (active) systems to receive FSS earth stations (E/Ss) with different antenna diameters (0.75-9 m) and different elevation angles located at different latitudes showed that the level of interference would exceed the FSS E/S protection criterion (I/N = 6% or –12.2 dB) during a very limited period of time (0.01% - 0.1%), which should not affect the quality of services provided.

Summary: Compatibility of proposed FSS (space-to-Earth) and considered EESS (active) sensors in the frequency band 13.25-13.4 GHz is possible should a pfd limit of -122 dB(W/(m$^2 \cdot$ MHz)) on the Earth surface from FSS space stations for all elevation angles not be exceeded.

Another study also analysed the interference for Scenario 2. The static analysis in this study shows that the permissible threshold for interference for Global Precipitation Mission (GPM) DPR will be exceeded as long as the backscattering coefficient is greater than about 1 dB. According to the statistics from precipitation radars (PR)’s observation there is more than 0.2% of the PR’s whole observation with a 1 dB or greater backscattering coefficient at most incidence angles. This means one FSS satellite may create harmful interference beyond the protection criteria for GPM DPR.

Considering that existing EESS (active) altimeter systems use 350 MHz bandwidth, and in future the EESS (active) is planning to use for altimeters the whole frequency band 13.25-13.75 GHz (500 MHz), it is necessary to consider the impact of aggregate interference simultaneously coming from all EESS (active) systems to FSS E/Ss.

4.1/1.6.1/4.4.3 FSS (space-to-Earth) sharing with the ARNS

The maximum allowable pfd to protect Doppler navigation systems (DNS) operating in the ARNS of −135.9 dB(W/(m^2 · MHz)) is 13.9 dB below the maximum pfd level of the proposed FSS (space-to-Earth) of −122 dB(W/(m^2 · MHz)).

The analysis of interference in the opposite direction, from emissions of DNS systems in ARNS to receive FSS E/S (with antenna size ranging 0.6 to 6.0 m) showed that in the considered interference scenarios the interference level significantly exceeds the allowable threshold (by 37.2-110.9 dB – to receive interference from radar side lobes and by 50.2-123.9 dB – to receive interference from radar main lobe).

Further studies should be performed to specify the probability and duration of interference impact from interference source in ARNS to the receive FSS E/S in the considered interference scenarios.

ARNS DNS systems operating in 13.25-13.4 GHz may cause out-of-band interference into the FSS (space-to-Earth and Earth-to-space) in the 13.4-13.75 GHz near the 13.4 GHz edge of the band.

4.1/1.6.1/4.4.4 FSS (Earth-to-space) sharing with the ARNS

Compatibility analysis between FSS (Earth-to-space) and ARNS (DNS systems installed in aircraft and helicopters, UAS) resulted in the allowable aggregate interference level being exceeded by up to 24.0 dB when considering interference from the side-lobes of FSS E/S into the side-lobes of ARNS DNS systems. When considering the main-lobe of single entry interference from the FSS E/S into the side-lobes of the ARNS DNS systems, the allowable interference level is exceeded by up to 53.7 dB.

ARNS DNS systems operating in 13.25-13.4 GHz may cause out-of-band interference into the FSS (space-to-Earth and Earth-to-space) in the 13.4-13.75 GHz near the 13.4 GHz edge of the band.

4.1/1.6.1/4.4.5 FSS (space-to-Earth and Earth-to-space) sharing with the SRS (active)

Since SRS (active) applications are active sensors used in the frequency band 13.25-13.4 GHz around other planets, no compatibility issue with the FSS proposed is expected.

4.1/1.6.1/4.4.6 FSS (space-to-Earth and Earth-to-space) sharing with the FS

No allocation to the FS exists in Region 1, thus no ITU-R studies are required.

4.1/1.6.1/4.4.7 Summary of studies for the band 13.25-13.4 GHz

Regarding an additional spectrum allocation for GSO FSS on a primary basis in Region 1 in the frequency band 13.25-13.4 GHz, compatibility between the FSS (space-to-Earth) and EESS (active) in the frequency band 13.25-13.4 GHz may be possible after considering the simultaneous allowable level of aggregate interference caused from all EESS (active) systems to FSS E/S. FSS (space-to-Earth) operations would be compatible with EESS (active) systems, assuming a backscatter coefficient less than 1 dB. FSS (Earth-to-space) emissions will exceed the protection criteria for EESS (active) altimeter measurement areas of interest (inland lakes, rivers, reservoirs, coasts) as well as EESS (active) precipitation radars. No mitigation technique to address this incompatibility has yet been identified.

Given the features of the use of SRS (active) in the frequency band 13.25-13.4 GHz, problems of compatibility with the FSS (Earth-to-space and space-to-Earth) proposed is not expected.

Interference generated by FSS (space-to-Earth and Earth-to-space) proposed towards ARNS (DNS systems on board airplanes) in the common frequency band 13.25-13.4 GHz significantly exceeds the ARNS DNS protection criteria levels by very large margins, +14 dB by FSS (space-to-Earth) and +53.7 dB by FSS (Earth-to-space).

4.1/1.6.1/4.5 13.4-13.75 GHz band

Consideration is given to this band for possible primary allocations to FSS (Earth-to-space and space-to-Earth) operations. The band 13.4-13.75 GHz is allocated to the EESS (active), RLS and SRS (active) on a primary basis.

RR No. **5.501A** indicates that the use of the band 13.4-13.75 GHz by the SRS on a primary basis is limited to active spaceborne sensors. Other uses of the band by the SRS are on a secondary basis. RR Nos. **5.499**, **5.500**, **5.501** and **5.501B** apply.

4.1/1.6.1/4.5.1 FSS (Earth-to-space and space-to-Earth) sharing with the EESS

4.1/1.6.1/4.5.1.1 FSS (Earth-to-space) sharing with the EESS (active)

The description of use of EESS (active) in the frequency band 13.25-13.75 GHz and the feasibility of sharing with the proposed FSS (Earth-to-space) is shown in section 4.1/1.6.1/4.4.1.

4.1/1.6.1/4.5.1.2 FSS (space-to-Earth) sharing with the EESS (active)

See section 4.1/1.6.1/4.4.2.

4.1/1.6.1/4.5.2 FSS (Earth-to-space) sharing with the SRS

The SRS is currently allocated on a secondary basis in this band.

The frequency band 13.4-13.75 GHz is used by data relay satellite (DRS) systems operating in the SRS for return feeder links (downlinks) and for forward inter-orbit links (see Recommendations ITU-R SA.1018 and ITU-R SA.1019). Recommendation ITU-R SA.1414 describes characteristics of DRS systems operated by some administrations.

Two studies were performed between FSS (Earth-to-space) and SRS DRS system 1 in this band, using different FSS earth station deployment models, as well as other initial assumptions. The first study, which employed an apportioned protection criteria as indicated by the relevant ITU-R study group, concluded that sharing between FSS (Earth-to-space) and the return feeder links of SRS DRS systems was feasible, but that sharing between FSS (Earth-to-space) and DRS forward inter-orbit links was not, with all FSS earth stations located at the same latitude and considering parametrically a range of earth station antenna size (0.6 to 2.4 m) and maximum power spectral density (−42 to −60 dBW/Hz). The second study, which employed the aggregate interference criteria and used FSS earth station location according to deployment model in section 4, reached the opposite result with respect to DRS forward inter-orbit links, concluding that sharing could be feasible subject to regulatory measures/technical limitations (minimum FSS earth station antenna diameter of 1.2 m, e.i.r.p. of any emission limited between 68 dBW and 85 dBW for earth stations having an antenna diameter greater than or equal to 4.5 m). Currently the forward inter-orbit links are not operated under DRS system 1 in the band 13.4-13.75 GHz.

Summary

Compatibility of the FSS uplinks with respect to SRS DRS return feeder links in the band 13.4-13.75 GHz is achievable by providing sufficient separation between FSS uplink earth stations and the DRS downlink earth stations. Necessary coordination distances could be defined by applying regulatory provisions for FSS uplinks (as for example application of RR No. **9.17A**).

Compatibility of the FSS uplinks with respect to the SRS DRS forward links in the band 13.4-13.75 GHz will not be ensured without adequate mitigation techniques which have not been identified. Mitigation techniques, such as hard limits for FSS earth station parameters, should be included into the RR.

The impact on SRS DRS system 2 forward links from FSS uplinks has not yet been studied.These studies are required to determine compatibility of the FSS uplinks with respect to the SRS DRS forward links in the band 13.4-13.75 GHz.

4.1/1.6.1/4.5.3 FSS (space-to-Earth) sharing with the SRS

The SRS is currently allocated on a secondary basis in this band.

Three studies were performed between FSS (space-to-Earth) and SRS DRS system 1 in this band and one study was performed between FSS (space-to-Earth) and SRS DRS system 2.

The results of the interference analysis, considering the same status for FSS and SRS allocations are summarized in Table 4.1/1.6.1/4-1 below.

TABLE 4.1/1.6.1/4-1

Summary of results of interference between SRS DRS systems and proposed FSS downlink allocation in the 13.4-13.75 GHz band

				Possible to establish compatibility between SRS and FSS for co-frequency operations?	
New allocation	**Frequency band (GHz)**	**Case**	**SRS (DRS) links**	**FSS interference into SRS**	**SRS interference into FSS**
FSS downlink (AI 1.6.1)	13.40-13.75	1	DRS return feeder link (downlink)	Yes*	Yes*
		2	DRS forward inter-orbit link	Yes**	Yes

* Coordination between SRS and FSS is feasible using measures like: satellite orbital separation, beam separation, E/S separation, etc.

** Compatibility between SRS and FSS is achievable using mitigation techniques which may include increasing minimum orbital separation and/or reducing e.i.r.p. of the FSS satellites.

Based on the summary table above and considering the assumptions used in the studies, the following can be observed for 13.4-13.75 GHz FSS downlinks:

– Case 1: The mutual interference between DRS downlinks and FSS downlinks would exceed the protection criterion, assuming the worst case condition. However, coordination measures like setting a minimum orbital separation between the GSO satellites, beam separation advantage for earth station locations and other measures could considerably reduce the interference and achieve the protection criteria for SRS DRS systems.

– Case 2: The minimum orbital separation at the GSO between the SRS DRS space station and the nearest FSS space station could be not less than (3 / 21) degrees depending on the parameters of the SRS DRS and FSS systems (see Table 9-17 in PDN Report ITU-R S.[R1.FSS]). To ensure the required minimum orbital separation, frequency assignments of the GSO FSS networks in the 13.4-13.75 GHz band shall be subject to coordination with respect to DRS systems in the SRS (space-to-space).

Summary

Compatibility between SRS and FSS (space-to-Earth) is achievable in the 13.4-13.75 GHz band after applying regulatory provisions (as for example application of RR Nos. **9.7**, **9.21**) and technical measures like setting minimum orbital separation at the GSO between the SRS DRS space station and the nearest FSS space station and limiting maximum e.i.r.p. spectral density for FSS downlinks.

4.1/1.6.1/4.5.4 FSS (space-to-Earth) sharing with the RLS and radionavigation service (RNS)

RLS systems in the frequency band 13.4-13.75 GHz are the same as in 13.75-14 GHz; see Recommendation ITU-R M.1644. Compatibility conditions between FSS (space-to-Earth) and RLS, RNS stations are possible based on pfd limits applied to FSS space stations.

4.1/1.6.1/4.5.5 FSS (Earth-to-space) sharing with the RLS and RNS

RLS systems in the frequency band 13.4-13.75 GHz are the same as in the band 13.75-14 GHz; see Recommendation ITU-R M.1644. The frequency band 13.4-13.75 GHz is allocated to the RNS in six countries through RR No. **5.501**. In some of those countries, the RNS and the FSS can share the 13.4-13.75 GHz band under the same conditions as those stipulated in RR Nos. **5.502**, **9.17** and **9.18**. In addition, at least one administration operates an aeronautical precipitation radar under the RLS in this band.

Two studies with a static and dynamic analysis were performed using the HIWRAP aeronautical precipitation radar/scatterometer which operates under the RLS.

The study #1 results of the static analysis considered the FSS transmission type median,1-sigma, and 2-sigma deviations. The results of the static analysis indicate that under all cases considered the interference from the FSS (Earth-to-space) will not exceed the RF front end saturation or maximum allowable sensor input power of the HIWRAP.

The study #1 results of the dynamic analysis for the HIWRAP aeronautical precipitation radar/scatterometer of the Gulf of Mexico were completed. Results indicate a maximum interference exceedance level of at least 26.4 dB for the −6 dB I/N criteria for radiolocation services operating over the Gulf of Mexico when considering FSS deployment FRF of 1.2. The results also indicate that for the analysis examining the operation of HIWRAP over the Gulf of Mexico that the −6 dB I/N criteria is exceeded 0.06% of the time for a FRF of 1.2.

The study #2 results of the dynamic analysis for an area of measurement of interest taken to be that of the Gulf of Mexico. This result of the parametric dynamic analysis shows that the Recommendation ITU-R M.1644 prescribed protection criteria of −6 dB I/N (equivalent to −130 dBW/100 MHz for HIWRAP) is exceeded 0.05% of the time considering a FRF of 1.5.

Following the revision of sharing conditions in the band 13.75-14 GHz under WRC-03 agenda item 1.24, some administrations might have migrated their radiolocation radar systems in the band 13.4-13.75 GHz, in order to limit interference from FSS earth stations. As the band 13.4-13.75 GHz is used by the same radars as the band 13.75-14 GHz, at a minimum, the provisions existing in the band 13.75-14 GHz should also be applied in the band 13.4-13.75 GHz, and, in particular, the provisions of RR No. **5.502**.

4.1/1.6.1/4.5.6 FSS (space-to-Earth) sharing with the FS and MS

Compatibility conditions between FSS (space-to-Earth) and FS, MS stations are possible based on pfd limits applied to FSS space stations.

4.1/1.6.1/4.5.7 FSS (Earth-to-space) sharing with the FS and MS

Compatibility between FSS (Earth-to-space) and FS/MS stations in the frequency band 13.4-13.75 GHz is possible based on coordination measures and application of geographic separation using RR Appendix **7** methodology.

4.1/1.6.1/4.5.8 FSS (Earth-to-space and space-to-Earth) sharing with the standard frequency and time signal-satellite service (SFTSSS)

With regard to sharing between the SFTSSS (Earth-to-space) and FSS (Earth-to-space), 3 studies have been performed to date.

The first study, using an outdated deployment model, indicated that the protection criterion of −125 dBW/125 MHz was not exceeded, with a margin limited to 0.4 dB.

The second study, using the agreed upon deployment model based on the number of FSS transmissions, indicated an interference level of exceeding the protection criterion by 7.6 dB.

The third study, using the agreed upon deployment model based on the allocation of the overall FSS frequency resource amongst diverse earth stations, looked at differing FSS E/S bandwidths and FSS E/S power density values. The results indicated that a deployment of 60 cm FSS E/S with power density levels of −50 dBW/Hz and −42 dBW/Hz showed harmful interference. However, FSS E/S deployments of several bandwidths as well as FSS E/S deployments using 60 cm antenna size with power densities of −55 dBW/Hz did not exceed the interference criteria.

There is therefore uncertainty on the compatibility between the FSS (Earth-to-space) and the SFTSSS (Earth-to-space).

Another study indicated the interference level from FSS space stations to SFTSSS space station meets the permissible level without using mitigation techniques. The maximum separation distance for FSS E/S protection is 21 km without taking into account the propagation path terrain of interfering signal.

Based on the above, it can be concluded that FSS (space-to-Earth) and SFTSSS (Earth-to-space) are compatible.

4.1/1.6.1/4.5.9 Summary of studies for the band 13.4-13.75 GHz

Compatibility between FSS (space-to-Earth) and RLS, RNS, FS, MS stations are possible by applying appropriate pfd limits to FSS transmit space stations.

For summary of studies for FSS with respect to EESS (active) see section 4.1/1.6.1/4.4.7.

Compatibility between SRS and FSS (space-to-Earth) is achievable in the 13.4-13.75 GHz band after applying regulatory provisions (as for example application of RR Nos. **9.7**, **9.21**) and technical measures like setting minimum orbital separation at the GSO between the SRS DRS space station and the nearest FSS space station and limiting maximum e.i.r.p. spectral density for FSS downlinks.

Compatibility of the FSS (Earth-to-space) with respect to SRS DRS return feeder links in the band 13.4-13.75 GHz is achievable by providing sufficient separation between FSS uplink earth stations and the DRS downlink earth stations. Necessary coordination distances could be defined by applying regulatory provisions for FSS uplinks (as for example application of RR No. **9.17A**).

Compatibility of the FSS (Earth-to-space) with respect to the SRS DRS forward links in the band 13.4-13.75 GHz will not be ensured without adequate mitigation techniques which have not been identified. Mitigation techniques, such as hard limits for FSS earth station parameters, should be included into the RR.

The impact on SRS DRS system 2 forward links from FSS (Earth-to-space) has not yet been studied.These studies are required to determine compatibility of the FSS (Earth-to-space) with respect to the SRS DRS forward links in the band 13.4-13.75 GHz.

There is some uncertainty about compatibility between the SFTSSS (Earth-to-space) and the FSS (Earth-to-space). However, no difficulty is expected with regard to FSS in the space-to-Earth direction. Further, to ensure compatibility with the FSS uplink allocation beginning at 13.75 GHz, the space-to-Earth allocation can be limited to 13.4-13.65 GHz whilst still achieving the objective of 250 MHz given in Resolution **151 (WRC-12)**.

Additional primary spectrum allocation to GSO FSS (Earth-to-space) in the frequency band 13.4-13.75 GHz in Region 1 could have significant impact on RLS systems without mitigation techniques, so the possibility of applying new FSS and minimum FSS E/S antenna diameter would be restricted by sharing conditions with RLS systems. For the HIWRAP operating in the RLS the protection criteria was exceeded by 26.4 dB for less than 0.06% of the time.

Therefore, to ensure protection from FSS (Earth-to-space) interference into RLS, at a minimum it is proposed to apply restrictions already existing for GSO FSS in the frequency band 13.75-14 GHz, including restrictions under RR No. **5.502**, that would avoid using in this band FSS E/S antenna with diameters less than 1.2 m and larger than 9 m. For FSS E/S antenna with diameters 4.5 m or more, e.i.r.p. of any emission shall comply with restrictions specified under RR No. **5.502**. For the HIWRAP system, further regulatory mechanisms may be needed to ensure that protection can be achieved in the above provisions.

4.1/1.6.1/4.6 14.5-14.8 GHz band

The band 14.5-14.8 GHz is allocated to the MS, FS and FSS (Earth-to-space) on a primary basis and to the SRS on a secondary basis. RR No. **5.510** indicates that the use of the band 14.5-14.8 GHz by the FSS (Earth-to-space) is limited to feeder links for the broadcasting-satellite service (BSS) and that this use is reserved for countries outside Europe.

Studies for sharing in this band included both (1) studies with other allocated services, and (2) studies within the FSS, taking into account Resolution **151 (WRC-12)**. Studies included consideration of utilizing existing allocations to the FSS through a review of regulatory provisions, except RR Nos. **5.502** and **5.503**.

4.1/1.6.1/4.6.1 FSS and BSS feeder link Plan/List, contained in RR Appendix 30A (AP 30A)

In the 14.5-14.8 GHz bands, appropriate measures need to be taken with regard to the AP **30A** Plan and List to ensure the integrity and full protection of the 14.5-14.8 GHz band, specifically taking into account:

a) the required coordination procedures between any new FSS utilization of the band and the existing AP **30A** networks and future evolution/modification of the Plan;

b) the need for transmitting earth stations in the AP **30A** Plan and List to be able to be located anywhere within their respective service areas;

c) the need to appropriately protect assignments in the AP **30A** Plan and List, as the case may be, from the aggregate effect of any new FSS utilization of the band so as the cumulative effect of the proposed FSS, if allocated, would not degrade the equivalent protection margin (EPM) below the level if such allocation was not made, i.e. maintaining the EPM degradation less than or equivalent to that emanated from BSS feeder links.

Appropriate regulatory procedures together with calculation methods and modification to the Bureau software (for example, GIBC) need to be developed to implement any agreed criteria to protect assignments in the AP **30A** Plan and List. In order to determine the appropriate criteria, interference simulation of the cumulative effect of the new FSS system is needed to demonstrate that protection of the AP **30A** Plan is ensured at levels equivalent to that of the EPM criteria in the RR and together with the EPM reference situation of the Plan and List assignments.

One of the difficulties of using the EPM approach to identify affected administrations is that, due to the structure of the MSPACE software and its implementation, assignments having very low EPM would not be identified as affected. This issue was brought to previous WRCs. No practical and implementable solution has yet been made available. This is the reason that there is a need to try to find criteria equivalent to EPM which could resolve the problem mentioned above as well as take into account the cumulative effect of potential FSS assignments to the assignments of the feeder link BSS Plan/List, if the band is allocated to FSS under WRC-15 agenda item 1.6.

The technical feasibility for FSS systems to operate in the band 14.5-14.8 GHz, whilst maintaining the protection of the AP **30A** planned assignments, has been assessed. The results of the studies show that coexistence between FSS systems subject to AP **30A** and other FSS systems is feasible under certain conditions, and compatibility between these systems could be provided through coordination process.

In order to ensure protection of the AP **30A** Plan and List assignments from new FSS (Earth-to-space) links, coordination triggers need to be defined. Three coordination triggers, pfd, ΔT/T, and C/I have been examined in the studies.

A pfd threshold is one of the methods proposed to be used as a trigger for coordination for a new assignment in the FSS (Earth-to-space) allocation with respect to an assignment in the Regions 1 & 3 feeder link Plan and List.

Specifically, in one of the studies it has been proposed that the pfd produced by a new assignment in the FSS (Earth-to-space) allocation in the orbital position of any existing assignment in the Regions 1 and 3 AP **30A** Plan and List has to be lower than −193.9 dB(W/(m^2 · Hz)). Therefore, if a new assignment in the FSS (Earth-to-space) produces a pfd higher than −193.9 dB(W/(m^2 · Hz)) in the orbital position of an existing assignment in the Regions 1 and 3 AP **30A** Plan and List, coordination between them will be required.

To obtain this pfd coordination threshold, MSPACE simulations have been run to calculate the maximum pfd that a new assignment in the Region 1 and 3 AP **30A** Plan and List could produce at the orbital position of an existing AP **30A** Plan assignment and not “affect” it. An assignment is considered as not affected when the EPM of the existing AP **30A** assignment does not fall more than 0.45 dB below 0 dB, or, if already negative, more than 0.45 dB. Extrapolating, the pfd value obtained has been proposed as threshold for coordination for a new assignment in the FSS (Earth-to-space) allocation with respect to any existing AP **30A** assignment.

To evaluate the impact that new assignments in the FSS allocation transmitting below the proposed coordination threshold would have into the existing AP **30A** Plan and List assignments, C/I calculations were performed and C/I values higher than 36.5 dB were found in all cases. MSPACE simulations were also performed and showed that no assignments of the AP **30A** Plan and List would be affected according to MSPACE simulations.

In addition, another study used MSPACE to examine the cumulative effect of multiple new FSS assignments to AP **30A** Plan or List assignments. A pfd threshold mask was derived from the results of the study. This pfd mask limits the effect a new FSS assignment would have on the EPM of the existing AP **30A** assignment. This pfd mask criteria is to be applied for cases where the orbital separation is larger than 0° and smaller than 9°.

Another of the proposed methods is a ΔT/T threshold to be used to trigger coordination for a new assignment in the FSS (Earth-to-space) allocation with respect to an assignment in the Regions 1 and 3 AP **30A** Plan and List. Specifically, it has been proposed that new FSS (Earth-to-space) systems that cause the ΔT/T of an AP **30A** Plan or List assignment to exceed 6% will require coordination. The 6% ΔT/T is the threshold currently used to trigger coordination between GSO systems in RR Appendix **5** and for coordination between networks defined in Annexes 1 and 4 of AP **30A**.

ITU-R also carried out the C/I studies for Regions 1 and 3 feeder-link Plan assignments considering interference from new FSS assignments not subject to AP **30A**. Both single-entry and aggregate C/I were determined for co-channel operation in a single polarization. Interference into the upper and lower adjacent channels of the protected assignment were not considered. The results showed that the single-entry C/I of the protected plan assignment was at least 27 dB at 1.5 degrees while the aggregate C/I for satellites with 0.5/2 degree spacing within ±9 degrees of a Plan assignment approaches 27 dB.

Summary

Compatibility analyses have been performed in order to determine if assignments in or proposed modifications to the AP **30A** Plan/List in the 14.5-14.8 GHz band can be protected from FSS systems sharing the band. Both single-entry and aggregate analyses have been conducted. The studies also provided technical criteria to trigger coordination with the AP **30A** assignments to ensure the protection and integrity of the AP **30A** Plan and List. Three alternatives were considered (ΔT/T, C/I and pfd threshold) and the studies have shown that the alternatives provide protection to Plan assignments. One alternative was considered and the studies showed that a pfd threshold provides protection of the List assignments.

4.1/1.6.1/4.6.2 FSS (Earth-to-space) sharing with the FS

Two studies were performed using the methods contained in RR Appendix **7** and both indicated that the RR Appendix **7** provisions are adequate to determine the coordination distances between FSS (Earth-to-space) and the FS.

An estimation was carried out of the coordination area necessary to protect FS receive stations from interference from FSS (Earth-to-space) E/Ss on worst-case interference scenario on RR Appendix **7** methodology for 37 countries of Region 3 and one country of Region 1. A separation distance value of the maximum coordination distance identified by RR Appendix **7** achieves 100-140 km with elevation angle of FSS E/S 5° and maximum interference power spectrum density (PSD) from –42 to –50 dBW/Hz. It should be noted that the separation distance can be 100-237 km without careful siting of stations, off-axis antenna gains of both systems, shielding, and avoidance of overlapping channels. While the sharing between FSS E/S and FS is manageable, it is preferable to have a small number of FSS earth-stations operating in this frequency band.

Additionally, in order to address the case of multiple FSS earth stations potentially interfering with FS, masks of allowable overall aggregate PSD interference coming from FSS E/S (Earth-to-space) to FS stations with antennas having antenna pattern of Recommendation ITU-R F.699-7 and maximum gain value 15, 30 and 40 dBi were constructed. For such cases, RR Appendix **7** should be used to determine the coordination area, such that the maximum aggregate interference power density (dBW/MHz) from all FSS earth stations to a FS station is below all FS PSD protection masks.

Summary

Provision of compatibility conditions between FSS (Earth-to-space) and FS stations in frequency band 14.5-14.8 GHz is possible based on coordination measures and application of geographic separation using RR Appendix **7** methodology.

4.1/1.6.1/4.6.3 FSS (Earth-to-space) sharing with the MS/AMS

Aeronautical mobile data links and land mobile data links currently operate in the 14.5-14.8 GHz band under the MS allocation, the parent service to the AMS and land mobile service (LMS). Six studies were performed and the results from all six studies show that interference from the FSS (Earth-to-space) into the AMS exceed the protection criterion depending on three main factors: the altitude of the AMS aircraft or MS land station, the distance between the AMS land station and the FSS earth station and the terrain scenario. The area around an AMS land station within which the protection criterion is exceeded is non-uniform. It is also noted that the AMS land station can be fixed or transportable. For transportable AMS land stations, the shape and orientation variation of the non-uniform area has to be taken into account after relocating the AMS land station itself.

With respect to the AMS (see PDN Report ITU-R S.[R1.FSS] section 10.2.3):

– Study #1 (static analysis) showed that VSAT FSS earth stations exceed the AMS protection criterion at distances up to 575 km when the aircraft station operates at 19 km in altitude.
– Study #1A (static analysis) showed that the percentage of total square area where the AMS protection criteria is exceeded is 0.05% at 550 km (when the AMS land station sees the AMS aircraft with an elevation angle of 0.1°) and 5.57% at 200 km (when the AMS land station sees the AMS aircraft with an elevation angle of 10°) when the aircraft station operates at 19 km in altitude.
– Study #2 (dynamic analysis) showed that the percentages of interference occurring from a VSAT FSS earth station into an AMS aircraft station operating at 19 km and 2.4 km were 0.9% and 7.3% respectively.
– Study #3 (static analysis) showed that using characteristics from AP **30A** feeder links currently allocated in this band exceed the AMS protection criteria at distances of 400-500 km when the AMS aircraft station operates at 19 km in altitude.
– Study #4 (dynamic analysis) showed that FSS earth station antenna size is irrelevant to the occurrence of interference that exceeds the I/N protection criterion of the AMS. The percentage of exceeding the protection criterion of an AMS station operating at 19 km was approximately 4% when a separation distance of 250 km is considered between the AMS land station and FSS earth station.
– Study #4A (dynamic analysis) showed that the interference relationship between the FSS earth station with the AMS aircraft station is dependent on (1) the distance between the FSS earth station and AMS land station and (2) the altitude of the AMS aircraft station where the likelihood of interference occurring from an FSS earth station into an AMS aircraft station operating at 19 km was 0% when a separation distance of 482 km is considered between the AMS land station and FSS earth station.

The following table summarizes Studies #1 through #4A (except Study #1A):

Study Number	Study Type	Separation Distance to meet I/N at −6 dB (for two AMS altitudes)		Probability of exceeding AMS protection criterion (for two AMS altitudes)	
		2.4 km	19 km	2.4 km	19 km
1	Static	152-184 km	470-575 km	N/A	N/A
2	Dynamic	N/A	N/A	7.3%	0.9%
3	Static	150 km	400-500 km	N/A	N/A
4	Dynamic	N/A	N/A	0.3%(1)	3%(1)
4A	Dynamic	180 km	482 km	(0-39%)(2)	

(1) When the FSS earth station and AMS land station are separation by 250 km

(2) When the FSS earth station and AMS land station separation is varied between 500 and 0 km and the AMS aircraft station altitude is varied between 0 and 19 km. The closer the distance between the AMS land station and the FSS earth station, the higher the likelihood of interference into the AMS aircraft station.

The following table summarizes Study #1A:

FSS earth station offset with respect to AMS land station (km)	Maximum elevation angle of AMS aircraft with I/N criteria exceeded	Percentage of total area where I/N criteria is exceeded
550	0.1˚	0.05%
500	0.5˚	0.15%
450	1.0˚	0.45%
400	1.5˚	1.10%
300	3.0˚	2.31%
200	10.0˚	5.57%

With respect to the LMS (see PDN Report S.[R1.FSS] section 10.2.4):

– Study #1 (static analysis) showed that VSAT FSS earth stations exceed the MS protection criterion at distances of 46 km when the MS land mobile station operates at 13 m above the terrain.

– Study #2 (dynamic analysis) showed that the percentage of interference occurring from a VSAT FSS earth station into an MS mobile station operating 13 m above the terrain was 15%.

– Study #3 (dynamic analysis) showed that an aggregate analysis of FSS earth stations interfering into MS mobile station operating at 13 m above the terrain exceeds the protection criteria by 0.3% of the time.

With respect to interference into FSS space stations at the GSO, since the main beams of AMS systems can point toward the GSO arc, FSS space stations may be subject to interference that exceeds the FSS protection criterion from AMS systems operating under the existing primary allocation in this band. Nevertheless, it is important to note that the time period, when the AMS aircraft/AMS base station's antenna beam is pointing towards the GSO, is very limited. Therefore, considering all possible configurations, study shows that the percentage of the potential interference impact from AMS into FSS GSO receiver is very limited, i.e. FSS availability greater than 99.96% considering a G/T of 7 dB/K.

4.1/1.6.1/4.6.4 FSS (Earth-to-space and space-to-Earth) sharing with the SRS

The SRS is currently allocated on a secondary basis in this band.

The frequency band 14.5-14.8 GHz is used by DRS systems operating in the SRS for forward feeder uplinks and for return inter-orbit links (see Recommendations ITU-R SA.1018 and ITU-R SA.1019). Recommendation ITU-R SA.1414 describes characteristics of DRS systems operated by some administrations.

The results of the interference analysis, considering the same status for FSS and SRS allocations, are summarized in Table 4.1/1.6.1/4-2.

TABLE 4.1/1.6.1/4-2

Summary of results of interference between SRS DRS systems and proposed FSS allocations in the 14.5-14.8 GHz band

				Possible to establish compatibility between SRS and FSS for co-frequency operations?	
New FSS allocation	**Frequency band (GHz)**	**Case**	**SRS (DRS) Links**	**FSS interference into SRS**	**SRS interference into FSS**
FSS uplink (AI 1.6)	14.5-14.8	1	DRS forward feeder link (uplink)[1]	Yes[3*]	Yes[3*]
		2	DRS return inter-orbit link[2]	No[4**]	Yes
FSS downlink (AI 1.6.1)		3	DRS forward feeder link (uplink)[1]	Yes[3*]	Yes[3*]
		4	DRS return inter-orbit link[2]	Yes[3*]	Yes

[1] DRS Earth station to GSO DRS space station.

[2] NGSO DRS user space station to GSO DRS space station.

[3*] Coordination between SRS and FSS is feasible using measures like: satellite orbital separation, beam separation, E/S separation, etc.

[4**] This band is not currently used for DRS return inter-orbit links.

Based on the summary table above, the following can be observed for 14.5-14.8 GHz FSS uplinks and downlinks:

– Case 1: The mutual interference between DRS uplinks and FSS uplinks would exceed the protection criterion, assuming worst case conditions with the FSS earth station being collocated with the DRS uplink station. However, coordination measures like setting a minimum orbital separation between the GSO satellites, beam separation advantage for earth station locations and possibly other measures could considerably reduce the interference.

– Case 2: DRS return inter-orbit links would receive interference from FSS uplinks higher than the protection criterion under co-frequency situations using the assumptions of this study. However, as the current DRS return inter-orbit links are using the band above 14.8 GHz, the band 14.5-14.8 GHz may be available for coordination between SRS and FSS.

– Case 3: The mutual interference between DRS uplinks and FSS downlinks represents a reverse band scenario and mutual compatibility can be established by using coordination measures like minimum orbital separation and earth station contour distance, etc.

– Case 4: The mutual interference between DRS return inter-orbit links and FSS downlinks represents another reverse band scenario and mutual compatibility can be established by using coordination measures like minimum orbital separation, etc.

Thus, taking into account that currently SRS DRS return links are restricted to bands above 14.8 GHz it can be summarized that the compatibility between FSS links and SRS DRS links in the band 14.5-14.8 GHz is achievable with coordination measures, assuming that SRS and FSS allocations will have equal status.

DRS return inter-orbit links and FSS downlinks in the band 14.5-14.8 GHz demonstrate mutual compatibility using coordination measures like minimum orbital separation.

Summary

Assuming that the SRS DRS return inter-orbit links are restricted to the band above 14.8 GHz, it can be summarized that the compatibility between FSS (Earth-to-space and space-to-Earth) links and SRS in the band 14.5-14.8 GHz is achievable with coordination measures, considering the same status for SRS and FSS.

4.1/1.6.1/4.6.5 FSS (Earth-to-space) sharing with the RAS operating in adjacent band

The band 14.5-14.8 GHz is already allocated to FSS (Earth-to-space) limited to BSS feeder link and due to the frequency separation with the adjacent RAS band (i.e. minimum 550 MHz), no compatibility issues are expected with the RAS band 15.35-15.40 GHz. However, no study has been performed to date.

4.1/1.6.1/4.6.6 FSS (space-to-Earth) sharing with the MS/AMS

Static analysis of compatibility between FSS (space-to-Earth) and AMS/MS stations in different scenarios has shown interference which exceeds the protection criteria in the worst case situation (i.e. MS/AMS transmit station located exactly in the line of sight of the GSO FSS and the MS/AMS receive station). Nevertheless, considering the nature of the MS/AMS transmit and receive stations, the time period when the MS/AMS receive station is in this situation may be limited.

One study demonstrated that FSS (space-to-Earth) operations, pfd levels of −128 dB(W/(m^2 · MHz)), –145 dB(W/(m^2 · MHz)), and –126 dB(W/(m^2 · MHz)), would be needed in order to protect AMS aircraft, AMS station and MS system receivers considering the worst case situation (i.e. MS/AMS receive station located exactly in the line of sight of the GSO FSS and the MS/AMS transmit station), respectively when the elevation angle is equal to 5°. Nevertheless, considering the nature of the MS/AMS transmit and receive stations, the time period when the MS/AMS receive station is in this situation may be limited.

With respect to AMS and MS interference into FSS earth stations, one study shows that the FSS protection criterion may be exceed at distances of up to 572 km and 46 km, respectively (not accounting for terrain obstructions).

4.1/1.6.1/4.6.7 FSS (space-to-Earth) sharing with the FS

4.1/1.6.1/4.6.7.1 Interference from FS to FSS (space-to-Earth)

See section 4.1/1.6.1/4.7.5.1.

Compatibility analysis results between FS and FSS (space-to-Earth) in the frequency band 14.8-15.35 GHz are applicable to the frequency band 14.5-14.8 GHz.

4.1/1.6.1/4.6.7.2 Interference from FSS (space-to-Earth) to FS

The development of pfd masks for allowable aggregate interference was considered in the frequency band 14.5-15.35 GHz from 120 GSO FSS space stations using the protection criteria for FS stations stated in Recommendation ITU-R F.758-5. Compatibility analysis with FSS (space-to-Earth) was carried out for FS stations with antenna elevation angle equal to 0°.

See section 4.1/1.6.1/4.7.5.2.

Compatibility analysis results between FSS (space-to-Earth) and FS in the frequency band 14.8-15.35 GHz are applicable to the frequency band 14.5-14.8 GHz.

4.1/1.6.1/4.6.8 Summary of studies for the band 14.5-14.8 GHz

Studies were performed and the results from all show that interference from the FSS (Earth-to-space) into the AMS/MS exceed the protection criterion depending on three main factors: the altitude of the AMS aircraft or MS land station, the distance between the AMS/MS land station and the FSS earth station and the terrain scenario.

To ensure the protection for the AMS from FSS (Earth-to-space), a separation distance of up to 575 km (not accounting for terrain obstruction) may be required considering a required 100% probability of meeting the protection criterion. At such distance, the percentage of total square area where the AMS protection criteria is exceeded is less than 0.01% when the AMS land station sees the AMS aircraft with an elevation angle of 0.1.

Similarly, considering FSS (space-to-Earth), interference from AMS into FSS earth stations may exceed the protection criterion of the FSS earth station at distances of up to 572 km (not accounting for terrain obstruction).

To ensure the protection for the MS from FSS (Earth-to-space) or FSS (space-to-Earth) from MS, a separation distance of up to 46 km (not accounting for terrain obstruction) may be required considering a required 100% probability of meeting the protection criterion.

To ensure protection for the AMS and MS from FSS (space-to-Earth), pfd levels of -128 dB(W/(m^2 · MHz)), -145 dB(W/(m^2 · MHz)), and -126 dB(W/(m^2 · MHz)), may be required in order to protect AMS aircraft, AMS station and MS system receivers considering the worst case situation (i.e. MS/AMS receive station located exactly in the line of sight of the GSO FSS and the MS/AMS transmit station), respectively when the elevation angle is equal to 5°. Nevertheless, considering the nature of the MS/AMS transmit and receive stations, the time period when the MS/AMS receive station is in this situation may be limited.

Interference from FSS (Earth-to-space) into the FS may exceed the protection criteria at hundreds of km without careful siting of stations, off-axis antenna gains of both systems, shielding, and avoidance of overlapping channels. The coordination between FSS (Earth-to-space) and FS is manageable for a small number of FSS earth stations.

Compatibility between FSS (space-to-Earth) and FS is achieved with appropriate FSS space station pfd limits.

With respect to the BSS feeder links under RR No. **5.510**, compatibility is possible with appropriate provisions and technical criteria for the new FSS assignments to ensure protection and integrity of AP **30A** Plan and List assignments.

Assuming that the SRS DRS return inter-orbit links are restricted to the band above 14.8 GHz, it can be summarized that the compatibility between FSS (Earth-to-space and space-to-Earth) links and SRS in the band 14.5-14.8 GHz is achievable with coordination measures, considering the same status for SRS and FSS.

4.1/1.6.1/4.7 14.8-15.35 GHz band

Consideration is given to this band for possible primary allocations to FSS Earth-to-space and space-to-Earth operations. The band 14.8-15.35 GHz is currently allocated to the FS and MS on a primary basis and to the SRS on a secondary basis.

4.1/1.6.1/4.7.1 FSS (Earth-to-space) sharing with the MS/AMS

See section 4.1/1.6.1/4.6.3 for sharing study results applicable to this frequency band.

4.1/1.6.1/4.7.2 FSS (Earth-to-space) sharing with the FS

The studies and conclusion on the possibility for compatibility between FSS (Earth-to-space) and FS stations based on coordination measures and separation protection distances as contained in section 4.1/1.6.1/4.6.2 dealing with the sharing between FSS (Earth-to-space) and FS in the frequency band 14.5-14.8 GHz are also applicable to the 14.8-15.35 GHz band.

4.1/1.6.1/4.7.3 FSS (space-to-Earth and Earth-to-space) sharing with the SRS

The SRS is currently allocated on a secondary basis in this band.

The frequency band 14.8-15.35 GHz is used by SRS DRS systems for forward feeder links (uplinks) and return inter-orbit links (see Recommendations ITU-R SA.1018 and ITU-R SA.1019). Recommendation ITU-R SA.1414 describes characteristics of DRS systems operated by some administrations.

The frequency band 14.8-15.35 GHz is also used by SRS systems for data transmit from spacecraft to earth stations. These missions are limited in number with an estimated three to five satellites per year worldwide, and will generally be either in a low-polar orbit or in an equatorial orbit with some at geostationary altitudes or in the highly elliptical Earth orbit (HEO) and others at the L1 or L2 libration points. The characteristics of the GSO, low-orbiting and highly elliptical-orbiting SRS satellites transmitting in the space-to-Earth direction are reflected in the Recommendation ITU-R SA.1626.

An analysis has been performed to assess the potential for interference between the near-Earth DRS missions and potential FSS systems in the 14.8-15.35 GHz band. Static analysis is used when analysing compatibility between FSS and SRS uplinks/downlinks and dynamic simulation is used when considering SRS inter-satellite links. Dynamic simulation is carried out assuming the FSS satellite beam gain of 20 dB and 30 dB and an uplink power spectral density ranging between −42 to −60 dBW/Hz at the input of a 60 cm to 2.8 m FSS earth station antenna and a downlink e.i.r.p. density of −20 dBW/Hz. Earth station sizes larger than 2.0 m would cause the same levels of interference because of the common off-axis pattern. One FSS earth station per FSS satellite is assumed to use the bandwidth used by SRS carriers. The FSS earth stations are assumed at different latitudes (0 deg, 30 deg and 60 deg) and GSO longitudes.

The results of the interference analysis, considering the same status for FSS and SRS allocations are summarized in Table 4.1/1.6.1/4-3.

TABLE 4.1/1.6.1/4-3

Summary of results of interference between SRS DRS systems and proposed FSS allocations in the 14.8-15.35 GHz band

				Possible to establish compatibility between SRS and FSS for co-frequency operations?	
New FSS allocation	**Frequency band (GHz)**	**Case**	**SRS (DRS) links**	**FSS interference into SRS**	**SRS interference into FSS**
FSS uplink (AI 1.6)	14.8-15.35	1	DRS forward feeder link (uplink)[1]	Yes[3*]	Yes[3*]
		2	DRS return inter-orbit link[2]	No	Yes
FSS downlink (AI 1.6.1)		3	DRS forward feeder link (uplink)[1]	Yes[3*]	Yes[3*]
		4	DRS return inter-orbit link[2]	Yes[3*]	Yes

[1] DRS Earth station to GSO DRS space station.

[2] NGSO DRS user space station to GSO DRS space station.

[3*] Coordination between SRS and FSS is feasible using measures like: satellite orbital separation, beam separation, E/S separation, etc.

Based on the summary table above, the following can be observed for 14.8-15.35 GHz FSS uplinks and downlinks:

– Case 1: The mutual interference between DRS uplinks and FSS uplinks would exceed the protection criteria, assuming worst case condition like the FSS uplink earth station being collocated with the DRS uplink station. However, coordination measures like setting a minimum orbital separation between the DRS satellites and a GSO FSS satellite, beam separation advantage for earth station locations and possibly other measures could considerably reduce the interference.

– Case 2: DRS return inter-orbit links would receive interference from FSS uplinks higher than the desired protection criterion under co-frequency situations using the assumptions of the study.

– Case 3: The mutual interference between DRS uplinks and FSS downlinks represents a reverse band scenario and mutual compatibility can be established by using coordination measures like minimum orbital separation and earth station contour distance, etc.

– Case 4: The mutual interference between DRS return links and FSS downlinks represents another reverse band scenario and mutual compatibility can be established by using coordination measures like minimum orbital separation, etc.

Summary

Compatibility between FSS (Earth-to-space and space-to-Earth) links and SRS (except return inter-orbit links) in the band 14.8-15.35 GHz is achievable with coordination measures, considering the same status for SRS and FSS.

Compatibility of the FSS uplinks with respect to the SRS DRS return inter-orbit links in the band 14.8-15.35 GHz will not be met without adequate mitigation techniques which have not been defined. Some mitigation techniques that could be studied include minimum orbital separation between DRS and FSS satellites, limits on off-axis e.i.r.p density of associated FSS earth stations, etc.

Further compatibility studies between FSS (uplinks and downlinks) and SRS system downlinks are required.

4.1/1.6.1/4.7.4 FSS (space-to-Earth) sharing with the MS/AMS

The studies as contained in section 4.1/1.6.1/4.6.6 concerning the sharing between FSS (space-to-Earth) and AMS/MS in the band of 14.5-14.8 GHz are applicable to the 14.8-15.35 GHz band.

4.1/1.6.1/4.7.5 FSS (space-to-Earth) sharing with the FS

4.1/1.6.1/4.7.5.1 Interference from FS to FSS (space-to-Earth)

The technical characteristics of PP FS systems in frequency band 14.4-15.35 GHz are derived using Recommendation ITU-R F.758 and the antenna pattern for PP FS stations was assumed according to Recommendation ITU-R F.1245.

The antenna pattern of GSO FSS earth stations in the frequency band 14.8-15.35 GHz was assumed according to Recommendations ITU-R S.1855 (for FSS earth station antennas with 0.6 to 1.2 m diameter) and ITU-R S.580-6 (for FSS earth station antennas with 2.4 to 6.0 m diameter).

Compatibility analysis between GSO FSS (space-to-Earth) and FS in the frequency band 14.8-15.35 GHz has shown that required protection level of receive FSS E/S from FS stations emission is provided with a separation distance between FS station and receive FSS E/S from 130-197 km to 23.7 km depending of mutual orientation antennas axes of these stations.

The required separation distance for FSS E/S with elevation angles of 10 to 20 degrees and for opposite azimuth orientation of the antennas is reduced to 60-150 km.

For 53.8% of possible cases of mutual azimuth orientation of FS transmit station and FSS E/S antenna, the required separation distance will be minimum S_{min} = 23.7 km for any elevation angle of the FSS E/S and the FS station antenna.

These results were obtained with maximum level of e.i.r.p. spectral density from FS station (32.4 dBW/MHz, System 1) to receiving FSS E/S. Protection of receiving FSS E/S from other types of FS stations (Systems 2 and 3) is provided with smaller separation distances due to the interference level reduced by 0.8 to 4.4 dB.

Compatibility between FS stations and receive FSS E/S (space-to-Earth) in the frequency band 14.8-15.35 GHz with maximum level of e.i.r.p. interference spectral density from FS station 32.4 dBW/MHz is achieved at separation distances from 130-197 km to 23.7 km depending of mutual orientation of FS and FSS E/S station antennas pattern axes.

4.1/1.6.1/4.7.5.2 Interference from FSS (space-to-Earth) to FS

Statistical analysis of overall interference to FS PP stations in the frequency band 14.8-15.35 GHz from 120 GSO FSS space stations (e.i.r.p. spectral density 40 dBW/MHz) with orbital separation 3 degrees between neighbor GSO FSS space stations has shown that probability to exceed protection criteria (I_{ag}/N = -10 dB) of FS stations has values from 3.92% to 1.76% and from 1.4% to 0.018% for interference scenarios without offset and with offset of FS station antenna beam from pointing to the GSO correspondingly. These results are to be taken into account when defining allowable limits of FSS (space-to-Earth) pfd in the given frequency band.

4.1/1.6.1/4.7.6 Summary of studies for the band 14.8-15.35 GHz

Regarding the sharing of MS and AMS with FSS, see section 4.1/1.6.1/4.6.8.

Compatibility between FSS (Earth-to-space and space-to-Earth) links and SRS (except return inter-orbit links) in the band 14.8-15.35 GHz is achievable with coordination measures, considering the same status for SRS and FSS.

Compatibility of the FSS uplinks with respect to the SRS DRS return inter-orbit links in the band 14.8-15.35 GHz will not be met without adequate mitigation techniques which have not been defined. Some mitigation techniques that could be studied include minimum orbital separation between DRS and FSS satellites, limits on off-axis e.i.r.p density of associated FSS earth stations, etc.

Interference from FSS (Earth-to-space) into the FS may exceed the protection criteria at hundreds of km without careful siting of stations, off-axis antenna gains of both systems, shielding, and avoidance of overlapping channels. The coordination between FSS (Earth-to-space) and FS is manageable for a small number of FSS earth stations.

Compatibility between FSS (space-to-Earth) and FS is achieved with appropriate FSS space station pfd limits.

4.1/1.6.1/4.8 15.35-15.4 GHz band

The frequency band 15.35-15.4 GHz is allocated to the EESS (passive), RAS and SRS (passive). In a range of countries, the frequency band 15.35-15.4 GHz is also allocated to FS and MS on a secondary base by means of RR No. **5.511**. All emissions in the frequency band 15.35-15.4 GHz excluding those that are foreseen in RR No. **5.511**, are forbidden in accordance with RR No. **5.340**.

4.1/1.6.1/4.8.1 Summary of studies for the band 15.35-15.4 GHz

The frequency band 15.35-15.4 GHz was excluded from consideration of possibility to allocate additionally spectrum for GSO FSS in accordance with Resolution **151 (WRC-12)** in regard with the difficulty for compatibility between FSS (space-to-Earth and Earth-to-space) and passive services (EESS, SRS) and RAS, having allocations on a primary basis in this frequency band.

4.1/1.6.1/4.9 15.4-15.7 GHz band

Consideration is given to this band for possible primary allocations to FSS Earth-to-space and space-to-Earth operations. The band 15.4-15.43 is allocated to the RLS and ARNS on a primary basis. RR Nos. **5.511E**, **5.511F** and **5.511D** apply.

The band 15.43-15.63 is allocated to the FSS (Earth-to-space), RLS and ARNS on a primary basis. RR Nos. **5.511A**, **5.511E**, **5.511F**, and **5.511C** apply.

The band 15.63-15.7 GHz is allocated to the RLS and ARNS on a primary basis. RR Nos. **5.511E**, **5.511F** and **5.511D** apply.

The band 15.4-17.1 GHz is used by many different types of radars including land-based, transportable, shipboard and airborne platforms. Radiolocation functions performed in the band include airborne and surface search, surface surveillance, ground-mapping, terrain-following, maritime and target-identification. Radar operating frequencies can be assumed to be uniformly spread throughout each radar’s tuning range. The major radiolocation radars operating or planned to operate in the band 15.7-16.6 GHz are primarily for detection of airborne objects and some are used for ground mapping. They are required to measure target altitude, range, bearing, and form terrain maps. Some of the airborne and ground targets are small and some are at ranges as great as 300 nautical miles (556 km), so these radiolocation radars must have great sensitivity and must provide a high degree of suppression to all forms of clutter return, including that from sea, land and precipitation. Some of the radars are used as the airport surveillance detection equipment (ASDE-3) to provide a tool to enhance the situational awareness of air traffic controllers in an effort to reduce runway incursions and aircraft collisions. These radars provide non-cooperative aeronautical surveillance including detection and position information for all aircraft and vehicles on the airport movement area.

4.1/1.6.1/4.9.1 FSS sharing with the RLS

4.1/1.6.1/4.9.1.1 FSS (Earth-to-space) sharing with the RLS

With respect to a potential allocation to the FSS (Earth-to-space), two studies were performed to determine the distance from a radiolocation station within which the I/N interference protection criteria of –6 dB will be exceeded. One analysis shows that in order to protect radiolocation stations operating in the 15.4-17.3 GHz band, a separation distance of up to 420 km or more (not accounting for terrain obstruction) describes a non-uniform area around a radiolocation receiver where the protection criteria is exceeded. For fixed, ground-based radiolocations systems (as opposed to airborne radiolocations systems), the other analysis indicates that the required separation distances may be reduced down to ranges between 5 to 53 km if the FSS earth station PSDs are reduced to values range from –55 dBW/Hz to –60 dBW/Hz, and if there are horizon obstruction losses. The receiver in the radiolocation system can either be fixed or mobile. When the radiolocation station moves, so does the associated non-uniform area.

In addition, since the main beams of such radiolocation systems can point toward the GSO, FSS space stations may be subject to unacceptable levels of interference over periods of time from radiolocation systems operating under the existing primary allocation in this band.

4.1/1.6.1/4.9.1.2 FSS (space-to-Earth) sharing with the RLS

With respect to a potential allocation to the FSS (space-to-Earth) in Region 1, the analysis shows that in order to protect FSS receiving earth stations in the 15.4-17 GHz band from radiolocation system transmissions, a separation distance of up to 435 km (not accounting for terrain obstruction) describes a non-uniform area around a FSS receiving earth station receiver where the protection criteria is exceeded.

In addition, since the main beams of such radiolocation systems, including those located in Region 2 or 3, may point at the GSO, radiolocation system receivers may be subject to unacceptable levels of interference over periods of time. This study determined that a pfd of -142 dB(W/(m^2 · MHz)), would protect radiolocation system receivers, which is more restrictive than the pfd limits applicable in nearby bands.

4.1/1.6.1/4.9.2 FSS (Earth-to-space) sharing with the ARNS

The band 15.4-15.7 GHz is allocated to ARNS on a primary basis and provision RR No. **4.10** (addressing safety-related services) applies. The characteristics of aeronautical radionavigation systems which operate in the band 15.4-15.7 GHz are contained in Recommendation ITU-R S.1340 as well as in Report ITU-R M.2170. One sharing study has been made between the FSS (Earth-to-space) and ARNS. This study shows that a separation distance of up to 486 km is required in order to protect aircraft landing system (ALS) receivers from transmitting FSS earth stations according to Recommendation ITU-R S.1340. It should be noted that according to this Recommendation, the minimum separation distance is equal to 472 km even in absence of FSS (Earth-to-space) emission. Such FSS (Earth-to-space) emission increases this distance by 13.7 km. Ground stations of ALS are often re-locatable and are used at unspecified points. ALS ground station transmitters can also cause interference to GSO space station receivers. The study between ALS transmitter and receiving GSO satellite shows that worst-case interference exceeds the permissible level by 42 dB above protection criteria considering the worst case situation (i.e. ALS transmitting station located exactly in the line of sight of the GSO FSS and the ALS receiving station and a satellite FSS G/T value of 17 dB). However, taking into account the nominal 3 dB beamwidth of ALS antenna and the fact that ALS antenna scans horizontally and vertically through the required coverage volume, transmitting ALS station can cause interference to satellites at any time and also when ALS is not pointing to a satellite.

4.1/1.6.1/4.9.3 Summary of studies for the band 15.4-15.7 GHz

For additional spectrum allocation to GSO FSS (Earth-to-space and space-to-Earth) in the frequency band 15.4-15.7 GHz in Region 1, FSS (Earth-to-space and space-to-Earth) exceeds the protection criteria levels of systems having allocations in this band without adequate technical/regulatory mitigation measures.

Sharing studies between ARNS and FSS (space-to-Earth) have not been conducted to date.

The band 15.4-15.7 GHz is allocated to the ARNS on a primary basis and provision RR No. **4.10** (addressing safety-related services) applies. One study shows that separation distances up to 486 km is required to ensure protection between the FSS earth station (Earth-to-space) and ARNS receiver considering worst case situation (i.e. FSS earth station antenna pointing towards the ARNS receiver), according to Recommendation ITU-R S.1340 that was used in this study. Separation distances will be lower considering earth station configurations that reduce e.i.r.p towards ARNS receiver, e.g. additional antenna discrimination between FSS earth station antenna and ARNS receiving antenna. Furthermore, if receiving GSO satellite is not having sufficient – in the worst case when the ARNS antenna is pointing directly towards the GSO, up to 42 dB – antenna discrimination, receiving GSO satellite could be subject to interference from existing ARNS transmitters.

With respect to RLS airborne systems, one study shows that separation distances of 420 km (not accounting for terrain obstruction) would be needed to ensure protection between the FSS and RLS airborne systems operating in this band. Moreover, if FSS receiving space stations are not having sufficient antenna discrimination at low elevation angles, these may be subject to interference from existing RLS airborne systems in this band.

Another study shows that for fixed, ground-based RLS systems (as opposed to airborne RLS systems) the required separation distances may be reduced down to ranges between 5 to 53 km if the FSS earth station PSDs are reduced to values ranging from –55 dBW/Hz to –60 dBW/Hz, and if there are horizon obstruction losses. The receiver in the radiolocation system can either be fixed or mobile. With respect to RLS ground-based systems into FSS space station receiving antennas, one study shows that an antenna discrimination of up to 60 dB may be required.

Concerning FSS (space-to-Earth), pfd limits ranging from −98 dB(W/(m^2 · MHz)), to −142 dB(W/(m^2 · MHz)), depending on which radiolocation system to protect, would be required to protect existing RLS systems operating in this band.

4.1/1.6.1/4.10 15.7-16.6 GHz band

Consideration is given to this band for possible primary allocations to FSS Earth-to-space and space-to-Earth operations. The band 15.7-16.6 GHz is allocated to the RLS on a primary basis. The band 15.7-17.3 is also allocated to the FS and MS in certain countries via RR No. **5.512**. Additional information on the use of this band by the RLS is provided in section 4.1/1.6.1/4.9.

4.1/1.6.1/4.10.1 FSS sharing with the RLS

4.1/1.6.1/4.10.1.1 FSS (Earth-to-space) sharing with the RLS

The sharing study results in section 4.1/1.6.1/4.9.1.1 are also applicable to this frequency band.

In addition to the studies in section 4.1/1.6.1/4.9.1.1, another study was performed considering the compatibility between FSS (Earth-to-space) and radiolocation system-5 RLS ground systems in the 15.7-16.6 GHz band.

The results of this study showed the required coordination/separation areas (using Recommendation ITU-R P.452-14 with p = 0.01%) to protect the RLS system-5 stations from interference due to transmitting FSS earth stations at 26 locations in the United States.

Coordination areas up to 304 km are required to protect RLS system-5 from the emissions of transmitting FSS E/S in the 15.7-16.6 GHz frequency range. These results should be taken into account should a primary FSS allocation in the Earth-to-space direction be considered in this frequency band.

Since the main beams of such radiolocation systems can point toward the GSO arc, FSS receiving space stations may, under such worst case scenarios, be subject to harmful levels of interference for periods of time from radiolocation systems operating under the existing primary allocation in this band, unless sufficient antenna discrimination of 60 dB is achieved.

4.1/1.6.1/4.10.1.2 FSS (space-to-Earth) sharing with the RLS

See section 4.1/1.6.1/4.9.1.2 for sharing study results applicable to this frequency band.

4.1/1.6.1/4.10.2 Summary of studies for the band 15.7-16.6 GHz

With respect to RLS airborne systems, one study shows that separation distances of 420 km (not accounting for terrain obstruction) would be needed to ensure protection between the FSS and RLS airborne systems operating in this band. Moreover, if FSS receiving space stations are not having sufficient antenna discrimination at low elevation angles, these may be subject to interference from existing RLS airborne systems in this band.

Another study shows that for fixed, ground-based RLS systems (as opposed to airborne RLS systems) the required separation distances may be reduced down to ranges between 5 to 53 km if the FSS earth station PSDs are reduced to values ranging from –55 dBW/Hz to −60 dBW/Hz, and if there are horizon obstruction losses. The receiver in the radiolocation system can either be fixed or mobile. With respect to RLS ground-based systems into FSS space station receiving antennas, one study shows that an antenna discrimination of up to 60 dB may be required.

Concerning FSS (space-to-Earth), pfd limits ranging from −98 dB(W/(m^2 · MHz)), to −142 dB(W/(m^2 · MHz)), depending on which radiolocation system to protect, would be required to protect existing RLS systems operating in this band.

4.1/1.6.1/4.11 16.6-17 GHz band

Consideration is given to this band for possible primary allocations to FSS Earth-to-space and space-to-Earth operations. The band 15.7-16.6 GHz is allocated to the RLS on a primary basis. The band 15.7-17.3 is also allocated to the FS and MS in certain countries via RR No. **5.512**.

4.1/1.6.1/4.11.1 FSS sharing with the RLS

4.1/1.6.1/4.11.1.1 FSS (Earth-to-space) sharing with the RLS

See section 4.1/1.6.1/4.9.1.1 for sharing study results applicable to this frequency band.

4.1/1.6.1/4.11.1.2 FSS (space-to-Earth) sharing with the RLS

See section 4.1/1.6.1/4.9.1.1 for sharing study results applicable to this frequency band.

4.1/1.6.1/4.11.2 Summary of studies for the band 16.6-17 GHz

With respect to RLS airborne systems, separation distances of 420 km (not accounting for terrain obstruction) would be needed to ensure protection between the FSS and RLS airborne systems operating in this band. Moreover, if FSS receiving space station is not having sufficient antenna discrimination at low elevation angles, these stations may be subject to interference from existing RLS airborne systems in this band.

Coordination distances up to 304 km are required to protect RLS system-5 from the emissions of transmitting FSS E/S in the 15.7-16.6 GHz frequency range.

Since the main beams of such radiolocation systems can point toward the GSO arc, FSS receiving space stations may, under such worst case scenarios, be subject to harmful levels of interference for periods of time from radiolocation systems operating under the existing primary allocation in this band, unless sufficient antenna discrimination of 60 dB is achieved.

Another study shows that for fixed, ground-based RLS systems (as opposed to airborne RLS systems), including RLS system-5, the required separation distances may be reduced down to ranges between 5 to 53 km if the FSS earth station PSDs are reduced to values ranging from -55 dBW/Hz to –60 dBW/Hz, and if there are horizon obstruction losses. The receiver in the radiolocation system can either be fixed or mobile. With respect to RLS ground-based systems into FSS space station receiving antennas, one study shows that an antenna discrimination of up to 60 dB may be required.

Concerning FSS (space-to-Earth), pfd limits ranging from −98 dB(W/($m^2 \cdot$ MHz)), to −142 dB(W/($m^2 \cdot$ MHz)), depending on which radiolocation system to protect, would be required to protect existing RLS systems operating in this band.

4.1/1.6.1/5 Methods to satisfy this part of the agenda item

The methods to satisfy the agenda item are considered below for each of the examined frequency bands. Therefore, each method should address all the concerned existing allocations in each examined frequency band. Each of the following methods suggests regulatory amendments (or no change) that would provide only for the use by GSO satellite networks.

The table below assigns a method “letters” to each of the sub-bands as split in section 4.1/1.6.1/4 (Analysis of the results of studies).

Sub-band frequency (GHz)	Assigned method "letters"	
	Earth-to-space	Space-to-Earth
10.00-10.50	A	AA
10.50-10.60	B	BB
10.60-10.68	C	CC
13.25-13.40	D	DD
13.40-13.75	E	EE
14.50-14.80	F	FF
14.80-15.35	G	GG
15.35-15.40	H	HH
15.40-15.70	I	II
15.70-16.60	J	JJ
16.60-17.00	K	KK

4.1/1.6.1/5.1 AA: 10.00-10.50 GHz for FSS (space-to-Earth)

4.1/1.6.1/5.1.1 Method AA1: No allocation to the FSS (space-to-Earth) of 250 MHz, and therefore no change to RR Article 5

Advantages:

– No impact on the existing services.

Disadvantages:

– The demand for the FSS spectrum may not be met.

4.1/1.6.1/5.1.2 Method AA2: Make an allocation of 250 MHz to the FSS (space-to-Earth) in the band 10.00-10.50 GHz in Region 1

This method includes the following provisions:

– Modification of RR Article **5**.

– Modification of RR Article **21** Table **21-4**.

Advantages:

– Balances the current inter-regional imbalance in FSS spectrum for ITU Region 1 and satisfies Resolution **151 (WRC-12)**.

– Same coordination procedures as currently in place in the band 10.7-11.7 GHz.

Disadvantages:

– The FS systems can be constrained in the future.

4.1/1.6.1/5.2 E: 13.4-13.75 GHz for FSS (Earth-to-space)

4.1/1.6.1/5.2.1 Method E1: No allocation to the FSS (Earth-to-space) of 250 MHz, and therefore no change to RR Article 5

Advantages:

– No impact on the existing services.

Disadvantages:

− The demand for the FSS spectrum may not be met.

4.1/1.6.1/5.2.2 Method E2: Make an allocation of 250 MHz to the FSS (Earth-to-space) in the band 13.4-13.75 GHz in Region 1

This method includes the following provisions:

- Modification of RR Article **5**.
  - Modification of RR No. **5.502** to only extend the frequency band to which it applies.
  - Footnote in RR Article **5** to restrict the PSD to -53.5 dB(W/Hz) computed from the peak envelope power and the occupied bandwidth.
- New provision to protect SRS (DRS) existing systems on a same status basis:
  - Option a)

    Protect existing SRS (DRS) systems (SRS feeder downlinks) with regard to FSS, by modifying RR No. **5.501A** and apply RR No. **9.17A** for the coordination of FSS earth stations (Earth-to-space) with regard to SRS receiving earth stations, for the grandfathered systems.
  - Option b)

    New provision to protect SRS inter-orbit links by imposing hard limits on FSS (Earth-to-space); and

    Protect existing SRS (DRS) systems (SRS feeder downlinks) with regard to FSS, by modifying RR No. **5.501A** and apply RR No. **9.17A** for the coordination of FSS earth stations (Earth-to-space) with regard to SRS receiving earth stations, for the grandfathered systems.
- Modify Table 7b of RR Appendix **7** to extend the coordination trigger between FSS (Earth-to-space) with the RLS and RNS.

Views expressed in favour of this method

Views were expressed that this method will provide for an FSS (Earth-to-space) allocation in the band 13.45-13.75 GHz. This will permit the balancing of the current inter-regional imbalance in FSS spectrum for ITU Region 1 and satisfies Resolution **151 (WRC-12).**

Sharing studies performed in ITU-R and using appropriate assumptions for FSS earth station deployment model developed in ITU-R, demonstrate compatibility between the proposed FSS (Earth-to-space) allocation in this band including the necessary technical/regulatory measures, to protect the incumbent services. For example, it is proposed under such method to apply the same constraints as in the band 13.75-14.00 GHz (i.e. RR No. **5.502**) to protect systems operating in the 13.4-14.00 GHz in order to ensure the sharing with the RLS.

Considering the proposed FSS earth station antenna size limitation under this method and the current allocation of other services in this band, each new FSS earth station shall be coordinated individually. Therefore, this band will not be used for VSAT type deployment and the limited number of FSS earth stations will be deployed worldwide (few hundreds). Therefore, all simulations performed in ITU-R considering several tens of thousands FSS earth stations are unrealistic and the associated sharing results are not valid for use in evaluating the sharing feasibility.

Views expressed against this method

Views were expressed that an allocation to the FSS (Earth-to-space) in the band 13.4-13.75 GHz is not feasible for the following reasons:

- An FSS (Earth-to-space) allocation imposes undue constraints on existing incumbent services.
- EESS (active) altimeter measurements of inland and coastal water heights would experience unacceptable measurement degradation in certain regions of the Earth.
- Aeronautical precipitation radar operating under the radiolocation service in this band would experience unacceptable interference.
- DRS systems operating forward inter-orbit links in the SRS would receive interference exceeding the protection criteria.
- For DRS, elevation of the SRS (space-to-Earth and space-to-space) allocation to primary status with respect to the additional use of the FSS (Earth-to-space) only, is needed to facilitate coordination under RR Article **9** providing protection of SRS DRS feeder downlink. This method does not adequately reflect this status change in RR Article **5** in the Table of Frequency Allocations.
- For DRS, grandfathering provisions imposed on the SRS would constrain future development of the DRS systems.
- ARNS airborne Doppler navigation systems operating near 13.4 GHz would not be protected (up to 53.7 dB exceedance of the ARNS protection criteria) from FSS (Earth-to-space) systems operating near 13.4 GHz.
- The SFTSSS would receive severe interference up to I/N of 7 dB on board the space station receivers operating in the secondary allocation.

4.1/1.6.1/5.3 EE: 13.4-13.75 GHz for FSS (space-to-Earth)

4.1/1.6.1/5.3.1 Method EE1: No allocation to the FSS (space-to-Earth) of 250 MHz, and therefore no change to RR Article 5

Advantages:

– No impact on the existing services.

Disadvantages:

– The demand for the FSS spectrum may not be met.

4.1/1.6.1/5.3.2 Method EE2: Make an allocation of 250 MHz to the FSS (space-to-Earth) in the band 13.4-13.75 GHz in Region 1

This method includes the following provisions:

– Modification of RR Article **5**.
  – Dividing the Table of Frequency Allocations into two sub-bands: 13.4-13.65 GHz and 13.65-13.75 GHz.
  – Making an allocation of 250 MHz for FSS (space-to-Earth) in the band 13.4-13.65 GHz in Region 1.

– New provision to protect SRS (DRS) systems:

  – Option a) (grandfathering)

    Protect existing SRS (DRS) systems through grandfathering, by adding a footnote indicating that the existing SRS (limited to DRS systems) operate on an equal basis with stations in the FSS, and that after a new date, new GSO space stations in the SRS will operate on a secondary basis.

  – Option b) (grandfathering)

    Protect existing SRS (DRS) systems with regard to FSS, by modifying RR No. **5.501A** and apply RR No. **9.7** for the coordination of FSS with regard to SRS feeder downlink, and RR No. **9.21** for the coordination of FSS with regard to SRS forward inter-orbit links, for the grandfathered systems.

– Pfd limits in RR Article **21** (hard limits on FSS) to protect existing services in the band.

Advantages:

– Balances the current inter-regional imbalance in FSS spectrum for ITU Region 1 and satisfies Resolution **151 (WRC-12)**.

– The demand for the FSS (space-to-Earth) spectrum in Region 1 may be met by an allocation in this band.

– Results of studies indicate that FSS (space-to-Earth) operations are compatible with EESS (active) operations in this band.

Disadvantages:

– A minimum orbital separation between DRS satellites and the nearest FSS satellite, and other technical measures are required in order to meet the aggregate interference criteria (Io/No level = −10 dB in 0.1% of time).

– The FSS receiving earth station could receive harmful interference from existing systems.

4.1/1.6.1/5.4 F: 14.5-14.8 GHz for FSS (Earth-to-space)

The methods developed in this section are developed for an allocation on a global basis. However, depending on the decisions of the Conference regional differences could apply.

4.1/1.6.1/5.4.1 Method F1: No change to the existing allocation to the FSS (Earth-to-space) in the band 14.5-14.8 GHz, and therefore no change to RR Article 5

Advantages:

– No impact on the existing services.

Disadvantages:

– The demand for the FSS spectrum may not be met.

4.1/1.6.1/5.4.2 Method F2: Modify the existing FSS allocation to support FSS uplinks that are not limited to BSS feeder links

This method includes the following provisions:

– Modify Article **5** to remove the limitation to BSS feeder links.

– Add consequential coordination provisions.

Consequential modifications to existing provisions are explained below:

With respect to coordination between FSS assignments (Earth-to-space) where both are not subject to AP **30A**:

– Modify Table 5-1 of RR Appendix **5** to include 14.5-14.8 GHz GSO/GSO coordination trigger under RR No. **9.7**.

With respect to coordination between FSS (Earth-to-space) assignments where one is subject to AP **30A** and the other one is not subject to AP **30A**:

Article revisions

Modification to Articles 4 and 7 of AP **30A** is required to define the procedure for coordination of unplanned FSS assignments vis-à-vis assignments in, or proposed modifications to, the AP **30A** Plan/List, in the band 14.5-14.8 GHz.

Option (A):

– Modify Article **7** of AP **30A** to define a mechanism for coordination between unplanned FSS assignments and assignments in, or proposed modifications to, the AP **30A** Plan/List in the band 14.5-14.8 GHz.

– Modify § 4.1.1 d) of Article **4** of AP **30A** to add requirements for coordination between FSS assignments in 14.5-14.8 GHz with the AP **30A** Plan or List.

Option (B): Option (A) + the following additional provision:

– Develop a new provision in Article **7** of AP **30A** using existing or new mechanism for coordination between unplanned FSS assignments with assignments in the AP **30A** Plan or List or already submitted under Article **4**.

Annex revisions

Modification to Annexes 1 and 4 for the trigger for coordination of unplanned FSS assignments vis-à-vis assignments in, or proposed modifications to, the AP **30A** Plan/List, in the band 14.5-14.8 GHz.

Option (A):

– Modify Section 2 of Annex 4 to AP **30A** to extend the existing $\Delta T/T$ trigger identifying the requirement to coordinate assignments in the unplanned FSS with assignments of, or proposed modifications to, the AP **30A** Plan/List, in the band 14.5-14.8 GHz.

– Modify Section 6 of Annex 1 to AP **30A** to extend the existing coordination trigger for unplanned services and the Plan/List to coordinate between FSS assignments in 14.5-14.8 GHz with the Regions 1 and 3 feeder-link Plan or List.

Option (B):

– Add a new Section 3 to Annex 4 to AP 30A to define a new trigger based on studies conducted under this agenda item identifying the requirement to coordinate assignments of the unplanned FSS with assignments in, or proposed modifications to, the AP **30A** Plan/List, in the band 14.5-14.8 GHz.

– Modify Section 6 of Annex 1 to AP **30A** to extend the existing coordination trigger for unplanned services and the Plan/List to coordinate between FSS assignments in 14.5-14.8 GHz with the Regions 1 and 3 feeder-link Plan or List.

With respect to the MS:

Option (A):

– Both FSS and MS are primary in the band 14.5-14.8 GHz. The current framework in the RR supports the coordination between the FSS and the MS.

Option (B):

– For coordination of FSS frequency assignments (not associated with AP **30A**) and MS frequency assignments, developing a new Resolution describing the procedures to coordinate fixed and known locations of FSS earth stations with MS stations is needed.

– For coordination of FSS frequency assignments subject to RR No. **5.510** and MS frequency assignments, the existing provisions of RR Article **9** and coordination methodologies of RR Appendix **7** continue to apply.

With respect to the SRS:

– The FSS is primary and the SRS is secondary in the band 14.5-14.8 GHz. Due to existing deployment of the DRS in the SRS, the SRS is treated on equal basis with FSS. The current framework in the RR supports the coordination between the FSS and the SRS by applying the procedures and criteria associated with RR No. **9.7** by upgrading the SRS (Earth-to-space) allocation to primary vis-à-vis the FSS (not including FSS providing feeder links to BSS (example AP **30A** assignments in Regions 1 and 3 and unplanned FSS in Region 2)).

Views expressed in favour of this method

Views were expressed in support of this method in the band 14.5-14.8 GHz as a way to increase the use of the orbit spectrum resource, in particular by removing current limitations on the use of an existing FSS allocation for supporting FSS uplinks that are not limited to BSS feeder links. This method contains appropriate measures which are needed to ensure the integrity and adequate protection of the AP **30A** Plan and List. Views were also expressed that the current provisions and procedures in the RR for coordination of the FSS (Earth-to-space) and other services were adequate and appropriate to coordinate this additional use of the FSS. Finally, views were stated that this method satisfied Resolution **151 (WRC-12)**. Additionally, other views also expressed the advantage that the 14.5-14.8 GHz band is contiguous to the current FSS allocation in the band 13.75-14.5 GHz band.

Views expressed against this method

• The coordination between FSS (Earth-to-space) and FS is manageable for a small number of FSS earth stations since the protection distance can be in hundreds of km without careful site selection.

• Increased complexity of regulatory examination of networks submitted under RR Articles **9** and **11**, or under AP **30A**, in the band 14.5-14.8 GHz.

• Places burden on administrations and AMS/MS operators to conduct operational and international bilateral/multilateral coordination with the FSS.

• Requires comprehensive sharing/coordinating mechanism between proposed FSS and existing authorized services.

• Places restrictions and/or constraints to the existing and future operations of the MS, FS and SRS.

• With respect to AMS/MS systems in the 14.5-14.8 GHz, all studies so far have demonstrated that the additional use of the FSS (Earth-to-space) will exceed the protection criteria of the AMS/MS if separation distances of more than 500 km between the FSS E/S and the AMS land station are not maintained. Further investigation is required to determine the impact, if any, to the AMS/MS or FSS from technical or regulatory methods that will enable sharing.

- Coordination under RR Article **9** was proposed but, given the large separation distances (greater than 500 km) between FSS E/S and AMS land station, this approach is not practical. Furthermore, the transportable nature of AMS land stations makes coordination extremely complicated and adds significant burden to administrations operating AMS/MS.
- For DRS, elevation of the SRS (Earth-to-space) allocation to primary status with respect to the additional use of the FSS (Earth-to-space) only, will facilitate coordination under RR Article **9** providing protection of SRS DRS feeder uplinks.

4.1/1.6.1/5.5 FF: 14.5-14.8 GHz for FSS (space-to-Earth)

4.1/1.6.1/5.5.1 Method FF1: No allocation to the FSS (space-to-Earth) of 250 MHz, and therefore no change to RR Article 5

Advantages:

− No impact on the existing services.

Disadvantages:

− The demand for the FSS spectrum may not be met.

4.1/1.6.1/5.5.2 Method FF2: New allocation to the FSS (space-to-Earth) in the band 14.5-14.8 GHz

This method includes the following provisions:

− modify RR Article **5** to allocate the frequency band to the GSO FSS (space-to-Earth). Insert footnote into RR Article **5** to limit use of the FSS allocation to the GSO systems.

− modify Table 8c in RR Appendix **7** to compute the coordination distance between receiving earth station in the FSS and transmitting stations in the FS and MS/AMS based on the allowable interference criterion I/N = 6%, see Recommendation ITU-R S.1432.

− insert the following regulatory provisions in order to coordinate and protect existing allocations to the FS, MS/AMS from GSO FSS (space-to-Earth) interferences:

− insert in Table **21-4** of RR Article **21** pfd limits (−132/−122) dB(W/(m^2 · MHz)) produced by GSO FSS satellites at the Earth's surface (free space) for corresponding angles of arrival, in order to protect receiving stations in terrestrial services (FS and MS/AMS).

− specify that the direction of maximum gain of FS receiving antennas in the frequency band 14.5-15.8 GHz in Region 1 should be separated from the geostationary-satellite orbit by at least 1.5°; appropriate modifications should be made to RR No. **21.2.1**.

− with respect to coordination in the FSS for opposite direction of transmission, RR No. **9.17A** will apply.

With respect to the compatibility between the FSS (space-to-Earth) and the SRS:

− to protect GSO SRS DRS space stations, the coordination procedure of RR No. **9.7** is required for newly filed GSO FSS networks. Relevant footnote should be added to RR Article **5**, as well as modification to RR Appendix **5**. Taking into account that coordination under RR Article **9** considers only those frequency assignments for which the frequency band is allocated on an equal basis, the relevant footnote should be added to RR Article **5**.

Disadvantages:

− Requires regulatory provisions to coordinate and protect DRS systems operating within the existing SRS allocation. In particular, technical and regulatory constraints to facilitate sharing between FSS uplinks and DRS feeder uplinks must be defined as part of this method.

4.1/1.6.1/5.6 G: 14.8-15.35 GHz for FSS (Earth-to-space)

4.1/1.6.1/5.6.1 Method G1: No allocation to the FSS (Earth-to-space) of 250 MHz, and therefore no change to RR Article 5

Advantages:

– No impact on the existing services.

Disadvantages:

– The demand for the FSS spectrum may not be met.

4.1/1.6.1/5.6.2 Method G2: Allocate the 14.8-15.1 GHz frequency band to the FSS (Earth-to-space)

This method includes the following provisions:

− Modify RR Article **5** to allocate the FSS (Earth-to-space) to this frequency band.

− Modify Table 7b of RR Appendix **7** to extend the coordination trigger between FSS (Earth-to-space) with the FS and MS.

− Regulatory provisions to coordinate and protect existing systems within SRS allocation need to be defined.

Views expressed in favour of this method

Views were expressed in support of this method in the band 14.8-15.1 GHz as a way to increase the use of the orbit spectrum resource. Views were also expressed that the current provisions and procedures in the RR for coordination of the FSS (Earth-to-space) and other services were adequate and appropriate to coordinate this additional use of the FSS. Finally, views were stated that this method satisfied Resolution **151 (WRC-12)**.

Views expressed against this method

• The coordination between FSS (Earth-to-space) and FS is manageable for a small number of FSS earth stations since the protection distance can be in hundreds of km without careful site selection.

• With respect to AMS/MS systems in the 14.8-15.1 GHz, all studies so far have demonstrated that the additional use of the FSS (Earth-to-space) will exceed the protection criteria of the AMS/MS if separation distances of more than 500 km between the FSS E/S and the AMS land station are not maintained. Further investigation is required to determine the impact, if any, to the AMS/MS or FSS from technical or regulatory methods that will enable sharing.

• Coordination under RR Article **9** was proposed but, given the large separation distances (greater than 500 km) between FSS E/S and AMS land station, this methodology is not practical. Furthermore, the transportable nature of AMS land stations makes coordination extremely complicated and adds significant burden to administrations operating AMS/MS.

- If the frequency band 14.8-15.1 GHz is allocated to FSS, the operation and development of the incumbent AMS/MS may be significantly constrained proportionally to the development of the proposed FSS service.
- SRS allocation upgrade to primary status with respect to the FSS (Earth-to-space) will be required together with the associated conditions to enable coordination under RR Article **9** which will provide protection of existing systems of SRS. This method does not adequately reflect this status change in RR Article **5** in the Table of Frequency Allocations.
- DRS systems operating return inter-orbit links in the SRS would receive harmful interference from FSS earth station resulting in the loss of valuable science data.
- Grandfathering provisions imposed on the SRS would constrain future development of the DRS systems.

Advantages:

− Expanded use of an existing FSS allocation for Earth-to-space transmissions in all ITU Regions which would increase the use of the orbit spectrum resource in this particular band.

− Balances the current inter-regional imbalance in FSS spectrum for ITU Region 1 and satisfies Resolution **151 (WRC-12)**.

Disadvantages:

− Incompatibility with aeronautical mobile data links currently operating in this frequency band has been demonstrated.

− DRS systems operating return inter-orbit links in the SRS would receive interference from FSS earth stations transmitting with PSD levels at −60 dBW/Hz which exceed the protection criteria. This would result in the loss of valuable science data.

− The DRS systems operating in the SRS can be constrained in the future regarding the non-GSO DRS user space station to GSO DRS space station link.

4.1/1.6.1/5.7 GG: 14.8-15.35 GHz for FSS (space-to-Earth)

4.1/1.6.1/5.7.1 Method GG1: No allocation to the FSS (space-to-Earth) of 250 MHz, and therefore no change to RR Article 5

Advantages:

– No impact on the existing services.

Disadvantages:

– The demand for the FSS spectrum may not be met.

4.1/1.6.1/5.7.2 Method GG2: New allocation to the FSS (space-to-Earth) within the band 14.8-15.35 GHz

This method includes the following provisions:

− modify RR Article **5** to allocate the frequency band to the GSO FSS (space-to-Earth). Insert footnote into RR Article **5** to limit use of the FSS allocation to the GSO systems.

− modify Table 8c in RR Appendix **7** to compute the coordination distance between receiving earth station in the FSS and transmitting stations in the FS and MS/AMS based on the allowable interference criterion I/N = 6%, see Recommendation ITU-R S.1432.

– insert the following regulatory provisions in order to coordinate and protect existing allocations to the FS, MS/AMS from GSO FSS (space-to-Earth) interferences:

– insert in Table **21-4** of RR Article **21** pfd limits (−132/−122) dB(W/(m^2 · MHz)) produced by GSO FSS satellites at the Earth's surface (free space) for corresponding angles of arrival, in order to protect receiving stations in terrestrial services (FS and MS/AMS).

– specify that the direction of maximum gain of FS receiving antennas in the frequency band 14.8-15.1 GHz in Region 1 should be separated from the geostationary-satellite orbit by at least 1.5°; appropriate modifications should be made to RR No. **21.2.1**.

With respect to the compatibility between the FSS (space-to-Earth) and the SRS:

– to protect GSO SRS DRS space stations, the coordination procedure of RR No. **9.7** is required for newly filed GSO FSS networks. Relevant footnote should be added to RR Article **5**, as well as modification to RR Appendix **5**. Taking into account that coordination under RR Article **9** considers only those frequency assignments for which the frequency band is allocated on an equal basis, the relevant footnote should be added to RR Article **5**.

Advantages:

– Balances the current inter-regional imbalance in FSS spectrum for ITU Region 1 and satisfies Resolution **151 (WRC-12)**.

Disadvantages:

– The FSS receiving earth station could receive harmful interference from existing systems.

4.1/1.6.1/5.8 I: 15.4-15.7 GHz for FSS (Earth-to-space)

4.1/1.6.1/5.8.1 Method I1: No allocation to the FSS (Earth-to-space) of 250 MHz, and therefore no change to RR Article 5

Advantages:

– No impact on the existing services.

4.1/1.6.1/5.9 II: 15.4-15.7 GHz for FSS (space-to-Earth)

4.1/1.6.1/5.9.1 Method II1: No allocation to the FSS (space-to-Earth) of 250 MHz, and therefore no change to RR Article 5

Advantages:

– No impact on the existing services.

4.1/1.6.1/6 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 4.1/1.6.1/5.

It should be noted that apart from the method described in section 4.1/1.6.1/6.1, all other proposed methods implicitly assume suppression (SUP) of Resolution **151 (WRC-12)**.

4.1/1.6.1/6.1 Methods AA1, E1, EE1, F1, FF1, G1, GG1, I1, II1: No change to RR Article 5

NOC

ARTICLE 5

Frequency allocations

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

SUP

RESOLUTION 151 (WRC-12)

Additional primary allocations to the fixed-satellite service in frequency bands between 10 and 17 GHz in Region 1

4.1/1.6.1/6.2 AA: 10.00-10.50 GHz for FSS (space-to-Earth)

4.1/1.6.1/6.2.1 Method AA2

ARTICLE 5

Frequency allocations

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

MOD

10-11.7 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>10-10.425
FIXED
MOBILE
RADIOLOCATION
Amateur
5.479</td><td>10-10.45
RADIOLOCATION
Amateur
5.479 5.480</td><td>10-10.45
FIXED
MOBILE
RADIOLOCATION
Amateur
5.479</td></tr>
<tr><td>10.25-10.45
FIXED-SATELLITE (space-to-Earth)
FIXED
MOBILE
RADIOLOCATION
Amateur
5.479</td><td></td><td></td></tr>
<tr><td>10.45-10.5
FIXED-SATELLITE (space-to-Earth)
RADIOLOCATION
Amateur
Amateur-satellite
5.481</td><td colspan="2">10.45-10.5
RADIOLOCATION
Amateur
Amateur-satellite
5.481</td></tr>
</table>

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section V – Limits of power flux-density from space stations

MOD

TABLE **21-4** (*continued*) (Rev.WRC-~~12~~15)

Frequency band	Service*	Limit in dB(W/m²) for angles of arrival (δ) above the horizontal plane			Reference bandwidth
		0°-5°	5°-25°	25°-90°	
8 025-8 500 MHz	Earth exploration-satellite (space-to-Earth) Space research (space-to-Earth)	−150	−150 + 0.5(δ −5)	−140	4 kHz
10.25-10.50 GHz	Fixed-satellite (space-to-Earth) (geostationary-satellite orbit)	−128	−128 + 0.6(δ −5)	−116	1 MHz
10.7-11.7 GHz	Fixed-satellite (space-to-Earth) (geostationary-satellite orbit)	−150	−150 + 0.5(δ −5)	−140	4 kHz
10.7-11.7 GHz	Fixed-satellite (space-to-Earth) (non-geostationary-satellite orbit) [20]	−126	−126 + 0.5(δ −5)	−116	1 MHz

4.1/1.6.1/6.3 E: 13.4-13.75 GHz for FSS (Earth-to-space)

4.1/1.6.1/6.3.1 Method E2

ARTICLE 5

Frequency allocations

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

MOD

11.7-14 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>13.4-13.~~7~~5</td><td colspan="2">EARTH EXPLORATION-SATELLITE (active)
RADIOLOCATION
SPACE RESEARCH 5.501A
Standard frequency and time signal-satellite (Earth-to-space)
5.499 5.500 5.501 5.501B</td></tr>
<tr><td>13.5~~4~~-13.75
EARTH EXPLORATION-SATELLITE (active)
FIXED-SATELLITE (Earth-to-space) ADD 5.A161
RADIOLOCATION
SPACE RESEARCH 5.501A
Standard frequency and time signal-satellite (Earth-to-space)
5.499 5.500 5.501 5.501B
MOD 5.502 ADD 5.B161</td><td colspan="2">13.5~~4~~-13.75
EARTH EXPLORATION-SATELLITE (active)
RADIOLOCATION
SPACE RESEARCH 5.501A
Standard frequency and time signal-satellite (Earth-to-space)
5.499 5.500 5.501 5.501B</td></tr>
</table>

ADD

5.A161 In the band 13.5-13.75 GHz in Region 1, the peak envelope power delivered to the antenna of stations of the fixed-satellite service (Earth-to-space) shall not exceed the spectral density of −53.5 dB(W/Hz) computed from the peak envelope power and the occupied bandwidth. (WRC-15)

MOD

5.502 In the band 13.5-13.75 GHz in Region 1 and in the band 13.75-14 GHz, an earth station of a geostationary fixed-satellite service network shall have a minimum antenna diameter of 1.2 m. ~~and~~ In the band 13.75-14 GHz, an earth station of a non-geostationary fixed-satellite service system shall have a minimum antenna diameter of 4.5 m. In addition, the e.i.r.p., averaged over one second, radiated by a station in the radiolocation or radionavigation services shall not exceed 59 dBW for elevation angles above 2° and 65 dBW at lower angles. Before an administration brings into use an earth station in a geostationary-satellite network in the fixed-satellite service in this band with an antenna diameter smaller than 4.5 m, it shall ensure that the power flux-density produced by this earth station does not exceed:

– –115 dB(W/(m^2 · 10 MHz)) for more than 1% of the time produced at 36 m above sea level at the low water mark, as officially recognized by the coastal State;

– –115 dB(W/(m^2 · 10 MHz)) for more than 1% of the time produced 3 m above ground at the border of the territory of an administration deploying or planning to deploy land mobile radars in this band, unless prior agreement has been obtained.

For earth stations within the fixed-satellite service having an antenna diameter greater than or equal to 4.5m, the e.i.r.p. of any emission should be at least 68 dBW and should not exceed 85 dBW. (WRC-03)

Start option 1) with respect to SRS

ADD

5.B161 In the band 13.5-13.75 GHz, geostationary space stations in the space research service (limited to data relay satellite systems) for which information for advance publication has been received by the Bureau prior to 27 November 2015 shall operate on an equal basis with stations in the fixed-satellite service; after that date, new geostationary space stations in the space research service will operate on a secondary basis. (WRC-15)

End option 1) with respect to SRS

Start option 2) with respect to SRS

MOD

5.501A The allocation of the band 13.4-13.75 GHz to the space research service on a primary basis is limited to active spaceborne sensors, as well as to the SRS DRS systems (space-to-Earth, space-to-space) for which information for advance publication has been received by the Bureau prior to [1 January 2016]. Other uses of the band by the space research service are on a secondary basis. (WRC-~~97~~15)

End option 2) with respect to SRS

APPENDIX 7 (REV.WRC-12)

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 7B (REV.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a transmitting earth station

Transmitting space radiocommunication service designation		**Fixed-satellite, mobile-satellite**	**Aero-nautical mobile-satellite (R) service**	**Aero-nautical mobile-satellite (R) service**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**		**Space operation, space research**		**Fixed-satellite, mobile-satellite, meteorological-satellite**		**Fixed-satellite**		**Fixed-satellite**		**Fixed-satellite**	**Fixed-satellite** [3]	**Fixed-satellite**	**Fixed-satellite** [3]
Frequency bands (GHz)		2.655-2.690	5.030-5.091	5.030-5.091	5.091-5.150	5.091-5.150	5.725-5.850	5.725-7.075		7.100-7.235 [5]		7.900-8.400		10.7-11.7		12.5-14.8		13.~~7~~5-14.3	15.43-15.65	17.7-18.4	19.3-19.7
Receiving terrestrial service designations		Fixed, mobile	Aeronautical radio-navigation	Aeronautical mobile (R)	Aeronautical radio-navigation	Aeronautical mobile (R)	Radiolocation	Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Radiolocation radionavigation (land only)	Aeronautical radionavigation	Fixed, mobile	Fixed, mobile
Method to be used		§ 2.1	§ 2.1, § 2.2	§ 2.1, § 2.2			§ 2.1	§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1, § 2.2	§ 2.2
Modulation at terrestrial station [1]		A						A	N	A	N	A	N	A	N	A	N	−		N	N
Terrestrial station interference parameters and criteria	p_0 (%)	0.01						0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01		0.005	0.005
	n	2						2	2	2	2	2	2	2	2	2	2	1		2	2
	p (%)	0.005						0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.01		0.0025	0.0025
	N_L (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
	M_s (dB)	26 [2]						33	37	33	37	33	37	33	40	33	40	1		25	25
	W (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
Terrestrial station parameters	G_x (dBi) [4]	49 [2]	6	10	6	6		46	46	46	46	46	46	50	50	52	52	36		48	48
	T_e (K)	500 [2]						750	750	750	750	750	750	1 500	1 100	1 500	1 100	2 636		1 100	1 100
Reference bandwidth	*B* (Hz)	4×10^3	150×10^3	37.5×10^3	150×10^3	10^6		4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	10^7		10^6	10^6
Permissible interference power	$P_r(p)$ (dBW) in *B*	−140	−160	−157	−160	−143		−131	−103	−131	−103	−131	−103	−128	−98	−128	−98	−131		−113	−113

4.1/1.6.1/6.4 EE: 13.4-13.75 GHz for FSS (space-to-Earth)

4.1/1.6.1/6.4.1 Method EE2

Start Option a)

ARTICLE 5

Frequency allocations

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

MOD

11.7-14 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
13.4-13.75 EARTH EXPLORATION-SATELLITE (active) FIXED-SATELLITE (space-to-Earth) ADD 5.C161 RADIOLOCATION SPACE RESEARCH MOD 5.501A Standard frequency and time signal-satellite (Earth-to-space) 5.499 5.500 5.501 5.501B	**13.4-13.75** EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION SPACE RESEARCH 5.501A Standard frequency and time signal-satellite (Earth-to-space) 5.499 5.500 5.501 5.501B	

Reasons: To allocate the band 13.4-13.75 GHz to the FSS (space-to-Earth) in Region 1.

ADD

5.C161 The band 13.4-13.75 GHz could be used by GSO FSS (space-to-Earth) systems subject to agreement obtained under No. **9.21** with respect to SRS DRS (space-to-space) systems for which information for advance publication has been received by the Bureau prior to [1 January 2016]. (WRC-15)

Reasons: To limit use of the new FSS allocation (space-to-Earth) in Region 1 to GSO FSS, and to specify the terms and conditions for sharing between newly filed GSO FSS networks and SRS systems already notified to the Bureau, operating on space-to-space link to relay data from GSO space station to non-GSO user space station. There is understanding, that coordination of newly filed GSO FSS networks and already notified to the Bureau SRS (space-to-Earth) systems is subject to RR No. **9.7**.

MOD

5.501A The allocation of the band 13.4-13.75 GHz to the space research service on a primary basis is limited to active spaceborne sensors, as well as to the SRS DRS systems (space-to-Earth, space-to-space) for which information for advance publication has been received by the Bureau prior to [1 January 2016]. Other uses of the band by the space research service are on a secondary basis. (WRC-~~97~~15)

Reasons: To ensure operation of notified to the Bureau SRS systems on space-to-Earth and space-to-space links on an equal basis with newly filed stations in the fixed-satellite service (space-to-Earth).

End Option a)

Start Option b)

ARTICLE 5

Frequency allocations

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

MOD

11.7-14 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
13.4-13.6~~7~~5 EARTH EXPLORATION-SATELLITE (active) FIXED-SATELLITE (space-to-Earth) RADIOLOCATION SPACE RESEARCH 5.501A Standard frequency and time signal-satellite (Earth-to-space) 5.499 5.500 5.501 5.501B ADD 5.C161	**13.4-13.6~~7~~5** EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION SPACE RESEARCH 5.501A Standard frequency and time signal-satellite (Earth-to-space) 5.499 5.500 5.501 5.501B	
13.654-13.75	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION SPACE RESEARCH 5.501A Standard frequency and time signal-satellite (Earth-to-space) 5.499 5.500 5.501 5.501B	

ADD

5.C161 In the band 13.5-13.75 GHz, geostationary space stations in the space research service (limited to data relay satellite systems) for which information for advance publication has been received by the Bureau prior to 27 November 2015 shall operate on an equal basis with stations in the fixed-satellite service; after that date, new geostationary space stations in the space research service will operate on a secondary basis. (WRC-15)

End Option b)

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section I − Choice of sites and frequencies

MOD

____

[1] **21.2.1** For their own protection receiving stations in the fixed or mobile service operating in bands shared with space radiocommunication services (space-to-Earth) should also avoid directing their antennas towards the geostationary-satellite orbit if their sensitivity is sufficiently high that interference from space station transmissions may be significant. In particular, in the bands 13.4-13.75 GHz and 21.4-22 GHz, it is recommended to maintain a minimum separation angle of 1.5° with respect to the direction of the geostationary-satellite orbit. (WRC-1~~2~~5)

Section V − Limits of power flux-density from space stations

MOD

TABLE **21-4** (*continued*) (Rev.WRC-~~12~~15)

<table>
<tr><th rowspan="2">Frequency band</th><th rowspan="2">Service*</th><th colspan="7">Limit in dB(W/m²) for angles of arrival (δ) above the horizontal plane</th><th rowspan="2">Reference bandwidth</th></tr>
<tr><th colspan="2">0°-5°</th><th colspan="3">5°-25°</th><th colspan="2">25°-90°</th></tr>
<tr><td>12.2-12.75 GHz[7] (Region 3)
12.5-12.75 GHz[7] (Region 1 countries listed in Nos. 5.494 and 5.496)</td><td>Fixed-satellite (space-to-Earth) (geostationary-satellite orbit)</td><td colspan="2">−148</td><td colspan="3">−148 + 0.5(δ − 5)</td><td colspan="2">−138</td><td>4 kHz</td></tr>
<tr><td rowspan="2">13.4-13.75 GHz
(Region 1)</td><td rowspan="2">Fixed-satellite (space-to-Earth) (geostationary-satellite orbit)</td><td>0°-0.6°</td><td colspan="2">0.6°-1.25°</td><td>1.25°-21.25°</td><td colspan="2">21.25°-70°</td><td>70°-90°</td><td rowspan="2">1 MHz</td></tr>
<tr><td>−137.5</td><td colspan="2">−136.5</td><td>−130.5</td><td colspan="2">−127.5</td><td>−122</td></tr>
</table>

Reasons: To insert pfd limits for GSO FSS (space-to-Earth) into RR Article 21 in order to protect allocations to terrestrial services (FS, MS) and RLS.

APPENDIX 5 (Rev.WRC-12)

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-~~12~~15)

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), 13.4-13.75 GHz (Region 1) and 13.75-14.5 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 ±8° 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 ±7° of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan iii) any network in the SRS and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of ±[X]° of the nominal orbital position of a proposed network in the FSS		With respect to the space services listed in the threshold/condition column in the bands in 1), 2),3), 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 Δ*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

Reasons: To specify the order and mechanism of coordination in accordance with provisions of RR No **9.7** between newly notifying networks of the FSS and SRS (space-to-Earth).

APPENDIX 7 (REV.WRC-12)

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 8C (REV.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a receiving earth station

Receiving space radiocommunication service designation			**Fixed-satellite**		**Fixed-satellite, radio-determination satellite**	**Fixed-satellite**	**Fixed-satellite**		**Meteoro-logical-satellite** [7, 8]	**Meteoro-logical-satellite** [9]	**Earth exploration-satellite** [7]	**Earth exploration-satellite** [9]	**Space research** [10]		**Fixed-satellite**		**Broadcasting-satellite**		**Fixed-satellite** [9]	**Broad-casting-satellite**	**Fixed-satellite** [7]
													Deep space								
Frequency bands (GHz)			4.500-4.800		5.150-5.216	6.700-7.075	7.250-7.750		7.450-7.550	7.750-7.900	8.025-8.400	8.025-8.400	8.400-8.450	8.450-8.500	10.7-12.75 13.4-13.75[7]		12.5-12.75 [12]		15.4-15.7	17.7-17.8	17.7-18.8 19.3-19.7
Transmitting terrestrial service designations			Fixed, mobile		Aeronautical radionavigation	Fixed, mobile	Fixed, mobile		Fixed, mobile	Fixed, mobile	Fixed, mobile	Fixed, mobile	Fixed, mobile		Fixed, mobile		Fixed, mobile		Aeronau-tical radio-navigation	Fixed	Fixed, mobile
Method to be used			§ 2.1		§ 2.1	§ 2.2	§ 2.1		§ 2.1, § 2.2	§ 2.2	§ 2.1	§ 2.2	§ 2.2		§ 2.1, § 2.2		§ 1.4.5			§ 1.4.5	§ 2.1
Modulation at earth station [1]			A	N		N	A	N	N	N	N	N	N	N	A	N	A	N	–		N
Earth station interference parameters and criteria	p_0 (%)		0.03	0.005		0.005	0.03	0.005	0.002	0.001	0.083	0.011	0.001	0.1	0.03	0.003	0.03	0.003	0.003		0.003
	n		3	3		3	3	3	2	2	2	2	1	2	2	2	1	1	2		2
	p (%)		0.01	0.0017		0.0017	0.01	0.0017	0.001	0.0005	0.0415	0.0055	0.001	0.05	0.015	0.0015	0.03	0.003	0.0015		0.0015
	N_L (dB)		1	1		1	1	1	–	–	1	0	0	0	1	1	1	1	1		1
	M_s (dB)		7	2		2	7	2	–	–	2	4.7	0.5	1	7	4	7	4	4		6
	W (dB)		4	0		0	4	0	–	–	0	0	0	0	4	0	4	0	0		0
Terrestrial station parameters	E (dBW) in B [2]	A	92 [3]	92 [3]		55	55	55	55	55	55	55	25 [5]	25 [5]	40	40	55	55			35
		N	42 [4]	42 [4]		42	42	42	42	42	42	42	−18	−18	43	43	42	42		40	40
	P_t (dBW) in B	A	40 [3]	40 [3]		13	13	13	13	13	13	13	−17 [5]	−17 [5]	−5	−5	10	10			−10
		N	0	0		0	0	0	0	0	0	0	−60	−60	−2	−2	−3	−3		−7	−5
	G_x (dBi)		52 [3, 4]	52 [3, 4]		42	42	42	42	42	42	42	42	42	45	45	45	45		47	45
Reference band-width [6]	B (Hz)		10^6	10^6		10^6	10^6	10^6	10^7	10^7	10^6	10^6	1	1	10^6	10^6	27×10^6	27×10^6			10^6
Permissible interference power	$P_r(p)$ (dBW) in B					−151.2			−125	−125	−154 [11]	−142	−220	−216			−131	−131			

Reasons: To specify coordination distances for the FSS receiving earth station in order to protect it from interferences produced by terrestrial FS and MS stations, based on the allowable interference criterion I/N = 6%, see Recommendation ITU-R S.1432.

4.1/1.6.1/6.5 F: 14.5-14.8 GHz for FSS (Earth-to-space)

4.1/1.6.1/6.5.1 Method F2

ARTICLE 5

Frequency allocations

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

MOD

14-15.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
14.5-14.8	FIXED FIXED-SATELLITE (Earth-to-space) MOD 5.510 ADD 5.D161 ADD 5.F161 MOBILE SPACE RESEARCH (Earth-to-space) ADD 5.E161 Space research (space-to-Earth) (space-to-space)	

Start option for modification to RR No. 5.510

MOD

5.510 The use of the band 14.5-14.8 GHz by the fixed-satellite service (Earth-to-space) ~~is limited to~~for feeder links for the broadcasting-satellite service is subject to the provisions of Appendix **30A** for Regions 1 and 3~~. This use~~ and is ~~reserved~~ limited for countries outside Europe.

End option for modification to RR No. 5.510

Start option for no modification to RR No. 5.510 but addition of new footnote 5.510A

NOC

5.510 The use of the band 14.5-14.8 GHz by the fixed-satellite service (Earth-to-space) is limited to feeder links for the broadcasting-satellite service. This use is reserved for countries outside Europe.

ADD

5.510A The band 14.5-14.8 GHz is also allocated to fixed-satellite service (Earth-to-space), for other use than feeder links for the BSS provided that unacceptable interference is not produced for the assignments contained in the Plan and List of Appendix **30A** for Regions 1 and 3. The coordination requirements for assignments of the fixed-satellite service not subject to Appendix **30A** in respect to assignments that are subject to Appendix **30A** are determined in accordance with the relevant provisions of Appendix **30A**.

Note: The relevant provisions mentioned in new footnote **5.510A** are Articles 2A, 4 and 7 of Appendix **30A**.

End option for no modification to RR No. 5.510 but addition of new footnote 5.510A

ADD

5.D161 For the use of the band 14.5-14.8 GHz by the fixed-satellite service (Earth-to-space) not subject to No. **5.510**, the fixed-satellite service earth stations shall have a minimum earth station antenna diameter of [X] metres.

Start option 1) with respect to SRS (no grandfathering approach)

ADD

5.E161 Stations in the space research service (Earth-to-space) shall not cause unacceptable interference to nor claim protection from stations in the fixed, mobile services and stations in the fixed-satellite service providing feeder links for the broadcasting satellite service in the unplanned FSS in Region 2 and assignments subject to Appendix **30A** and its evolution.

End option 1) with respect to SRS

Start option 2) with respect to SRS (including grandfathering approach)

ADD

5.E161 Stations in the space research service (Earth-to-space) shall not cause unacceptable interference to nor claim protection from stations in the fixed, mobile services and stations in the fixed-satellite service providing feeder links for the broadcasting satellite service in the unplanned FSS in Region 2 and assignments subject to Appendix **30A** and its evolution. In addition, the use of the band by stations in the space research service (Earth-to-space) for which information for advanced publication has been received by the BR after DATE shall not cause unacceptable interference to nor claim protection from stations in FSS not subject to Appendix **30A**.

End option 2) with respect to SRS

ADD

5.F161 In the band 14.5-14.8 GHz, the fixed-satellite service (Earth-to-space) not subject to No. **5.510** shall coordinate with the aeronautical mobile service in accordance with Resolution **[A161] (WRC-15)**.

APPENDIX 5 (REV.WRC-12)

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-~~12~~15)

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. ~~5~~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 ±8° 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 ±7° of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan		With respect to the space services listed in the threshold/condition column in the bands in 1), 2), 3), 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

APPENDIX 30A (REV.WRC-12)*

Provisions and associated Plans and List[1] 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[2] and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-03)

(See Articles **9** and **11**) (WRC-03)

ARTICLE 4 (Rev.WRC-03)

Procedures for modifications to the Region 2 feeder-link Plan or for additional uses in Regions 1 and 3

MOD

4.1 Provisions applicable to Regions 1 and 3

4.1.1 An administration proposing to include a new or modified assignment in the feeder-link List shall seek the agreement of those administrations whose services are considered to be affected, i.e. administrations[4, 5]:

a) of Regions 1 and 3 having a feeder-link frequency assignment in the fixed-satellite service (Earth-to-space) to a space station in the broadcasting-satellite service which is included in the Regions 1 and 3 feeder-link Plan with a necessary bandwidth, any portion of which falls within the necessary bandwidth of the proposed assignment; *or*

b) of Regions 1 and 3 having a feeder-link frequency assignment included in the feeder-link List or for which complete Appendix **4** information has been received by the

---

* The expression "frequency assignment to a space station", wherever it appears in this Appendix, shall be understood to refer to a frequency assignment associated with a given orbital position. (WRC-03)

1 The Regions 1 and 3 feeder-link List of additional uses is annexed to the Master International Frequency Register (see Resolution **542 (WRC-2000)****). (WRC-03)

2 This use of the band 14.5-14.8 GHz is reserved for countries outside Europe.

** *Note by the Secretariat*: This Resolution was abrogated by WRC-03.

Note by the Secretariat: Reference to an Article with the number in roman is referring to an Article in this Appendix.

4 Agreement with administrations having a frequency assignment in the bands 14.5-14.8 GHz or 17.7-18.1 GHz to a terrestrial station, or having a frequency assignment in the band 17.7-18.1 GHz to an earth station in the fixed-satellite service (space-to-Earth), or having a frequency assignment in the band 17.3-17.8 GHz in the broadcasting-satellite service shall be sought under No. **9.17**, No. **9.17A** or No. **9.19**, respectively.

5 Coordination under Nos. **9.17** or **9.17A** is not required for an earth station of an administration on the territory of which this earth station is located and for which the procedures of former § 4.2.1.2 and 4.2.1.3 of Appendix **30A (WRC-97)** have been successfully applied by that administration before 3 June 2000 in respect of terrestrial stations or earth stations operating in the opposite direction of transmission. (WRC-03)

Radiocommunication Bureau in accordance with the provisions of § 4.1.3, and any portion of which falls within the necessary bandwidth of the proposed assignment; *or*

c) of Region 2 having a feeder-link frequency assignment in the fixed-satellite service (Earth-to-space) to a space station in the broadcasting-satellite service which is in conformity with the Region 2 feeder-link Plan, or in respect of which proposed modifications to that Plan have already been received by the Bureau in accordance with the provisions of § 4.2.6 with a necessary bandwidth, any portion of which falls within the necessary bandwidth of the proposed assignment; *or*

d) having a feeder-link frequency assignment in the band 17.8-18.1 GHz in Region 2 in the fixed-satellite service (Earth-to-space) to a space station in the broadcasting-satellite service or a frequency assignment in the band 14.5-14.8 GHz in the fixed-satellite service (Earth-to-space) not subject to this Appendix which is recorded in the Master Register or which has been coordinated or is being coordinated under the provisions of No. **9.7**, or under § 7.1 of Article 7, with a necessary bandwidth, any portion of which falls within the necessary bandwidth of the proposed. (Rev.WRC-~~03~~15)

Start Option (A)

MOD

ARTICLE 7 (Rev.WRC-~~12~~15)

Coordination, notification and recording in the Master International Frequency Register of frequency assignments to stations in the fixed-satellite service (space-to-Earth) in Region 1 in the band 17.3-18.1 GHz and in Regions 2 and 3 in the band 17.7-18.1 GHz, to stations in the fixed-satellite service (Earth-to-space) in Region 2 in the band 17.8-18.1 GHz, to stations in the fixed-satellite service (Earth-to-space) in all Regions in the band 14.5-14.8 GHz where those stations are not subject to the Regions 1 and 3 feeder-link Plan or List and to stations in the broadcasting-satellite service in Region 2 in the band 17.3-17.8 GHz when frequency assignments to feeder links for broadcasting-satellite stations in the 17.3-18.1 GHz band in Regions 1 and 3 or in the band 17.3-17.8 GHz in Region 2 are involved[28]

Section I – Coordination of transmitting space or earth stations in the fixed-satellite service or transmitting space stations in the broadcasting-satellite service with assignments to broadcasting-satellite service feeder links

[28] These provisions do not replace the procedures prescribed in Articles **9** and **11** when stations other than those for feeder links in the broadcasting-satellite service subject to a Plan are involved. (WRC-03)

7.1 The provisions of No. **9.7**[29] and the associated provisions under Articles **9** and **11** are applicable to transmitting space stations in the fixed-satellite service in Region 1 in the band 17.3-18.1 GHz, to transmitting space stations in the fixed-satellite service in Regions 2 and 3 in the band 17.7-18.1 GHz, to transmitting earth stations in the fixed-satellite service in Region 2 in the band 17.8-18.1 GHz, to transmitting earth stations in the fixed-satellite service in any region in the band 14.5-14.8 GHz where those stations are not subject to the Regions 1 and 3 feeder link Plan or List and to transmitting space stations in the broadcasting-satellite service in Region 2 in the band 17.3-17.8 GHz. (Rev.WRC-0315)

7.2 In applying the procedures referred to in § 7.1, the provisions of Appendix **5** are replaced by the following:

7.2.1 The frequency assignments to be taken into account are:

a) the assignments in conformity with the appropriate Regional feeder-link Plan in Appendix **30A**;

b) the assignments included in the Regions 1 and 3 feeder-link List;

c) the assignments for which the procedure of Article 4 has been initiated as from the date of receipt of the complete Appendix **4** information under § 4.1.3 or 4.2.6. (WRC-0315)

7.2.2 The criteria to be applied are those given in Annex 4.

End Option (A)

Start Option (B)

Note: Option (B) also includes Option (A)’s changes to Article **7**

7.3 In applying the procedures referred to in § 7.1 for FSS frequency assignments in the band 14.5-14.8 GHz not subject to No. **5.510**, the provision of No. **11.41** is replaced by the following provision. No. **11.41.2** continues to apply.

7.3.1 If, after a notice is returned under No. **11.38**, should the notifying administration resubmit the notice and insist upon its reconsideration, and the assignment which was the basis of the unfavourable finding is not an assignment in the Regions 1 and 3 Plan, the Bureau shall enter the assignment in the Master Register with an indication of those administrations whose assignments were the basis of the unfavourable finding (see also No. **11.42**).

[29] The provisions of Resolution **33 (Rev.WRC-97)*** are applicable to space stations in the broadcasting-satellite service for which the advance publication information or the request for coordination has been received by the Bureau prior to 1 January 1999.

* *Note by the Secretariat*: This Resolution was revised by WRC-03.

End Option (B)

Modifications to the Annexes

ANNEX 1

Limits for determining whether a service of an administration is considered to be affected by a proposed modification to the Region 2 feeder-link Plan or by a proposed new or modified assignment in the Regions 1 and 3 feeder-link List or when it is necessary under this Appendix to seek the agreement of any other administration (Rev.WRC-03)

MOD

6 Limits applicable to protect a frequency assignment in the band 17.8-18.1 GHz (Region 2) to a receiving feeder-link space station in the fixed-satellite service (Earth-to-space) or a frequency assignment in the band 14.5-14.8 GHz (any region where the frequency assignment is not subject to the Regions 1 and 3 feeder-link Plan or List) to a receiving space station in the fixed-satellite service (Earth-to-space) (Rev.WRC-~~03~~15)

With respect to § 4.1.1 *d)* of Article 4, an administration is considered affected by a proposed new or modified assignment in the Regions 1 and 3 feeder-link List when the power flux-density arriving at the receiving space station of a broadcasting-satellite feeder-link in Region 2 or at the receiving space station of the fixed-satellite service uplinks not subject to this Appendix, in any region of that administration would cause an increase in the noise temperature of the receiving ~~feeder-link~~ space station which exceeds the threshold value of $\Delta T/T$ corresponding to 6%, where $\Delta T/T$ is calculated in accordance with the method given in Appendix **8**, except that the maximum power densities per hertz averaged over the worst 1 MHz are replaced by power densities per hertz averaged over the necessary bandwidth of the ~~feeder-link~~uplink carriers. (Rev.WRC-~~03~~15)

ANNEX 4 (Rev.WRC-03)

Criteria for sharing between services

1 Threshold values for determining when coordination is required between, on one hand, transmitting space stations in the fixed-satellite service or the broadcasting-satellite service and, on the other hand, a receiving space station in the feeder-link Plan or List or a proposed new or modified receiving space station in the List, in the frequency bands 17.3-18.1 GHz (Regions 1 and 3) and in the feeder-link Plan or a proposed modification to the Plan in the frequency band 17.3-17.8 GHz (Region 2) (WRC-03)

With respect to § 7.1, Article **7**, coordination of a transmitting space station in the fixed-satellite service or in the broadcasting-satellite service with a receiving space station in a broadcasting-satellite service feeder link in the Regions 1 and 3 feeder-link Plan or List, or a proposed new or modified receiving space station in the List, or in the Region 2 feeder-link Plan or proposed modification to the Plan is required when the power flux-density arriving at the receiving space station of a broadcasting-satellite service feeder link of another administration would cause an increase in the noise temperature of the feeder-link space station which exceeds a threshold value of $\Delta T_s / T_s$ corresponding to 6%. $\Delta T_s / T_s$ is calculated in accordance with Case II of the method given in Appendix **8**. (WRC-03)

Start Option (A)

MOD

2 Threshold values for determining when coordination is required between<u>, on one hand,</u> transmitting feeder-link earth stations in the fixed-satellite service in Region 2<u> in 17.8-18.1 GHz or transmitting earth stations in the fixed-satellite service in 14.5-14.8 GHz not subject to the Regions 1 and 3 feeder-link Plan or List</u> and<u>, on the other hand,</u> a receiving space station in the Regions 1 and 3 feeder-link Plan or List or a proposed new or modified receiving space station in the List, in the frequency band<u>s 14.5-14.8 GHz or</u> 17.8-18.1 GHz (<u>Rev.</u>WRC-~~03~~<u>15</u>)

With respect to § 7.1, Article **7**, coordination of a transmitting ~~feeder-link~~ earth station in the fixed-satellite service with a receiving space station in a broadcasting-satellite feeder link in the Regions 1 and 3 feeder-link Plan or List, or a proposed new or modified receiving space station in the List, is required when the power flux density arriving at the receiving space station of a broadcasting-satellite service feeder link of another administration would cause an increase in the noise temperature of the feeder-link space station which exceeds a threshold value of $\Delta T/T$ corresponding to 6%, where $\Delta T/T$ is calculated in accordance with the method given in Appendix **8**, except that the maximum power densities per hertz averaged over the worst 1 MHz are replaced by power densities per hertz averaged over the necessary bandwidth of the ~~feeder-link~~<u>uplink</u> carriers. (<u>Rev.</u>WRC-~~03~~<u>15</u>)

End Option (A)

Start Option (B)

2 Threshold values for determining when coordination is required between transmitting feeder-link earth stations in the fixed-satellite service in Region 2 and a receiving space station in the Regions 1 and 3 feeder-link Plan or List or a proposed new or modified receiving space station in the List, in the frequency band 17.8-18.1 GHz (WRC-03)

With respect to § 7.1, Article **7**, coordination of a transmitting feeder-link earth station in the fixed-satellite service with a receiving space station in a broadcasting-satellite feeder link in the Regions 1 and 3 feeder-link Plan or List, or a proposed new or modified receiving space station in the List, is required when the power flux density arriving at the receiving space station of a broadcasting-satellite service feeder link of another administration would cause an increase in the noise temperature of the feeder-link space station which exceeds a threshold value of $\Delta T/T$ corresponding to 6%, where $\Delta T/T$ is calculated in accordance with the method given in Appendix **8**, except that the maximum power densities per hertz averaged over the worst 1 MHz are replaced by power densities per hertz averaged over the necessary bandwidth of the feeder-link carriers. (WRC-03)

ADD

3 Threshold values for determining when coordination is required between, transmitting earth stations in the fixed-satellite service in 14.5-14.8 GHz not subject to the Regions 1 and 3 feeder-link Plan or List and a receiving space station in the Regions 1 and 3 feeder-link Plan or List or a proposed new or modified receiving space station in the List, in the frequency band 14.5-14.8 GHz (WRC-15)

With respect to § 7.1, Article **7**, coordination of a transmitting earth station in the fixed-satellite service with a receiving space station in a broadcasting-satellite feeder link in the Regions 1 and 3 feeder-link Plan or List, or a proposed new or modified receiving space station in the List, is required when the power flux-density arriving at the receiving space station of a broadcasting-satellite service feeder link of another administration exceeds the value of [−193.9 dB(W/(m^2 · Hz))/mask (see below)]. (WRC-15)

Orbital separation (degrees)	Maximal pfd value (dB(W/(m^2 · Hz)))
0 < = θ < 2	−193.9
2 > = θ > = 9	−185.1 − 25·log (topocentric separation)

End Option (B)

ADD

RESOLUTION [A161] (WRC-15)

Coordination between the fixed-satellite service* in the Earth-to-space direction and the mobile service in the frequency band 14.5-14.8 GHz

The World Radiocommunication Conference (Geneva, 2015),

considering

a) that the existing unplanned bands for the fixed-satellite service (FSS) in the 10-15 GHz range are extensively used for a large variety of applications, and these applications have triggered a rapid rise in the demand for this frequency range;

b) that prior to WRC-15, in ITU Region 3 the spectrum allocated to the unplanned FSS in the Earth-to-space and space-to-Earth directions in the 10-15 GHz band is 750 MHz and 1.05 GHz, respectively;

c) that prior to WRC-15, in ITU Region 2 the spectrum allocated to the unplanned FSS in the Earth-to-space and space-to-Earth directions in the 10-15 GHz band is 750 MHz and 1.0 GHz, respectively;

d) that the difference of capacity in *considering b)* and *c)* created a bandwidth limitation in the Earth-to-space direction and therefore restricted satellite operators from fully and effectively utilizing the limited frequency resource to cope with the increasing spectrum demand in *considering a)*;

e) that additional primary allocations to the unplanned FSS in the Earth-to-space direction that are contiguous (or near contiguous) to the existing allocations can best solve the spectrum insufficiency issue in *considering b)* and *c)* on a worldwide basis,

recognizing

a) that it is important to ensure that the FSS satellite networks in the band 14.5-14.8 GHz do not cause undue constraints to existing services;

b) that there are assignments in the 14.5-14.8 GHz band in the Regions 1 and 3 BSS feeder-link Plan, contained in Appendix **30A**, for 22 countries in Africa, Middle East and Asia-Pacific;

c) that new assignments could be added to the Appendix **30A** List of assignments for BSS feeder links Regions 1 and 3 following the successful application of Article 4 of Appendix **30A**;

d) that transmitting earth stations of these above-mentioned assignments in the Plans or Lists, as the case may be, could be located at any point within the service area of its associated satellite network,

further recognizing

that the fixed and mobile services are allocated on a primary basis in this frequency band,

resolves

TBD

instructs the Radiocommunication Bureau

TBD

ANNEX TO RESOLUTION [A161] (WRC-15)

TBD

4.1/1.6.1/6.6 FF: 14.5-14.8 GHz for FSS (space-to-Earth)

4.1/1.6.1/6.6.1 Method FF2

ARTICLE 5

Frequency allocations

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

MOD

14-15.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
14.5-14.8	FIXED FIXED-SATELLITE (Earth-to-space) 5.510 FIXED-SATELLITE (space-to-Earth) ADD 5.G161 MOBILE Space research ADD 5.H161	

ADD

5.G161 The use of the band 14.5-14.8 GHz is limited to GSO FSS (space-to-Earth) systems subject to the application of No. **9.7** provisions for coordination with GSO SRS DRS systems for which information for advance publication has been received by the Bureau prior to [1 January 2016], as well as to other GSO FSS systems. (WRC-15)

ADD

5.H161 In the band 14.5-14.8 GHz, stations in the space research service for which information for advance publication has been received by the Bureau prior to [1 January 2016] shall operate on an equal basis with stations in the fixed-satellite service for which information for advance publication has been received by the Bureau after [1 January 2016]. (WRC-15)

Note: Similar provisions with respect to RR Article **21**, RR Appendix **5** and RR Appendix **7** as those in Method GG2 would apply.

4.1/1.6.1/6.7 G: 14.8-15.1 GHz for FSS (Earth-to-space)

4.1/1.6.1/6.7.1 Method G2

ARTICLE 5

Frequency allocations

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

MOD

14-15.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
14.5-14.8	FIXED FIXED-SATELLITE (Earth-to-space) 5.510 MOBILE Space research	
14.8-15.~~3~~05 FIXED-SATELLITE (Earth-to-space) FIXED MOBILE Space research 5.339 ADD 5.I161	**14.8-15.~~3~~05** FIXED MOBILE Space research 5.339	
14.~~8~~5.05-15.35	FIXED MOBILE Space research 5.339	

ADD

5.I161 In the band 14.8-15.05 GHz, geostationary space stations in the space research service (limited to data relay satellite systems) for which information for advance publication has been received by the Bureau prior to 27 November 2015 shall operate on an equal basis with stations in the fixed-satellite service; after that date, new geostationary space stations in the space research service will operate on a secondary basis. (WRC-15)

APPENDIX 7 (REV.WRC-12)

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 7B (Rev.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a transmitting earth station

Transmitting space radiocommunication service designation		**Fixed-satellite, mobile-satellite**	**Aero-nautical mobile-satellite (R) service**	**Aero-nautical mobile-satellite (R) service**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**		**Space operation, space research**		**Fixed-satellite, mobile-satellite, meteorological-satellite**		**Fixed-satellite**		**Fixed-satellite**		**Fixed-satellite**	**Fixed-satellite** [3]	**Fixed-satellite**	**Fixed-satellite** [3]
Frequency bands (GHz)		2.655-2.690	5.030-5.091	5.030-5.091	5.091-5.150	5.091-5.150	5.725-5.850	5.725-7.075		7.100-7.235 [5]		7.900-8.400		10.7-11.7		12.5-15.05~~4.8~~		13.75-14.3	15.43-15.65	17.7-18.4	19.3-19.7
Receiving terrestrial service designations		Fixed, mobile	Aeronautical radio-navigation	Aeronautical mobile (R)	Aeronautical radio-navigation	Aeronautical mobile (R)	Radiolocation	Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Radiolocation radionavigation (land only)	Aeronautical radionavigation	Fixed, mobile	Fixed, mobile
Method to be used		§ 2.1	§ 2.1, § 2.2	§ 2.1, § 2.2			§ 2.1	§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1, § 2.2	§ 2.2
Modulation at terrestrial station [1]		A						A	N	A	N	A	N	A	N	A	N	–		N	N
Terrestrial station interference parameters and criteria	p_0 (%)	0.01						0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01		0.005	0.005
	n	2						2	2	2	2	2	2	2	2	2	2	1		2	2
	p (%)	0.005						0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.01		0.0025	0.0025
	N_L (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
	M_s (dB)	26 [2]						33	37	33	37	33	37	33	40	33	40	1		25	25
	W (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
Terrestrial station parameters	G_x (dBi) [4]	49 [2]	6	10	6	6		46	46	46	46	46	46	50	50	52	52	36		48	48
	T_e (K)	500 [2]						750	750	750	750	750	750	1 500	1 100	1 500	1 100	2 636		1 100	1 100
Reference bandwidth	B (Hz)	4×10^3	150×10^3	37.5×10^3	150×10^3	10^6		4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	10^7		10^6	10^6
Permissible interference power	$P_r(p)$ (dBW) in B	−140	−160	−157	−160	−143		−131	−103	−131	−103	−131	−103	−128	−98	−128	−98	−131		−113	−113

4.1/1.6.1/6.8 GG: 14.8-15.1 GHz for FSS (space-to-Earth)

4.1/1.6.1/6.8.1 Method GG2

ARTICLE 5

Frequency allocations

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

MOD

14-15.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
14.8-15.1~~35~~ FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.J161 MOBILE Space research ADD 5.K161 5.339	**14.8-15.35** FIXED MOBILE Space research	
~~14.8~~15.1-15.35 FIXED MOBILE Space research 5.339	5.339	

Reasons: To allocate the band 14.8-15.1 GHz to the FSS (space-to-Earth) in Region 1.

ADD

5.J161 The use of the band 14.8-15.1 GHz is limited to GSO FSS (space-to-Earth) systems subject to the application of No. **9.7** provisions for coordination with GSO SRS DRS systems for which information for advance publication has been received by the Bureau prior to [1 January 2016], as well as to other GSO FSS systems. (WRC-15)

Reasons: To limit use of the new FSS allocation (space-to-Earth) in Region 1 to GSO FSS, and to specify the terms and conditions for sharing between newly filed GSO FSS networks and SRS systems already notified to the Bureau, operating on space-to-Earth and space-to-space links to relay data from non-GSO user space station to GSO space station. There is understanding, that coordination of newly filed GSO FSS networks and already notified to the Bureau SRS systems is subject to RR No. **9.7**.

ADD

5.K161 In the band 14.8-15.1 GHz, stations in the space research service for which information for advance publication has been received by the Bureau prior to [1 January 2016] shall operate on an equal basis with stations in the fixed-satellite service for which information for advance publication has been received by the Bureau after [1 January 2016]. (WRC-15)

Reasons: To ensure operation of SRS systems notified to Bureau on space-to-Earth and space-to-space links on an equal basis with newly filed stations in the fixed-satellite service (space-to-Earth).

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section I − Choice of sites and frequencies

MOD

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[1] **21.2.1** For their own protection receiving stations in the fixed or mobile service operating in bands shared with space radiocommunication services (space-to-Earth) should also avoid directing their antennas towards the geostationary-satellite orbit if their sensitivity is sufficiently high that interference from space station transmissions may be significant. In particular, in the bands 14.8-15.1 GHz and 21.4-22 GHz, it is recommended to maintain a minimum separation angle of 1.5° with respect to the direction of the geostationary-satellite orbit. (WRC-~~12~~15)

Reasons: To protect receiving stations in terrestrial services (FS, MS) from GSO FSS (space-to-Earth) interferences.

Section V − Limits of power flux-density from space stations

MOD

TABLE **21-4** (*continued*) (Rev.WRC-~~12~~15)

Frequency band	Service*	Limit in dB(W/m^2) for angles of arrival (δ) above the horizontal plane			Reference bandwidth
		0°-5°	5°-25°	25°-90°	
12.2-12.75 GHz [7] (Region 3) 12.5-12.75 GHz [7] (Region 1 countries listed in Nos. **5.494** and **5.496**)	Fixed-satellite (space-to-Earth) (geostationary-satellite orbit)	−148	−148 + 0.5(δ − 5)	−138	4 kHz
14.8-15.1 GHz (Region 1)	Fixed-satellite (space-to-Earth) (geostationary-satellite orbit)	−132	−132 + 0.5(δ − 5)	−122	1 MHz

Reasons: To insert pfd limits for GSO FSS (space-to-Earth) into RR Article **21** in order to protect allocations to terrestrial services (FS, MS).

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-~~12~~15)

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~~ 13.75-14.5 GHz and 14.8-15.1 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 ±8° 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 ±7° of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan iii) any network in the space research service (SRS) and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of ±[X]° of the nominal orbital position of a proposed network in the FSS		With respect to the space services listed in the threshold/condition column in the bands in 1), 2), 3), 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

Reasons: To specify the order and mechanism of coordination in accordance with provisions of RR No **9.7** between newly notified networks of the FSS and SRS networks.

APPENDIX 7 (REV.WRC-12)

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 8C (Rev.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a receiving earth station

Receiving space radiocommunication service designation	Fixed-satellite		Fixed-satellite, radio-determination satellite	Fixed-satellite	Fixed-satellite		Meteoro-logical-satellite [7, 8]	Meteoro-logical-satellite [9]	Earth exploration-satellite [7]	Earth exploration-satellite [9]	Space research [10]		Fixed-satellite		Broadcasting-satellite		Fixed-satellite [9]	Broad-casting-satellite	Fixed-satellite [7]
											Deep space								
Frequency bands (GHz)	4.500-4.800		5.150-5.216	6.700-7.075	7.250-7.750		7.450-7.550	7.750-7.900	8.025-8.400	8.025-8.400	8.400-8.450	8.450-8.500	10.7-12.75		12.5-12.75 [12]		15.4-15.7	17.7-17.8	14.8-15.1 [7] 17.7-18.8 19.3-19.7
Transmitting terrestrial service designations	Fixed, mobile		Aeronautical radionavigation	Fixed, mobile	Fixed, mobile		Fixed, mobile	Fixed, mobile	Fixed, mobile	Fixed, mobile	Fixed, mobile		Fixed, mobile		Fixed, mobile		Aeronau-tical radio-navigation	Fixed	Fixed, mobile
Method to be used	§ 2.1		§ 2.1	§ 2.2	§ 2.1		§ 2.1, § 2.2	§ 2.2	§ 2.1	§ 2.2	§ 2.2		§ 2.1, § 2.2		§ 1.4.5			§ 1.4.5	§ 2.1
Modulation at earth station [1]	A	N		N	A	N	N	N	N	N	N	N	A	N	A	N	–		N
Earth station interference parameters and criteria: p_0 (%)	0.03	0.005		0.005	0.03	0.005	0.002	0.001	0.083	0.011	0.001	0.1	0.03	0.003	0.03	0.003	0.003		0.003
n	3	3		3	3	3	2	2	2	2	1	2	2	2	1	1	2		2
p (%)	0.01	0.0017		0.0017	0.01	0.0017	0.001	0.0005	0.0415	0.0055	0.001	0.05	0.015	0.0015	0.03	0.003	0.0015		0.0015
N_L (dB)	1	1		1	1	1	–	–	1	0	0	0	1	1	1	1	1		1
M_s (dB)	7	2		2	7	2	–	–	2	4.7	0.5	1	7	4	7	4	4		6
W (dB)	4	0		0	4	0	–	–	0	0	0	0	4	0	4	0	0		0
Terrestrial station parameters: E (dBW) in B [2], A	92 [3]	92 [3]		55	55	55	55	55	55	55	25 [5]	25 [5]	40	40	55	55			35
E (dBW) in B [2], N	42 [4]	42 [4]		42	42	42	42	42	42	42	−18	−18	43	43	42	42		40	40
P_t (dBW) in B, A	40 [3]	40 [3]		13	13	13	13	13	13	13	−17 [5]	−17 [5]	−5	−5	10	10			−10
P_t (dBW) in B, N	0	0		0	0	0	0	0	0	0	−60	−60	−2	−2	−3	−3		−7	−5
G_x (dBi)	52 [3, 4]	52 [3, 4]		42	42	42	42	42	42	42	42	42	45	45	45	45		47	45
Reference bandwidth [6]: B (Hz)	10^6	10^6		10^6	10^6	10^6	10^7	10^7	10^6	10^6	1	1	10^6	10^6	27×10^6	27×10^6			10^6
Permissible interference power: $P_r(p)$ (dBW) in B				−151.2			−125	−125	−154 [11]	−142	−220	−216			−131	−131			

Reasons: To specify coordination distances for the FSS receiving earth station in order to protect it from interferences produced by terrestrial FS and MS stations, based on the allowable interference criterion I/N = 6%, see Recommendation ITU-R S.1432.

4.1/1.6.2 Resolution 152 (WRC-12)

4.1/1.6.2/1 Executive summary

ITU-R has undertaken studies of possible bands for new primary allocations to the FSS in the Earth-to-space direction within the frequency range 13-17 GHz in ITU Regions 2 and 3. Studies were performed in 8 different sub-bands from 13 to 17 GHz, and the analysis of the results of the studies and the methods to satisfy the agenda item can be found in section 4.1/1.6.2/4 and section 4.1/1.6.2/5 respectively. It should be noted that the studies performed and the methods considered only address GSO FSS.

It should be noted that for the frequency bands under consideration for the FSS in the Earth-to-space direction, the studies performed, the conclusions reached and methodologies developed are the same as those under WRC-15 agenda item 1.6.1. Therefore, the sections below, where relevant will provide a cross-reference to the sections in § 4.1/1.6.1 of this document, and point out the differences, if any.

4.1/1.6.2/2 Background

The existing unplanned FSS bands in the 10-15 GHz range are used extensively for a myriad of applications such as VSAT services, video distribution, broadband networks, internet services, satellite news gathering, and backhaul links. Growth in demand for these applications has triggered a rapid rise in the demand for spectrum. Moreover, satellite traffic is typically symmetrical in a large variety of applications, i.e. similar amounts of Earth-to-space (uplink) and space-to-Earth (downlink) traffic are transmitted. However, in ITU Regions 2 and 3, there are asymmetrical Earth-to-space and space-to-Earth FSS allocations that are used for these services. Studies sought to address this imbalance so that the limited spectrum resources could be used in the most efficient and economical manner.

WRC-12 adopted WRC-15 agenda item 1.6.2 to consider additional primary allocations to the FSS in the range 13-17 GHz and review regulatory provisions for existing FSS allocations, taking into account ITU-R studies in accordance with Resolution **152 (WRC-12)**.

4.1/1.6.2/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The main elements required for the decision under WRC-15 agenda item 1.6.2 are the established technical characteristics and operational parameters of GSO FSS systems (Earth-to-space) which could operate in the 13-17 GHz band, and also sharing studies of GSO FSS (Earth-to-space) with other radio services.

Relevant ITU-R documents:

The PDN Report ITU-R S.[R2R3.FSS] and PDN Report ITU-R S.[FSS.DEPLOYMENT] and also the relevant ITU-R Recommendations and ITU-R Reports are indicated in the abovementioned PDN Reports which were used in the studies performed in accordance with Resolution **152 (WRC-12)**.

4.1/1.6.2/3.1 Overview of current unplanned FSS allocations in Regions 2 and 3

In Table 4.1/1.6.2/3-1 below, the unplanned FSS allocations in Region 2 are shown where there is a difference of 200 MHz when comparing the amounts of spectrum allocated to the uplink and downlink operations.

TABLE 4.1/1.6.2/3-1

The current unplanned FSS bands in the 10-15 GHz range in Region 2

Frequency bands (GHz)	Bandwidth (MHz)
Earth-to-space direction (uplink)	
12.7-12.75	50
13.75-14.5	750
Total spectrum in the uplink	**800**
space-to-Earth direction (downlink)	
10.95-11.2	250
11.45-11.7	250
11.7-12.2	500
Total spectrum in the downlink	**1 000**
Uplink and downlink spectrum difference	**200**

In Table 4.1/1.6.2/3-2 below, the unplanned FSS allocations in Region 3 are shown where there is a difference of 300 MHz when comparing the amounts of spectrum allocated to the uplink and downlink operations.

TABLE 4.1/1.6.2/3-2

The current unplanned FSS bands in the 10-15 GHz range in Region 3

Frequency bands (GHz)	Bandwidth (MHz)
Earth-to-space direction (uplink)	
13.75-14.5	750
Total spectrum in the uplink	**750**
space-to-Earth direction (downlink)	
10.95-11.2	250
11.45-11.7	250
12.2-12.75	550
Total spectrum in the downlink	**1 050**
Uplink and downlink spectrum difference	**300**

4.1/1.6.2/3.2 Frequency bands examined

ITU-R has examined frequency bands in the 13-17 GHz range for their suitability in addressing the shortage in the uplink spectrum in Region 2 and Region 3.

Detailed study results on these bands are contained in PDN Report ITU-R S.[R2R3.FSS].

4.1/1.6.2/4 Analysis of the results of studies

Studies were performed in 8 different sub-bands from 13 to 17 GHz.

4.1/1.6.2/4.1 13.25-13.4 GHz band

Consideration is given to this band for possible primary allocations to FSS Earth-to-space operations. The band 13.25-13.4 GHz is allocated to the EESS (active), ARNS and SRS (active) on a primary basis.

4.1/1.6.2/4.1.1 FSS (Earth-to-space) sharing with the EESS and SRS

The analysis and results are the same as given in section 4.1/1.6.1/4.4.1.

4.1/1.6.2/4.1.2 FSS (Earth-to-space) sharing with the ARNS

The analysis and results are the same as given in section 4.1/1.6.1/4.4.3.

4.1/1.6.2/4.1.3 FSS (Earth-to-space) sharing with the SRS (active)

Since SRS (active) applications are active sensors used in the frequency band 13.25-13.4 GHz around other planets, no compatibility issue with the proposed FSS is expected.

4.1/1.6.2/4.1.4 FSS (Earth-to-space) sharing with the FS

According to RR No. **5.499** in some countries of Region 3 the band 13.25-13.75 GHz is also allocated to the FS on a primary basis.

4.1/1.6.2/4.1.5 Summary of studies for the band 13.25-13.40 GHz

The summary of studies is the same as given in section 4.1/1.6.1/4.4.7, but only with respect to parts of the summary that deal with FSS (Earth-to-space).

4.1/1.6.2/4.2 13.4-13.75 GHz band

Consideration is given to this band for possible primary allocations to FSS Earth-to-space operations. The band 13.4-13.75 GHz is allocated to the EESS (active), RLS and SRS (active) on a primary basis. Per RR No. **5.501A**, the allocation of the band 13.4-13.75 GHz to the SRS on a primary basis is limited to active spaceborne sensors. Other uses of the band by the SRS are on a secondary basis.

RR No. **5.501A** indicates that the use of the band 13.4-13.75 GHz by the SRS on a primary basis is limited to active spaceborne sensors. Other uses of the band by the SRS are on a secondary basis. RR Nos. **5.499**, **5.500**, **5.501** and **5.501B** apply.

4.1/1.6.2/4.2.1 FSS (Earth-to-space) sharing with the EESS

See section 4.1/1.6.1/4.4.1 for sharing study results applicable to this frequency band.

4.1/1.6.2/4.2.2 FSS (Earth-to-Space) sharing with the SRS

The analysis and results are the same as given in section 4.1/1.6.1/4.5.2.

4.1/1.6.2/4.2.3 FSS (Earth-to-Space) sharing with the RLS and RNS

The analysis and results are the same as given in section 4.1/1.6.1/4.5.5.

4.1/1.6.2/4.2.4 Summary of studies for the band 13.4-13.75 GHz

The summary of studies is the same as given in section 4.1/1.6.1/4.5.9, but only with respect to parts of the summary that deal with FSS (Earth-to-space).

4.1/1.6.2/4.3 14.5-14.8 GHz band

The band 14.5-14.8 GHz is currently allocated to the MS, FS and FSS (Earth-to-space) on a primary basis and the SRS on a secondary basis. RR No. **5.510** indicates that the use of the band 14.5-14.8 GHz by the FSS (Earth-to-space) is limited to feeder links for the BSS. This use is reserved for countries outside Europe.

Studies for sharing in this band included both (1) studies with other allocated services, and (2) studies within the FSS service, taking into account Resolution **152 (WRC-12)**. Studies included consideration of utilizing existing allocations to the FSS through a review of regulatory provisions, except RR Nos. **5.502** and **5.503**.

Consideration is given to this band for possible primary allocations to FSS Earth-to-space operations.

4.1/1.6.2/4.3.1 FSS (Earth-to-space) and BSS feeder links

The analysis and results are the same as given in section 4.1/1.6.1/4.6.1.

4.1/1.6.2/4.3.2 FSS (Earth-to-space) sharing with the MS

The analysis and results are the same as given in section 4.1/1.6.1/4.6.3.

4.1/1.6.2/4.3.3 FSS (Earth-to-space) sharing with the FS

The analysis and results are the same as given in section 4.1/1.6.1/4.6.2.

4.1/1.6.2/4.3.4 FSS (Earth-to-space) sharing with the SRS

The analysis and results are the same as given in section 4.1/1.6.1/4.6.4.

4.1/1.6.2/4.3.5 Summary of studies for the band 14.5-14.8 GHz

The summary of studies is the same as given in section 4.1/1.6.1/4.6.8, but only with respect to parts of the summary that deal with FSS (Earth-to-space).

4.1/1.6.2/4.4 14.8-15.35 GHz band

Consideration is given to this band for possible primary allocations to FSS Earth-to-space operations. The band 14.8-15.35 GHz is currently allocated to the FS and MS on a primary basis and the SRS on a secondary basis.

4.1/1.6.2/4.4.1 FSS (Earth-to-space) sharing with the SRS

The analysis and results are the same as given in section 4.1/1.6.1/4.6.4.

4.1/1.6.2/4.4.2 FSS (Earth-to-space) sharing with the MS/AMS

The analysis and results are the same as given in section 4.1/1.6.1/4.6.3.

4.1/1.6.2/4.4.3 FSS (Earth-to-space) sharing with the FS

The analysis and results are the same as given in section 4.1/1.6.2/4.3.3.

4.1/1.6.2/4.4.4 Summary of studies for the band 14.8-15.35 GHz

The summary of studies is the same as given in section 4.1/1.6.1/4.7.6, but only with respect to parts of the summary that deal with FSS (Earth-to-space).

4.1/1.6.2/4.5 15.35-15.4 GHz band

The analysis and results are the same as given in section 4.1/1.6.1/4.8.

The frequency band 15.35-15.4 GHz was excluded from consideration of possibility to allocate additionally spectrum for GSO FSS in accordance with Resolution **152 (WRC-12)** in regard with the difficulty for compatibility between FSS (Earth-to-space) and passive services (EESS, SRS) and RAS, having allocations on a primary basis in this frequency band.

4.1/1.6.2/4.6 15.4-15.7 GHz band

Consideration is given to this band for possible primary allocations to FSS Earth-to-space operations. The band 15.4-15.43 is allocated to the RLS and ARNS on a primary basis. RR Nos. **5.511E**, **5.511F** and **5.511D** apply.

The band 15.43-15.63 is allocated to the FSS (Earth-to-space), RLS and ARNS on a primary basis. RR Nos. **5.511A**, **5.511E**, **5.511F**, and **5.511C** apply.

The band 15.63-15.7 GHz is allocated to the RLS and ARNS on a primary basis. RR Nos. **5.511E**, **5.511F** and **5.511D** apply.

The band 15.4-17.1 GHz is used by many different types of radars including land-based, transportable, shipboard and airborne platforms. Radiolocation functions performed in the band include airborne and surface search, surface surveillance, ground-mapping, terrain-following, maritime and target-identification. Radar operating frequencies can be assumed to be uniformly spread throughout each radar's tuning range. The major radiolocation radars operating or planned to operate in the band 15.7-16.6 GHz are primarily for detection of airborne objects and some are used for ground mapping. They are required to measure target altitude, range, bearing, and form terrain maps. Some of the airborne and ground targets are small and some are at ranges as great as 300 nautical miles (556 km), so these radiolocation radars must have great sensitivity and must provide a high degree of suppression to all forms of clutter return, including that from sea, land and precipitation. Some of the radars are used as the airport surveillance detection equipment (ASDE-3) to provide a tool to enhance the situational awareness of air traffic controllers in an effort to reduce runway incursions and aircraft collisions. These radars provide non-cooperative aeronautical surveillance including detection and position information for all aircraft and vehicles on the airport movement area.

Recommendation ITU-R M.1730-1 provides the characteristics of and protection criteria for the radiolocation service in the frequency band 15.4-17.3 GHz. This Recommendation recommends that the I/N *of* −6 dB should be used as the required protection level for the portions of the 15.4-17.3 GHz band where there is a radiolocation allocation and that this represents the net protection level if multiple interferers are present.

4.1/1.6.2/4.6.1 FSS (Earth-to-space) sharing with the RLS

The analysis and results are the same as given in section 4.1/1.6.1/4.9.1.1.

4.1/1.6.2/4.6.2 FSS (Earth-to-space) sharing with the ARNS

The analysis and results are the same as given in section 4.1/1.6.1/4.9.2.

4.1/1.6.2/4.6.3 Summary of studies for the band 15.4-15.7 GHz

The summary of studies is the same as given in section 4.1/1.6.1/4.9.3, but only with respect to parts of the summary that deal with FSS (Earth-to-space).

4.1/1.6.2/4.7 15.7-16.6 GHz band

Consideration is given to this band for possible primary allocations to FSS Earth-to-space operations. The band 15.7-16.6 GHz is allocated to the RLS on a primary basis. The band 15.7-17.3 is also allocated to the FS and MS in certain countries via RR No. **5.512**. Additional information on the use of this band by the RLS is provided in section 4.1/1.6.2/4.5.

4.1/1.6.2/4.7.1 FSS (Earth-to-space) sharing with the RLS

The analysis and results are the same as given in section 4.1/1.6.1/4.10.1.1.

4.1/1.6.2/4.7.2 Summary of studies for the band 15.7-16.6 GHz

The summary of studies is the same as given in section 4.1/1.6.1/4.10.2, but only with respect to parts of the summary that deal with FSS (Earth-to-space).

4.1/1.6.2/4.8 16.6-17 GHz band

Consideration is given to this band for possible primary allocations to FSS Earth-to-space operations. The band 15.7-16.6 GHz is allocated to the RLS on a primary basis. The band 15.7-17.3 is also allocated to the FS and MS in certain countries via RR No. **5.512**. Additional information on the use of this band by the RLS is provided in section 4.1/1.6.2/4.5.

For additional spectrum allocation to GSO FSS (Earth-to-space) in the frequency band 15.7-16.6 GHz in Regions 2 and 3, FSS (Earth-to-space) exceed the protection criteria levels of systems having allocations in this band without adequate technical/regulatory mitigation measures.

4.1/1.6.2/4.8.1 FSS (Earth-to-space) sharing with the RLS

The analysis and results are the same as given in section 4.1/1.6.1/4.9.1.1.

4.1/1.6.2/4.8.2 Summary of studies for the band 16.6-17 GHz

The summary of studies is the same as given in section 4.1/1.6.1/4.11.2, but only with respect to parts of the summary that deal with FSS (Earth-to-space).

4.1/1.6.2/5 Method(s) to satisfy this part of the agenda item

The methods to satisfy the agenda item are considered below for each of the examined frequency bands. Therefore, each method should address all the concerned existing allocations in each examined frequency band. Each of the following methods suggest regulatory amendments (or no change) that would provide only for the use by GSO satellite networks.

The table below assign a method “letters” to each of the sub-bands as split in section 4.1/1.6.2/4 (Analysis of the results of studies). To avoid confusion between WRC-15 agenda items 1.6.1 and 1.6.2, the same “letters” are used for the same sub-band.

Sub-band frequency (GHz)	Assigned method “letters”
13.25-13.40	D
13.40-13.75	E
14.50-14.80	F
14.80-15.35	G
15.35-15.40	H
15.40-15.70	I
15.70-16.60	J
16.60-17.00	K

4.1/1.6.2/5.1 D: 13.25-13.4 GHz for FSS (Earth-to-space)

4.1/1.6.2/5.1.1 Method D1: No change to RR Article 5

The description of this method is the same as in 4.1/1.6.1/5.1.1, except for the fact that an allocation for the FSS (Earth-to-space) of 250 MHz in Region 2 and 300 MHz in Region 3 is concerned.

4.1/1.6.2/5.2 E: 13.4-13.75 GHz for FSS (Earth-to-space)

4.1/1.6.2/5.2.1 Method E1: No change to RR Article 5

The description of this method is the same as in section 4.1/1.6.1/5.2.1.

4.1/1.6.2/5.2.2 Method E2: Make an allocation of 250 MHz in the 13.4-13.75 GHz band to the FSS (Earth-to-space) in Regions 2 and 3

The description of this method is the same as in section 4.1/1.6.1/5.2.2, except for the fact that an allocation for the FSS (Earth-to-space) of 250 MHz in Region 2 and 300 MHz in Region 3 is concerned.

4.1/1.6.2/5.3 F: 14.5-14.8 GHz for FSS (Earth-to-space)

4.1/1.6.2/5.3.1 Method F1: No change to RR Article 5

The description of this method is the same as in section 4.1/1.6.1/5.4.1.

4.1/1.6.2/5.3.2 Method F2: Modify the existing FSS allocation to support FSS uplinks that are not limited to BSS feeder links

The description of this method is the same as in section 4.1/1.6.1/5.4.2, except for the fact that an allocation for the FSS (Earth-to-space) of 250 MHz in Region 2 and 300 MHz in Region 3 is concerned.

4.1/1.6.2/5.4 G: 14.8-15.35 GHz for FSS (Earth-to-space)

4.1/1.6.2/5.4.1 Method G1: No change to RR Article 5

The description of this method is the same as in section 4.1/1.6.1/5.6.1.

4.1/1.6.2/5.4.2 Method G2: Allocate the 14.8-15.1 GHz frequency band to the FSS (Earth-to-space)

The description of this method is the same as in section 4.1/1.6.1/5.6.2, except for the fact that an allocation for the FSS (Earth-to-space) of 250 MHz in Region 2 and 300 MHz in Region 3 is concerned.

4.1/1.6.2/5.5 H: 15.35-15.4 GHz for FSS (Earth-to-space)

4.1/1.6.2/5.5.1 Method H1: No change to RR Article 5

Under this Method, there would be no additional allocations to the FSS in the Earth-to-space direction within the frequency range 15.35-15.4 GHz in Regions 2 and 3 and therefore no change to RR Article **5**.

Advantages:

− There would be no impact on existing services.

Disadvantages:

– The imbalance of spectrum between Earth-to-space and space-to-Earth FSS allocations would not be resolved.

4.1/1.6.2/5.6 I: 15.4-15.7 GHz for FSS (Earth-to-space)

4.1/1.6.2/5.6.1 Method I1: No change to RR Article 5

The description of this method is the same as in section 4.1/1.6.1/5.8.1.

4.1/1.6.2/5.7 J: 15.7-16.6 GHz for FSS (Earth-to-space)

4.1/1.6.2/5.7.1 Method J1: No change to RR Article 5

Under this Method, there would be no additional allocations to the FSS in the Earth-to-space direction within the frequency range 15.7-16.6 GHz in Regions 2 and 3 and therefore no change to RR Article **5**.

Advantages:

− There would be no impact on existing services.

Disadvantages:

– The imbalance of spectrum between Earth-to-space and space-to-Earth FSS allocations would not be resolved.

4.1/1.6.2/5.8 K: 16.6-17 GHz for FSS (Earth-to-space)

4.1/1.6.2/5.8.1 Method K1: No change to RR Article 5

Under this Method, there would be no additional allocations to the FSS in the Earth-to-space direction within the frequency range 16.6-17 GHz in Regions 2 and 3 and therefore no change to RR Article **5**.

Advantages:

− There would be no impact on existing services.

Disadvantages:

– The imbalance of spectrum between Earth-to-space and space-to-Earth FSS allocations would not be resolved.

4.1/1.6.2/6 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 4.1/1.6.2/5.

It should be noted that apart from the method described in section 4.1/1.6.2/6.1, all other proposed methods implicitly assume suppression (SUP) of Resolution **152 (WRC-12)**.

4.1/1.6.2/6.1 Methods D1, E1, F1, G1, H1, I1, J1 and K1: No change to RR Article 5

NOC

ARTICLE 5

Frequency allocations

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

SUP

RESOLUTION 152 (WRC-12)

Additional primary allocations to the fixed-satellite service in the Earth-to-space direction in frequency bands between 13-17 GHz in Region 2 and Region 3

4.1/1.6.2/6.2 E: 13.4-13.75 GHz for FSS (Earth-to-space)

4.1/1.6.2/6.2.1 Method E2

ARTICLE 5

Frequency allocations

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

MOD

11.7-14 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>13.4-13.~~7~~45</td><td colspan="2">EARTH EXPLORATION-SATELLITE (active)
RADIOLOCATION
SPACE RESEARCH 5.501A
Standard frequency and time signal-satellite (Earth-to-space)
5.499 5.500 5.501 5.501B</td></tr>
<tr><td colspan="2">13.4~~5~~-13.~~7~~5
EARTH EXPLORATION-SATELLITE (active)
RADIOLOCATION
SPACE RESEARCH 5.501A
Standard frequency and time signal-satellite (Earth-to-space)
5.499 5.500 5.501 5.501B</td><td>13.45-13.~~7~~5
EARTH EXPLORATION-SATELLITE (active)
FIXED-SATELLITE (Earth-to-space) ADD 5.A162
RADIOLOCATION
SPACE RESEARCH 5.501A
Standard frequency and time signal-satellite (Earth-to-space)
5.499 5.500 5.501 5.501B</td></tr>
<tr><td>13.54-13.75
EARTH EXPLORATION-SATELLITE (active)
RADIOLOCATION
SPACE RESEARCH 5.501A
Standard frequency and time signal-satellite (Earth-to-space)
5.499 5.500 5.501 5.501B</td><td colspan="2">13.54-13.75
EARTH EXPLORATION-SATELLITE (active)
FIXED-SATELLITE (Earth-to-space) ADD 5.A162
RADIOLOCATION
SPACE RESEARCH 5.501A
Standard frequency and time signal-satellite (Earth-to-space)
5.499 5.500 5.501 5.501B
MOD 5.502 ADD 5.B162</td></tr>
</table>

ADD

5.A162 In the band 13.45-13.75 GHz in Region 3 and in the band 13.5-13.75 GHz in Region 2, the peak envelope power delivered to the antenna of stations of the fixed-satellite service (Earth-to-space) shall not exceed the spectral density of −53.5 dB(W/Hz) computed from the peak envelope power and the occupied bandwidth. (WRC-15)

MOD

5.502 In the band 13.45-13.75 GHz in Region 3, in the band 13.5-13.75 GHz in Region 2 and in the band 13.75-14 GHz, an earth station of a geostationary fixed-satellite service network shall have a minimum antenna diameter of 1.2 m. In the band 13.75-14 GHz, ~~and~~ an earth station of a non-geostationary fixed-satellite service system shall have a minimum antenna diameter of 4.5 m. In addition, the e.i.r.p., averaged over one second, radiated by a station in the radiolocation or radionavigation services shall not exceed 59 dBW for elevation angles above 2° and 65 dBW at lower angles. Before an administration brings into use an earth station in a geostationary-satellite network in the fixed-satellite service in this band with an antenna diameter smaller than 4.5 m, it shall ensure that the power flux-density produced by this earth station does not exceed:

– −115 dB(W/(m^2 · 10 MHz)) for more than 1% of the time produced at 36 m above sea level at the low water mark, as officially recognized by the coastal State;

– −115 dB(W/(m^2 · 10 MHz)) for more than 1% of the time produced 3 m above ground at the border of the territory of an administration deploying or planning to deploy land mobile radars in this band, unless prior agreement has been obtained.

For earth stations within the fixed-satellite service having an antenna diameter greater than or equal to 4.5 m, the e.i.r.p. of any emission should be at least 68 dBW and should not exceed 85 dBW. (WRC-~~03~~15)

Start option 1) with respect to SRS

ADD

5.B162 In the band 13.45-13.75 GHz in Region 3 and 13.5-13.75 GHz in Region 2, geostationary space stations in the space research service (limited to data relay satellite systems) for which information for advance publication has been received by the Bureau prior to 27 November 2015 shall operate on an equal basis with stations in the fixed-satellite service; after that date, new geostationary space stations in the space research service will operate on a secondary basis. (WRC-15)

End option 1) with respect to SRS

Start option 2) with respect to SRS

MOD

5.501A The allocation of the band 13.4-13.75 GHz to the space research service on a primary basis is limited to active spaceborne sensors, as well as to the SRS DRS systems (space-to-Earth, space-to-space) for which information for advance publication has been received by the Bureau prior to [1 January 2016]. Other uses of the band by the space research service are on a secondary basis. (WRC-~~97~~15)

End option 2) with respect to SRS

APPENDIX 7 (REV.WRC-12)

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 7B (REV.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a transmitting earth station

Transmitting space radiocommunication service designation		**Fixed-satellite, mobile-satellite**	**Aero-nautical mobile-satellite (R) service**	**Aero-nautical mobile-satellite (R) service**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**		**Space operation, space research**		**Fixed-satellite, mobile-satellite, meteorological-satellite**		**Fixed-satellite**		**Fixed-satellite**		**Fixed-satellite**	**Fixed-satellite** [3]	**Fixed-satellite**	**Fixed-satellite** [3]
Frequency bands (GHz)		2.655-2.690	5.030-5.091	5.030-5.091	5.091-5.150	5.091-5.150	5.725-5.850	5.725-7.075		7.100-7.235 [5]		7.900-8.400		10.7-11.7		12.5-14.8		13.~~7~~45-14.3	15.43-15.65	17.7-18.4	19.3-19.7
Receiving terrestrial service designations		Fixed, mobile	Aeronautical radio-navigation	Aeronautical mobile (R)	Aeronautical radio-navigation	Aeronautical mobile (R)	Radiolocation	Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Radiolocation radionavigation (land only)	Aeronautical radionavigation	Fixed, mobile	Fixed, mobile
Method to be used		§ 2.1	§ 2.1, § 2.2	§ 2.1, § 2.2			§ 2.1	§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1, § 2.2	§ 2.2
Modulation at terrestrial station [1]		A						A	N	A	N	A	N	A	N	A	N	−		N	N
Terrestrial station interference parameters and criteria	p_0 (%)	0.01						0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01		0.005	0.005
	n	2						2	2	2	2	2	2	2	2	2	2	1		2	2
	p (%)	0.005						0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.01		0.0025	0.0025
	N_L (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
	M_s (dB)	26 [2]						33	37	33	37	33	37	33	40	33	40	1		25	25
	W (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
Terrestrial station parameters	G_x (dBi) [4]	49 [2]	6	10	6	6		46	46	46	46	46	46	50	50	52	52	36		48	48
	T_e (K)	500 [2]						750	750	750	750	750	750	1 500	1 100	1 500	1 100	2 636		1 100	1 100
Reference bandwidth	B (Hz)	4×10^3	150×10^3	37.5×10^3	150×10^3	10^6		4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	10^7		10^6	10^6
Permissible interference power	$P_r(p)$ (dBW) in B	−140	−160	−157	−160	−143		−131	−103	−131	−103	−131	−103	−128	−98	−128	−98	−131		−113	−113

4.1/1.6.2/6.3 F: 14.5-14.8 GHz for FSS (Earth-to-space)

4.1/1.6.2/6.3.1 Method F2

See section 4.1/1.6.1/6.5.1 for the regulatory and procedural considerations for this method.

4.1/1.6.2/6.4 G: 14.8-15.35 GHz for FSS (Earth-to-space)

4.1/1.6.2/6.4.1 Method G2

ARTICLE 5

Frequency allocations

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

MOD

14-15.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
14.5-14.8	FIXED FIXED-SATELLITE (Earth-to-space) 5.510 MOBILE Space research	
14.8-15.~~3~~05 FIXED MOBILE Space research 5.339	**14.8-15.~~3~~05** FIXED-SATELLITE (Earth-to-space) FIXED MOBILE Space research 5.339 ADD 5.C162	
14~~.8~~5.05-15.~~35~~1 FIXED MOBILE Space research 5.339		**14~~.8~~5.05-15.~~35~~1** FIXED-SATELLITE (Earth-to-space) FIXED MOBILE Space research 5.339 ADD 5.C162
14~~.8~~5.1-15.35	FIXED MOBILE Space research 5.339	

ADD

5.C162 In the band 14.8-15.05 GHz in Region 2 and in the band 14.8-15.1 GHz in Region 3, geostationary space stations in the space research service (limited to data relay satellite systems) for which information for advance publication has been received by the Bureau prior to 27 November 2015 shall operate on an equal basis with stations in the fixed-satellite service; after that date, new geostationary space stations in the space research service will operate on a secondary basis. (WRC-15)

APPENDIX 7 (REV.WRC-12)

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 7B (REV.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a transmitting earth station

Transmitting space radiocommunication service designation		**Fixed-satellite, mobile-satellite**	**Aero-nautical mobile-satellite (R) service**	**Aero-nautical mobile-satellite (R) service**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**		**Space operation, space research**		**Fixed-satellite, mobile-satellite, meteorological-satellite**		**Fixed-satellite**		**Fixed-satellite**		**Fixed-satellite**	**Fixed-satellite** [3]	**Fixed-satellite**	**Fixed-satellite** [3]
Frequency bands (GHz)		2.655-2.690	5.030-5.091	5.030-5.091	5.091-5.150	5.091-5.150	5.725-5.850	5.725-7.075		7.100-7.235 [5]		7.900-8.400		10.7-11.7		12.5-15.1~~4.8~~		13.75-14.3	15.43-15.65	17.7-18.4	19.3-19.7
Receiving terrestrial service designations		Fixed, mobile	Aeronautical radio-navigation	Aeronautical mobile (R)	Aeronautical radio-navigation	Aeronautical mobile (R)	Radiolocation	Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Radiolocation radionavigation (land only)	Aeronautical radionavigation	Fixed, mobile	Fixed, mobile
Method to be used		§ 2.1	§ 2.1, § 2.2	§ 2.1, § 2.2			§ 2.1	§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1, § 2.2	§ 2.2
Modulation at terrestrial station [1]		A						A	N	A	N	A	N	A	N	A	N	−		N	N
Terrestrial station interference parameters and criteria	p_0 (%)	0.01						0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01		0.005	0.005
	n	2						2	2	2	2	2	2	2	2	2	2	1		2	2
	p (%)	0.005						0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.01		0.0025	0.0025
	N_L (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
	M_s (dB)	26 [2]						33	37	33	37	33	37	33	40	33	40	1		25	25
	W (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
Terrestrial station parameters	G_x (dBi) [4]	49 [2]	6	10	6	6		46	46	46	46	46	46	50	50	52	52	36		48	48
	T_e (K)	500 [2]						750	750	750	750	750	750	1 500	1 100	1 500	1 100	2 636		1 100	1 100
Reference bandwidth	*B* (Hz)	4×10^3	150×10^3	37.5×10^3	150×10^3	10^6		4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	10^7		10^6	10^6
Permissible interference power	$P_r(p)$ (dBW) in *B*	−140	−160	−157	−160	−143		−131	−103	−131	−103	−131	−103	−128	−98	−128	−98	−131		−113	−113

AGENDA ITEM 1.7

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

1.7 to review the use of the band 5 091-5 150 MHz by the fixed-satellite service (Earth-to-space) (limited to feeder links of the non-geostationary mobile-satellite systems in the mobile-satellite service) in accordance with Resolution ***114 (Rev.WRC-12)****;*

Resolution **114 (Rev.WRC-12)**: *Studies on compatibility between new systems of the aeronautical radionavigation service and the fixed-satellite service (Earth-to-space) (limited to feeder links of the non-geostationary mobile-satellite systems in the mobile-satellite service) in the frequency band 5 091-5 150 MHz*

4.1/1.7/1 Executive summary

Resolution **114 (Rev.WRC-12)** calls for a review of allocations to both the aeronautical radionavigation service (ARNS) and the fixed-satellite service (FSS) in the band 5 091-5 150 MHz. In particular, studies are called for in *resolves* 3 between any new ARNS and the systems of the FSS providing feeder links of non-GSO systems in the mobile-satellite service (MSS) (Earth-to-space). In the *invites*, ICAO is asked to supply technical and operational criteria suitable for sharing studies for new aeronautical systems. During the study cycle, no additional information was received from ICAO in regards to the *invites* 1 in Resolution **114 (Rev.WRC-12)** as no new ARNS systems in the band 5 091-5 150 MHz are foreseen other than the international standard system (microwave landing system (MLS)) for precision approach and landing. On this basis, no new studies were required in the band 5 091-5 150 MHz and ITU-R concluded that the regulatory conditions contained in Resolution **114 (Rev.WRC-12)** and the technical and operational requirements contained in Recommendation ITU-R S.1342 will continue to ensure the compatibility of the FSS providing Earth-to-space feeder links in the band 5 091-5 150 MHz and international standard MLS operating in the adjacent band 5 030-5 091 MHz. Accordingly, the time limitations attached to the FSS allocation can be suppressed, while maintaining the application of Resolution **114 (Rev.WRC-12)**, with consequential modifications. A method transposing these findings into regulatory provisions is therefore proposed to satisfy this agenda item.

4.1/1.7/2 Background

Initially, the band 5 091-5 150 MHz was allocated to the ARNS on a primary basis and was subsequently reserved as an extension MLS band to meet requirements for future planned MLS assignments which could not be satisfied in the core MLS band 5 030-5 091 MHz. Afterwards, RR No. **5.444A** introduced an additional allocation to permit use of the MLS extension band 5 091-5 150 MHz by the FSS feeder links on a primary basis. The current regulatory conditions under RR No. **5.444A** permit use of the band 5 091-5 150 MHz by the FSS feeder links, with a foreseen reversion to secondary in 2018, subject to the requirements of RR No. **5.444** to protect MLS assignments and to avoid causing interference to the ARNS. The 5 030-5 091 MHz core MLS band supports 200 internationally standardized channels for use by MLS systems. Channels may be re-used within a Region or country, whenever sufficient geographic separation exists between MLS systems. Originally, in accordance with RR No. **5.444**, MLS had priority over other uses in the band 5 030-5 150 MHz. At WRC-07, the priority to MLS was removed in the band 5 091-5 150 MHz and the sunset date for assignments to the FSS in this band was extended from 2012 to 2016 (a date after which no new assignments should be made to the FSS). A review of the allocation to the FSS and ARNS in this band is therefore scheduled for WRC-15.

4.1/1.7/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Previous studies have resulted in Recommendation ITU-R S.1342 which describes a method for determining coordination distances between international standard MLS stations operating in the band 5 030-5 091 MHz and FSS earth stations in the adjacent band 5 091-5 150 MHz providing Earth-to-space feeder links for non-geostationary MSS systems.

Previous studies have also resulted in the creation of Recommendation ITU-R M.1827 which provides the technical and operational requirements for stations of the aeronautical mobile (R) service (AM(R)S) limited to surface applications at airports ensuring compatibility with FSS feeder link earth stations operating in the band 5 091-5 150 MHz.

4.1/1.7/3.1 Summary of studies performed

ICAO indicated during the study cycle that it does not foresee or plan any new ARNS (non MLS) systems, in the band 5 091-5 150 MHz. On this basis, no new studies in that band were required. Recommendation ITU-R S.1342 remains the technical reference for determining the need for coordination between the international standard MLS, in the band 5 030-5 091 MHz, and systems of the FSS providing Earth-to-space feeder links, in the adjacent band 5 091-5 150 MHz.

4.1/1.7/3.2 Applicable Recommendations

Recommendations ITU-R S.1342 and ITU-R M.1827.

4.1/1.7/4 Analysis of the results of studies

Based on the information from ICAO that no new ARNS system is planned in the band 5 091-5 150 MHz, the regulatory conditions contained in Resolution **114 (Rev.WRC-12)** and the technical and operational requirements contained in Recommendation ITU-R S.1342 will continue to ensure the compatibility of the FSS providing Earth-to-space feeder links, in the band 5 091-5 150 MHz, and international standard MLS in the band 5 030-5 091 MHz.

4.1/1.7/5 Method to satisfy the agenda item

The Method proposes:

– that the use of the band 5 091-5 150 MHz by systems of the FSS providing Earth-to-space feeder links of non-GSO systems in the MSS be maintained as a primary allocation;

– that each of the time limits on this allocation given in RR No. **5.444A**, i.e. after 1 January 2016 no new assignments shall be made, and after 1 January 2018 the FSS will become secondary to the ARNS, be suppressed;

– that the text specifying that "use of the band 5 091-5 150 MHz by FSS feeder links shall be made in accordance with Resolution **114 (Rev.WRC-15)**" be added to the footnote;

– that coordination between FSS earth stations and ARNS ground stations is required under certain circumstances to ensure that the ARNS is protected from harmful interference and that a fixed distance be used in determining the coordination area; and

– that flexibility for AM(R)S be improved while ensuring protection of the FSS.

An improved flexibility would be possible for managing the interference contribution from AM(R)S by allowing its contribution to $\Delta T_s/T_s$ to increase beyond the 2% limit, set forth in Recommendation ITU-R M.1827-1, whenever the ARNS contribution is below 3%. When the ARNS contribution is above 3%, the current hard limit of 2% on the AM(R)S contribution still applies.

Reasons: The Method has been developed to satisfy the *resolves* part of Resolution **114 (Rev.WRC-12)** that the allocations to the ARNS and the FSS be reviewed prior to 2018 and that studies be undertaken between new systems of the ARNS and systems of the FSS providing feeder links of the non-GSO systems in the MSS (Earth-to-space) in the band 5 091-5 150 MHz. In addition, considering that the long term operating requirements of the FSS feeder links need to be maintained, suppression of the time limitations in RR No. **5.444A** is required, while continuing to protect the operation of the international standard MLS. Further, the consequential amendment of Recommendation ITU-R M.1827 allows for improved flexibility in managing the permitted interference from AM(R)S by allowing its contribution to $\Delta T_s/T_s$ to increase beyond 2%.

Advantages:

– By suppressing the time limitations on the FSS feeder links authorized in RR No. **5.444A**, a long-term, stable sharing environment amongst the primary allocated services in the band 5 091-5 150 MHz will be preserved;

– Revision of Resolution **748 (WRC-12)**, along with the revision of Recommendation ITU-R M.1827, will provide more flexibility for managing the potential interference from AM(R)S systems sharing spectrum with the FSS in the band 5 091-5 150 MHz, and allow MSS systems to maintain their current level of service including to areas that are underserved by other means of communications;

– The Method satisfactorily addresses the *resolves* part of Resolution **114 (Rev.WRC-12)**.

Disadvantages:

– No disadvantages were identified for the Method.

4.1/1.7/6 Regulatory and procedural considerations

ARTICLE 5

Frequency allocations

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

MOD

4 800-5 570 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
5 091-5 150	FIXED-SATELLITE (Earth-to-space) 5.444A AERONAUTICAL MOBILE 5.444B AERONAUTICAL MOBILE-SATELLITE (R) 5.443AA AERONAUTICAL RADIONAVIGATION 5.444 ~~5.444A~~	
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	

Reasons: The FSS allocation has been moved from footnote RR No. **5.444A** to the Table of Frequency Allocations as a consequence of rendering the FSS allocation without time limits.

MOD

5.444A ~~Additional allocation: the band 5 091-5 150 MHz is also allocated to the fixed-satellite service (Earth-to-space) on a primary basis. This~~ The use of the allocation to the fixed-satellite service (Earth-to-space) in the band 5 091-5 150 MHz is limited to feeder links of non-geostationary satellite systems in the mobile-satellite service and is subject to coordination under No. **9.11A**. The use of the band 5 091-5 150 MHz by feeder links of non-geostationary satellite systems in the mobile-satellite service shall be subject to application of Resolution **114 (Rev.WRC-15)**. Moreover, to ensure that the aeronautical radionavigation service is protected from harmful interference, coordination is required for feeder-link earth stations of the non-geostationary satellite systems in the mobile-satellite service which are separated by less than 450 km from the territory of an administration operating ground stations in the aeronautical radionavigation service.

~~In the band 5 091-5 150 MHz, the following conditions also apply:~~

~~prior to 1 January 2018, the use of the band 5 091-5 150 MHz by feeder links of non-geostationary-satellite systems in the mobile-satellite service shall be made in accordance with Resolution **114 (Rev.WRC-03)**[*];~~

~~after 1 January 2016, no new assignments shall be made to earth stations providing feeder links of non-geostationary mobile-satellite systems;~~

~~after 1 January 2018, the fixed-satellite service will become secondary to the aeronautical radionavigation service. (WRC-07)~~

Reasons: To remove time limitations from the FSS allocation (limited to feeder links of non-geostationary systems in the MSS), while keeping all the other applicable regulatory provisions, i.e. RR No. **9.11A** and Resolution **114 (Rev.WRC-15)**.

~~[*] *Note by the Secretariat:* This Resolution was revised by WRC-12.~~

APPENDIX 7 (REV.WRC-12)

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 10 (Rev.WRC-~~07~~15)

Predetermined coordination distances

Frequency sharing situation		**Coordination distance (in sharing situations involving services allocated with equal rights) (km)**
Type of earth station	**Type of terrestrial station**	
Ground-based in the bands below 1 GHz to which No. **9.11A** applies. Ground-based mobile in the bands within the range 1-3 GHz to which No. **9.11A** applies	Mobile (aircraft)	500
Aircraft (mobile) (all bands)	Ground-based	500
Aircraft (mobile) (all bands)	Mobile (aircraft)	1 000
Ground-based in the bands: 400.15-401 MHz 1 668.4-1 675 MHz	Station in the meteorological aids service (radiosonde)	580
Aircraft (mobile) in the bands: 400.15-401 MHz 1 668.4-1 675 MHz	Station in the meteorological aids service (radiosonde)	1 080
Ground-based in the radiodetermination-satellite service (RDSS) in the bands: 1 610-1 626.5 MHz 2 483.5-2 500 MHz 2 500-2 516.5 MHz	Ground-based	100
Airborne earth station in the radiodetermination-satellite service (RDSS) in the bands: 1 610-1 626.5 MHz 2 483.5-2 500 MHz 2 500-2 516.5 MHz	Ground-based	400
Receiving earth stations in the meteorological-satellite service	Station in the meteorological aids service	The coordination distance is considered to be the visibility distance as a function of the earth station horizon elevation angle for a radiosonde at an altitude of 20 km above mean sea level, assuming 4/3 Earth radius (see Note 1)
Non-GSO MSS feeder-link earth stations (all bands)	Mobile (aircraft)	500 (see Note 2)
Ground-based in the bands in which the frequency sharing situation is not covered in the rows above	Mobile (aircraft)	500

NOTE 1 – The coordination distance, *d* (km), for fixed earth stations in the meteorological-satellite service vis-à-vis stations in the meteorological aids service assumes a radiosonde altitude of 20 km and is determined as a function of the physical horizon elevation angle ε_h (degrees) for each azimuth, as follows:

$$d = 100 \qquad \text{for} \qquad \varepsilon_h \geq 11°$$

$$d = 582\left(\sqrt{1 + (0.254\,\varepsilon_h)^2} - 0.254\,\varepsilon_h\right) \qquad \text{for} \qquad 0° < \varepsilon_h < 11°$$

$$d = 582 \qquad \text{for} \qquad \varepsilon_h \leq 0°$$

The minimum and maximum coordination distances are 100 km and 582 km, and correspond to physical horizon angles greater than 11° and less than 0°. (WRC-2000)

NOTE 2 – For the coordination distance in the band 5 091-5 150 MHz vis-à-vis stations in the aeronautical radionavigation service, see No. **5.444A**. (WRC-15)

Reasons: In order to avoid any confusion, the coordination distance vis-à-vis a specific service determined by a specific footnote (i.e. RR No. **5.444A**) needs to be specified.

MOD

RESOLUTION 114 (REV.WRC-~~12~~15)

~~Studies on c~~Compatibility between ~~new systems of~~ the aeronautical radionavigation service and the fixed-satellite service (Earth-to-space) (limited to feeder links of the non-geostationary mobile-satellite systems in the mobile-satellite service) in the frequency band 5 091-5 150 MHz

The World Radiocommunication Conference (Geneva, ~~2012~~2015),

considering

a) the current allocation of the frequency band 5 000-5 250 MHz to the aeronautical radionavigation service;

b) the requirements of both the aeronautical radionavigation and the fixed-satellite (FSS) (Earth-to-space) (limited to feeder links of non-geostationary satellite (non-GSO) systems in the mobile-satellite service (MSS)) services in the above-mentioned band,

recognizing

a) that priority must be given to the microwave landing system (MLS) in accordance with No. **5.444** and to other international standard systems of the aeronautical radionavigation service in the frequency band 5 030-5 091~~150~~ MHz;

b) that, in accordance with Annex 10 of the Convention of the International Civil Aviation Organization (ICAO) on international civil aviation, it may be necessary to use the frequency band 5 091-5 150 MHz for the MLS if its requirements cannot be satisfied in the frequency band 5 030-5 091 MHz;

c) that the FSS providing feeder links for non-GSO systems in the MSS will need continuing access to the frequency band 5 091-5 150 MHz~~ in the short term~~, *noting*

a) that Recommendation ITU-R S.1342 describes a method for determining coordination distances between international standard MLS stations operating in the band 5 030-5 091 MHz and FSS earth stations providing Earth-to-space feeder links in the band 5 091-5 150 MHz;

b) the small number of FSS stations to be considered~~;~~,

~~*c)* the development of new systems that will provide supplemental navigation information integral to the aeronautical radionavigation service,~~

resolves

~~1~~ that administrations authorizing stations providing feeder links for non-GSO systems in the MSS in the frequency band 5 091-5 150 MHz shall ensure that they do not cause harmful interference to stations of the aeronautical radionavigation service~~;~~,

~~2 that the allocation to the aeronautical radionavigation service and the FSS in the frequency band 5 091-5 150 MHz should be reviewed at a future competent conference prior to 2018;~~

~~3 that studies be undertaken on compatibility between new systems of the aeronautical radionavigation service and systems of the FSS providing feeder links of the non-GSO systems in the MSS (Earth-to-space),~~

invites administrations

when assigning frequencies in the band 5 091-5 150 MHz ~~before 1 January 2018~~ to stations of the aeronautical radionavigation service or to stations of the FSS providing feeder links of the non-GSO systems in the MSS (Earth-to-space), to take all practicable steps to avoid mutual interference between them,

~~*invites ITU-R*~~

~~to study the technical and operational issues relating to sharing of this band between new systems of the aeronautical radionavigation service and the FSS providing feeder links of the non-GSO systems in the MSS (Earth-to-space),~~

~~*invites*~~

~~1 ICAO to supply technical and operational criteria suitable for sharing studies for new aeronautical systems;~~

~~2 all Members of the Radiocommunication Sector, and especially ICAO, to participate actively in such studies,~~

instructs the Secretary-General

to bring this Resolution to the attention of ICAO.

Reasons: Consequential changes as a result of rendering the FSS allocation (limited to feeder links of non-geostationary systems in the mobile-satellite service) without time limits.

MOD

RESOLUTION 748 (REV.WRC-~~12~~15)

Compatibility between the aeronautical mobile (R) service and the fixed-satellite service (Earth-to-space) in the band 5 091-5 150 MHz

The World Radiocommunication Conference (Geneva, ~~2012~~2015),

considering

a) that the allocation of the 5 091-5 150 MHz band to the fixed-satellite service (FSS) (Earth-to-space) is limited to feeder links of non-geostationary-satellite (non-GSO) systems in the mobile-satellite service (MSS);

b) that the frequency band 5 000-5 150 MHz is currently allocated to the aeronautical mobile-satellite (R) service (AMS(R)S), subject to agreement obtained under No. **9.21**, and to the aeronautical radionavigation service (ARNS);

c) that WRC-07 allocated the band 5 091-5 150 MHz to the aeronautical mobile service (AMS) on a primary basis subject to No. **5.444B**;

d) that the International Civil Aviation Organization (ICAO) is in the process of identifying the technical and operating characteristics of new systems operating in the AM(R)S in the band 5 091-5 150 MHz;

e) that the compatibility of one AM(R)S system, to be used by aircraft operating on the airport surface, and the FSS has been demonstrated in the 5 091-5 150 MHz band;

f) that ITU-R studies have examined potential sharing among ~~AMS~~aeronautical applications and the FSS in the band 5 091-5 150 MHz~~and have shown that the aggregate interference from aeronautical telemetry and AM(R)S should total no more than 3% $\Delta T_s/T_s$~~;

g) that the frequency band 117.975-137 MHz currently allocated to the AM(R)S is reaching saturation in certain areas of the world, and therefore that band would not be available to support additional surface applications at airports;

h) that this new allocation is intended to support the introduction of applications and concepts in air traffic management which are data intensive, and which will support data links that carry safety-critical aeronautical data,

recognizing

a) that in the frequency band 5 030-5 091 MHz priority is to be given to the microwave landing system (MLS) in accordance with No. **5.444**;

b) that ICAO publishes recognized international aeronautical standards for AM(R)S systems;

c) that Resolution **114 (Rev.WRC-~~12~~15)** applies to the sharing conditions between the FSS and ARNS in the 5 091-5 150 MHz band,

noting

a) that the number of FSS transmitting stations required may be limited;

b) that the use of the band 5 091-5 150 MHz by the AM(R)S needs to ensure protection of the current or planned use of this band by the FSS (Earth-to-space);

c) that ITU-R studies describe methods for ensuring compatibility between the AM(R)S and FSS operating in the band 5 091-5 150 MHz, and compatibility has been demonstrated for the AM(R)S system referred to in *considering e)*,

resolves

1 that any AM(R)S systems operating in the band 5 091-5 150 MHz shall not cause harmful interference to, nor claim protection from, systems operating in the ARNS;

2 that any AM(R)S systems operating in the frequency band 5 091-5 150 MHz shall meet the SARPs requirements published in Annex 10 of the ICAO Convention on International Civil Aviation and the requirements of Recommendation ITU-R M.1827-1, to ensure compatibility with FSS systems operating in that band;

3 that, in part to meet the provisions of No. **4.10**, the coordination distance with respect to stations in the FSS operating in the band 5 091-5 150 MHz shall be based on ensuring that the signal received at the AM(R)S station from the FSS transmitter does not exceed −143 dB(W/MHz), where the required basic transmission loss shall be determined using the methods described in Recommendations ITU-R P.525-2 and ITU-R P.526-11,

invites

1 administrations to supply technical and operational criteria necessary for sharing studies for the AM(R)S, and to participate actively in such studies;

2 ICAO and other organizations to actively participate in such studies,

instructs the Secretary-General

to bring this Resolution to the attention of ICAO.

Reasons: To improve the operational flexibility of the aeronautical-mobile (Route) service and to reflect the revision of Recommendation ITU-R M.1827.

NOTE: Resolution **748 (Rev.WRC-12)** is referred to in *recognizing c)* of Resolution **418 (Rev.WRC-12)**. Should WRC-15 revise Resolution **748 (Rev.WRC-12)**, a consequential update of the reference would be need in Resolution **418 (Rev.WRC-12)**.

AGENDA ITEM 1.8

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

1.8 to review the provisions relating to earth stations located on board vessels (ESVs), based on studies conducted in accordance with Resolution ***909 (WRC-12)****;*

Resolution **909 (WRC-12)**: *Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz*

4.1/1.8/1 Executive summary

WRC-12 decided to review the provisions relating to 5 925-6 425 MHz (C band) and 14.0-14.5 GHz (Ku band) earth stations on board vessels (ESVs) in preparation for WRC-15. Studies are being coordinated by ITU-R to consider possible modifications to Resolution **902 (WRC-03)**. To this effect, WRC-12 established WRC-15 agenda item 1.8 together with Resolution **909 (WRC-12)**.

WRC-15 agenda item 1.8 calls for a review of the existing provisions relating to ESVs, based on studies conducted in accordance with Resolution **909 (WRC-12)**. In particular, it considers the need to review and possibly revise limitations and restrictions contained in Resolution **902 (WRC-03)** to reflect current ESV technologies and technical characteristics that are being used or planned to be used, while ensuring the continued protection of other services to which the frequency bands 5 925-6 425 MHz and 14-14.5 GHz are allocated.

The latest version of Recommendation ITU-R S.1587-2 describes the current technologies and technical characteristics that are being used or planned to be used for ESVs communicating with fixed-satellite service (FSS) satellites in the frequency bands 5 925-6 425 MHz and 14-14.5 GHz.

Resolution **902 (WRC-03)** had set separation distances from the low-water mark as the relevant parameter to protect terrestrial services from unacceptable interference. In C band and to a lesser extent in Ku band, the fixed service (FS) is implemented in many countries for IMT backhauls, infrastructure backbones or to connect remote coastal stations (offshore oil platforms). The studies conducted in response to this agenda item have kept these parameters to assess the impact on terrestrial services from a potential relaxation of the current regulatory regime.

One study proposes to update the regulatory protection distances from low water mark from the point of view of an increased number of operational ESVs when compared to the scenario considered in 2003, and proposes to increase the regulatory protection distances for C band while maintaining the maximum ESV transmitted e.i.r.p. densities unchanged with respect to the levels contained in Resolution **902 (WRC-03)**.

A second study proposes to update the regulatory protection distances by establishing a discrete set of different regulatory protection distances for different maximum values of e.i.r.p. density transmitted by ESVs in the C and Ku bands. Because of the smaller C band ESV antenna diameter found in Recommendation ITU-R S.1587-2 when compared to the minimum diameter prescribed in Resolution **902 (WRC-03)**, this study also takes into account an increase in the number of operational C band ESVs when compared to the scenario considered in 2003.

A third study proposes to update the regulatory protection distances from the point of view of an increased number of operational ESVs when compared to the scenario considered in 2003, but also takes into account the new ESV systems employing transmission techniques requiring lower e.i.r.p. densities. This study therefore also proposes a discrete set of different regulatory protection distances for different maximum values of e.i.r.p. density transmitted by ESVs in the C and Ku bands.

4.1/1.8/2 Background

Consideration of ESVs in the ITU started in 1997 when WRC-97 placed ESVs on the WRC-2000 agenda (agenda item 1.8) in its Resolution **721(WRC-97)**.

WRC-03 adopted RR Nos. **5.457A**, **5.506A** and **5.506B** establishing technical and operational provisions allowing for the use of ESVs in the FSS frequency bands as prescribed in the above mentioned footnotes and Resolution **902 (WRC-03)**.

In particular, Resolution **902 (WRC-03)** limits the use of ESVs to 125 km "from the low-water mark as officially recognized by the coastal State" for Ku band and 300 km for C band" without the prior agreement of any administration".

While ESV licensing is available in a handful of countries, most simply adhere to the existing Resolution **902 (WRC-03)** coordination requirements. Moreover, the circulation of ESVs within other countries require appropriate administrative and procedural arrangements to ensure that the sovereignty of the country in which ESVs are intended to operate is preserved. This issue should be discussed and agreed between the ESV operator and the licensing authority of each administration in the country where the ESVs will operate, at the time the ESV operator seeks the necessary authorization to operate.

The WRC-03 decisions were reached with a great degree of reluctance from several countries believing that such earth stations were maritime mobile earth stations (RR No. **5.457B**) and should not have been dealt with under the FSS. However, some countries believed that ESVs could operate in the FSS if properly regulated.

Since that time, the use of these earth stations on ships has increased but no studies updating the ESV deployment scenario considered in 2003 are available.

During the 2007-2012 ITU-R study cycle, an input document called attention to the assumptions used in Recommendations ITU-R S.1587-1 and ITU-R SF.1650-1 to develop Resolution **902 (WRC-03)** considering that they are no longer representatives of all current ESV technologies. For example, some of the typical ESVs in the frequency band 5 925-6 425 MHz may operate today with e.i.r.p. density levels that are more than 20 dB lower than those used in Recommendation ITU-R SF.1650-1. As a consequence, ESV operations at lower power could coordinate more easily with the terrestrial administration if they operate inside the 300 km and 125 km in C and Ku bands, respectively, or even be allowed to operate at smaller distance without the need to coordinate.

However, it should be noted that, for the 14 GHz band, Recommendation ITU-R SF.1650-1 uses the number of ferry arrivals of the Dover port in 1999. The number is approximately 24 000 and the Recommendation derives the number of vessel passes per day multiplying it by the probability of the frequency overlap. This means the Recommendation assumes that all the ferries are equipped with ESV terminals operating in the 14 GHz band.

The frequency bands referred to in Resolution **909 (WRC-12)** are, in some countries, extensively used for medium- and long-distance backhaul for cellular networks, and their use is likely to further grow. These terrestrial services also provide the backbone of infrastructure in developing countries including terrestrial stations that are near coastlines and point towards the sea for broadband communications to remote communities or offshore oil platforms.

Pursuant to CPM15-1, studies are being carried out in relation to WRC-15 agenda item 1.8, namely to review the provisions applying to ESVs operating in the FSS in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz, in accordance with Resolution **909 (WRC-12)**.

4.1/1.8/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant ITU-R Recommendations: ITU-R S.1587-2, ITU-R SF.1650-1, ITU-R P.620-6, ITU-R P.452-14.

These Recommendations contain information on the characteristics, frequency bands, guidance and example methods for use with ESVs operating at 4/6 GHz and 11/14 GHz to provide protection to the FS. It can be however noted that these Recommendations may not cover all characteristics of terrestrial stations currently operating in the terrestrial services.

Recommendation ITU-R S.1587-2 provides a description of technical characteristics of existing and planned ESVs that operate in the bands 5 925-6 425 MHz and 14-14.5 GHz in FSS networks.

Recommendation ITU-R SF.1650-1 recommends distances beyond which in motion ESVs are assumed not to cause unacceptable interference to the FS. For the band 5 925-6 425 MHz, the distance is 300 km and for the 14 GHz band, the distance is 125 km based, among others, on the assumption of a moving vessel (10 knots).

Recommendation ITU-R P.620-6 provides propagation data for use in the calculation of a coordination area and sets out a straightforward method for the assessment of the propagation factors concerned in the determination of coordination distances in the frequency range 100 MHz to 105 GHz.

Recommendation ITU-R P.452-14 contains a prediction method for the evaluation of interference between stations on the surface of the Earth at frequencies from about 0.1 GHz to 50 GHz, accounting for both clear-air and hydrometeor scattering interference mechanisms.

4.1/1.8/3.1 Study based on increasing the number of passes of ships in the C and Ku bands

The minimum distance of 300 km at C band (for an antenna diameter of 2.4 m) and 125 km at Ku band (for an antenna diameter of 1.2 m) from the low-water mark as officially recognized by the coastal State, beyond which ESVs can operate without the prior agreement of any administration as mentioned in Resolution **902 (WRC-03)**, had been calculated in the 2000-2003 timeframe based on assumptions and technical parameters prevailing at that time.

It was considered that parameters used in previous studies should be reviewed to take into account an increase in the number of passes of ships. In view of the fact that the number of ESVs in the 6 GHz and 14 GHz bands have increased in recent years, the calculations have been carried out, according to new assumptions as tabulated in Table 4.1/1.8/3-1.

TABLE 4.1/1.8/3-1

Number of vessel passes across the beam of the fixed service receiver (FSR)

Frequency band	Number of vessels
6 GHz band	1 vessel every third day; 1, 3, **4** and **6** vessels every day
14 GHz band	3, 6 and **8** vessels every day

In order to take into account the prevailing situation (numbers of ship passes and etc.) these calculations have been reviewed and the results obtained are reflected in the paragraphs below.

The calculations provided are based on the methodology using the propagation model described in Recommendation ITU-R P.620-6 and also the iterative method for determining the minimum distance presented in Recommendation ITU-R SF.1650-1.

Using the new assumptions of the maximum numbers of vessels with 36° discrimination angle and keeping the same limitations as those mentioned in Resolution **902 (WRC-03)** including maximum e.i.r.p. density levels towards the horizon of 17 dBW/MHz for C band and 12.5 dBW/MHz for Ku band, the results show almost 345 km as the increased protection distance for C band and approximately 125 km as the retained protection distance for Ku band, which has been mentioned in Resolution **902 (WRC-03)**.

It means that, increasing the number of the passing vessels, off-shore distance in the C band should be increased but in the Ku band it could be retained.

Protection distance calculations in the 6 GHz band using Recommendation ITU-R P.452-14 have been made for the fixed stations with the altitudes of 120 m and 1035 m above the sea level. In the first case, the fixed station with the altitude of 120 m above the sea level and distance of zero from the shore and in the second case the fixed station with the altitude of 1035 m above the sea level and distance of 25 km from the shore have been considered. Since in the most cases the fixed stations are located on the mountains with high altitude, therefore in the second case, the fixed stations with the altitude of 1 035 m above the sea level and distance of 25 km from the shore have been taken into account.

Using the parameter values described above and based on the methodology specified in Recommendation ITU-R SF.1650-1 and using the propagation model described in Recommendation ITU-R P.452-14, the results show that almost the same conclusion is reached for C band (~ 345 km), as using the propagation model described in Recommendation ITU-R P.620-6. Therefore, it is confirmed that the off-shore distance of 300 km for C band in uplink directions should be increased. To this effect, it is necessary to examine and remedy the assumptions again in Recommendation ITU-R SF.1650-1 and review, as appropriate, during this study period.

4.1/1.8/3.2 Study establishing different protection distances for different maximum e.i.r.p. density levels, which yields shorter protection distances for e.i.r.p. density levels lower than those currently allowed by Resolution 902 (WRC-03)

This study follows the same methodology described in Recommendation ITU-R SF.1650-1 and the propagation model described in Recommendation ITU-R P.452-14, and takes into account an increase in the number of passes of ships in order to account for 6 GHz ESV antenna diameters as small as 1.2 m, and different values of uplink transmitted power density for ESVs employing state of the art technologies and technical characteristics.

This study also considers different values of uplink ESV transmitted power density and, for the 14 GHz band, that the deployment of ESVs implicitly assumed by WRC-03 when establishing the protection environment for the FS, including the number of passing vessels used during the studies carried out before WRC-03, is still valid today and equivalent to that of about 11.2 passes per year of ESV transmitting within the FSR receiver channel bandwidth with the ESV antenna pointing to the FSR with a 10° discrimination angle[25].

Based on the results of this study, the separation distances shown in Tables 4.1/1.8/3-2 and 4.1/1.8/3-3 are proposed to replace the single distance currently found in Resolution **902 (WRC-03)** for the 6 GHz and 14 GHz frequency bands:

[25] The highest value of f_{ESV} for which results of the methodology described in Recommendation ITU-R SF.1650-1 are presented in Annex 1 of that Recommendation corresponds to 2 190 passes per year, and the maximum discrimination angle is 36º.

TABLE 4.1/1.8/3-2

Minimum distances versus maximum e.i.r.p. transmitted toward the horizon – C Band

Maximum e.i.r.p. transmitted toward the horizon (dBW in 11.2 MHz)	Minimum distance from low-water mark* (km)
20.8	323
10.8	227
0.8	130
–9.2	64

* Low-water mark as officially recognized by the coastal State.

TABLE 4.1/1.8/3-3

Minimum distances versus maximum e.i.r.p. transmitted toward the horizon – Ku band

Maximum e.i.r.p. transmitted toward the horizon (dBW in 14 MHz)	Minimum distance from low-water mark*(km)
16.3	125
6.3	85
–3.7	29

* Low-water mark as officially recognized by the coastal State.

The protection distances associated with the above maximum e.i.r.p. levels transmitted toward the horizon were derived using the methodology described in Recommendation ITU-R SF.1650-1 and the propagation model described in Recommendation ITU-R P.452-14. However, use of Recommendation ITU-R P.620 would modify the values derived by this study.

The lower e.i.r.p. spectral density levels indicated in the above Tables are consistent with the parameters provided for low power density ESV systems reflected in Recommendation ITU-R S.1587-2. Lower e.i.r.p. density levels may be achieved through spreading of the ESV transmitted carrier in bandwidths larger than 11.2 MHz for the C band and 14 MHz for the Ku band, in which case the probability of frequency overlap between the ESV transmission and the FSR will increase, with a corresponding effect on the protection distances. Quantification of that effect requires knowledge of the extent these cases will occur.

4.1/1.8/3.3 Study establishing different protection distances for different maximum e.i.r.p. density levels for the increasing ESVs passes in the C and Ku bands

This study assumed that establishing the protecting distances for the FS takes into account the increasing number of the passing vessels. Based on these assumptions, the distances shown in Tables 4.1/1.8/3-4 and 4.1/1.8/3-5 associated with values of ESV e.i.r.p. spectral density toward the horizon were found to produce the same level of interference protection as that afforded by the values in Resolution **902 (WRC-03)**.

TABLE 4.1/1.8/3-4

Minimum distances versus maximum e.i.r.p. transmitted toward the horizon – C Band

Maximum e.i.r.p. transmitted toward the horizon (dBW in 11.2 MHz)	Minimum distance from low-water mark*(km) for increasing numbers of ESVs passing
20.8	345
10.8	236
0.8	141
–9.2	59

* Low-water mark as officially recognized by the coastal State.

TABLE 4.1/1.8/3-5

Minimum distances versus maximum e.i.r.p. transmitted toward the horizon – Ku Band

Maximum e.i.r.p. transmitted toward the horizon (dBW in 14 MHz)	Minimum distance from low-water mark* (km) for increasing numbers of ESVs passing
16.3	125
6.3	108
–3.7	44

* Low-water mark as officially recognized by the coastal State.

The lower e.i.r.p. spectral density levels indicated in the above table are consistent with the parameters provided for the new ESVs with spread-spectrum modulation reflected in Recommendation ITU-R S.1587-2. Lower e.i.r.p. density levels may be achieved through spreading of the ESV transmitted carrier in bandwidths larger than 11.2 MHz for the C band and 14 MHz for the Ku band, in which case the probability of frequency overlap between the ESV transmission and the FSR will increase, with a corresponding effect on the protection distances. Quantification of that effect requires knowledge of the extent these cases will occur.

4.1/1.8/4 Analysis of the results of studies

Consideration needs to be given to new modulation methods and lower e.i.r.p. values highlighted by operators in current ESV operations which could lead to the use of reduced diameter of antennas, and consequently, to a significant increase in the number of ESVs. In order to review the possibility of implementing revised criteria it is necessary to review the full results of previous studies to determine the extent to which the assumptions and statistics leading to the distance criteria and antenna size are applicable to the technologies being deployed today taking into account new modulation methods, which may operate with lower e.i.r.p. density levels, volume of maritime traffic in international waters and the cumulative effect of the total number of vessels which the terrestrial services would encounter on the shores of the coastal country. In so doing, it may also be necessary to repeat some of the historical studies in their entirety to take into account changed circumstances.

Such studies would enable administrations to better understand the potential for relaxing the current restrictions applying to ESVs enabling an informed decision about the future of Resolution **902 (WRC-03)** taking into account the critical importance of the bands under reference for public telecommunication services and broadband communications to remote rural communities and communications to offshore oil platforms in developing countries.

The circulation of ESVs within other countries would require appropriate administrative and procedural arrangements to ensure that the sovereign rights of the country in which ESVs are intended to operate is preserved. This issue should be discussed and agreed between the ESVs operator and the licensing authority of each administration in the country where the ESVs will operate, at the time the ESVs operator seeks the necessary authorization to operate.

Some administrations believe that, since the date of the revision of Recommendation ITU-R SF.1650-1 (2003-2005), the number of ESVs has considerably increased. Some administrations believe that the deployment scenario considered by WRC-03 when adopting Resolution **902 (WRC-03)** may still be valid today for the Ku band.

Moreover, if the minimum regulatory diameter of the antennas of these ESVs is reduced, then the number of ESVs is likely to increase compared with the numbers assumed in Recommendation ITU-R SF.1650-1. It should be noted that Resolution **902 (WRC-03)** already envisages for Ku band antenna diameters as small as 60 cm.

Consequently, studies that considered ESV deployment scenarios where the number of ESVs is larger than that considered by WRC-03 have concluded that, for the maximum levels of e.i.r.p. density transmitted toward the horizon, protection distances should be increased.

Finally, studies that also considered levels of e.i.r.p. density transmitted toward the horizon lower than those considered by WRC-03 concluded that, for these cases, the protection distances could be decreased.

Some administrations are of the strong view that any modification to the distance would be detrimental to the operation of terrestrial services of coastal administrations in particular when these terrestrial services are the only infrastructure of telecommunication of these countries.

Other administrations, on the other hand, are of the strong view that it is possible to reduce the protection distances for these cases of ESV transmitting lower power levels than the maximum levels currently allowed by Resolution **902 (WRC-03)** and still protect the terrestrial services of coastal administrations to the same level currently afforded by Resolution **902 (WRC-03)** for ESVs transmitting maximum power levels.

The results of studies carried out in sections 4.1/1.8/3.1, 4.1/1.8/3.2 and 4.1/1.8/3.3 are summarized below (for more information in details, see the relevant mentioned sections above).

Based on the results of the study described in section 4.1/1.8/3.1, the calculation of the off-shore distance values from the baseline for protection of the FS, based on the methodology using the propagation model described in Recommendation ITU-R P.620-6 and Recommendation ITU-R P.452-14 and also the iterative method for determining the minimum distance presented in Recommendation ITU-R SF.1650-1 with the new assumptions on the number of vessels in the 6 GHz and 14 GHz bands shows that the protection distance increases to almost 345 km for the C band but it could be reached to approximately 125 km for the Ku band.

According to the information received from the Radiocommunication Bureau (BR), since 2003 when the ESV concept was adopted, no single ESV has been notified to the BR under RR Article **11**. Consequently, no information about the technical and operational characteristics of these stations is available. However, in practice, many ESVs are currently operating without any information on their characteristics in order to know whether they are within the envelope of the specific or typical earth stations of the satellite networks under which and to which they are operating.

On the other hand, some administrations are of the view that this should not be a reason for concern because:

a) Resolution **902 (WRC-03)** requires the ESV licensing administration and service providers to ensure that the operational provisions and technical limitations of the Resolution are met. If coordination is needed, the information required to conduct the coordination process, such as precise e.i.r.p. density and elevation angle, will be provided by the administration licensing the ESV, in accordance with *encourages concerned administrations* in Resolution **902 (WRC-03)**; and

b) It is up to the licensing administration to ensure that the ESVs under their responsibility conform to the international regulations, implement mechanisms to avoid their infringement and conform to the conditions agreed in the coordination of ESVs with coastal administrations.

Based on the results of the study described in section 4.1/1.8/3.2, the distances shown in Tables 4.1/1.8/3-2 and 4.1/1.8/3-3 associated with the values of ESV e.i.r.p. spectral density toward the horizon produce the same level of interference protection as that afforded by the values in Resolution **902 (WRC-03)**.

The study in section 4.1/1.8/3.3 assumed that the combinations 'minimum distance from ESVs/maximum e.i.r.p. spectral density toward horizon' would take into account the increasing numbers of the passing vessels.

Based on the results of this study, the distances shown in the right hand column of Tables 4.1/1.8/3-4 and 4.1/1.8/3-5 were associated with the values of ESV e.i.r.p. spectral density toward the horizon producing the same level of interference protection as that afforded by the values in Resolution **902 (WRC-03)** with the increasing numbers of the passing vessels.

It should be noted that some of the separation distances that resulted from the aforementioned studies are smaller than the minimum coordination distance determined by RR Appendix **7**.

It is worth to mention that the raised 8-10 questions, as the following, should be clarified, as appropriate:

"1 How many ESVs, operating with parameters in line with Recommendation ITU-R SF.1650-1-1are deployed today and how many are foreseen deployed in the future?

2 How many ESVs with significantly reduced e.i.r.p. (up to 20 dB) are operating today and how many are foreseen deployed in the future?

Note: Below are two options (Option a) & Option b)), for the remaining questions in this note, in response to the comments/questions regarding the distribution between "high e.i.r.p." and "low e.i.r.p." ESVs and the implications on the number of ESVs to be assumed deployed. Just one of the two should be selected.

Option a)

3 What are the characteristics of the corresponding satellite networks with which these low e.i.r.p. ESVs are communicating?

4 Has any of these low e.i.r.p. ESVs been notified to the BR?

5 What were the conclusions of the BR?

6 Can statistics on the ESVs and their status be formally provided with sufficient evidence?

7 These low e.i.r.p. ESVs, apparently communicate within their corresponding space stations within the typical characteristics contained in the coordinated satellite networks. In that case how is the overall performance of the communication network ensured?

8 What is the status of an ESV operating under a typical characteristics of an earth station (E/S) pertaining to a given satellite network if the E/S drastically reduces the e.i.r.p. up to 20 dB compared to that of the typical E/S associated with the satellite network?

9 Could such a drastic e.i.r.p. reduction make the ESV more sensitive to interference from other satellites than what was agreed during the coordination? Would this imply that such an ESV would accept the increased interference?

10 What would be the effect on the overall link budget if the e.i.r.p. is drastically reduced?

Option b)

*Note: New **Q3** below is the combination of **Q3** and **Q10** in the above **Option a)**.*

3 What are the technical characteristics of the corresponding satellite networks with which these low e.i.r.p. ESVs are communicating, what is the overall link performance and what is the service availability of such links?

4 Has any of these low e.i.r.p. ESVs been notified to the BR?

5 What were the conclusions of the BR?

6 Can statistics on the ESVs and their status be formally provided with sufficient evidence?

*Note: New **Q7** below is the combination of **Q7** and **Q8** in the above **Option a)** and **Q8** below is the same **Q9** above.*

7 These low e.i.r.p. ESVs are understood to communicate with the corresponding space station within the typical characteristics contained in the coordinated satellite networks as recorded with the ITU-R. What is the status of an ESV operating under characteristics of a typical earth station (E/S) pertaining to a given satellite network if the E/S drastically reduces the e.i.r.p. up to 20 dB compared to that of the typical E/S associated with the satellite network?

8 Could such a drastic e.i.r.p. reduction make the ESV more sensitive to interference from other satellites than what was agreed during the coordination? Would this imply that such an ESV would accept the increased interference?"

Some administrations have the following views concerning the above questions:

As ESVs are not required to be notified, and therefore are not entitled to protection against interference, BR databases do not provide meaningful information about their numbers.

The level of protection received by ESV terminals is that afforded indirectly by the coordination of the typical FSS earth stations filed for the respective satellite network. The reduced levels of e.i.r.p. radiated by some ESV terminals, if not within the envelope of those filed for typical FSS earth stations, will be associated with lower values of C/N, and consequently the type of modulation and coding for use with the ESVs will have to be suited for operation with these C/N levels. However, it is not unusual to find in satellite filings differences between maximum and minimum power levels as high as 30 dB for the same frequency assignment.

In several areas in the studies in the above sections (4.1/1.8/3.2 and 4.1/1.8/3.3), references are made to technical characteristics of ESVs communicating with FSS satellites in the C and Ku bands. In this connection, it is worth to mention that most of these references are related to ESV systems 4 and 5 (for Ku and C band, respectively) of Recommendation ITU-R S.1587-2 in which the antenna diameters are 1.2 m and 60 cm, respectively whereas other ESV systems contained in the above mentioned Recommendation, used antenna diameters of 2.4 m and 1.2 m for C and Ku bands, respectively.

In view of the above, ESV systems 4 and 5 in Recommendation ITU-R S.1587-2 are not representative of all ESV systems used in the current studies. However, some administrations are of the view that, although it is recognized that ESV systems 4 and 5 in Recommendation ITU-R S.1587-2 are not representative of all ESV systems used in the studies undertaken in response to this agenda item, the regulatory solutions proposed in the draft CPM text are not exclusive to these systems, but cover all types of EVS systems described in that Recommendation.

ITU-R Working Party 5C, as the contributing group on the ESV issue and dealing with FS, submitted the following information in regard with WRC-15 agenda item 1.8, in particular the number of the passes, calculation method and direction of moving as stated below:

"– WP 5C notes that smaller antenna diameters down to 1.2 m are now being considered for ESVs in the 6 GHz band (i.e. current minimum restriction is 2.4 m) and the 60 cm for the 14 GHz band. As noted in the working document this is likely to significantly increase the number and type of vessel that can utilise 6 GHz ESVs and therefore the number of likely passes across the main beam of the FS receiver which are being considered in the studies. In addition WP 5C has noted that 6 GHz ESVs could be installed on smaller vessels which may have different travelling routes so could create different interference geometries/scenarios with respect to FS. Of particular concern would be where vessel could travel in a straight line in perpendicular to a coast line for a reasonable length of time. i.e. vessel could be in the main beam of FS receiver that is pointing towards the sea for much longer. WP 5C requests that WP 4A takes these points into account.

– WP 5C notes that under WRC-15 agenda item 1.9.2, studies presented for a similar service (maritime mobile-satellite service (MMSS)) lead to much larger separation distances in the nearby 8 GHz band for transmitting uplink MMSS earth stations compared to ESVs under WRC-15 agenda item 1.8 for the protection of the FS.

– Due to the different population and movement environment which might occur with the smaller antenna sizes, the applicability of the FDP concept may be questioned. However, even if it is used in this context as done in Annex 12, WP 5C has considered the use of the FDP concept for sharing studies between FS and ESVs in Sections 3.4 and 3.5 of Annex 12 to Document 4A/468 and concluded that FDP can only be used for these cases in conjunction with a supplementary requirement that I/N should not exceed 20 dB. The reasons for this are provided in the following paragraphs.

The scenario that is used in Sections 3.4 and 3.5 of Annex 12 to Document 4A/468 to determine minimum offshore distance is one in which a prescribed number of ESVs in a time period cross within a beam-width of the main-beam axis of a FS receiving antenna pointing out to sea. Assume that ESVs with a prescribed transmit power are operating at the minimum offshore distance. If the transmit power of each is reduced, they can presumably operate nearer to shore because FDP only requires that the average interference power (averaged over a long time period or over the average period of ESV crossings) be maintained for each pass. However, the (peak) interference power at the FS receiver while the ESV is in the main beam will increase because the time that it takes for the ESV to transit the main beam has decreased. Thus, for operation closer to the shore, the peak to average interference power will increase as the distance from shore decreases.

To determine the significance of this effect, the results presented in Sections 3.4 and 3.5 of Annex 12 to Document 4A/468 were used to determine the maximum value of the I/N as a vessel is crossing the main beam axis of a receiving antenna. The results are summarized in Table 1 for the 4 cases *considered at 6 GHz and the 3 cases at 14 GHz.*

TABLE 1

The average value of I/N that would be experienced at a fixed service receiver as an ESV crossed its antenna main beam at the minimum offshore distance proposed in § 3.4 and 3.5 of Annex 12 to Doc. 4A/468[26]

f_{GHz}	P_t (dBW)	$d_{offshore}$(km)	L_{p452}(20%) (dB)	I/N (dB)
6.00	16.7	96	168.0	21.6
	6.7	81	157.3	22.3
	–3.3	68	146.5	23.1
	–13.3	13	129.3	30.3
14.25	12.2	61	153.8	27.9
	2.2	12	136.8	34.9
	–7.8	2	119.0	42.7

The occurrence of I/N ratios of 20 dB or more have been identified as a probable source of performance degradation in FS receivers, particularly where they are operating with Automatic Transmit Power Control (ATPC). Such a possibility has been considered in the past in a neighbouring frequency band. Recommendation ITU-R F.1494 develops the interference criteria to protect the fixed service from time varying interference from other services sharing the 10.7-12.75 GHz frequency band on a co-primary basis. It recommends the use of FDP and that I/N at the input of the FS receiver input should not exceed +20 dB.

This condition is easily included into the developments in § 3.4 and § 3.5 of WD PDNRep S.[ESV]. It is only necessary to require that for ESV operations at the minimum offshore distance I/N should not exceed +20 dB and the FDP should not exceed 0.1.

In conclusion on this issue, the separation distances determined in § 3.4 and 3.5 of the WD PDNRep S.[ESV] are not acceptable to WP 5C. The text and the calculations need to include a requirement for meeting a +20 dB limit on the value of I/N (as determined with a receiver gain of $G_{r,AVE}$ as defined in Recommendation ITU-R SF.1650). Where the minimum off shore distance determined by this method exceeds that determined by the short term interference criterion, the larger distance should be included in the concluding section (§ 3.6) for Study 2. These re-determined values may also need to be reflected, as necessary, in the draft CPM text."

Some administrations have the following views concerning the points raised above:

Concerning the first point, it is worth noting that, for the 14 GHz frequency band, vessels of sizes compatible with ESV terminals with antenna diameters as small as 1.2 m, and even 60 cm, were considered by WRC-03 when determining the geometry of the traveling route used in the derivation of protection distances. It was based on these assumptions that the traveling routes were established and used in the derivation of the protection distances found in Recommendation ITU-R SF.1650 and Resolution **902 (WRC-03)**, and therefore the proposed change in 6 GHz antenna diameter should not impact the traveling routes assumed in the current studies.

[26] In the notation in § 3.4 and § 3.5 of Annex 12 to Doc. 4A/468, $L_{p452}(20\%) = P_t + G_t + G_{r,\text{AVE}} - F - N_{FSR} + 10 + 10\log(p_{ESVR}\}$ and $I/N = P_t + G_t + G_{r,\text{AVE}} - F - N_{FSR} - L_{p452}(20\%)$.

Concerning the second point, the assumptions used in the derivation of protection distances for the FS in the 8 GHz frequency band indicate that, besides the difference in power levels for the MMSS terminals with respect to those used for the ESVs (from 20 to 33 dBW for the MMSS transmitters and 16.7 dBW for the 6 GHz ESVs), the protection criteria used for the FS were those of RR Appendix **7**, which assume that the interfering terminal is stationary and transmitting toward the peak of the FS receive antenna. These assumptions are different from those used by WRC-03 in the derivation of the protection distances of Resolution **902 (WRC-03)**, which took into account the moving nature of the ESVs. Consequently, the resulting protection distances are not directly comparable.

Finally, concerning the third point, taking into account the additional proposed constraint, the long term protection distances indeed increase by a few km, but the short term protection distances continue to be the worst case situation and, consequently, there is no change to the distances proposed in Method C, i.e., no impact on the draft CPM text.

Other administrations believe that, except for the C band where possible reduced minimum ESV transmit antenna diameters may give rise to a larger number of ESVs, the deployment scenario taken into account by WRC-03 in the derivation of Resolution **902 (WRC-03)** is still valid today and should be used in responding to WRC-15 agenda item 1.8. These administrations also consider that licensing administrations should ensure compliance of ESV operations under their responsibility with the applicable regulatory provisions, so as to not burden coastal administrations with the need to monitor such compliance.

4.1/1.8/4.1 Several concerns on the studies

4.1/1.8/4.1.1 Some administrations are of the view that:

– The number of ESVs has actually considerably increased since the date of revision of Recommendation ITU-R SF.1650-1 and the protection distance in C band from the coastline would have to be increased.

– Any flexibility in applying the provisions of Resolution **902 (WRC-03)** (e.g. e.i.r.p. as a function of distance from coastline) would make the task of administrations extremely difficult and harder for checking the right application of regulations due to the fact that these administrations need to continuously and dynamically verify the e.i.r.p. of each of very many ESVs to ensure that the terrestrial stations are properly protected. Such course of action would impose additional burden to the developing countries, in particular, when processing interference report analysis or when supervising conformance of ESV characteristics and operational aspects with the applicable regulatory procedures. It is worth to mention that the above-mentioned terrestrial services /stations are the backbone of telecommunication / ICT infrastructure and thus need to be fully protected.

– In addition to concerns expressed by some countries in 2003 on the appropriateness of allowing the implementation of ESVs links in FSS frequency bands, such relaxation in the current regulations, could adversely impact the availability of the FS links, and provided new increased separation distance values to ensure protection of FS coastal stations, considering an increase of number of ships passes as a consequence of antenna size reduction.

– Considering Annex 1 to Resolution **902 (WRC-03)** (paragraph 6) which states that "the ESV systems shall include means of identification and mechanisms to immediately cease emissions, whenever the station does not operate in compliance with the provisions...", the proponents of an appropriate relaxation in ESVs regulations are confident in the ability and desire for operators to apply RR provisions, in the same way as current practices for protecting other primary services. It is recalled that such interference management system is difficult to operate and to act in order to immediately cease or reduce the interference to the acceptable level taking into account that the costal administrations responsible for terrestrial services would need to continually monitor the interference environment in order to report occurrence of such interference. Moreover, it is not clear how quickly and to which entity the interference would be reported and how quickly that report will be taken into account by the control centre and how quickly the control centre will advise the ESV operator to cease or reduce interference to acceptable level. In summary, the whole process is merely hypothetic and un-implementable.

– It should be emphasized that use of different e.i.r.p. density resulting different protection distance would considerably put burden to the coastal administration responsible for terrestrial service. Consequently any claim that reduction of protection distance reduces regulatory burden to the costal administrations is not valid.

– With respect to proponent of the method C's assertion that there is no evidence indicating that the ESV deployment scenario considered by WRC-03 for the 14 GHz is no longer valid today, the fact is that there is no evidence indicating the opposite situation either.

The above administrations in discussing studies dealing with reduction of protection distances as result of use of advance technologies such as spread spectrum technology and use of dynamic power density control of the ESV raised the following questions:

1. How the terrestrial administrations should react on the need for coordination without precise knowledge that which ESV operates on what e.i.r.p. density and what antenna elevation angle?

2. Moreover, even if, that administration is received information on the exact e.i.r.p. power density and exact antenna elevation angle, how that administration should be ensured that such announced e.i.r.p. power density and antenna elevation angle would be respected operation during the actual operation of the ESV?

3. How the terrestrial administrations should react in regard with the coordination requirement of the ESV with respect to its terrestrial services of numerous ESV each with different e.i.r.p. density and eventually different antenna elevation angles?

4. How the terrestrial administrations should react in regard with the required off-shore distance arising from the cumulative effects of a) different earth stations mounted on a given board vessels and b) the cumulative effects of different earth stations mounted on a given board vessels and different earth stations mounted on other board vessels ?

5. How the terrestrial administrations should react on the required off-shore distance arising from the pass of different ESVs consisting of a) a ship having either one or several earth stations on its board with different e.i.r.p. and different eventual antenna elevation angles and b) various ships each either one or several earth stations with different e.i.r.p. density and different angles on each day.

6. How the terrestrial administrations should react on circumstances in which some ESVs continue to operate under the current environment as prescribed in Resolution **902 (WRC-03)** and some other ESVs operate under the new operational environment (different e.i.r.p. density and different eventual antenna elevation angle as outlined above)? However, other administrations are of the view that this issue is proposed to be addressed in the new *resolves* 2 and 3 of Resolution **902** according to Method C.

7. The burden, compared to the current single distance requirement, on that terrestrial administration, in particular those of developing and least developed countries, to take into account the variety of cases mentioned above to ensure that its terrestrial services are duly protected.

8. The issue of reduction of e.i.r.p. density of the ESV resulting from advances in technology, if really implementable, is an interesting issue which should not be limited and deployed for ESV only. On the contrary, it should be deployed and / or used for all FSS earth stations. In fact, if such advance in technology is available and used in all type of FSS earth stations, this could contribute to the efficient rational economical use of the orbital spectrum resources as highlighted in Article 44 of the Constitution.

   In view of the above, ITU-R needs first to examine the applicability and implementation of advance technology, such as use of spread spectrum and use of lower e.i.r.p. density mentioned in some studies under WRC-15 agenda item 1.8 in the use orbit spectrum utilization in other space service, if such technique is practical, valid and implementable in these other services. No information is yet officially available on such use. Consequently, any claim that this technique is only available for ESV seems to undermine the fact and reality in saying that only such technique in only available to ESV and not to other services.

9. Based on the studies for different off-shore distances, using maximum e.i.r.p., question raised is that how the terrestrial administration measures the e.i.r.p. density of current monitoring of the e.i.r.p. density?

4.1/1.8/4.1.2 Some other administrations are of the view that:

– Concerning paragraph 6 of Annex 1 to Resolution **902 (WRC-03)** as mentioned above, the proponents of an appropriate relaxation in ESV regulations are confident in the ability and desire for operators to apply RR provisions, in the same way as current practices for protecting other primary services. It must be reminded that typical ESV network structure includes a Network Operation Center which monitors the registered stations, with the view to implement the appropriate regulations as well as to ensure an efficient use of the satellite spectral resource while allowing ship stations to benefit from this transmit power reduction by extending the operational area where prior agreement of coastal administrations is not required.

Such an approach could usefully alleviate administrations workload associated with coordination with ESV operators willing to offer access to broadband services within the limits of Resolution **902 (WRC-03)**, as already planned by several different regional procedures.

– It should be noticed that Resolution **902 (WRC-03)** already envisaged for Ku band antennas as small as 60 cm. These administrations also believe that reducing the protection distances for operation of ESV transmitting low e.i.r.p density levels will in fact reduce the regulatory burden of administrations since the number of cases of required coordination will be reduced. These administrations also consider that licensing administrations should ensure compliance of ESV operations under their responsibility with the applicable regulatory provisions, so as to not burden coastal administrations with the need to monitor such compliance.

– The goal of mentioned studies is to define separation distance within which the ship stations (ESVs) will be allowed to operate without prior agreement in the same way as currently done.

– With respect to question 1 in section 4.1/1.8/4.1.1, the answer to this question lies on the fact that Resolution **902 (WRC-03)** already requires the ESV licensing administration and service providers to ensure that the operational provisions and technical limitations of the Resolution are met. If coordination is needed, the information required to conduct the coordination process, such as precise e.i.r.p. density and elevation angle, will be provided by the administration licensing the ESV, in accordance with *encourages concerned administrations* in Resolution **902 (WRC-03)**.

– With respect to question 2 in section 4.1/1.8/4.1.1, the answer to this question lies on the fact that in accordance with items 1 and 2 of Annex 1 of Resolution **902 (WRC-03)**, enforcement of the provisions and technical limitations, including conditions agreed during coordination, are to be ensured by the ESV licensing administration and ESV service providers.

– With respect to question 3 in section 4.1/1.8/4.1.1, the answer to this question lies on the fact that the methodology used in the derivation of the protection distances takes into account multiple passes of ESVs transmitting the maximum allowed e.i.r.p. density toward the horizon, and therefore the derived protection for terrestrial services cater for the aggregate effect of multiple worst-case transmitting ESVs. ESVs operating with power levels and elevation angles such that the e.i.r.p. density toward the coast is smaller than the maximum value assumed in the derivation of protection distances can only improve the interference scenario.

– With respect to question 4 in section 4.1/1.8/4.1.1, the answer to this question lies on the fact that the derivation of protection distances was made for the 6 and 14 GHz independently, which does not prevent the same vessel from being equipped with terminals operating in both frequency bands. As to multiple ESVs operating on the same vessel in the same frequency band, this situation would only arise if the service provider used several different satellite networks for service to the same vessel, which is highly unlikely for this type of service. The issue of aggregation of interference from multiple ESVs was addressed in the paragraph above.

– With respect to question 5 in section 4.1/1.8/4.1.1, the answer to this question lies on the fact that the regulatory regime applies to the operation of individual ESVs and not to the vessels. Consequently, each ESV is or is not allowed to operate in accordance with the terms of Resolution **902 (WRC-03)** and with the terms of agreements reached between the ESV licensing administration/service providers and the potentially affected administrations.

– With respect to question 6 in section 4.1/1.8/4.1.1, this question is proposed to be addressed in the new *resolves* 2 and 3 of Resolution **902** according to Method C.

– With respect to question 7 in section 4.1/1.8/4.1.1, the answer to this question lies on the fact that, once ESVs operating with e.i.r.p. density levels lower than the maximum levels currently prescribed by Resolution **902 (WRC-03)** are allowed to come closer to the coast before they need to coordinate, the total number of requests to coordinate will necessarily be smaller than it would be the case if all ESVs, regardless of their potential to cause interference, were required to coordinate if they were to operate within the current protection distances. Consequently, the proposed new regulatory regime can only decrease the administrative burden of administrations, which is one of the advantages of Methods C and D.

– With respect to question 9 in section 4.1/1.8/4.1.1, the answer to this question lies on the fact that it should be up to the licensing administration to ensure that the ESVs under its responsibility conform to the international regulations and implement mechanisms to avoid their infringement. Monitoring of ESV transmitted power levels should not be required of administrations in whose territory terrestrial facilities are deployed just as no requirement exists for potentially affected administrations to monitor the transmit power levels filed for earth stations or agreed as a result of intersystem coordination of potentially affecting satellite networks.

4.1/1.8/4.2 Other considerations

Some administrations are of the view that, in general, there are two possible different interference scenarios with respect to the FS:

Scenario 1: ESV passes in parallel to a coast line.

Scenario 2: ESV passes in perpendicular to a coast line.

The first scenario corresponds to Recommendation ITU-R SF.1650-1 where the results of the protection distances were received, namely, 300 km and 125 km, in the C and Ku bands, respectively.

On this base, Resolution **902 (WRC-03)** was developed with detailed regulatory and operational provisions for ESVs transmitting in the C and Ku bands.

The second scenario corresponds to the long-term protection and is based on the concept of the “Fractional Degradation in Performance” (FDP) and Recommendation ITU-R F.1494. Using of this concept will give much larger separation distances for the ESVs, but this problem is out of the scope of Resolution **909 (WRC-12)** for modifications to Resolution **902 (WRC-03)**.

Some administrations believe that at this study period it is necessary to solve the problem put by Resolution **909 (WRC-12)**, namely, to modify Resolution **902 (WRC-03)** based on the results of the short-term separation distances (this is the first scenario). To solve the problem on the second scenario it will take a great deal of time and trouble, including the detailed development of regulatory, operational provisions and technical limitations (it is the problem for the next study period: 2015-2018 years).

Some other administrations are of the view that, for the 14 GHz frequency band, vessels of sizes compatible with ESV terminals with antenna diameters as small as 1.2 m, and even 60 cm, were considered by WRC-03 when determining the geometry of the traveling route used in the derivation of protection distances. It was based on these assumptions that the traveling routes were established and used in the derivation of the protection distances found in Recommendation ITU-R SF.1650 and Resolution **902 (WRC-03)**, and therefore the proposed change in 6 GHz antenna diameter should not impact the traveling routes assumed in the current studies.

4.1/1.8/4.3 Views on the ESV regulatory framework

Two views with respect to the ESV regulatory frameworks were proposed, as follows:

View 1:

Some administrations are of the view that in dealing with the operation of ESV either in application of Resolution **902 (WRC-03)** or a modified version of that or a new Resolution on the matter, ESV operator/administration needs to provide all information, where required, to the terrestrial administration in order to enable that administration to verify to whether the 300 km distance in C band and 125 km distance in Ku band have been properly respected.

View 2:

Some other administrations believe that the current regulatory framework where the ESV operators only provide detailed information on the ESV transmissions if they intend to operate within the regulatory distances is working and practice today, and therefore there is no need to change that aspect of the regulations.

"Transitional arrangement"

Due to the fact that many if not all ESVs would continue to operate using criteria contained in Resolution **902 (WRC-03)** and some may be deployed using improved characteristics such as digital modulation, it is necessary to establish transitional arrangements to be used by coastal administrations using terrestrial services to clarify how to deal with these ESVs operating with a combination of old and new characteristics.

This issue is further elaborated and reflected in the modification proposal to Resolution **902 (WRC-03)** as proposed in Methods C and D.

4.1/1.8/5 Method(s) to satisfy the agenda item

4.1/1.8/5.1 Method A: No change to the Radio Regulations

Proponents of this method believe that in fact, any reduction in antenna size and reduction of distance between the vessels and shore would adversely impact the deployment of terrestrial services of countries for which these services constitute their infrastructure backbone telecommunication services.

Advantages:

– No additional text to the RR and no modification to Resolution **902 (WRC-03)**.

– Retention of the limits as currently specified in Resolution **902 (WRC-03)** for operation of ESVs.

– Straightforward and simple criteria currently used by administrations in carrying out their tasks with respect to the operation of the ESVs; whereas proposed criteria/parameters to define distance based on variable maximum e.i.r.p. involving continual monitoring of the situation would be cumbersome to administrations in particular those from developing countries.

– The sovereignty of the country involved in coordination of their terrestrial services with ESVs is appropriately preserved.

– Coastal administration does not need to continuously monitor different values of e.i.r.p. density and also does not need to have any information on the type of modulation used taking into account administrative and other burdens that may be imposed due to the use of different e.i.r.p and different modulation technique.

Disadvantages:

– Technological advances such as new modulation technologies would not be considered, which does not allow ESV operators to have shorter coordination distance.

4.1/1.8/5.2 Method B: Increasing off-shore protection distance in the C band

Proponents of this method believe that the number of passes of ships has significantly increased. This would have direct impact on distance from shore/coast. By increasing the number of vessels, the protection distance increases to almost 345 km in the C band but it could be reached to approximately 125 km for the Ku band. These figures are proposed based on the increasing number of vessels and the current maximum ESV e.i.r.p density levels contained in Resolution **902 (WRC-03)**.

Advantages:

- By increasing the protective off-shore distance in the C band to the above mentioned value and using of the old and new operational ESVs simultaneously, the FS would be better protected without any interference.
- Simple modification of the protective off-shore distance value in Resolution **902 (WRC-03)**.
- No additional text to be added to the RR.
- Straightforward and simple criteria to be used by administrations in carrying out their task with respect to the operation of the ESVs, whereas proposed criteria /parameters to define distance based on variable maximum e.i.r.p. involving continual monitoring of the situation would be cumbersome to administrations in particular those from developing countries.
- The sovereignty of the country involved in coordination of their terrestrial services with ESV is appropriately preserved.

Disadvantages:

- Single distances will impose unnecessary administrative burden to ESVs transmitting lower power levels than those considered by WRC-03 and reflected in Resolution **902 (WRC-03)**.
- May over protect FS if assumption of a denser deployment of ESVs with respect to that of WRC-03 is not confirmed.

4.1/1.8/5.3 Method C: Establishment of different protection distances for different maximum e.i.r.p. density levels, with shorter protection distances for e.i.r.p. density levels lower than those currently allowed by Resolution 902 (WRC-03)

Method C proposes the adoption of distances associated with maximum values of ESV e.i.r.p. spectral density towards the horizon according to the values mentioned above (see section 4.1/1.8/3.2).

Proponents of this method believe that there is no evidence indicating that the ESV deployment scenario considered by WRC-03 for the 14 GHz band is no longer valid today. Consequently, the protection against interference afforded by Resolution **902 (WRC-03)** to the FS can be used to derive different protection distances for ESVs transmitting lower e.i.r.p. density levels toward the horizon, in accordance with the current ESV technologies being deployed (e.g. use of spread spectrum modulation) or planned to be used, while still adequately protecting terrestrial services. Since the minimum ESV antenna diameter considered for the 6 GHz band nowadays is 1.2 m instead of the 2.4 m diameter provided in Resolution **902 (WRC-03)**, the effect of increased frequency of ESV passes need to be taken into account.

Advantages:

- Eliminates unnecessary geographic limitations on ESVs operating or planned to operate with lower power levels as afforded by current technologies.
- Reduces administrative burden of having to coordinate ESVs which have no potential for causing unacceptable interference to terrestrial services.
- Straightforward and simple criteria to be used by administrations to determine the need to coordinate the operation of the ESVs.
- The sovereignty of the country involved for the coordination of ESVs with its terrestrial services would be appropriately preserved.

Disadvantages:

− Different distances, associated with different values of ESV e.i.r.p. spectral density toward the horizon and taking into account the cumulative effect of the total number of passing vessels, will impose additional technical, regulatory and administrative burden for the deployment of FS and MS in countries for which these services constitute their infra-structure backbone telecommunication services.

− Added complexity to the regulatory provisions given the additional granularity of the off-shore distances specified under this Method.

− Even if the e.i.r.p. spectral density is reduced, there is no assurance that such e.i.r.p. density levels as mentioned in the above tables would be practically observed when the earth station is operating.

4.1/1.8/5.4 Method D: Establishment of different protection distances for different maximum e.i.r.p. density levels for the increasing ESVs passes in the C and Ku bands

Method D proposes the adoption of the distances associated with values of maximum ESV e.i.r.p. spectral density toward the horizon according to the values mentioned above (see section 4.1/1.8/3.3).

Proponents of this method believe that the protection against interference afforded by Resolution **902 (WRC-03)** to the FS can be used to derive different protection distances for ESVs transmitting lower e.i.r.p. density levels toward the horizon, in accordance with the current ESV technologies being deployed (e.g. use of spread spectrum modulation) or planned to be used, while still adequately protecting terrestrial services. It is correctly as for the number of vessels adopted in Recommendation ITU-R SF.1650-1, and for the increasing numbers of vessels passing. However, even though different protection distances for ESVs transmitting lower e.i.r.p. density levels toward the horizon could be derived, the fundamental rules in Resolution **902 (WRC-03**) are still valid.

It is noted that the advantages and disadvantages of this method are same as the advantages and disadvantages of the Method C.

4.1/1.8/5.5 Method E: Review of the regulatory regime governing operation of ESVs

Method E proposes to review the regulatory regime governing the operation of ESVs to conform to the principles and objectives of the RR.

4.1/1.8/6 Regulatory and procedural considerations

4.1/1.8/6.1 Method A

No changes to the Radio Regulations.

SUP

RESOLUTION 909 (WRC-12)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

4.1/1.8/6.2 Method B

A proposed text of a revised Resolution **902 (WRC-03)** incorporating the proposals under Method B is provided below.

MOD

RESOLUTION 902 (REV.WRC-~~03~~15)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

The World Radiocommunication Conference (Geneva, 20~~03~~15),

considering

a) that there is a demand for global wideband satellite communication services on vessels;

b) that the technology exists that enables earth stations on board vessels (ESVs) to use fixed-satellite service (FSS) networks operating in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz;

c) that ESVs are currently operating through FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz under No. **4.4**;

d) that ESVs have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

e) that, with respect to the bands considered in this Resolution, global coverage is only available in the band 5 925-6 425 MHz and that only a limited number of geostationary FSS systems can provide such global coverage;

f) that, without special regulatory provisions, ESVs could place a heavy coordination burden on some administrations, especially those in developing countries;

g) that, in order to ensure the protection and future growth of other services, ESVs need to operate under certain technical and operational limitations;

h) that, within ITU-R studies, based on agreed technical assumptions, minimum distances from the low-water mark as officially recognized by the coastal State have been calculated, beyond which an ESV will not have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

i) that, in order to limit the interference into other networks in the FSS, it is necessary to establish maximum off-axis e.i.r.p. density limits on ESV emissions;

j) that establishing a minimum antenna diameter for ESVs has an impact on the number of ESVs that will ultimately be deployed, hence it will reduce interference into the fixed service,

noting

a) that ESVs may be assigned frequencies to operate in FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz pursuant to No. **4.4** and shall not claim protection from, nor cause interference to, other services having allocations in these bands;

b) that the regulatory procedures of Article **9** apply for ESVs operating at specified fixed points,

resolves

that ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands shall operate under the regulatory and operational provisions contained in Annex 1 and the technical limitations in Annex 2 of this Resolution,

encourages concerned administrations

to cooperate with administrations which license ESVs while seeking agreement under the above-mentioned provisions, taking into consideration the provisions of Recommendation **37 (WRC-03)**,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of the International Maritime Organization (IMO).

ANNEX 1 TO RESOLUTION 902 (REV.WRC-~~03~~15)

Regulatory and operational provisions for ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands

1 The administration that issues the licence for the use of ESVs in these bands (licensing administration) 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 other concerned administrations.

2 ESV service providers shall comply with the technical limitations listed in Annex 2 and, when operating within the minimum distances as identified in item 4 below, with the additional limitations agreed by the licensing and other concerned administrations.

3 In the 3 700-4 200 MHz band and 10.7-12.75 GHz range, ESVs in motion shall not claim protection from transmissions of terrestrial services operating in accordance with the Radio Regulations.

4 The minimum distances from the low-water mark as officially recognized by the coastal State beyond which ESVs can operate without the prior agreement of any administration are ~~300~~345 km in the 5 925-6 425 MHz band and 125 km in the 14-14.5 GHz band, taking into account the technical limitations in Annex 2. Any transmissions from ESVs within the minimum distances shall be subject to the prior agreement of the concerned administration(s).

5 The potentially concerned administrations referred to in the previous item 4 are those where fixed or mobile services are allocated on a primary basis in the Table of Frequency Allocations of the Radio Regulations:

Frequency bands	Potentially concerned administrations
5 925-6 425 MHz	All three Regions
14-14.25 GHz	Countries listed in No. **5.505**, except those listed in No. **5.506B**
14.25-14.3 GHz	Countries listed in Nos. **5.505**~~,~~ and **5.508** ~~and **5.509**,~~ except those listed in No. **5.506B**
14.3-14.4 GHz	Regions 1 and 3, except countries listed in No. **5.506B**
14.4-14.5 GHz	All three Regions, except countries listed in No. **5.506B**

6 The ESV system shall include means of identification and mechanisms to immediately cease emissions, whenever the station does not operate in compliance with the provisions of items 2 and 4 above.

7 Cessation of emissions as referred to in item 6 above shall be implemented in such a way that the corresponding mechanisms cannot be bypassed on board the vessel, except under the provisions of No. **4.9**.

8 ESVs shall be equipped so as to:

– enable the licensing administration under the provisions of Article **18** to verify earth station performance; and

– enable the cessation of ESV emissions immediately upon request by an administration whose services may be affected.

9 Each licence-holder shall provide a point of contact to the administration with which agreements have been reached for the purpose of reporting unacceptable interference caused by the ESV.

10 When ESVs operating beyond the territorial sea but within the minimum distance (as referred to in item 4 above) fail to comply with the terms required by the concerned administration pursuant to items 2 and 4, then that administration may:

– request the ESV to comply with such terms or cease operation immediately; or

– request the licensing administration to require such compliance or immediate cessation of the operation.

ANNEX 2 TO RESOLUTION 902 (REV.WRC-0315)

Technical limitations applicable to ESVs transmitting in the bands 5 925-6 425 MHz and 14-14.5 GHz

	5 925-6 425 MHz	**14-14.5 GHz**
Minimum diameter of ESV antenna	2.4 m	1.2 m[1]
Tracking accuracy of ESV antenna	±0.2° (peak)	±0.2° (peak)
Maximum ESV e.i.r.p. spectral density toward the horizon	17 dB(W/MHz)	12.5 dB(W/MHz)
Maximum ESV e.i.r.p. towards the horizon	20.8 dBW	16.3 dBW
Maximum off-axis e.i.r.p. density[2]	See below	See below

[1] While operations within the minimum distances are subject to specific agreement with concerned administrations, licensing administrations may authorize the deployment of smaller antenna sizes down to 0.6 m at 14 GHz provided that the interference to the terrestrial services is no greater than that which would be caused with an antenna size of 1.2 m, taking into account Recommendation ITU-R SF.1650. In any case, the use of smaller antenna size shall be in compliance with the tracking accuracy of ESV antenna, maximum ESV e.i.r.p. spectral density toward the horizon, maximum ESV e.i.r.p. towards the horizon and maximum off-axis e.i.r.p. density limits in the Table above and the protection requirements of the FSS intersystem coordination agreements.

[2] In any case, the e.i.r.p. off-axis limits shall be compliant with the FSS intersystem coordination agreements that may agree to more stringent off-axis e.i.r.p. levels.

Off-axis limits

For earth stations on board vessels operating in the 5 925-6 425 MHz band, at any angle φ specified below, off the main-lobe axis of an earth-station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

5 925-6 425 MHz

Angle off-axis	*Maximum e.i.r.p. per 4 kHz band*
$2.5° \leq \varphi \leq 7°$	$(32 - 25 \log \varphi)$ dB(W/4 kHz)
$7° < \varphi \leq 9.2°$	11 dB(W/4 kHz)
$9.2° < \varphi \leq 48°$	$(35 - 25 \log \varphi)$ dB(W/4 kHz)
$48° < \varphi \leq 180°$	−7 dB(W/4 kHz)

For ESV operating in the 14.0-14.5 GHz band, at any angle φ specified below, off the main-lobe axis of an earth station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

14.0-14.5 GHz

Angle off-axis	*Maximum e.i.r.p. per 40 kHz band*
$2° \leq \varphi \leq 7°$	$(33 - 25 \log \varphi)$ dB(W/40 kHz)
$7° < \varphi \leq 9.2°$	12 dB(W/40 kHz)
$9.2° < \varphi \leq 48°$	$(36 - 25 \log \varphi)$ dB(W/40 kHz)
$48° < \varphi \leq 180°$	−6 dB(W/40 kHz)

SUP

RESOLUTION 909 (WRC-12)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

4.1/1.8/6.3 Method C

A proposed text of a revised Resolution **902 (WRC-03)** incorporating the proposals under Method C is provided below.

MOD

RESOLUTION 902 (REV.WRC-~~03~~15)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

The World Radiocommunication Conference (Geneva, 20~~03~~15),

considering

a) that there is a demand for global wideband satellite communication services on vessels;

b) that the technology exists that enables earth stations on board vessels (ESVs) to use fixed-satellite service (FSS) networks operating in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz;

c) that ESVs are currently operating through FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz under No. **4.4**;

d) that ESVs have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

e) that, with respect to the bands considered in this Resolution, global coverage is only available in the band 5 925-6 425 MHz and that only a limited number of geostationary FSS systems can provide such global coverage;

f) that, without special regulatory provisions, ESVs could place a heavy coordination burden on some administrations, especially those in developing countries;

g) that, in order to ensure the protection and future growth of other services, ESVs need to operate under certain technical and operational limitations;

h) that, within ITU-R studies, based on agreed technical assumptions, minimum distances from the low-water mark as officially recognized by the coastal State have been calculated, beyond which an ESV will not have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

i) that, in order to limit the interference into other networks in the FSS, it is necessary to establish maximum off-axis e.i.r.p. density limits on ESV emissions;

j) that establishing a minimum antenna diameter for ESVs has an impact on the number of ESVs that will ultimately be deployed, hence it will reduce interference into the fixed service,

noting

a) that ESVs may be assigned frequencies to operate in FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz pursuant to No. **4.4** and shall not claim protection from, nor cause interference to, other services having allocations in these bands;

b) that the regulatory procedures of Article **9** apply for ESVs operating at specified fixed points,

resolves

1 that ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands shall operate under the regulatory and operational provisions contained in Annex 1 and the technical limitations in Annex 2 of this Resolution,;

2 that ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances established in this Resolution are shorter than those contained in Resolution **902 (WRC-03)** shall operate in accordance with the regulatory conditions established in this Resolution from the date it comes into force;

3 that ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances established in this Resolution are larger than those contained in Resolution **902 (WRC-03)** shall have one year from the date this Resolution comes into force to conform to the conditions established herein,

Note: It is worth to mention that the language used in *resolves* 2 and 3 above may need refinement to be consistent with the purpose of the Resolution and the need to decide on the period “one year” referred to in *resolves* 3 above.

encourages concerned administrations

to cooperate with administrations which license ESVs while seeking agreement under the above-mentioned provisions, taking into consideration the provisions of Recommendation **37 (WRC-03)**,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of the International Maritime Organization (IMO).

ANNEX 1 TO RESOLUTION 902 (REV.WRC-0315)

Regulatory and operational provisions for ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands

1 The administration that issues the licence for the use of ESVs in these bands (licensing administration) 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 other concerned administrations.

2 ESV service providers shall comply with the technical limitations listed in Annex 2 and, when operating within the minimum distances as identified in item 4 below, with the additional limitations agreed by the licensing and other concerned administrations.

3 In the 3 700-4 200 MHz band and 10.7-12.75 GHz range, ESVs in motion shall not claim protection from transmissions of terrestrial services operating in accordance with the Radio Regulations.

4 The minimum distances from the low-water mark as officially recognized by the coastal State beyond which ESVs can operate without the prior agreement of any administration are ~~300 km~~given in Table 1 for the 5 925-6 425 MHz band and ~~125 km~~ in Table 2 for the 14-14.5 GHz band, taking into account the technical limitations in Annex 2. Any transmissions from ESVs within the minimum distances shall be subject to the prior agreement of the concerned administration(s).

5 The potentially concerned administrations referred to in the previous item 4 are those where fixed or mobile services are allocated on a primary basis in the Table of Frequency Allocations of the Radio Regulations:

Frequency bands	Potentially concerned administrations
5 925-6 425 MHz	All three Regions
14-14.25 GHz	Countries listed in No. **5.505**, except those listed in No. **5.506B**
14.25-14.3 GHz	Countries listed in Nos. **5.505**~~,~~ and **5.508** ~~and **5.509**,~~ except those listed in No. **5.506B**
14.3-14.4 GHz	Regions 1 and 3, except countries listed in No. **5.506B**
14.4-14.5 GHz	All three Regions, except countries listed in No. **5.506B**

6 The ESV system shall include means of identification and mechanisms to immediately cease emissions, whenever the station does not operate in compliance with the provisions of items 2 and 4 above.

7 Cessation of emissions as referred to in item 6 above shall be implemented in such a way that the corresponding mechanisms cannot be bypassed on board the vessel, except under the provisions of No. **4.9**.

8 ESVs shall be equipped so as to:

– enable the licensing administration under the provisions of Article **18** to verify earth station performance; and

– enable the cessation of ESV emissions immediately upon request by an administration whose services may be affected.

9 Each licence-holder shall provide a point of contact to the administration with which agreements have been reached for the purpose of reporting unacceptable interference caused by the ESV.

10 When ESVs operating beyond the territorial sea but within the minimum distance (as referred to in item 4 above) fail to comply with the terms required by the concerned administration pursuant to items 2 and 4, then that administration may:

– request the ESV to comply with such terms or cease operation immediately; or

– request the licensing administration to require such compliance or immediate cessation of the operation.

TABLE 1

Values for the 5 925-6 425 MHz band ESVs

Maximum e.i.r.p. transmitted toward the horizon (dBW in 11.2 MHz)	Minimum distance from low-water mark* (km)
20.8	323
10.8	227
0.8	130
−9.2	64

* Low-water mark as officially recognized by the coastal State.

TABLE 2

Values for the 14-14.5 GHz band ESVs

Maximum e.i.r.p. transmitted toward the horizon (dBW in 14 MHz)	Minimum distance from low-water mark* (km)
16.3	125
6.3	85
–3.7	29

* Low-water mark as officially recognized by the coastal State.

ANNEX 2 TO RESOLUTION 902 (REV.WRC-~~03~~15)

Technical limitations applicable to ESVs transmitting in the bands 5 925-6 425 MHz and 14-14.5 GHz

	5 925-6 425 MHz	14-14.5 GHz
Minimum diameter of ESV antenna	~~2.4~~1.2 m	~~1.2 m~~[~~1~~]60 cm
Tracking accuracy of ESV antenna	±0.2° (peak)	±0.2° (peak)
Maximum ESV e.i.r.p. spectral density toward the horizon	17 dB(W/MHz)	12.5 dB(W/MHz)
Maximum ESV e.i.r.p. towards the horizon	20.8 dBW	16.3 dBW
Maximum off-axis e.i.r.p. density[~~2~~1]	See below	See below

~~1 While operations within the minimum distances are subject to specific agreement with concerned administrations, licensing administrations may authorize the deployment of smaller antenna sizes down to 0.6 m at 14 GHz provided that the interference to the terrestrial services is no greater than that which would be caused with an antenna size of 1.2 m, taking into account Recommendation ITU-R SF.1650. In any case, the use of smaller antenna size shall be in compliance with the tracking accuracy of ESV antenna, maximum ESV e.i.r.p. spectral density toward the horizon, maximum ESV e.i.r.p. towards the horizon and maximum off-axis e.i.r.p. density limits in the Table above and the protection requirements of the FSS intersystem coordination agreements.~~

~~2~~1 In any case, the e.i.r.p. off-axis limits shall be compliant with the FSS intersystem coordination agreements that may agree to more stringent off-axis e.i.r.p. levels.

Off-axis limits

For earth stations on board vessels operating in the 5 925-6 425 MHz band, at any angle φ specified below, off the main-lobe axis of an earth-station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

5 925-6 425 MHz

Angle off-axis					*Maximum e.i.r.p. per 4 kHz band*
2.5°	≤	φ	≤	7°	(32 − 25 log φ) dB(W/4 kHz)
7°	<	φ	≤	9.2°	11 dB(W/4 kHz)
9.2°	<	φ	≤	48°	(35 − 25 log φ) dB(W/4 kHz)
48°	<	φ	≤	180°	−7 dB(W/4 kHz)

For ESV operating in the 14-14.5 GHz band, at any angle φ specified below, off the main-lobe axis of an earth station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

14.0-14.5 GHz

Angle off-axis					*Maximum e.i.r.p. per 40 kHz band*
2°	≤	φ	≤	7°	(33 − 25 log φ) dB(W/40 kHz)
7°	<	φ	≤	9.2°	12 dB(W/40 kHz)
9.2°	<	φ	≤	48°	(36 − 25 log φ) dB(W/40 kHz)
48°	<	φ	≤	180°	−6 dB(W/40 kHz)

SUP

RESOLUTION 909 (WRC-12)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

4.1/1.8/6.4 Method D

A proposed text of a revised Resolution **902 (WRC-03)** incorporating the proposals under Method D is provided below.

MOD

RESOLUTION 902 (REV.WRC-~~03~~15)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

The World Radiocommunication Conference (Geneva, 20~~03~~15), *considering*

a) that there is a demand for global wideband satellite communication services on vessels;

b) that the technology exists that enables earth stations on board vessels (ESVs) to use fixed-satellite service (FSS) networks operating in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz;

c) that ESVs are currently operating through FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz under No. **4.4**;

d) that ESVs have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

e) that, with respect to the bands considered in this Resolution, global coverage is only available in the band 5 925-6 425 MHz and that only a limited number of geostationary FSS systems can provide such global coverage;

f) that, without special regulatory provisions, ESVs could place a heavy coordination burden on some administrations, especially those in developing countries;

g) that, in order to ensure the protection and future growth of other services, ESVs need to operate under certain technical and operational limitations;

h) that, within ITU-R studies, based on agreed technical assumptions, minimum distances from the low-water mark as officially recognized by the coastal State have been calculated, beyond which an ESV will not have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

i) that, in order to limit the interference into other networks in the FSS, it is necessary to establish maximum off-axis e.i.r.p. density limits on ESV emissions;

j) that establishing a minimum antenna diameter for ESVs has an impact on the number of ESVs that will ultimately be deployed, hence it will reduce interference into the fixed service,

noting

a) that ESVs may be assigned frequencies to operate in FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz pursuant to No. **4.4** and shall not claim protection from, nor cause interference to, other services having allocations in these bands;

b) that the regulatory procedures of Article **9** apply for ESVs operating at specified fixed points,

resolves

1 that ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands shall operate under the regulatory and operational provisions contained in Annex 1 and the technical limitations in Annex 2 of this Resolution,

2 that ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances established in this Resolution are shorter than those contained in Resolution **902 (WRC-03)** shall operate in accordance with the regulatory conditions established in this Resolution from the date it comes into force;

3 that ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances established in this Resolution are larger than those contained in Resolution **902 (WRC-03)** shall have one year from the date this Resolution comes into force to conform to the conditions established herein,

Note: It is worth to mention that the language used in *resolves* 2 and 3 above may need refinement to be consistent with the purpose of the Resolution and the need to decide on the period “one year” referred to in *resolves* 3 above.

encourages concerned administrations

to cooperate with administrations which license ESVs while seeking agreement under the above-mentioned provisions, taking into consideration the provisions of Recommendation **37 (WRC-03)**,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of the International Maritime Organization (IMO).

ANNEX 1 TO RESOLUTION 902 (REV.WRC-~~03~~15)

Regulatory and operational provisions for ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands

1 The administration that issues the licence for the use of ESVs in these bands (licensing administration) 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 other concerned administrations.

2 ESV service providers shall comply with the technical limitations listed in Annex 2 and, when operating within the minimum distances as identified in item 4 below, with the additional limitations agreed by the licensing and other concerned administrations.

3 In the 3 700-4 200 MHz band and 10.7-12.75 GHz range, ESVs in motion shall not claim protection from transmissions of terrestrial services operating in accordance with the Radio Regulations.

4 The minimum distances from the low-water mark as officially recognized by the coastal State beyond which ESVs can operate without the prior agreement of any administration are ~~300 km~~given in Table 1 for the 5 925-6 425 MHz band and ~~125 km~~ in Table 2 for the 14-14.5 GHz band, taking into account the technical limitations in Annex 2. Any transmissions from ESVs within the minimum distances shall be subject to the prior agreement of the concerned administration(s).

5 The potentially concerned administrations referred to in the previous item 4 are those where fixed or mobile services are allocated on a primary basis in the Table of Frequency Allocations of the Radio Regulations:

Frequency bands	Potentially concerned administrations
5 925-6 425 MHz	All three Regions
14-14.25 GHz	Countries listed in No. **5.505**, except those listed in No. **5.506B**
14.25-14.3 GHz	Countries listed in Nos. **5.505**~~,~~ and **5.508** ~~and **5.509**~~, except those listed in No. **5.506B**
14.3-14.4 GHz	Regions 1 and 3, except countries listed in No. **5.506B**
14.4-14.5 GHz	All three Regions, except countries listed in No. **5.506B**

6 The ESV system shall include means of identification and mechanisms to immediately cease emissions, whenever the station does not operate in compliance with the provisions of items 2 and 4 above.

7 Cessation of emissions as referred to in item 6 above shall be implemented in such a way that the corresponding mechanisms cannot be bypassed on board the vessel, except under the provisions of No. **4.9**.

8 ESVs shall be equipped so as to:

– enable the licensing administration under the provisions of Article **18** to verify earth station performance; and

– enable the cessation of ESV emissions immediately upon request by an administration whose services may be affected.

9 Each licence-holder shall provide a point of contact to the administration with which agreements have been reached for the purpose of reporting unacceptable interference caused by the ESV.

10 When ESVs operating beyond the territorial sea but within the minimum distance (as referred to in item 4 above) fail to comply with the terms required by the concerned administration pursuant to items 2 and 4, then that administration may:

– request the ESV to comply with such terms or cease operation immediately; or

– request the licensing administration to require such compliance or immediate cessation of the operation.

TABLE 1

Values for the 5 925-6 425 MHz band ESVs

Maximum e.i.r.p. transmitted toward the horizon (dBW in 11.2 MHz)	**Minimum distance from low-water mark* (km)**
20.8	345
10.8	236
0.8	141
−9.2	59

* Low-water mark as officially recognized by the coastal State.

TABLE 2

Values for the 14-14.5 GHz band ESVs

Maximum e.i.r.p. transmitted toward the horizon (dBW in 14 MHz)	**Minimum distance from low-water mark* (km)**
16.3	125
6.3	108
–3.7	44

* Low-water mark as officially recognized by the coastal State.

ANNEX 2 TO RESOLUTION 902 (REV.WRC-0315)

Technical limitations applicable to ESVs transmitting in the bands 5 925-6 425 MHz and 14-14.5 GHz

	5 925-6 425 MHz	14-14.5 GHz
Minimum diameter of ESV antenna	2.41.2 m	1.2 m[1]60 cm
Tracking accuracy of ESV antenna	±0.2° (peak)	±0.2° (peak)
Maximum ESV e.i.r.p. spectral density toward the horizon	17 dB(W/MHz)	12.5 dB(W/MHz)
Maximum ESV e.i.r.p. towards the horizon	20.8 dBW	16.3 dBW
Maximum off-axis e.i.r.p. density[21]	See below	See below

[1] While operations within the minimum distances are subject to specific agreement with concerned administrations, licensing administrations may authorize the deployment of smaller antenna sizes down to 0.6 m at 14 GHz provided that the interference to the terrestrial services is no greater than that which would be caused with an antenna size of 1.2 m, taking into account Recommendation ITU-R SF.1650. In any case, the use of smaller antenna size shall be in compliance with the tracking accuracy of ESV antenna, maximum ESV e.i.r.p. spectral density toward the horizon, maximum ESV e.i.r.p. towards the horizon and maximum off-axis e.i.r.p. density limits in the Table above and the protection requirements of the FSS intersystem coordination agreements.

[21] In any case, the e.i.r.p. off-axis limits shall be compliant with the FSS intersystem coordination agreements that may agree to more stringent off-axis e.i.r.p. levels.

Off-axis limits

For earth stations on board vessels operating in the 5 925-6 425 MHz band, at any angle φ specified below, off the main-lobe axis of an earth-station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

5 925-6 425 MHz

Angle off-axis					*Maximum e.i.r.p. per 4 kHz band*
2.5°	≤	φ	≤	7°	(32 − 25 log φ) dB(W/4 kHz)
7°	<	φ	≤	9.2°	11 dB(W/4 kHz)
9.2°	<	φ	≤	48°	(35 − 25 log φ) dB(W/4 kHz)
48°	<	φ	≤	180°	−7 dB(W/4 kHz)

For ESV operating in the 14-14.5 GHz band, at any angle φ specified below, off the main-lobe axis of an earth station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

14.0-14.5 GHz

Angle off-axis					*Maximum e.i.r.p. per 40 kHz band*
2°	≤	φ	≤	7°	(33 − 25 log φ) dB(W/40 kHz)
7°	<	φ	≤	9.2°	12 dB(W/40 kHz)
9.2°	<	φ	≤	48°	(36 − 25 log φ) dB(W/40 kHz)
48°	<	φ	≤	180°	−6 dB(W/40 kHz)

SUP

RESOLUTION 909 (WRC-12)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

AGENDA ITEM 1.9.1

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

1.9 to consider, in accordance with Resolution ***758 (WRC-12)****:*

1.9.1 possible new allocations to the fixed-satellite service in the frequency bands 7 150-7 250 MHz (space-to-Earth) and 8 400-8 500 MHz (Earth-to-space), subject to appropriate sharing conditions;

Resolution **758 (WRC-12)**: *Allocation to the fixed-satellite service and the maritime-mobile satellite service in the 7/8 GHz range*

4.1/1.9.1/1 Executive summary

In accordance with Resolution **758 (WRC-12)**, the ITU-R has undertaken studies for possible new allocation of the bands 7 150-7 250 MHz (space-to-Earth) and 8 400-8 500 MHz (Earth-to-space) to the fixed-satellite service (FSS), subject to appropriate sharing conditions. The results of the sharing studies for GSO FSS are contained in PDN Report ITU-R S.[FSS 7/8GHz Compatibility].

In the 7 GHz band, sharing with incumbent services requires appropriate technical and regulatory measures. Moreover, sharing studies with the space research service (SRS) have identified limited regions around FSS GSO satellites in which interference from FSS GSO satellites could exceed the SRS protection criteria. In the particular case of SRS spacecraft crossing this interference area, operational measures between involved FSS and SRS systems will be required.

In the 8 GHz band, the results show that the incumbent services can be protected from FSS earth station transmissions by coordination.

Based on the results of the studies, different methods have been developed to satisfy WRC-15 agenda item 1.9.1.

Method A proposes primary worldwide allocations of the bands 7 150-7 250 MHz in the space-to-Earth direction and 8 400-8 500 MHz in the Earth-to-space direction to the FSS.

Method B proposes the same primary worldwide allocations except the band 7 150-7 190 MHz. For both methods, the use of these bands is limited to GSO FSS space stations and existing services are protected through the introduction of additional technical and regulatory measures including operational measures under specific circumstances. Additionally, the FSS shall not claim protection from the SRS and the space operation service (SOS).

Method C proposes no change to the Radio Regulations.

4.1/1.9.1/2 Background

Currently, there is a worldwide allocation to the FSS in the bands 7 250-7 750 MHz (space-to-Earth) and 7 900-8 400 MHz (Earth-to-space) and WRC-15 agenda item 1.9.1 addresses the possibility of extending the existing bands for FSS in accordance with Resolution **758 (WRC-12)** to the bands 7 150-7 250 MHz (space-to-Earth) and 8 400-8 500 MHz (Earth-to-space).

Currently, the band 7 150-7 235 MHz is allocated on a primary basis to the fixed service (FS), mobile service (MS), SOS (Earth-to-space)[27] and SRS (Earth-to-space)[28] while the band 7 235-7 250 MHz is allocated on a primary basis to the FS and MS only. Similarly, the band 8 400-8 500 MHz is allocated on a primary basis to the FS, MS (except aeronautical), and SRS (space-to-Earth).

Additionally, WRC-15 agenda item 1.11 invites the ITU-R to conduct compatibility studies between the Earth exploration-satellite service (EESS) (Earth-to-space) and existing services in the 7-8 GHz range, with priority to the band 7 145-7 235 MHz, with a view to obtain a primary allocation to EESS (Earth-to-space) in order to complement telemetry operations of EESS (space-to-Earth) in the 8 025-8 400 MHz band.

4.1/1.9.1/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant ITU-R Recommendations: ITU-R SA.363, ITU-R SA.1157, ITU-R SA.1014, ITU-R SA.609-2, ITU-R SA.514-3, ITU-R F.758-5, ITU-R F.699, ITU-R F.1245, ITU-R F.1336, ITU-R P.525, ITU-R P.452.

New relevant ITU-R Recommendations and Reports: PDN Report ITU-R S.[FSS 7/8GHz Compatibility].

4.1/1.9.1/4 Analysis of the results of studies

The proposed 7 150-7 250 MHz FSS (space-to-Earth) allocation will overlap with allocations to SRS (Earth-to-space), SOS (Earth-to-space), FS and MS. Similarly, the proposed 8 400-8 500 MHz FSS (Earth-to-space) allocation overlaps with SRS (space-to-Earth), FS and MS.

The results of sharing studies reported in PDN Report ITU-R S.[FSS 7/8GHz Compatibility] are analysed below.

Note: For the methods in response to this agenda item, consideration should be given to possible additional constraints to the operation and development of terrestrial services to which the band is currently allocated.

It should be noted that spectrum requirements as well as technical characteristics for FSS are limited to GSO FSS networks. No requirement for non-GSO FSS has been made.

4.1/1.9.1/4.1 Sharing in the 7 150-7 250 MHz band

4.1/1.9.1/4.1.1 FSS sharing with the SRS (deep space) in the 7 150-7 190 MHz band

Static and dynamic analyses were conducted for SRS deep space spacecraft during the launch-and-early-orbit (LEOP), Earth flyby, and sample return phases of the SRS deep space spacecraft operating in the 7 150-7 190 MHz band, which are critical events for SRS deep space missions (see Appendix B of Annex 4 in PDN Report ITU-R S.[FSS 7/8GHz Compatibility]). These analyses used a FSS space station e.i.r.p. spectral density of −26 dBW/Hz and Recommendation ITU-R SA.1157 as the SRS spacecraft protection criterion. The studies did not consider any apportionment of the protection criterion as described in the Recommendation ITU-R SA.1743.

Studies concluded that the SRS spacecraft protection criterion is met when the SRS missions are in the deep space region, where the range of deep space SRS spacecraft exceeds 2 million km.

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[27] Under provision RR No. **5.459**.

[28] Under provision RR No. **5.460**.

However, the spacecraft range can be as small as about 500 km and close to the geostationary-satellite orbit during near-Earth operations phase of deep space SRS spacecraft. During this phase, SRS spacecraft is expected to use Low Gain Antenna (LGA)/Medium Gain Antenna (MGA), but it can also use the High Gain Antenna (HGA) by off-pointing it from Earth when no other alternative is available or due to operational constraints. In this case, interference to SRS spacecraft may potentially occur depending on the relative configurations of the FSS satellite and SRS spacecraft.

Studies give the critical separation distances between the space stations of FSS and SRS (deep space), below which the received interference would exceed the protection criterion of the SRS. These critical separation distances calculated for the main beam coupling configuration range from 2 377 km to 597 179 km. The lower limit of this range is for 0 dBi spacecraft antenna gain. For a 7 dBi spacecraft antenna gain the lower limit becomes 5 322 km.

Although the trajectory of near-Earth phases of all SRS deep space missions studied so far were not in the equatorial plane but can cross it during the transitional phases, an analysis has considered a scenario with 90 FSS satellites, an SRS spacecraft in a theoretical equatorial trajectory and 3 different antennas (LGA, MGA, and HGA) for the deep space mission. This analysis shows that the SRS spacecraft would receive interference exceeding the protection criterion of SRS when the spacecraft travel at altitudes from 30 214 km to 95 000 km.

Dynamic analyses were conducted on the basis of the real trajectories of all SRS deep space missions for which orbital parameters during transitional near-Earth phases have been made available, using the same scenario of 90 FSS satellites and assuming a 20 dBi antenna gain for these FSS satellites. Initial studies for 3 deep space SRS missions show that, for 2 of them, harmful interference may occur for a continuous duration of up to about 5 minutes during the launch phase. The protection criterion of −190 dBW/20 Hz would be exceeded by up to 5 dB. When applying the e.i.r.p. spectral density mask described in section 4.1/1.9.1/6 to FSS satellites, no harmful interference would occur in any of the three missions analysed. The efficiency of this mitigation technique was then further confirmed through additional studies on seven additional SRS deep space missions for which orbital parameters have been made available.

All studies recognize that there exist regions around FSS GSO satellites, in which interference from FSS satellites exceeds the deep space SRS protection criteria. The sizes of these interference regions are reduced by introducing an e.i.r.p. spectral density mask on the FSS GSO transmission, but some interference region still exists.

Some studies, using 11 SRS (deep space) missions whose trajectories may not have flown through these regions, have concluded that sharing the 7 150-7 190 MHz band between FSS GSO and these SRS missions is feasible.

In the remaining case of SRS spacecraft crossing this interference area, operational measures between involved FSS and SRS systems will be required. Such operational measures would have to be conducted with all involved parties during the near-Earth critical events of SRS missions. These tasks will have to consider also that the launch of deep space SRS missions is frequently delayed due to weather or technical reasons. It should also be noted that some SRS deep space missions may operate at near-Earth distances for several months after launch.

It can therefore be concluded that, with the constraint of the e.i.r.p. spectral density mask and operational measures for the particular case of SRS spacecraft close to the GSO satellite, sharing is feasible, including during near-Earth transitional phases.

In the 7 150-7 190 MHz band, the impact of SRS (deep space) earth station transmissions into FSS earth station receivers was not assessed.

4.1/1.9.1/4.1.2 FSS sharing with the SRS (near-Earth) in the 7 190-7 235 MHz band

The studies assessed the impact of interference from FSS space stations into SRS (near-Earth) space stations for a FSS space station e.i.r.p. spectral density of −26 dBW/Hz. The studies did not consider any apportionment of the protection criterion as described in the Recommendation ITU-R SA.1743.

A separation distance of 3 700 km is needed for HEO and LEO near-Earth SRS missions and 29 700 km for Lagrange SRS missions. Note, however, that HEO and Lagrange SRS missions may be at distances lower than this for relatively short periods of time during transit.

For mitigation of GSO FSS interference into GSO SRS spacecraft, the static analyses indicate that the minimum orbital separation between FSS and SRS satellites needs to be greater than 0.5 degrees. Taking into account the e.i.r.p. spectral density mask described in section 4.1/1.9.1/6, the orbital separation is reduced to 0.1 deg.

Dynamic analyses were performed in order to assess the level and duration of the potential interference levels for these HEO and Lagrangian missions.

A dynamic analysis shows that harmful interference will occur for most of the near-Earth missions analysed with actual spacecraft trajectories. With regard to the most sensitive mission, the interference protection threshold from Recommendation ITU-R SA.609 is exceeded by up to 30 dB, periodically, during at least one complete month, and 11 dB for 0.1% of the time. These results were obtained for an FSS satellite antenna gain of 20 dBi. However, when considering the e.i.r.p. spectral density mask provided in section 4.1/1.9.1/6, the SRS protection criterion is met, although peaks up to 17 dB above the protection level would still be experienced. This was confirmed for other near-Earth SRS missions in an additional study.

A dynamic analysis considered a SRS circular non-GSO equatorial orbit and calculated interference from GSO FSS satellites with 4 degree orbital spacing and using the newly proposed FSS e.i.r.p. spectral density mask in section 4.1/1.9.1/6 into SRS spacecraft with both low-gain and medium-gain antennas. This study determined that there is a small range of altitudes for which the SRS spacecraft may receive interference above the protection criterion. However, no known mission has used this orbit in practice and is not expected to be used in the future.

Considering the results above, it appears that sharing is feasible between FSS (space-to-Earth) and SRS (Earth-to-space) in the band 7 190-7 235 MHz by limiting the FSS emission levels towards the SRS spacecraft (for example by using an e.i.r.p. spectral density mask).

In the 7 190-7 235 MHz band, the impact of SRS (near-Earth) earth station transmissions into FSS earth station receivers was not assessed.

4.1/1.9.1/4.1.3 FSS sharing with the FS in the 7 150-7 250 MHz band

The different studies confirmed that the extension of the provisions applicable to FSS stations above 7 250 MHz in the adjacent frequency band 7 150-7 250 MHz is sufficient to provide protection for FS receiving stations. Therefore, it seems appropriate to apply pfd limits as specified in RR No. **21.16**, Table **21-4**. It would be appropriate to establish GSO avoidance requirement for newly notified FS stations.

4.1/1.9.1/4.1.4 FSS sharing with the MS in the 7 150-7 250 MHz band

Since the interference characteristics from an FSS space station into an MS station in the band 7 250-7 750 MHz may not be much different from those in the band 7 150-7 250 MHz, any additional sharing condition may not be required provided that the pfd limit as specified in RR No. **21.16**, Table **21-4**, applies also to a space station in the FSS in the band 7 150-7 250 MHz.

4.1/1.9.1/4.1.5 FSS sharing with the EESS in the 7 150-7 235 MHz band

Sharing between FSS (space-to-Earth) and EESS (Earth-to-space) can be achieved through coordination process under RR No. **9.17A**. The coordination distance, calculated based on the TVG methodology (described in Annex 6 to RR Appendix **7**) and flat terrain, can reach up to 350 km for the worst case scenario. When taking into account real terrain elevation, the studies show that coordination distance is reduced from 60% to 90% for the considered stations.

4.1/1.9.1/4.1.6 FSS sharing with the SOS in the 7 150-7 235 MHz band

The studies assess the ratio of useful signal to interference power caused by emissions from a single or a set of FSS space stations located on the GSO. The results show that the protection criteria would be met in all modes of SOS operations except for one particular case for which an excess of 2.5 dB is calculated. Taking the above into consideration, sharing between FSS (space-to-Earth) and SOS (E-s) in the 7 GHz band seems attainable.

4.1/1.9.1/4.2 Sharing in the 8 400-8 500 MHz band

4.1/1.9.1/4.2.1 FSS sharing with the SRS (deep space) in the 8 400-8 450 MHz band

The studies assessed the required separation distances between FSS and SRS earth stations for a set of representative SRS deep space stations based on the Recommendation ITU-R SA.1157 protection criteria for the SRS deep space earth stations and the Recommendation ITU-R P.452 propagation loss model.

Depending on the terrain configuration, the required separation distances range from 250 km to 675 km assuming a transmitter power spectral density at the antenna input of FSS earth station of −30 dBW/Hz. Similar results are expected to apply for the other deep space SRS earth stations that are not considered here.

The required separation distances are based on the presence of a single FSS terminal operating on a single channel around the deep space SRS earth station. In case of multiple FSS terminals operating on multiple channels, the required distances may grow accordingly depending on the channel width.

Note that the required separation distances may extend into the territory of another administration, in which case coordination will be required.

The impact of SRS (deep space) spacecraft transmissions into FSS satellite receivers was not assessed.

4.1/1.9.1/4.2.2 FSS sharing with the SRS (near-Earth) in the 8 450-8 500 MHz band

The studies assessed the separation distances between the near-Earth SRS and FSS earth stations for a set of representative near-Earth SRS stations.

Depending on the terrain configuration, the required separation distances range from 84 km to 496 km assuming a transmitter power spectral density at the antenna input of FSS earth station of −30 dBW/Hz. Similar results would be expected to protect other SRS earth stations not considered above.

It is to be noted that these distances are based on the presence in the area of a single FSS terminal operating on a single channel. In case of multiple FSS terminals operating on multiple channels, the required distances may grow accordingly depending on the channel width. It should be noted that this analysis does not consider any manned SRS mission for which the protection criteria are more stringent.

The required separation distance may extend into the territory of another administration therefore requiring coordination.

The impact of SRS (near-Earth) spacecraft transmissions into FSS satellite receivers was not assessed.

4.1/1.9.1/4.2.3 FSS sharing with the FS in the 8 400-8 500 MHz band

The studies show that separation distances assuming flat terrain between FS systems and FSS earth stations are around 100 km (83.5 to 120 km) to meet long-term protection criterion and between 211.5 and 426 km to meet short-term protection criterion. These distances could be reduced when actual terrain elevation is taken into account. Sharing between FSS (Earth-to-space) and FS can be achieved through coordination process under RR No. **9.17** applying the methods of RR Appendix **7**.

4.1/1.9.1/4.2.4 FSS sharing with the MS (except aeronautical mobile) in the 8 400-8 500 MHz band

There is no ITU-R deliverable providing the characteristics of mobile applications and no ITU-R contributions related to this service have been received. Due to this fact, sharing studies have not been carried out.

4.1/1.9.1/5 Methods to satisfy this part of the agenda item

4.1/1.9.1/5.1 Method A

Under this method, the bands 7 150-7 250 MHz in the space-to-Earth direction and 8 400-8 500 MHz in the Earth-to-space direction are allocated worldwide on a primary basis to the FSS. The use of these bands is limited to GSO FSS space stations.

FSS space stations emissions in the band 7 150-7 235 MHz shall comply with an e.i.r.p. spectral density mask. The mask is described in section 4.1/1.9.1/6.1. FSS earth stations in the band 8 400-8 500 MHz shall be limited to specific earth stations, i.e. operating at fixed, known locations with a minimum antenna diameter of 3.5 m.

Coordination under RR No. **9.17** and No. **9.17A** (which is also applicable to sharing with stations of the EESS that may be allocated to this band at WRC-15 under agenda item 1.11) and notification under RR No. **11.2** will apply.

RR Article **21** (Tables **21-2**, **21-3** and **21-4**) and RR Appendix **7** (Tables **7b**, **8c** and **9a**) are amended to include the bands 7 150-7 250 MHz or 8 400-8 500 MHz.

In addition, the FSS shall not claim protection from the SRS and the SOS, nor constrain the use and development of SRS and SOS earth stations. RR No. **5.43A** does not apply.

Under this method, to protect some cases of the near-Earth operations of SRS (deep space) missions, operational measures between involved FSS and SRS missions may be needed. Some administrations are of the view that a resolution needs to be developed to explain the concept of operational measures and facilitate their implementation.

Advantages:

- FSS spectrum needs are properly addressed.
- Provides more flexibility to administrations and optimises use of the bands 7 150-7 250 MHz (space-to-Earth) and 8 400-8 500 MHz (Earth-to-space).

Disadvantages:

- The near-Earth operations of SRS (deep space) missions might not be protected in particular cases for which operational measures would be required, placing constraints on FSS and/or SRS.

- Would add additional constraints to the operation of terrestrial services.
- Limits the types of applications that can be submitted under the FSS.

4.1/1.9.1/5.2 Method B

Under this method, the bands 7 190-7 250 MHz in the space-to-Earth direction and 8 400-8 500 MHz in the Earth-to-space direction are allocated worldwide on a primary basis to the FSS. The use of these bands is limited to GSO FSS space stations.

FSS space stations emissions in the band 7 190-7 235 MHz shall comply with an e.i.r.p. spectral density mask. The mask is described in section 4.1/1.9.1/6.2. FSS earth stations in the band 8 400-8 500 MHz shall be limited to specific earth stations, i.e. operating at fixed, known locations with a minimum antenna diameter of 3.5 m.

Coordination under RR No. **9.17** and No. **9.17A** (which is also applicable to sharing with stations of the EESS that may be allocated to this band at WRC-15 under agenda item 1.11) and notification under RR No. **11.2** will apply.

RR Article **21** (Tables **21-2**, **21-3** and **21-4**) and RR Appendix **7** (Tables **7b**, **8c** and **9a**) are amended to include the bands 7 190-7 250 MHz or 8 400-8 500 MHz.

In addition, the FSS shall not claim protection from the SRS and the SOS, nor constrain the use and development of SRS and SOS earth stations. RR No. **5.43A** does not apply.

Advantages:

- FSS spectrum needs are partially addressed.
- Provides more flexibility to administrations and optimises use of the bands 7 190-7 250 MHz (space-to-Earth) and 8 400-8 500 MHz (Earth-to-space).

Disadvantages:

- Would add additional constraints to the operation of terrestrial services.
- Limits the types of applications that can be submitted under the FSS.

4.1/1.9.1/5.3 Method C

Under this method, there would be no allocation to the FSS in the entire bands 7 150-7 250 MHz and 8 400-8 500 MHz, and therefore no change to the Radio Regulations.

Advantages:

- Avoids any impact to the fixed, mobile, space research (both deep space and near-Earth) and space operation services.

Disadvantages:

- FSS spectrum needs are not met.
- The bands 7 235-7 250 MHz and 8 400-8 500 MHz are not allocated to the FSS despite the positive results of sharing studies.

4.1/1.9.1/6 Regulatory and procedural considerations

4.1/1.9.1/6.1 Method A

ARTICLE 5

Frequency allocations

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

MOD

5 570-7 250 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
7 075-7 145	FIXED MOBILE 5.458 5.459	
7 145-~~7 235~~7 150	FIXED MOBILE SPACE RESEARCH (Earth-to-space) 5.460 5.458 5.459	
~~7 145~~7 150-7 235	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.A191 ADD 5.B191 ADD 5.C191 MOBILE SPACE RESEARCH (Earth-to-space) 5.460 5.458 5.459	
7 235-7 250	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.A191 MOBILE 5.458	

MOD

7 250-8 500 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
8 400-8 500	FIXED FIXED-SATELLITE (Earth-to-space) ADD 5.A191 ADD 5.D191 ADD 5.E191 MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) 5.465 5.466	

ADD

5.A191 The use of the frequency bands 7 150-7 250 MHz (space-to-Earth) and 8 400-8 500 MHz (Earth-to-space) by the fixed-satellite service is limited to geostationary-satellite networks.

ADD

5.B191 In the band 7 150-7 235 MHz, the e.i.r.p. spectral density of emissions from any space station in the fixed-satellite service shall not exceed:

$-26-3\times\left(\frac{\varphi}{3.10}\right)^2$	dBW/Hz	for	$0 \leq \varphi \leq 8$
-46	dBW/Hz	for	$8 < \varphi \leq 19.6$
$-46-25\times\log_{10}\left(\frac{\varphi}{19.6}\right)$	dBW/Hz	for	$19.6 < \varphi \leq 64.9$
-59	dBW/Hz	for	$64.9 < \varphi \leq 180$

Where φ is the off-axis angle in degrees of the antenna. The pointing direction of the maximum e.i.r.p. density is limited to within ±8° with respect to the sub-satellite point.

NOTE: It may be necessary to revise RR Appendix 4 in order to assess compliance with the limit above.

ADD

5.C191 In the band 7 150-7 235 MHz, earth stations in the fixed-satellite service shall not claim protection from, nor constrain the use and development of earth stations in the space research service (Earth-to-space) in all regions and the space operation service (Earth-to-space) allocated in the Russian Federation under No. **5.459**. No. **5.43A** does not apply.

ADD

5.D191 The use of the band 8 400-8 500 MHz by stations of the fixed-satellite service (Earth-to-space) is limited to networks operating with specific earth stations at fixed known locations and with a minimum antenna diameter of 3.5 m.

ADD

5.E191 In the band 8 400-8 500 MHz, geostationary space stations in the fixed-satellite service shall not claim protection from space stations in the space research service. No. **5.43A** does not apply. Earth stations in the fixed-satellite service shall not constrain the use and development of earth stations in the space research service.

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-~~12~~15)

Frequency band	Service	Limit as specified in Nos.
1 427-1 429 MHz 1 610-1 645.5 MHz (No. **5.359**) 1 646.5-1 660 MHz (No. **5.359**) 1 980-2 010 MHz 2 010-2 025 MHz (Region 2) 2 025-2 110 MHz 2 200-2 290 MHz 2 655-2 670 MHz[5] (Regions 2 and 3) 2 670-2 690 MHz[5] (Regions 2 and 3) 5 670-5 725 MHz (Nos. **5.453** and **5.455**) 5 725-5 755 MHz[5] (Region 1 countries listed in Nos. **5.453** and **5.455**) 5 755-5 850 MHz[5] (Region 1 countries listed in Nos. **5.453**, **5.455** and **5.456**) 5 850-7 075 MHz 7 145-7 2~~35~~50 MHz* 7 900-8 ~~4~~500 MHz	Fixed-satellite Meteorological-satellite Space research Space operation Earth exploration-satellite Mobile-satellite	**21.2**, **21.3**, **21.4** and **21.5**

* For this frequency band only the limits of Nos**. 21.3** and **21.5** apply.

Section III − Power limits for earth stations

MOD

TABLE **21-3** (Rev.WRC-~~12~~15)

Frequency band		Services
2 025-2 110 MHz		Fixed-satellite
5 670-5 725 MHz	(for the countries listed in No. **5.454** with respect to the countries listed in Nos. **5.453** and **5.455**)	Earth-exploration-satellite Meteorological-satellite Mobile-satellite
5 725-5 755 MHz[6]	(for Region 1 with respect to the countries listed in Nos. **5.453** and **5.455**)	Space operation
5 755-5 850 MHz[6]	(for Region 1 with respect to the countries listed in Nos. **5.453**, **5.455** and **5.456**)	Space research
5 850-7 075 MHz		
7 190-7 235 MHz		
7 900-8 ~~4~~5̲00 MHz		
10.7-11.7 GHz[6]	(for Region 1)	
12.5-12.75 GHz[6]	(for Region 1 with respect to the countries listed in No. **5.494**)	
12.7-12.75 GHz[6]	(for Region 2)	
12.75-13.25 GHz		
14.0-14.25 GHz	(with respect to the countries listed in No. **5.505**)	
14.25-14.3 GHz	(with respect to the countries listed in Nos. **5.505**, **5.508** and **5.509**)	
14.3-14.4 GHz[6]	(for Regions 1 and 3)	
14.4-14.8 GHz		

Section V – Limits of power flux-density from space stations

MOD

TABLE **21-4** (Rev.WRC-~~12~~15)

Frequency band	Service*	Limit in dB(W/m²) for angles of arrival (δ) above the horizontal plane			Reference bandwidth
		0°-5°	**5°-25°**	**25°-90°**	
3 400-4 200 MHz	Fixed-satellite (space-to-Earth) (geostationary-satellite orbit)	−152	−152 + 0.5(δ − 5)	−142	4 kHz
3 400-4 200 MHz	Fixed-satellite (space-to-Earth) (non-geostationary-satellite orbit)	−138 − *Y* [17, 18]	−138 − *Y* + (12 + *Y*)(δ − 5)/20[17, 18]	−126 [18]	1 MHz
4 500-4 800 MHz 5 670-5 725 MHz (Nos. **5.453** and **5.455**) 7 ~~2~~150-7 900 MHz	Fixed-satellite (space-to-Earth) Meteorological-satellite (space-to-Earth) Mobile-satellite Space research	−152	−152 + 0.5(δ − 5)	−142	4 kHz

APPENDIX 7 (REV.WRC-12)

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 7b (Rev.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a transmitting earth station

Transmitting space radiocommunication service designation		Fixed-satellite, mobile-satellite	Aero-nautical mobile-satellite (R) service	Aero-nautical mobile-satellite (R) service	Fixed-satellite	Fixed-satellite	Fixed-satellite	Fixed-satellite		Space operation, space research		Fixed-satellite, mobile-satellite, meteorological-satellite		Fixed-satellite		Fixed-satellite		Fixed-satellite	Fixed-satellite [3]	Fixed-satellite	Fixed-satellite [3]
Frequency bands (GHz)		2.655-2.690	5.030-5.091	5.030-5.091	5.091-5.150	5.091-5.150	5.725-5.850	5.725-7.075		7.100-7.235 [5]		7.900-8.~~4~~500 [6]		10.7-11.7		12.5-14.8		13.75-14.3	15.43-15.65	17.7-18.4	19.3-19.7
Receiving terrestrial service designations		Fixed, mobile	Aeronautical radio-navigation	Aeronautical mobile (R)	Aeronautical radio-navigation	Aeronautical mobile (R)	Radiolocation	Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Radiolocation radionavigation (land only)	Aeronautical radionavigation	Fixed, mobile	Fixed, mobile
Method to be used		§ 2.1	§ 2.1, § 2.2	§ 2.1, § 2.2			§ 2.1	§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1, § 2.2	§ 2.2
Modulation at terrestrial station [1]		A						A	N	A	N	A	N	A	N	A	N	–		N	N
Terrestrial station interference parameters and criteria	p_0 (%)	0.01						0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01		0.005	0.005
	n	2						2	2	2	2	2	2	2	2	2	2	1		2	2
	p (%)	0.005						0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.01		0.0025	0.0025
	N_L (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
	M_s (dB)	26 [2]						33	37	33	37	33	37	33	40	33	40	1		25	25
	W (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
Terrestrial station parameters	G_x (dBi) [4]	49 [2]	6	10	6	6		46	46	46	46	46	46	50	50	52	52	36		48	48
	T_e (K)	500 [2]						750	750	750	750	750	750	1 500	1 100	1 500	1 100	2 636		1 100	1 100
Reference bandwidth	B (Hz)	4×10^3	150×10^3	37.5×10^3	150×10^3	10^6		4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	10^7		10^6	10^6
Permissible interference power	$P_r(p)$ (dBW) in B	−140	−160	−157	−160	−143		−131	−103	−131	−103	−131	−103	−128	−98	−128	−98	−131		−113	−113

[1] A: analogue modulation; N: digital modulation.

[2] The parameters for the terrestrial station associated with transhorizon systems have been used. Line-of-sight radio-relay parameters associated with the frequency band 5 725-7 075 MHz may also be used to determine a supplementary contour with the exception that G_X = 37 dBi.

[3] Feeder links of non-geostationary-satellite systems in the mobile-satellite service.

[4] Feeder losses are not included.

[5] Actual frequency bands are 7 100-7 155 MHz and 7 190-7 235 MHz for space operation service and 7 145-7 235 MHz for the space research service.

[6] The operation of fixed-satellite service earth stations in the band 8 400-8 500 MHz is limited to specific stations at fixed known locations and with a minimum antenna diameter of 3.5 m.

MOD

TABLE 8c (Rev.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a receiving earth station

Receiving space radiocommunication service designation			Fixed-satellite		Fixed-satellite, radio-determination satellite	Fixed-satellite	Fixed-satellite		Meteoro-logical-satellite [7, 8]	Meteoro-logical-satellite [9]	Earth exploration-satellite [7]	Earth exploration-satellite [9]	Space research [10]		Fixed-satellite		Broadcasting-satellite		Fixed-satellite [9]	Broad-casting-satellite	Fixed-satellite [7]
													Deep space								
Frequency bands (GHz)			4.500-4.800		5.150-5.216	6.700-7.075	7.~~2~~150-7.750[13]		7.450-7.550	7.750-7.900	8.025-8.400	8.025-8.400	8.400-8.450	8.450-8.500	10.7-12.75		12.5-12.75 [12]		15.4-15.7	17.7-17.8	17.7-18.8 19.3-19.7
Transmitting terrestrial service designations			Fixed, mobile		Aeronautical radionavigation	Fixed, mobile	Fixed, mobile		Fixed, mobile	Fixed, mobile	Fixed, mobile	Fixed, mobile	Fixed, mobile		Fixed, mobile		Fixed, mobile		Aeronau-tical radio-navigation	Fixed	Fixed, mobile
Method to be used			§ 2.1		§ 2.1	§ 2.2	§ 2.1		§ 2.1, § 2.2	§ 2.2	§ 2.1	§ 2.2	§ 2.2		§ 2.1, § 2.2		§ 1.4.5			§ 1.4.5	§ 2.1
Modulation at earth station [1]			A	N		N	A	N	N	N	N	N	N	N	A	N	A	N	–		N
Earth station interference parameters and criteria	p_0 (%)		0.03	0.005		0.005	0.03	0.005	0.002	0.001	0.083	0.011	0.001	0.1	0.03	0.003	0.03	0.003	0.003		0.003
	n		3	3		3	3	3	2	2	2	2	1	2	2	2	1	1	2		2
	p (%)		0.01	0.0017		0.0017	0.01	0.0017	0.001	0.0005	0.0415	0.0055	0.001	0.05	0.015	0.0015	0.03	0.003	0.0015		0.0015
	N_L (dB)		1	1		1	1	1	–	–	1	0	0	0	1	1	1	1	1		1
	M_s (dB)		7	2		2	7	2	–	–	2	4.7	0.5	1	7	4	7	4	4		6
	W (dB)		4	0		0	4	0	–	–	0	0	0	0	4	0	4	0	0		0
Terrestrial station parameters	E (dBW) in B [2]	A	92 [3]	92 [3]		55	55	55	55	55	55	55	25 [5]	25 [5]	40	40	55	55			35
		N	42 [4]	42 [4]		42	42	42	42	42	42	42	−18	−18	43	43	42	42		40	40
	P_t (dBW) in B	A	40 [3]	40 [3]		13	13	13	13	13	13	13	−17 [5]	−17 [5]	−5	−5	10	10			−10
		N	0	0		0	0	0	0	0	0	0	−60	−60	−2	−2	−3	−3		−7	−5
	G_x (dBi)		52 [3, 4]	52 [3, 4]		42	42	42	42	42	42	42	42	42	45	45	45	45		47	45
Reference bandwidth [6]	B (Hz)		10^6	10^6		10^6	10^6	10^6	10^7	10^7	10^6	10^6	1	1	10^6	10^6	27×10^6	27×10^6			10^6
Permissible interference power	$P_r(p)$ (dBW) in B					−151.2			−125	−125	−154 [11]	−142	−220	−216			−131	−131			

Notes to Table 8c:

1 A: analogue modulation; N: digital modulation.

2 E is defined as the equivalent isotropically radiated power of the interfering terrestrial station in the reference bandwidth.

[3] In this band, the parameters for the terrestrial stations associated with transhorizon systems have been used. If an administration believes that transhorizon systems do not need to be considered, the line-of-sight radio-relay parameters associated with the frequency band 3.4-4.2 GHz may be used to determine the coordination area.

[4] Digital systems assumed to be non-transhorizon. Therefore G_x = 42.0 dBi. For digital transhorizon systems, parameters for analogue transhorizon systems above have been used.

[5] These values are estimated for 1 Hz bandwidth and are 30 dB below the total power assumed for emission.

[6] In certain systems in the fixed-satellite service it may be desirable to choose a greater reference bandwidth *B*. However, a greater bandwidth will result in smaller coordination distances and a later decision to reduce the reference bandwidth may require recoordination of the earth station.

[7] Geostationary-satellite systems.

[8] Non-geostationary satellites in the meteorological-satellite service notified in accordance with No. **5.461A** may use the same coordination parameters.

[9] Non-geostationary-satellite systems.

[10] Space research earth stations in the band 8.4-8.5 GHz operate with non-geostationary satellites.

[11] For large earth stations: $P_r(p) = (G - 180)$ dBW

For small earth stations: $P_r(20\%) = 2\,(G - 26) - 140$ dBW for $26 < G \leq 29$ dBi

$P_r(20\%) = G - 163$ dBW for $G > 29$ dBi

$P_r(p)\% = G - 163$ dBW for $G \leq 26$ dBi

[12] Applies to the broadcasting-satellite service in unplanned bands in Region 3.

[13] Fixed-satellite service earth stations in the band 7 150-7 250 MHz operate only with geostationary satellites.

MOD

TABLE 9a (Rev.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a transmitting earth station in bands shared bidirectionally with receiving earth stations

Space service designation in which the transmitting earth station operates		**Land mobile-satellite**	**Mobile-satellite**	**Land mobile-satellite**	**Earth exploration-satellite, meteorological-satellite**	**Mobile-satellite**		**Fixed-satellite, mobile-satellite**	**Aeronautical mobile-satellite (R) service**		**Fixed-satellite** [3]		**Fixed-satellite**	**Fixed-satellite, meteorological-satellite**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**
Frequency bands (GHz)		0.1499-0.15005	0.272-0.273	0.3999-0.40005	0.401-0.402	1.670-1.675		2.655-2.690	5.030-5.091		5.150-5.216		6.700-7.075	8.025-8.400	8.025-8.400	8.400-8.450	8.450-8.500
Space service designation in which the *receiving* earth station operates		Radio-navigation -satellite	Space operation	Radio-navigation-satellite	Space operation	Meteorological-satellite		Fixed-satellite, broadcasting-satellite	Aeronautical mobile-satellite (R) service		Fixed-satellite	Radiodeter-mination-satellite	Fixed-satellite	Earth exploration-satellite	Earth exploration-satellite	Space research (deep space)	Space research
Orbit [6]			Non-GSO		Non-GSO	Non-GSO	GSO		Non-GSO	GSO	Non-GSO		Non-GSO	Non-GSO	GSO		
Modulation at *receiving* earth station [1]			N		N	N	N						N	N	N	N	N
Receiving earth station interference parameters and criteria	p_0 (%)		1.0		0.1	0.006	0.011						0.005	0.011	0.083	0.001[12]	0.1
	n		1		2	3	2						3	2	2	1	2
	p (%)		1.0		0.05	0.002	0.0055						0.0017	0.0055	0.0415	0.001[12]	0.05
	N_L (dB)	0	0	0	0	0	0						1	0	1	0	0
	M_s (dB)	2	1	2	1	2.8	0.9	2			2	2	2	4.7	2	0.5	1
	W (dB)	0	0	0	0	0	0						0	0	0	0	0
Receiving earth station parameters	G_m (dBi) [2]	0	20	0	20	30	45		45	45	48.5		50.7				
	G_r (dBi) [4]	0	19	0	19	19 [9]	8		8	8	10		10	10	8		
	ε_{min} [5]	3°	10°	3°	10°	5°	3°	3°	10°	10°	3°	3°	3°	5°	3°	10°	5°
	T_e (K) [7]	200	500	200	500	370	118	75	340	340	75	75	75				
Reference bandwidth	B (Hz)	4×10^3	10^3	4×10^3	1	10^6	4×10^3		37.5×10^3	37.5×10^3			10^6	10^6	10^6	1	1
Permissible interference power	$P_r(p)$ (dBW) in B	–172	–177	–172	–208	–145	–178		−163.5	−163.5			–151	–142	–154	-221	-216

Notes to Table 9a:

1 A: analogue modulation; N: digital modulation.

2 On-axis gain of the receive earth station antenna.

[3] Feeder links of non-geostationary-satellite systems in the mobile-satellite service.

[4] Horizon antenna gain for the receive earth station (refer to § 3 of the main body of this Appendix).

[5] Minimum elevation angle of operation in degrees (non-geostationary or geostationary).

[6] Orbit of the space service in which the receiving earth station operates (non-geostationary or geostationary).

[7] The thermal noise temperature of the receiving system at the terminal of the receiving antenna (under clear-sky conditions). Refer to § 2.1 of this Annex for missing values.

[8] Horizon antenna gain is calculated using the procedure of Annex 5. Where no value of G_m is specified, a value of 42 dBi is to be used.

[9] Non-geostationary horizon antenna gain, $G_e = G_{min} + 20$ dB (see § 2.2), with $G_{min} = 10 - 10 \log (D/\lambda)$, $D/\lambda = 13$ (refer to Annex 3 for definition of symbols).

[10] Unmanned space research is not a separate radiocommunication service and the system parameters are only to be used for the generation of supplementary contours.

SUP

RESOLUTION 758 (WRC-12)

Allocation to the fixed-satellite service and the maritime-mobile satellite service in the 7/8 GHz range

4.1/1.9.1/6.2 Method B

ARTICLE 5

Frequency allocations

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

MOD

5 570-7 250 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
7 075-7 145	FIXED MOBILE 5.458 5.459	
7 145-7 190~~7 235~~	FIXED MOBILE SPACE RESEARCH (Earth-to-space) 5.460 5.458 5.459	
~~7 145~~7 190-7 235	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.F191 ADD 5.G191 ADD 5.H191 MOBILE SPACE RESEARCH (Earth-to-space) 5.460 5.458 5.459	
7 235-7 250	FIXED FIXED-SATELLITE (space-to-Earth) ADD 5.F191 MOBILE 5.458	

MOD

7 250-8 500 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
8 400-8 500	FIXED FIXED-SATELLITE (Earth-to-space) ADD 5.F191 ADD 5.I191 ADD 5.J191 MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) 5.465 5.466	

ADD

5.F191 The use of the frequency bands 7 190-7 250 MHz (space-to-Earth) and 8 400-8 500 MHz (Earth-to-space) by the fixed-satellite service is limited to geostationary-satellite networks.

ADD

5.G191 In the band 7 190-7 235 MHz, the e.i.r.p. spectral density of emissions from any space station in the fixed-satellite service shall not exceed:

$-26-3\times\left(\frac{\varphi}{3.10}\right)^2$	dBW/Hz	for	$0 \le \varphi \le 8$
-46	dBW/Hz	for	$8 < \varphi \le 19.6$
$-46-25\times\log_{10}\left(\frac{\varphi}{19.6}\right)$	dBW/Hz	for	$19.6 < \varphi \le 64.9$
-59	dBW/Hz	for	$64.9 < \varphi \le 180$

Where φ is the off-axis angle in degrees of the antenna. The pointing direction of the maximum e.i.r.p. density is limited to within ±8° with respect to the sub-satellite point.

NOTE: It may be necessary to revise RR Appendix **4** in order to assess compliance with the limit above.

ADD

5.H191 In the band 7 190-7 235 MHz, earth stations in the fixed-satellite service shall not claim protection from, nor constrain the use and development of earth stations in the space research service (Earth-to-space) in all regions and the space operation service (Earth-to-space) allocated in the Russian Federation under No. **5.459**. No. **5.43A** does not apply.

ADD

5.I191 The use of the band 8 400-8 500 MHz by stations of the fixed-satellite service (Earth-to-space) is limited to networks operating with specific earth stations at fixed known locations and with a minimum antenna diameter of 3.5 m.

ADD

5.J191 In the band 8 400-8 500 MHz, geostationary space stations in the fixed-satellite service shall not claim protection from space stations in the space research service. No. **5.43A** does not apply. Earth stations in the fixed-satellite service shall not constrain the use and development of earth stations in the space research service.

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-~~12~~15)

Frequency band	Service	Limit as specified in Nos.
1 427-1 429 MHz 1 610-1 645.5 MHz (No. **5.359**) 1 646.5-1 660 MHz (No. **5.359**) 1 980-2 010 MHz 2 010-2 025 MHz (Region 2) 2 025-2 110 MHz 2 200-2 290 MHz 2 655-2 670 MHz[5] (Regions 2 and 3) 2 670-2 690 MHz[5] (Regions 2 and 3) 5 670-5 725 MHz (Nos. **5.453** and **5.455**) 5 725-5 755 MHz[5] (Region 1 countries listed in Nos. **5.453** and **5.455**) 5 755-5 850 MHz[5] (Region 1 countries listed in Nos. **5.453**, **5.455** and **5.456**) 5 850-7 075 MHz 7 145-7 250~~35~~ MHz* 7 900-8 ~~4~~500 MHz	Fixed-satellite Meteorological-satellite Space research Space operation Earth exploration-satellite Mobile-satellite	**21.2**, **21.3**, **21.4** and **21.5**

* For this frequency band only the limits of Nos**. 21.3** and **21.5** apply.

Section III − Power limits for earth stations

MOD

TABLE **21-3** (Rev.WRC-~~12~~15)

Frequency band		**Services**
2 025-2 110 MHz		Fixed-satellite
5 670-5 725 MHz	(for the countries listed in No. **5.454** with respect to the countries listed in Nos. **5.453** and **5.455**)	Earth-exploration-satellite Meteorological-satellite Mobile-satellite
5 725-5 755 MHz[6]	(for Region 1 with respect to the countries listed in Nos. **5.453** and **5.455**)	Space operation
5 755-5 850 MHz[6]	(for Region 1 with respect to the countries listed in Nos. **5.453**, **5.455** and **5.456**)	Space research
5 850-7 075 MHz		
7 190-7 235 MHz		
7 900-8 ~~4~~5 00 MHz		
10.7-11.7 GHz[6]	(for Region 1)	
12.5-12.75 GHz[6]	(for Region 1 with respect to the countries listed in No. **5.494**)	
12.7-12.75 GHz[6]	(for Region 2)	
12.75-13.25 GHz		
14.0-14.25 GHz	(with respect to the countries listed in No. **5.505**)	
14.25-14.3 GHz	(with respect to the countries listed in Nos. **5.505**, **5.508** and **5.509**)	
14.3-14.4 GHz[6]	(for Regions 1 and 3)	
14.4-14.8 GHz		

Section V – Limits of power flux-density from space stations

MOD

TABLE **21-4** (Rev.WRC-~~12~~15)

Frequency band	**Service***	**Limit in dB(W/m^2) for angles of arrival (δ) above the horizontal plane**			**Reference bandwidth**
		0°-5°	**5°-25°**	**25°-90°**	
3 400-4 200 MHz	Fixed-satellite (space-to-Earth) (geostationary-satellite orbit)	−152	−152 + 0.5(δ − 5)	−142	4 kHz
3 400-4 200 MHz	Fixed-satellite (space-to-Earth) (non-geostationary-satellite orbit)	−138 − *Y* [17, 18]	−138 − *Y* + (12 + *Y*)(δ − 5)/20 [17, 18]	−126 [18]	1 MHz
4 500-4 800 MHz 5 670-5 725 MHz (Nos. **5.453** and **5.455**) 7 ~~25~~190-7 900 MHz	Fixed-satellite (space-to-Earth) Meteorological-satellite (space-to-Earth) Mobile-satellite Space research	−152	−152 + 0.5(δ − 5)	−142	4 kHz

APPENDIX 7 (REV.WRC-12)

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 7b (Rev.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a transmitting earth station

Transmitting space radiocommunication service designation		**Fixed-satellite, mobile-satellite**	**Aero-nautical mobile-satellite (R) service**	**Aero-nautical mobile-satellite (R) service**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**		**Space operation, space research**		**Fixed-satellite, mobile-satellite, meteorological-satellite**		**Fixed-satellite**		**Fixed-satellite**		**Fixed-satellite**	**Fixed-satellite** [3]	**Fixed-satellite**	**Fixed-satellite** [3]
Frequency bands (GHz)		2.655-2.690	5.030-5.091	5.030-5.091	5.091-5.150	5.091-5.150	5.725-5.850	5.725-7.075		7.100-7.235 [5]		7.900-8.~~4~~5̲00 [6]		10.7-11.7		12.5-14.8		13.75-14.3	15.43-15.65	17.7-18.4	19.3-19.7
Receiving terrestrial service designations		Fixed, mobile	Aeronautical radio-navigation	Aeronautical mobile (R)	Aeronautical radio-navigation	Aeronautical mobile (R)	Radiolocation	Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Fixed, mobile		Radiolocation radionavigation (land only)	Aeronautical radionavigation	Fixed, mobile	Fixed, mobile
Method to be used		§ 2.1	§ 2.1, § 2.2	§ 2.1, § 2.2			§ 2.1	§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1		§ 2.1, § 2.2		§ 2.1		§ 2.1, § 2.2	§ 2.2
Modulation at terrestrial station [1]		A						A	N	A	N	A	N	A	N	A	N	−		N	N
Terrestrial station interference parameters and criteria	p_0 (%)	0.01						0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005	0.01		0.005	0.005
	n	2						2	2	2	2	2	2	2	2	2	2	1		2	2
	p (%)	0.005						0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.005	0.0025	0.01		0.0025	0.0025
	N_L (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
	M_s (dB)	26 [2]						33	37	33	37	33	37	33	40	33	40	1		25	25
	W (dB)	0						0	0	0	0	0	0	0	0	0	0	0		0	0
Terrestrial station parameters	G_x (dBi) [4]	49 [2]	6	10	6	6		46	46	46	46	46	46	50	50	52	52	36		48	48
	T_e (K)	500 [2]						750	750	750	750	750	750	1 500	1 100	1 500	1 100	2 636		1 100	1 100
Reference bandwidth	B (Hz)	4×10^3	150×10^3	37.5×10^3	150×10^3	10^6		4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	4×10^3	10^6	10^7		10^6	10^6
Permissible interference power	$P_r(p)$ (dBW) in B	−140	−160	−157	−160	−143		−131	−103	−131	−103	−131	−103	−128	−98	−128	−98	−131		−113	−113

[1] A: analogue modulation; N: digital modulation.

[2] The parameters for the terrestrial station associated with transhorizon systems have been used. Line-of-sight radio-relay parameters associated with the frequency band 5 725-7 075 MHz may also be used to determine a supplementary contour with the exception that G_X = 37 dBi.

[3] Feeder links of non-geostationary-satellite systems in the mobile-satellite service.

[4] Feeder losses are not included.

[5] Actual frequency bands are 7 100-7 155 MHz and 7 190-7 235 MHz for space operation service and 7 145-7 235 MHz for the space research service.

[6] The operation of fixed-satellite service earth stations in the band 8 400-8 500 MHz is limited to specific stations at fixed known locations and with a minimum antenna diameter of 3.5 m.

MOD

TABLE 8c (Rev.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a receiving earth station

Receiving space radiocommunication service designation		Fixed-satellite		Fixed-satellite, radio-determination satellite	Fixed-satellite	Fixed-satellite		Meteoro-logical-satellite[7, 8]	Meteoro-logical-satellite[9]	Earth exploration-satellite[7]	Earth exploration-satellite[9]	Space research[10]		Fixed-satellite		Broadcasting-satellite		Fixed-satellite[9]	Broad-casting-satellite	Fixed-satellite[7]
												Deep space								
Frequency bands (GHz)		4.500-4.800		5.150-5.216	6.700-7.075	7.~~2~~1950-7.750[13]		7.450-7.550	7.750-7.900	8.025-8.400	8.025-8.400	8.400-8.450	8.450-8.500	10.7-12.75		12.5-12.75[12]		15.4-15.7	17.7-17.8	17.7-18.8 19.3-19.7
Transmitting terrestrial service designations		Fixed, mobile		Aeronautical radionavigation	Fixed, mobile	Fixed, mobile		Fixed, mobile	Fixed, mobile	Fixed, mobile	Fixed, mobile	Fixed, mobile		Fixed, mobile		Fixed, mobile		Aeronau-tical radio-navigation	Fixed	Fixed, mobile
Method to be used		§ 2.1		§ 2.1	§ 2.2	§ 2.1		§ 2.1, § 2.2	§ 2.2	§ 2.1	§ 2.2	§ 2.2		§ 2.1, § 2.2		§ 1.4.5			§ 1.4.5	§ 2.1
Modulation at earth station[1]		A	N		N	A	N	N	N	N	N	N	N	A	N	A	N	–		N
Earth station interference parameters and criteria	p_0 (%)	0.03	0.005		0.005	0.03	0.005	0.002	0.001	0.083	0.011	0.001	0.1	0.03	0.003	0.03	0.003	0.003		0.003
	n	3	3		3	3	3	2	2	2	2	1	2	2	2	1	1	2		2
	p (%)	0.01	0.0017		0.0017	0.01	0.0017	0.001	0.0005	0.0415	0.0055	0.001	0.05	0.015	0.0015	0.03	0.003	0.0015		0.0015
	N_L (dB)	1	1		1	1	1	–	–	1	0	0	0	1	1	1	1	1		1
	M_s (dB)	7	2		2	7	2	–	–	2	4.7	0.5	1	7	4	7	4	4		6
	W (dB)	4	0		0	4	0	–	–	0	0	0	0	4	0	4	0	0		0
Terrestrial station parameters	E (dBW) in B[2] A	92[3]	92[3]		55	55	55	55	55	55	55	25[5]	25[5]	40	40	55	55			35
	E (dBW) in B[2] N	42[4]	42[4]		42	42	42	42	42	42	42	−18	−18	43	43	42	42		40	40
	P_t (dBW) in B A	40[3]	40[3]		13	13	13	13	13	13	13	−17[5]	−17[5]	−5	−5	10	10			−10
	P_t (dBW) in B N	0	0		0	0	0	0	0	0	0	−60	−60	−2	−2	−3	−3		−7	−5
	G_x (dBi)	52[3, 4]	52[3, 4]		42	42	42	42	42	42	42	42	42	45	45	45	45		47	45
Reference bandwidth[6]	B (Hz)	10^6	10^6		10^6	10^6	10^6	10^7	10^7	10^6	10^6	1	1	10^6	10^6	27×10^6	27×10^6			10^6
Permissible interference power	$P_r(p)$ (dBW) in B				−151.2			−125	−125	−154[11]	−142	−220	−216			−131	−131			

Notes to Table 8c:

1 A: analogue modulation; N: digital modulation.

2 *E* is defined as the equivalent isotropically radiated power of the interfering terrestrial station in the reference bandwidth.

[3] In this band, the parameters for the terrestrial stations associated with transhorizon systems have been used. If an administration believes that transhorizon systems do not need to be considered, the line-of-sight radio-relay parameters associated with the frequency band 3.4-4.2 GHz may be used to determine the coordination area.

[4] Digital systems assumed to be non-transhorizon. Therefore G_x = 42.0 dBi. For digital transhorizon systems, parameters for analogue transhorizon systems above have been used.

[5] These values are estimated for 1 Hz bandwidth and are 30 dB below the total power assumed for emission.

[6] In certain systems in the fixed-satellite service it may be desirable to choose a greater reference bandwidth *B*. However, a greater bandwidth will result in smaller coordination distances and a later decision to reduce the reference bandwidth may require recoordination of the earth station.

[7] Geostationary-satellite systems.

[8] Non-geostationary satellites in the meteorological-satellite service notified in accordance with No. **5.461A** may use the same coordination parameters.

[9] Non-geostationary-satellite systems.

[10] Space research earth stations in the band 8.4-8.5 GHz operate with non-geostationary satellites.

[11]

For large earth stations:	$P_r(p) = (G - 180)$	dBW	
For small earth stations:	$P_r(20\%) = 2\,(G - 26) - 140$	dBW	for $26 < G \leq 29$ dBi
	$P_r(20\%) = G - 163$	dBW	for $G > 29$ dBi
	$P_r(p)\% = G - 163$	dBW	for $G \leq 26$ dBi

[12] Applies to the broadcasting-satellite service in unplanned bands in Region 3.

[13] Fixed-satellite service earth stations in the band 7 190-7 250 MHz operate only with geostationary satellites.

MOD

TABLE 9a (Rev.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a transmitting earth station in bands shared bidirectionally with receiving earth stations

Space service designation in which the transmitting earth station operates		**Land mobile-satellite**	**Mobile-satellite**	**Land mobile-satellite**	**Earth exploration-satellite, meteorological-satellite**	**Mobile-satellite**		**Fixed-satellite, mobile-satellite**	**Aeronautical mobile-satellite (R) service**		**Fixed-satellite [3]**		**Fixed-satellite**	**Fixed-satellite, meteorological-satellite**	**Fixed-satellite**	**Fixed-satellite**	**Fixed-satellite**
Frequency bands (GHz)		0.1499-0.15005	0.272-0.273	0.3999-0.40005	0.401-0.402	1.670-1.675		2.655-2.690	5.030-5.091		5.150-5.216		6.700-7.075	8.025-8.400	8.025-8.400	8.400-8.450	8.450-8.500
Space service designation in which the *receiving* earth station operates		Radio-navigation-satellite	Space operation	Radio-navigation-satellite	Space operation	Meteorological-satellite		Fixed-satellite, broadcasting-satellite	Aeronautical mobile-satellite (R) service		Fixed-satellite	Radiodetermination-satellite	Fixed-satellite	Earth exploration-satellite	Earth exploration-satellite	Space research (deep space)	Space research
Orbit [6]			Non-GSO		Non-GSO	Non-GSO	GSO		Non-GSO	GSO	Non-GSO		Non-GSO	Non-GSO	GSO		
Modulation at *receiving* earth station [1]			N		N	N	N						N	N	N	N	N
Receiving earth station interference parameters and criteria	p_0 (%)		1.0		0.1	0.006	0.011						0.005	0.011	0.083	0.001[12]	0.1
	n		1		2	3	2						3	2	2	1	2
	p (%)		1.0		0.05	0.002	0.0055						0.0017	0.0055	0.0415	0.001[12]	0.05
	N_L (dB)	0	0	0	0	0	0						1	0	1	0	0
	M_s (dB)	2	1	2	1	2.8	0.9	2			2	2	2	4.7	2	0.5	1
	W (dB)	0	0	0	0	0	0						0	0	0	0	0
Receiving earth station parameters	G_m (dBi) [2]	0	20	0	20	30	45		45	45	48.5		50.7				
	G_r (dBi) [4]	0	19	0	19	19 [9]	8		8	8	10		10	10	8		
	ε_{min} [5]	3°	10°	3°	10°	5°	3°	3°	10°	10°	3°	3°	3°	5°	3°	10°	5°
	T_e (K) [7]	200	500	200	500	370	118	75	340	340	75	75	75				
Reference bandwidth	B (Hz)	4×10^3	10^3	4×10^3	1	10^6	4×10^3		37.5×10^3	37.5×10^3			10^6	10^6	10^6	1	1
Permissible interference power	$P_r(p)$ (dBW) in B	–172	–177	–172	–208	–145	–178		−163.5	−163.5			–151	–142	–154	−221	−216

Notes to Table 9a:

1 A: analogue modulation; N: digital modulation.

[2] On-axis gain of the receive earth station antenna.

[3] Feeder links of non-geostationary-satellite systems in the mobile-satellite service.

[4] Horizon antenna gain for the receive earth station (refer to § 3 of the main body of this Appendix).

[5] Minimum elevation angle of operation in degrees (non-geostationary or geostationary).

[6] Orbit of the space service in which the receiving earth station operates (non-geostationary or geostationary).

[7] The thermal noise temperature of the receiving system at the terminal of the receiving antenna (under clear-sky conditions). Refer to § 2.1 of this Annex for missing values.

[8] Horizon antenna gain is calculated using the procedure of Annex 5. Where no value of G_m is specified, a value of 42 dBi is to be used.

[9] Non-geostationary horizon antenna gain, $G_e = G_{min}$ + 20 dB (see § 2.2), with G_{min} = 10 – 10 log (D/λ), D/λ = 13 (refer to Annex 3 for definition of symbols).

[10] Unmanned space research is not a separate radiocommunication service and the system parameters are only to be used for the generation of supplementary contours.

SUP

RESOLUTION 758 (WRC-12)

Allocation to the fixed-satellite service and the maritime-mobile satellite service in the 7/8 GHz range

4.1/1.9.1/6.3 Method C

SUP

RESOLUTION 758 (WRC-12)

Allocation to the fixed-satellite service and the maritime-mobile satellite service in the 7/8 GHz range

SUB-CHAPTER 4.2

Mobile-satellite service

(Agenda items 1.9.2, 1.10)

AGENDA ITEM 1.9.2

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

1.9 to consider, in accordance with Resolution ***758 (WRC-12)****:*

1.9.2 the possibility of allocating the bands 7 375-7 750 MHz and 8 025-8 400 MHz to the maritime-mobile satellite service and additional regulatory measures, depending on the results of appropriate studies;

Resolution **758 (WRC-12)**: *Allocation to the fixed-satellite service and the maritime mobile-satellite service in the 7/8 GHz range*

4.2/1.9.2/1 Executive summary

WRC-12 invites the ITU-R in Resolution **758 (WRC-12)** to conduct technical and regulatory studies on the possibility of allocating the bands 7 375-7 750 MHz and 8 025-8 400 MHz or portion of those bands to the maritime mobile-satellite service (MMSS) while ensuring the compatibility with existing services. Studies conducted in ITU-R show that there are many earth stations, all over the world, operating in science services, as well as fixed and mobile terrestrial stations which need to be protected from harmful interference from MMSS stations in those frequency bands. In accordance with those studies, separation distances in the order of several hundred kilometres are required to protect the earth stations in the Earth exploration-satellite service (EESS) and also fixed stations from interference. Studies also show that space research service (SRS) deep space earth stations operating in adjacent band would have to be protected through combination of unwanted emission limit and/or separation distance. Moreover, there is uncertainty on how to apply RR Nos. **9.17**, **9.17A** and **9.18** for MMSS earth stations.

4.2/1.9.2/2 Background

Under Resolution **758 (WRC-12)**, WRC-15 agenda item 1.9.2 calls for a study on the possibility of allocating the bands 7 375-7 750 MHz and 8 025-8 400 MHz to the MMSS and a study of the additional regulatory measures necessary to ensure compatibility with existing services.

The band 7 375-7 750 MHz is allocated on a primary basis to the fixed service (FS), mobile service (MS) (except aeronautical mobile) and fixed-satellite service (FSS) (space-to-Earth (s-E)); and the band 7 450-7 550 MHz is also allocated on a primary basis to the meteorological-satellite service (MetSat) (s-E). Similarly, the 8 025-8 400 MHz band is currently allocated on a primary basis to the Earth exploration-satellite service (EESS) (s-E), FS, MS and fixed-satellite service (FSS) (Earth-to-space (E-s)); and the band 8 175-8 215 MHz is also allocated to the MetSat (E-s).

4.2/1.9.2/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Technical and operational studies for this agenda item are contained in the preliminary draft new (PDN) Report ITU-R M.[MMSS 7/8 GHz SHARING].

Existing relevant ITU-R Recommendations: ITU-R F.699, ITU-R F.1094, ITU-R F.758, ITU-R SA.1277, ITU-R S.465, ITU-R SA.1027, ITU-R SA.1157, ITU-R SA.514, ITU-R SA.1022, ITU-R P.452.

New relevant ITU-R Recommendations and Reports: PDN Report ITU-R M.[MMSS 7/8 GHz SHARING].

Sharing of the 8 GHz band by MMSS with EESS and compatibility with SRS systems in adjacent band was evaluated by computing the separation distance using the Recommendation ITU-R P.452 propagation loss model.

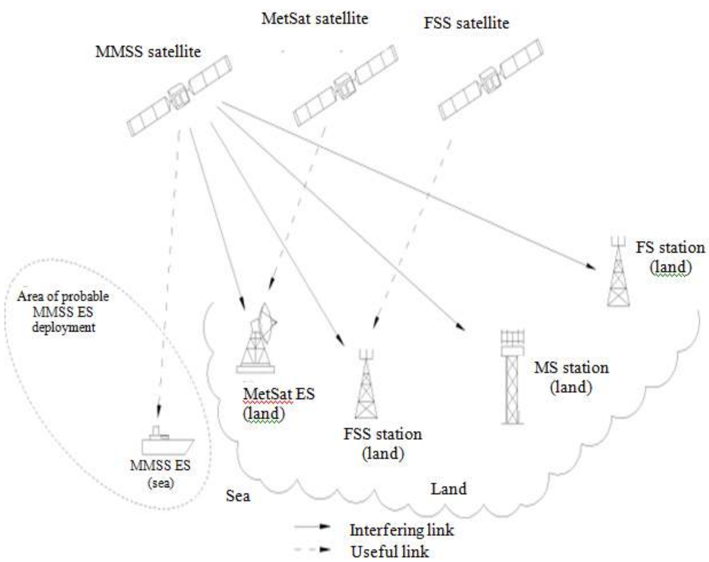
4.2/1.9.2/4 Analysis of the results of studies

The characteristics used in the study for non-GSO MMSS systems were derived from the GSO MMSS systems since no parameters of non-GSO MMSS systems that might operate in the considered frequency band have been provided.

The scenario of interference between envisioned MMSS (s-E) and radio services allocated in the frequency band 7 375-7 750 MHz is shown in Figure 4.2/1.9.2/4-1.

FIGURE 4.2/1.9.2/4-1

Scenario of interference between envisioned MMSS (s-E) and other services allocated in the band 7 375-7 750 MHz

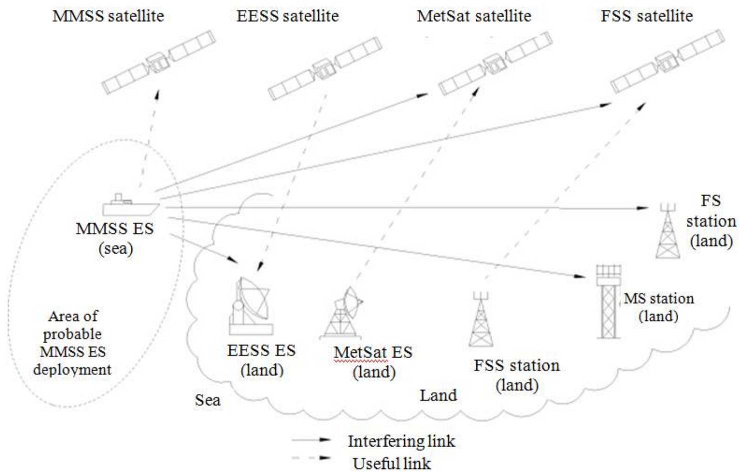


The analysis shows that the scenarios of interference between the envisioned MMSS (s-E) and other services in the frequency band 7 375-7 750 MHz would be similar to those for FSS (s-E) and these services in the subject frequency band. The only difference consists in the additional scenario of interference between MMSS (s-E) and FSS (s-E) which is actually similar to the interference scenario for different networks operating in the FSS (s-E).

The scenario of interference between envisioned MMSS (E-s) and radio services allocated in the frequency band 8 025-8 400 MHz is shown in Figure 4.2/1.9.2/4-2.

FIGURE 4.2/1.9.2/4-2

Scenario of interference between envisioned MMSS (E-s) and other services allocated in the band 8 025-8 400 MHz



Compatibility with the sensitive SRS (deep space) receiving earth stations in the adjacent band 8 400-8 450 MHz was also analysed.

4.2/1.9.2/4.1 MMSS (s-E) sharing with the fixed service in 7 375-7 750 MHz

Multiple studies noted that the interference characteristics from a space station in the proposed MMSS into the fixed service are identical to the interference characteristics from a space station in the existing FSS into the FS. The terrestrial FS is protected from the FSS by a pfd limit applicable to the FSS, which is given in RR No. **21.16** (Table **21-4**). It is further noted that the same pfd limit also applies to the MSS, and thus it would also apply to the proposed MMSS.

4.2/1.9.2/4.2 MMSS (s-E) sharing with the FSS (s-E) in 7 375-7 750 MHz

No technical studies regarding sharing between the MMSS and the FSS in the 7 375-7 750 MHz band have been performed. However, if MMSS operations in the band would be limited to GSO systems and the interference characteristics between MMSS and FSS would therefore be the same as between two FSS systems, sharing can be accomplished through coordination under RR Article **9**.

4.2/1.9.2/4.3 MMSS (s-E) sharing with the MS (except aeronautical mobile) in 7 375-7 750 MHz

Multiple studies noted that the interference characteristics from a space station in the proposed MMSS into the MS (except aeronautical mobile) are identical to the interference characteristics from a space station in the existing FSS into the MS (except aeronautical mobile). The existing MS (except aeronautical mobile) is protected from the FSS by a pfd limit applicable to the FSS, which is given in RR No. **21.16** (Table **21-4**). It is further noted that the same pfd limit also applies to the MSS, and thus it would also apply to the proposed MMSS.

4.2/1.9.2/4.4 MMSS (s-E) sharing with the MetSat (s-E) in 7 450-7 550 MHz

No technical studies regarding sharing between the MMSS and MetSat in the 7 375–7 750 MHz band have been performed. However, if MMSS operations in the band would be limited to GSO systems and the interference characteristics between MMSS and systems in the MetSat would be the same as between FSS and MetSat systems, it is expected that sharing could be accomplished through coordination under RR Article **9**.

4.2/1.9.2/4.5 MMSS (E-s) sharing with the EESS (s-E) in 8 025-8 400 MHz

Studies show that an allocation to the MMSS in the band 8 025-8 400 MHz would create a potential for harmful interference to receiving EESS earth stations worldwide when MMSS earth stations operate within the exclusion zones identified to protect each of these EESS earth stations. From a list of over 100 known EESS earth stations, a subset of EESS earth stations was examined. Most EESS earth stations that were within 100 km of the coast would require some significant separation distance to prevent interference from MMSS operations.

For non-GSO MMSS systems operating with typical parameters, the required separation distances for the large samples EESS earth stations considered in the studies range between 148 km and 544 km depending upon the geographical characteristics surrounding the EESS earth station. Similarly, for GSO MMSS networks, the separation distances range from 78 km to 484 km.

For the typical MMSS characteristics proposed, an additional analysis based on a Monte Carlo methodology was performed for three of the earth stations. The study determines the probability for a MMSS earth station located in the exclusion area (deterministic methodology) to cause harmful interference to an EESS earth station. The randomly determined MMSS earth station locations are contained within the exclusion zones around the EESS station calculated through the static analysis.

The probability of interference ranges from 0.77% to 1.41% for a separation distance of 200 km and from 0.41% to 0.82% for a separation distance of 300 km. These results show how low is the probability for an MMSS earth station located within the exclusion area (defined by the maximum separation distance) to cause harmful interference into the receiving EESS earth station. However, the maximum separation distances obtained in the Monte Carlo analyses confirm the results obtained through the static methodology. It should be noted that the Monte Carlo methodology used in this analysis determines the geometric probability of harmful interference to an EESS earth station based on a single randomly positioned MMSS earth station in a defined area around the EESS station. This differs from the other 8 GHz sharing analyses which calculate a maximum separation distance between the EESS and MMSS earth stations needed to satisfy the Recommendation ITU-R SA.1027 sharing criteria defined for a percentage of time, assuming a single MMSS earth station and using the methodology defined in Recommendation ITU-R SA.1277. The geometric probability of harmful interference cases is not the same as the percentage of time the EESS earth station sharing criteria is exceeded. Nevertheless, the results highlight that MMSS earth stations located within the exclusion area defined by the maximum separation distance do not necessarily create harmful interference into the receiving EESS earth station all the time.

Should the MMSS transmitters operate with the maximum e.i.r.p. density allowed by RR No. **21.8** towards the horizon, the required separation distances would range from 300 km to 892 km for non-GSO MMSS systems and from 266 km to 718 km for GSO MMSS networks. Similar distances might be expected for the other EESS earth stations located within one hundred km or more from the coast worldwide. These separation distances have been computed using Recommendation ITU-R SA.1277 which is close to a Time Invariant Gain (TIG) methodology, and gives a relatively larger distance than what would be determined using a Time Variable Gain (TVG) methodology developed to cover non-GSO satellite victim systems, noting that the protection criteria from Recommendation ITU-R SA.1027 cover only non-GSO satellites.

This study shows that even when transmitting at the lower power density, an MMSS station at a distance from a receiving EESS earth station of less than 544 km (when transmitting to an non-GSO MMSS satellite) or 417 km (when transmitting to a GSO MMSS satellite) can cause harmful interference into the EESS system.

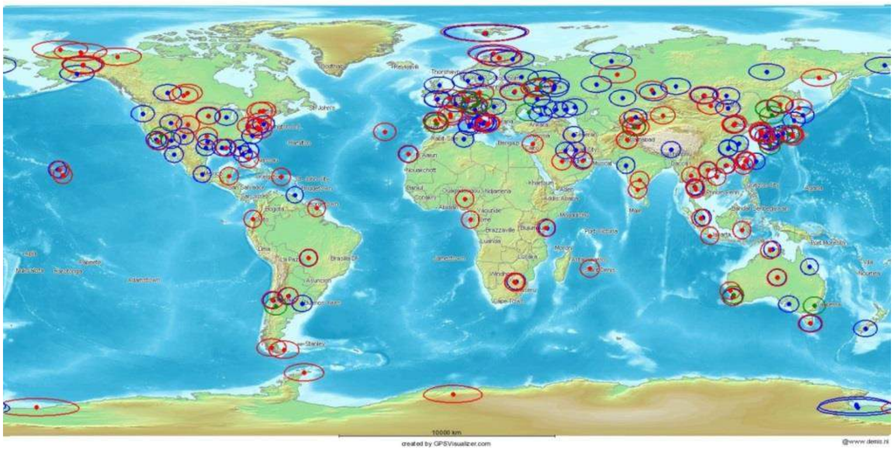
A minimum MMSS seaborne transmitting antenna elevation was considered as 10 degrees above the horizon. This minimum antenna elevation limits MMSS service to operation at latitudes less than 71.4 degrees when looking South (Antarctic) or North (Arctic). However, EESS earth stations track satellites down to 5 degrees above the horizon, not 10 degrees. Communications using MMSS antenna elevation angles less than 10 degrees are possible, which could result in a near main beam coupling situation.

This analysis is based on the presence of a single MMSS terminal operating on a single channel. In the case of multiple MMSS terminals operating on multiple channels, the required exclusion zone may grow accordingly, also depending on the respective width of EESS and MMSS channels. Note that more and more EESS systems need the entire allocated band to download very large amounts of data.

Figure 4.2/1.9.2/4-3 is provided below, noting that some of the inland stations shown in this picture may not require exclusion zones.

FIGURE 4.2/1.9.2/4-3

400 km exclusion zones around high data rate (red) and low data rate (blue) X-band EESS earth stations (SRS deep space stations (green) may require similar exclusion zones)



In addition, such an MMSS allocation could also be envisaged for global maritime distress and safety service (GMDSS) operations. This usage would lead to a very large number of ships potentially transmitting close to the coasts, therefore substantially increasing the risk of harmful interference to receiving EESS earth stations or even the physical risk to the RF front-end receivers of these earth stations. The International Maritime Organization has liaised that it is not interested in pursuing this allocation and thus the likelihood of GMDSS operations in this band is small.

The current provisions of RR Appendix **7** can be applied for the determination of a coordination area between the transmitting MMSS and the EESS receiving stations in the frequency band 8 025-8 400 MHz. For one study, the parameters required for protection of EESS receiving earth stations in the bi-directionally allocated frequency band 8 025-8 400 MHz were taken from RR Appendix **7** Table 9a. For the considered example obtained in accordance with RR Appendix **7** the maximum coordination distance providing protection for the EESS receiving earth stations is up to 363 km.

4.2/1.9.2/4.6 MMSS (E-s) sharing with the FS in 8 025-8 400 MHz

Based on the results of the sharing study, the calculated separation distances of 317 km from the territorial coasts line are required to protect FS stations from one MMSS earth station. It is noted that there are 4 primary services sharing the 8 025-8 400 MHz frequency band, namely, EESS (s-E), FS, FSS (E-s) and MS. Some of the systems in these services could potentially interfere with a FS system in addition to multiple MMSS earth stations. Hence, the required separation distance would be larger than the separation distance due to a single MMSS earth station alone.

4.2/1.9.2/4.7 MMSS (E-s) sharing with the FSS (E-s) in 8 025-8 400 MHz

No technical studies have been conducted to examine MMSS sharing with the FSS in the 8 025-8 400 MHz band. However, if MMSS operations in the band would be limited to GSO systems and the interference characteristics between MMSS and FSS would therefore be the same as between two FSS systems, sharing can be accomplished through coordination under RR Article **9**.

4.2/1.9.2/4.8 MMSS (E-s) sharing with the MS (except aeronautical mobile) in 8 025-8 400 MHz

Protection of the MS from interference by the proposed MMSS (E-s) in the frequency band 8 025-8 400 MHz could be provided by using protection distances specified for MMSS earth stations. In this case it would require determining appropriate performances of MMSS and MS for incorporation into RR Appendix **7** or for calculation of coordination distances. However, the responsible Working Party has expressed concerns with regard to this solution.

4.2/1.9.2/4.9 MMSS (E-s) sharing with the MetSat in 8 175-8 215 MHz

No technical studies have been conducted to examine MMSS sharing with the MetSat in the 8 025-8 400 MHz band. However, if MMSS operations in the band would be limited to GSO systems and the interference characteristics between MMSS and MetSat would therefore be the same as between FSS and MetSat systems, it is expected that sharing between the MMSS and the MetSat could be accomplished through coordination under RR Article **9**.

4.2/1.9.2/4.10 MMSS (E-s) compatibility with the SRS (deep space) (s-E) in 8 400-8 450 MHz

The potential for out-of-band interference from MMSS earth stations to SRS (deep space) earth stations in the adjacent 8 400-8 450 MHz deep space band is of great concern due to the high sensitivity of SRS deep space receivers, and due to the importance of critical events in SRS deep space missions. The exclusion zone for non-GSO MMSS and GSO MMSS earth stations under the proposed 8 025-8 400 MHz allocation by WRC-15 agenda item 1.9.2 were computed for the three NASA deep space stations Goldstone – USA, Canberra – Australia, and Robledo – Spain, the three ESA deep space stations Cebreros – Spain, Malargüe Sur – Argentina and New Norcia – Australia, and the two JAXA deep space stations in Uchinoura and Usuda, using the approach defined in Recommendation ITU-R SA.1277, which is in principle applicable for sharing (in-band) studies in the 8 025-8 400 MHz band, and the SRS protection criteria contained in Recommendation ITU-R SA.1157.

For non-GSO MMSS systems operating with typical parameters, the required separation distances for the sample SRS (deep space) earth stations considered in this document range between 280 km and 660 km depending upon the geographical characteristics surrounding the SRS (deep space) earth station. Similarly, for GSO MMSS networks, the range is from 275 km to 660 km. For three of the SRS earth stations located close to coastal areas, the distances extend into the sea.

The required separation distances, when the MMSS transmitters operate with the maximum allowed e.i.r.p. density towards the horizon allowed by RR No. **21.8,** range from 570 km to 830 km for non-GSO MMSS systems and from 410 km to 820 km for GSO MMSS networks. In all cases, the distances extend into the sea.

The analysis is based on the presence in the area of a single MMSS terminal operating on a single channel. In case of multiple MMSS terminals operating on multiple channels, the required exclusion zone may grow accordingly.

The results of a Monte Carlo analysis show that the probability of interference is lower than 0.001% for 5 of the SRS stations considered and ranges from 0.0062% to 0.0409% for the rest of the stations when the MMSS earth station is at 250 km away from the SRS station and when no attenuation of out-of-band emissions is considered.

It should be noted that the Monte Carlo methodology used in this analysis determines the probability of harmful interference to an SRS earth station based on a number of randomly determined factors including geo-spatial (position and velocity of MMSS station), programmatic (MMSS contact duration, SRS antenna pointing), and weather dependent propagation elements. This differs from the other 8 GHz sharing studies using a deterministic methodology which calculated a maximum separation distance between the SRS and MMSS earth stations needed to satisfy the Recommendation ITU-R SA.1157 sharing criteria defined for a percentage of time, assuming a single MMSS earth station. Over a period of time, each of these factors is certainly variable in time.

Moreover, it should be emphasized that 0.001% exceedance level used for this study is an assumed value as Recommendation ITU-R SA.1157 does not explicitly define an allowable non-zero exceedance time. Recommendation ITU-R SA.1157 does explicitly indicate that the weather dependent propagation used in assessing interference into the SRS earth stations should be based on a p = .001% exceedance, rather than a variable exceedance assumed in this approach.

In order to limit the exclusion zone around the SRS (deep space) earth stations to overland distances, it may be necessary to limit the unwanted emission e.i.r.p. spectral density of the MMSS earth stations to a given value. For the SRS stations studied this value is in the order of –30 dBW/Hz. However, for the SRS earth stations located close to coastal areas, a more stringent value would be needed. Alternatively, for these stations a combination of exclusion zones together with unwanted emission e.i.r.p. spectral density limits would be required.

4.2/1.9.2/4.11 Summary for all affected services

4.2/1.9.2/4.11.1 Frequency band 7 375-7 750 MHz

A possible technical and regulatory solution for the problem of sharing between MMSS (space-to-Earth) and existing terrestrial services or space services in the frequency band 7 375-7 750 MHz could be application of the RR Article **21** provisions referred to limits of power flux-density produced by MMSS space stations in the frequency band 7 375-7 750 MHz for protecting the terrestrial services as well as subject to application of effective RR Article **9** provisions to provide sharing with space services. It has been considered that the MMSS allocation is limited only to GSO satellite networks.

4.2/1.9.2/4.11.2 Frequency band 8 025-8 400 MHz

Sharing between FS and MMSS uplinks in the 8 025-8 400 MHz band requires a minimum separation distance to protect the FS receiver. The calculated separation distances of 317 Km from the coast lines are required to protect FS stations from one MMSS earth station. The separation distance would be larger when considering aggregated interference from systems of the existing co-primary services in addition to multiple MMSS stations.

Sharing between MMSS and EESS requires a minimum separation distance to the EESS receiver. The same is also true for protection of highly sensitive SRS (deep space) receivers operating in the adjacent 8 400-8 450 MHz band from out-of-band interference from MMSS transmitters. Depending on the MMSS system parameters and the local terrain, separation distances in the range from 100 km to 850 km may be required.

It has been suggested that sharing between envisioned MMSS (Earth-to-space) and existing terrestrial services or space services operating in reverse direction in the frequency band 8 025-8 400 MHz could be solved through coordination under RR Nos. **9.17** and **9.17A**. To implement this procedure it is required to determine coordination distances. One of the possible mechanisms for determination of coordination distances for protection of concerned receiving stations is the mechanism described in RR Appendix **7**. However, besides the fact that an MMSS earth station can only be notified by an administration within its territorial waters, several factors must be considered in assessing the practicality of this approach.

MMSS earth stations are mobile in nature in all sea areas, and the number of such stations could potentially be very large. There are large numbers of EESS earth stations and FS stations located in close proximity to the sea, and the required separation distances for many of these stations are large and extend across the borders between administrations. Due to the potentially large number of MMSS earth stations in the 8 GHz band operating in proximity to the coast, the possibility of interference from multiple MMSS stations into the FS and EESS earth stations exist. Moreover, the mobile nature of the MMSS earth stations would make it very difficult to identify the source of interference in the time frame in which the interference could be remediated. Each of the EESS earth stations may use the whole frequency band in support of multiple EESS missions. Finally, some receive-only EESS stations are not notified and their locations cannot be known. In consideration of these factors, coordination by MMSS transmitters to prevent interference into FS and EESS stations is not practical and effectively would be equivalent to the application of exclusion zones around these stations, which size has been evaluated in sections 4.2/1.9.2/4.5 and 4.2/1.9.2/4.10 above in the order of several hundreds of km.

This approach requires that each ship using an MMSS earth station must shut down its emissions as soon as it enters in one of these exclusions zones, and therefore each ship must have knowledge of the location of all victim stations worldwide with their associated exclusion zones. Such a database would have to be frequently updated by a central authority which must handle a dynamically evolving and steadily increasing list of stations. In addition, this yet-undefined authority would also have to enforce these exclusion zones and verify their application.

However, given the density of FS stations close to the shore in some countries, the large numbers of known existing EESS stations and the existence of typical receive only EESS stations whose locations cannot be known, protection of terrestrial and space service receivers from harmful interference could only be ensured if the MMSS transmitter were constrained to operate at a certain distance from the shore, unless otherwise agreed by the relevant administration. This approach would be similar to that of Resolution **902 (WRC-03)**. The required offshore distance would be a function of other constraints levied upon the MMSS system (e.g. maximum transmit power, use of GSO networks only, etc.); but the required separation distance would be so large (potentially 650 km or more) that it may diminish the utility of the allocation to MMSS operations for certain applications.

In addition, the protection of SRS (deep space) earth stations operating in the adjacent band 8 400-8 500 MHz would have to be ensured either by a limitation of MMSS earth station unwanted emissions, by relevant exclusion zones (green circles in Figure 3), or a combination of both.

Although no technical studies have been provided, it is expected that sharing between the MMSS and the FSS, MetSat and MS (except aeronautical mobile) could be accomplished through coordination under RR Article **9**.

4.2/1.9.2/5 Method(s) to satisfy this part of the agenda item

4.2/1.9.2/5.1 Method A

There would be no allocation to the MMSS within the 7 375-7 750 MHz and 8 025-8 400 MHz bands and therefore no change to the RR.

Advantages:

– Would ensure the continued operation of the FS, FSS, MS, MetSat and EESS in band within their existing environment.

– Would ensure no impact to the SRS in the adjacent 8 400–8 450 MHz band.

– Would avoid the imposition of minimum separation distance for MMSS transmitters to avoid interference into systems of other services located near the coastline.

Disadvantages:

– The demand for MMSS spectrum may not be met and shortfall of spectrum for current and future MMSS in these bands still remains.

4.2/1.9.2/5.2 Method B

The 7 375-7 750 MHz and 8 025-8 400 MHz bands would be allocated to the MMSS under the following conditions:

– Use of the MMSS to be limited to geostationary satellites.

– Application of pfd limits in Table **21-4** of RR Article **21** in the 7 375-7 750 MHz band for MMSS downlink.

– Coordination under RR Nos. **9.7** and **9.21** for MMSS satellite networks.

To address sharing and compatibility between MMSS earth stations and other services, two options are considered:

– Option A: Agreement-seeking procedure under RR No. **9.21** together with the coordination procedures under RR Nos. **9.17, 9.17A** and **9.18** (including RR Appendix **7**) for MMSS earth stations, as appropriate, or,

– Option B: Adoption of a WRC Resolution, referenced in a footnote to the Table of Frequency Allocations of RR Article **5**, that would explain the dynamic evolution of the exclusion zones around the FS stations as well as the EESS and SRS (deep space) earth stations to be respected and would indicate which entity will be in charge of managing their map and how this process will take place.

Advantages:

– The new allocation would satisfy the spectrum demand of MMSS.

– Harmonized use of spectrum would be possible between MMSS and existing services in the 7/8 GHz bands.

– The conditions, such as pfd limits and coordination procedures, would protect the existing services against an impact of a new allocation to MMSS.

Disadvantages:

– Existing RR procedures do not allow administrations to notify an MMSS earth station outside the territorial waters of the relevant administration. Therefore, coordination under RR Nos. **9.17**, **9.17A**, **9.18**, would not be possible for an MMSS earth station located within international waters. It has to be noted that Resolution **758 (WRC-12)**, through its considering *i)*, only covers international waters.

– Coordination would impose severe burden to the administrations operating MMSS and to the large number of administrations operating large numbers of systems in the incumbent services.

– In any case, the result of such coordination can only be the imposition of large exclusion zones around FS stations and EESS earth stations where MMSS earth stations would be unable to operate, and the definition and maintenance of these large exclusion zones would be impracticable.

– Such a method does not address the protection of the growing number of future FS stations and EESS earth stations, worldwide, and would therefore prevent the development of both services in proximity of coastal areas.

– This method currently does not address the protection of very sensitive SRS (deep space) earth stations which are located close to coastal areas.

– Due to the large number of MMSS earth stations operating near the shore which are mobile in nature in all sea areas, the interfered-with systems/services will not be able to easily identify the interfering MMSS earth station/stations.

– No studies of interference from incumbent services into MMSS have been provided.

4.2/1.9.2/6 Regulatory and procedural considerations

Note: The disposition of Resolution **758 (WRC-12)** under this agenda item (i.e. no change, modified, or suppressed) needs to take into account discussions and results of WRC-15 agenda item 1.9.1.

4.2/1.9.2/6.1 Method A

No change to the RR.

4.2/1.9.2/6.2 Method B

ARTICLE 5

Frequency allocations

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

MOD

7 250-8 500 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
7 300-7 450	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile 5.461 ADD 5.A192	
7 450-7 550	FIXED FIXED-SATELLITE (space-to-Earth) METEOROLOGICAL-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile 5.461A ADD 5.A192	
7 550-7 750	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile ADD 5.A192	

ADD

Option A

5.A192 *Additional allocation:* the bands 7 375-7 750 MHz (space-to-Earth) and 8 025-8 400 MHz (Earth-to-space) are also allocated to the maritime mobile-satellite service on a primary basis limited to the geostationary-satellite networks, subject to No. **9.21**.

Option B

5.A192 *Additional allocation:* the bands 7 375-7 750 MHz (space-to-Earth) and 8 025-8 400 MHz (Earth-to-space) are also allocated to the maritime mobile-satellite service on a primary basis limited to the geostationary-satellite networks. Moreover, such use is subject to the application of Resolution **XXX (WRC-15)**.

Note: A Resolution XXX is needed which would explain the dynamic evolution of the exclusion zones to be respected and will indicate which entity will be in charge of managing their map and how this process will take place.

MOD

7 250-8 500 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
8 025-8 175	EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A ADD 5.A192	
8 175-8 215	EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A ADD 5.A192	
8 215-8 400	EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A ADD 5.A192	

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section V − Limits of power flux-density from space stations

NOC

TABLE **21-4** (Rev.WRC-12)

Reasons: No change is proposed because the current wording of Table **21-4** already covers the case of MMSS in the band 7 375-7 750 MHz.

APPENDIX 7 (REV.WRC-12)

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 9a (Rev.WRC-~~12~~15)

Parameters required for the determination of coordination distance for a transmitting earth station in bands shared bidirectionally with receiving earth stations

Space service designation in which the transmitting earth station operates		Land mobile-satellite	Mobile-satellite	Land mobile-satellite	Earth exploration-satellite, meteorological-satellite	Mobile-satellite		Fixed-satellite, mobile-satellite	Aeronautical mobile-satellite (R) service		Fixed-satellite [3]		Fixed-satellite	Fixed-satellite, meteorological-satellite, maritime mobile- satellite	Fixed-satellite, maritime mobile-satellite
Frequency bands (GHz)		0.1499-0.15005	0.272-0.273	0.3999-0.40005	0.401-0.402	1.670-1.675		2.655-2.690	5.030-5.091		5.150-5.216		6.700-7.075	8.025-8.400	8.025-8.400
Space service designation in which the *receiving* earth station operates		Radio-navigation-satellite	Space operation	Radio-navigation-satellite	Space operation	Meteorological-satellite		Fixed-satellite, broadcasting-satellite	Aeronautical mobile-satellite (R) service		Fixed-satellite	Radiodeter-mination-satellite	Fixed-satellite	Earth exploration-satellite	Earth exploration-satellite
Orbit [6]			Non-GSO		Non-GSO	Non-GSO	GSO		Non-GSO	GSO	Non-GSO		Non-GSO	Non-GSO	GSO
Modulation at *receiving* earth station [1]			N		N	N	N						N	N	N
Receiving earth station interference parameters and criteria	p_0 (%)		1.0		0.1	0.006	0.011						0.005	0.011	0.083
	n		1		2	3	2						3	2	2
	p (%)		1.0		0.05	0.002	0.0055						0.0017	0.0055	0.0415
	N_L (dB)	0	0	0	0	0	0						1	0	1
	M_s (dB)	2	1	2	1	2.8	0.9	2			2	2	2	4.7	2
	W (dB)	0	0	0	0	0	0						0	0	0
Receiving earth station parameters	G_m(dBi) [2]	0	20	0	20	30	45		45	45	48.5		50.7		
	G_r(dBi) [4]	0	19	0	19	19 [9]	8		8	8	10		10	10	8
	ε_{min} [5]	3°	10°	3°	10°	5°	3°	3°	10°	10°	3°	3°	3°	5°	3°
	T_e (K) [7]	200	500	200	500	370	118	75	340	340	75	75	75		
Reference bandwidth	B (Hz)	4×10^3	10^3	4×10^3	1	10^6	4×10^3		37.5×10^3	37.5×10^3			10^6	10^6	10^6
Permissible interference power	$P_r(p)$ (dBW) in B	–172	–177	–172	–208	–145	–178		−163.5	−163.5			–151	–142	–154

AGENDA ITEM 1.10

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

1.10 to consider spectrum requirements and possible additional spectrum allocations for the mobile-satellite service in the Earth-to-space and space-to-Earth directions, including the satellite component for broadband applications, including International Mobile Telecommunications (IMT), within the frequency range from 22 GHz to 26 GHz, in accordance with Resolution ***234 (WRC-12)****;*

Resolution **234 (WRC-12)**: *Additional primary allocations to the mobile-satellite service within the bands from 22 GHz to 26 GHz*

4.2/1.10/1 Executive summary

ITU-R has undertaken studies of possible bands for new allocations to the mobile-satellite service (MSS) in the Earth-to-space (E-s) and space-to-Earth (s-E) directions within the frequency range 22-26 GHz, taking into account numerous sharing and compatibility aspects. Resolution **234 (WRC-12)** has considered and recognized that the lack of spectrum to implement IMT and broadband applications in the range 4-16 GHz for MSS of between 240 MHz and 335 MHz has not been satisfied, but the ITU-R has not yet estimated the total requirements for the MSS in the 22-26 GHz frequency range. A number of frequency bands in the 22-26 GHz frequency range have been assessed for possible sharing with new MSS systems, although not all services within those bands have been studied for sharing with new MSS systems. Some frequency bands within the 22-26 GHz range have had no studies. The results of ongoing sharing studies are contained in preliminary draft new (PDN) Report ITU-R M.[MSS SHARE].

4.2/1.10/2 Background

WRC-12 adopted WRC-15 agenda item 1.10 in order to consider additional allocations to the MSS, taking into account ITU-R studies in accordance with Resolution **234 (WRC-12)**. Resolution **234 (WRC-12)** invites the ITU-R to complete, for WRC-15, sharing and compatibility studies towards additional allocations to the MSS in the Earth-to-space and space-to-Earth directions, within portions of the bands between 22 GHz and 26 GHz, while ensuring protection of existing services within this frequency range, as well as taking into account RR No. **5.340** and RR No. **5.149**.

In some regions and countries of the world, the use of satellite communication systems for the purpose of mobile satellite telephony and data applications is increasing. In these countries, further development and advancement of these systems may require additional spectrum resources.

Certain allocated bands for MSS may not be suitable for future broadband applications. These bands may be further limited by the constraints and conditions for protection of other services. This potentially reduces the use of the actual available and accessible spectrum for MSS systems.

Some administrations do not see a need for additional spectrum for future MSS growth beyond that already allocated for the MSS in the Radio Regulations, and furthermore believe that existing MSS spectrum allocations are sufficient (in particular, the range 20/30 GHz of which some portions have not been implemented). It is further recognized that some spectrum requirements may be satisfied by fixed-satellite service (FSS) systems.

The success of the service of MSS also depends on the desirable key features of MSS: global coverage, small antenna size, terminal portability, mobility, fast deployment, and low sensitivity to rain fade. Some administrations think that it may be difficult to accomplish these features for frequency bands above 20 GHz due to high level of rain attenuation. However, other administrations believe that there are already FSS systems operational in Ka-band and these problems can be handled by the technological advancements.

4.2/1.10/3 Summary of the technical and operational studies, including a list of relevant ITU-R Recommendations

The main elements required for the studies are: 1) to establish technical characteristics of MSS systems that are proposed to operate in the frequency range in question; 2) to evaluate the possible spectrum requirements for such new MSS applications; and 3) to carry out sharing studies with the systems of other services in the designated frequency range. Spectrum requirements for the MSS in the frequency range covered by this agenda item are addressed in working document towards a preliminary draft new (WDPDN) Report ITU-R M.[MSS KA REQ]. Technical characteristics and sharing analyses for example MSS systems are contained in PDN Report ITU-R M.[MSS SHARE].

Relevant ITU-R Documents:

Recommendations: ITU-R P.452, ITU-R P.530, ITU-R P.618, ITU-R P.620, ITU-R P.1144, ITU-R P.1410, ITU-R P.1546, ITU-R P.1623, ITU-R RA.517, ITU-R RA.611, ITU-R RA.769, ITU-R RA.1031, ITU-R RA.1237, ITU-R RA.1513, ITU-R RA.1631, ITU-R RS.515, ITU-R RS.577, ITU-R RS.1028, ITU-R RS.1029, ITU-R RS.1166, ITU-R RS.1813, ITU-R RS.1861, ITU-R S.465, ITU-R S.671, ITU-R S.1323, ITU-R S.1329, ITU-R S.1716, ITU-R S.1899, ITU-R SA.509, ITU-R SA.609, ITU-R SA.1018, ITU-R SA.1019, ITU-R SA.1026, ITU-R SA.1027, ITU-R SA.1155, ITU-R SA.1276, ITU-R SA.1414, ITU-R SA.1743, ITU-R SA.1862, ITU-R SA.1882, ITU-R TF.1011, ITU-R TF.1153

Reports: ITU-R M.2149, ITU-R SA.2192

The characteristics and protection criteria of services impacted in this frequency range may be found in Table 4.2/1.10/3-1.

TABLE 4.2/1.10/3-1

Service (PRIMARY or Secondary)	**Band (GHz)**	**Characteristics**	**Protection Criteria**
AMATEUR	24.0-24.05	Rec. ITU-R M.1732	Not available
Amateur	24.05-24.25	ITU-R M.1732	Not available
AMATEUR-SATELLITE	24.0-24.05	Not available	Not available
EARTH EXPLORATION-SATELLITE (passive)	22.21-22.5 23.6-24.0	Rec. ITU-R RS.515 Rec. ITU-R RS.1028 Rec. ITU-R RS.1813 Rec. ITU-R RS.1861	Rec. ITU-R RS.1029
EARTH EXPLORATION-SATELLITE (space-to-Earth)	25.5-27.0	Rec. ITU-R SA.1026 Rec. ITU-R SA.1027	Rec. ITU-R RS.1166 Rec. ITU-R SA.1026 Rec. ITU-R SA.1027
Earth exploration-satellite (active)	24.05-24.25	Rec. ITU-R RS.577 Rec. ITU-R SA.1166	Rec. ITU-R RS.1029 Rec. ITU-R RS.1166
FIXED	22.0-23.6 24.25-25.25 (Regions 1 and 3) 25.25-27.0	Rec. ITU-R F.758 PDN Rep. ITU-R M.[MSS SHARE] (Table A1-3)	Rec. ITU-R F.758

Service (PRIMARY or Secondary)	Band (GHz)	Characteristics	Protection Criteria
FIXED-SATELLITE (Earth-to-space)	24.65-24.75 (Regions 1 and 3) 24.75-25.25	Rec. ITU-R S.465 Rec. ITU-R S.1329	Rec. ITU-R S.1323 Rec. ITU-R S.1329
INTER-SATELLITE	22.55-23.15 23.15-23.55 24.45-24.65 24.65-24.75 25.25-27.5	Rec. ITU-R SA.509 Rec. ITU-R S.1899 Rec. ITU-R SA.1018 Rec. ITU-R SA.1019 Rec. ITU-R SA.1276 Rec. ITU-R SA.1414 Rec. ITU-R SA.1882 Rec. ITU-R SM.1633 (Annex 13) Rep. ITU-R SA.2192	Rec. ITU-R S.1899 Rec. ITU-R SA.1155 Rec. ITU-R SA.1743
MOBILE	22.5-23.6 24.25-25.25 (Region 3) 25.25-27.0	Not available	Not available
MOBILE except aeronautical mobile	22.0-22.5	Not available	Not available
RADIO ASTRONOMY	22.21-22.5 23.6-24.0	Rec. ITU-R SA.509 Rec. ITU-R RA.769 Rec. ITU-R RA.1631	Rec. ITU-R RA.517 Rec. ITU-R RA.611 Rec. ITU-R RA.769 Rec. ITU-R RA.1031 Rec. ITU-R RA.1237 Rec. ITU-R RA.1513
RADIOLOCATION	24.05-24.25	Not available	Not available
RADIOLOCATION-SATELLITE (Earth-to-space)	24.65-24.75 (Region 2)	Not available	Not available
RADIONAVIGATION	24.25-24.45 24.45-24.65 (Regions 2 and 3)	Not available	Not available
SPACE RESEARCH (Earth-to-space)	22.55-23.15	Rec. ITU-R SA.509 Rec. ITU-R SA.1743 Rec. ITU-R SA.1882	Rec. ITU-R SA.609 Rec. ITU-R SA.1743
SPACE RESEARCH (space-to-Earth)	25.5-27.0	Rec. ITU-R SA.509 Rec. ITU-R SA.1862	Rec. ITU-R SA.609 Rec. ITU-R SA.1743
SPACE RESEARCH (passive)	22.21-22.5 23.6-24.0	Rec. ITU-R RS.515 Rec. ITU-R RS.1028 Rec. ITU-R SA.1813 Rec. ITU-R SA.1861	Rec. ITU-R RS.1029
Standard frequency and time signal-satellite (Earth-to-space)	25.25-27.0	Rec. ITU-R TF.1011 Rec. ITU-R TF.1153	Rec. ITU-R TF.374

4.2/1.10/3.1 Estimated spectrum needs

Resolution **234 (WRC-12)** “Additional primary allocations to the mobile-satellite service within the bands from 22 GHz to 26 GHz”, in its *considering* part states that ITU-R has studied the spectrum requirements for the satellite component of International Mobile Telecommunications (IMT) for the period 2010-2020, and the results are contained in Report ITU-R M.2077. The results in Report ITU-R M.2077 indicate a shortfall of spectrum available for the satellite component of IMT in the Earth-to-space direction of between 19 MHz and 90 MHz by the year 2020. The results in Report ITU-R M.2077 indicate a shortfall of spectrum available for the satellite component of IMT in the space-to-Earth direction of between 144 MHz and 257 MHz by the year 2020. MSS systems which are not part of the satellite component of IMT may also require additional spectrum.

ITU-R has also studied the spectrum requirements for MSS broadband applications by the year 2020, and the results are contained in Report ITU-R M.2218. The results in Report ITU-R M.2218 indicate a shortfall of spectrum for MSS broadband applications of between 240 MHz and 335 MHz by the year 2020 in both the space-to-Earth and Earth-to-space directions. Resolution **234 (WRC-12)** in its *recognizing* part, also states “that no allocations were made for the mobile-satellite service in the range 4-16 GHz at WRC-12, and therefore the shortfall of spectrum for satellite IMT and broadband applications still needs to be addressed”.

The MSS spectrum estimates resulting from Report ITU-R M.2077 and Report ITU-R M.2218 were derived based on the MSS applications in the 1-6 GHz and 4-16 GHz bands, respectively. No spectrum requirements studies have been performed to confirm whether the MSS applications driving these requirements can be met by MSS systems operating in the 22-26 GHz band.

The WDPDN Report ITU-R M.[MSS KA_REQ] is intended to address the spectrum requirements for MSS under this agenda item. Studies regarding the MSS spectrum requirements are still ongoing. To date, the MSS spectrum requirements, in either the space-to-Earth or Earth-to-space directions, have yet to be identified.

4.2/1.10/4 Analysis of the results of studies

To date, no sharing studies have been performed with respect to the following services: amateur service, amateur-satellite service, Earth exploration-satellite service (EESS) (passive), EESS (active), FSS (E-s), mobile service (MS) (except aeronautical mobile) in the 22-22.5 GHz frequency band, radio astronomy service (RAS), radiolocation service, radiolocation-satellite service (E-s) and radionavigation service. The frequency bands to which these services are allocated can be found in Table 4.2/1.10/3-1 above.

It should be noted that a number of studies were not conducted because of the lack of Recommendations containing systems characteristics or sharing criteria, or lack of operational systems (where relevant Recommendations were not available), specifically for the amateur, amateur-satellite, mobile (some bands), radiolocation, radiolocation-satellite, and radionavigation services (see Table 4.2/1.10/3-1 above).

Additionally, it should be noted that only a limited number of studies were performed concerning interference into the MSS from the incumbent services allocated in the bands under consideration under this agenda item.

4.2/1.10/4.1 Earth exploration-satellite service (passive)

The EESS (passive) is allocated on a worldwide primary basis in the frequency bands 22.21-22.5 GHz and 23.6-24.0 GHz. Additionally, RR No. **5.340** applies to the 23.6-24.0 GHz band and therefore emissions are not allowed in this band. Furthermore, unwanted emissions in the passive bands must also be considered: a spectral emission mask would be needed to determine the maximum power levels that the MSS systems in operation in the adjacent bands would be allowed to emit in the passive sensor band.

For the 22.21-22.5 GHz band, to date, no sharing studies have been performed with respect to the EESS (passive). For the 23.6-24.0 GHz band, PDN Report ITU-R M.[MSS SHARE] also notes that

"As a "passive band" protected by RR No. **5.340**, this band is not considered for allocation to the MSS under WRC-15 agenda item 1.10." No out-of-band compatibility studies have been performed to ensure protection of EESS (passive) systems operating in 23.6-24 GHz from unwanted emissions, as recognized in Resolution **234 (WRC-12)**.

4.2/1.10/4.2 Space research and Earth exploration-satellite services (space-to-Earth)

The SRS (s-E) and EESS (s-E) are allocated on a worldwide primary basis in the frequency band 25.5-27.0 GHz.

Potential sharing of the SRS (s-E) and EESS (s-E) with MSS is addressed in sections 3.15.2.5 and 3.15.3 of the PDN Report ITU-R M.[MSS SHARE]. The study given in that Report shows that MSS operations in the band 25.5-26 GHz will create a potential for harmful interference to SRS and EESS links operating in the space-to-Earth direction.

The band 25.5-27 GHz is used by geostationary and non-geostationary SRS applications and non-geostationary EESS applications.

For the purposes of this sharing analysis, the technical parameters for MSS systems were gathered from Recommendation ITU-R S.1328, Report ITU-R M.2221 as well as correspondence from the responsible Working Party.

Three sharing scenarios were considered.

- A MSS earth station uplink into a SRS earth station receiver operating with a SRS non-geostationary satellite.
- A MSS geostationary satellite downlink into a SRS earth station receiver operating with a SRS non-geostationary satellite.
- A MSS geostationary satellite downlink into a SRS earth station receiver operating with a SRS geostationary satellite.

In order to reduce computational complexity, simplifying assumptions related to the distribution of users were made. These assumptions reduced MSS user density from the given characteristic of 8 users/square km to between 0.0004-0.1 users/square km.

For the specific case of a MSS uplink into a SRS earth station receiver operating with a satellite in non-geostationary orbit, aggregate I/N exceeded the protection criteria by 23 dB. This case involves interference from one earth station into another. In such a case, a coordination zone can be calculated to determine the minimum required separation distance between the MSS user terminal and the SRS earth station to avoid interference.

Using a generic path calculated with Recommendation ITU-R P.452-14 and assuming a maximum sidelobe gain consistent with Recommendation ITU-R S.580, a coordination distance of over 330 km would be needed to avoid interference from a MSS user terminal into an SRS earth station.

In the two specific cases of MSS downlinks from satellites operating in geostationary-satellite orbit into SRS earth stations receiving wanted transmissions from the geostationary and non-geostationary-satellite orbits, the interference criterion given in Recommendation ITU-R SA.1155 was exceeded by 30 dB and 10 dB respectively. In the specific case of interference to SRS satellite downlinks from geostationary-satellite orbits, harmful interference could only be avoided if the SRS and MSS satellites maintained an orbital separation on the order of 31 degrees. In the specific case of interference to SRS downlinks from non-geostationary-satellite orbits, no methods for avoiding exceedance of the interference criterion could be identified.

4.2/1.10/4.3 Fixed service

The FS is allocated on a worldwide primary basis in the frequency bands 22-23.6 GHz and 25.25-27.0 GHz, as well as in the frequency band 24.25-25.25 GHz in Regions 1 and 3 only. Potential sharing of the FS with MSS is described in sections 3.1.2.1, 3.1.3, 3.2.2.1, 3.2.3, 3.3.2.1, 3.3.3, 3.4.2.1, 3.4.3, 3.5.2.1, 3.5.3, 3.6.2.1, 3.6.3, 3.10.2.1, 3.10.3, 3.11.2.1, 3.11.3, 3.12.2.1, 3.12.3, 3.13.2.1, 3.13.3, 3.14.2.1, 3.14.3, 3.15.2.1 and 3.15.3 of PDN Report ITU-R M.[MSS SHARE]. Fixed systems in these bands are deployed worldwide and used both for point-to-point radio-relay systems and other applications. In the case of new MSS allocations, restrictions will have to be applied to protect the existing FS systems.

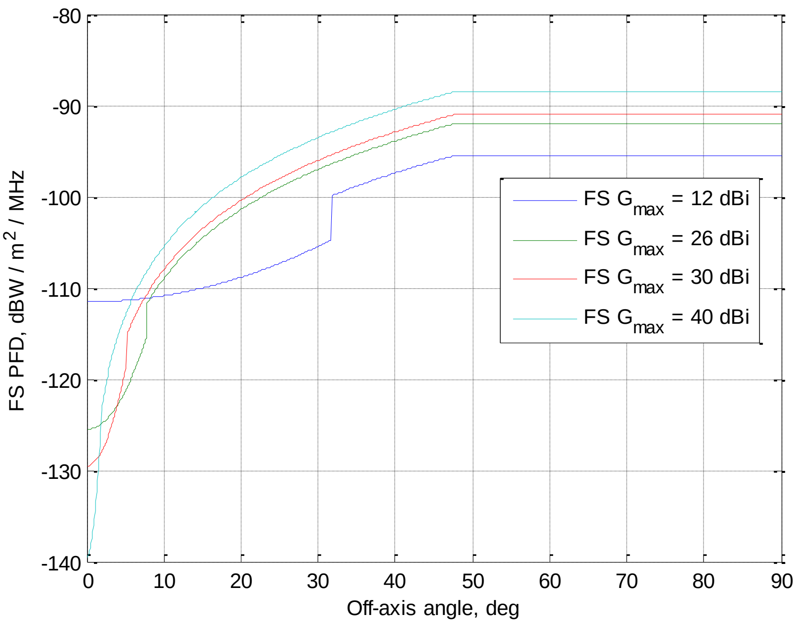
4.2/1.10/4.3.1 MSS (space-to-Earth) to FS

Case 1: MSS pfd limit derived from FS nominal long-term interference protection

The interference protection threshold required to protect the FS systems, in (dBW/(m^2·MHz)), as a function of off-axis arrival angles from 0° to 90°, shown in Figure 4.2/1.10/4.3-1, is based on the nominal long-term interference power density for 128-QAM FS systems (Table 8 of Recommendation ITU-R F.758-5), the representative FS antenna gains of 12, 26, 30, and 40 dBi (at a carrier frequency of 22.4 GHz), and the FS interference protection criteria I/N of −10 dB (Recommendation ITU-R F.758-5).

FIGURE 4.2/1.10/4.3-1

FS interference protection threshold – (dBW/(m^2·MHz))



Case 2: MSS pfd limit derived from probabilistic analysis

The results of the MSS pfd limits are also derived using the probabilistic analysis, provided in the PDN Report ITU-R M.[MSS SHARE].

Conclusion:

Results of calculation show that with the power flux-density mask given in Table 4.2/1.10/4.3-1 (−115/−125) dBW/MHz, created by MSS geostationary space stations at the Earth's surface in frequency bands which are shown in Table A1-9 of PDN Report ITU-R M.[MSS SHARE], the number of FS affected stations (interference exceeds the tolerable criterion) will be 0.191%-0.314% from general number of stations that will amount to 1-66 stations registered (by administrations) in the Master International Frequency Register (MIFR) in absolute figures. With the power flux-density mask given in Table 4.2/1.10/4.3-2 (−105/−115) dBW/MHz, as contained in RR Article **21**, Table **21-4** for other space services, created by MSS geostationary space stations at the Earth’s surface in frequency bands which are shown in Table A1-9, the number of FS affected stations (interference exceeds the tolerable criterion) will be 2.491%-2.769% from general number of stations that will amount to 9-638 stations registered (by administrations) in the MIFR in absolute figures. The concept of a pfd mask can be taken as hard limit for these frequency bands. It should be noted that only a small part of operating FS stations is registered (by administrations) in the MIFR, i.e. mainly stations located in frontier areas, and besides, when one station in the chain is affected, all the chain can be subsequently affected. The real number of affected stations only in Europe would be 10 times more than the number of affected stations registered in the MIFR.

TABLE 4.2/1.10/4.3-1

Frequency band	Service	Limit in dB(W/m²) for angles of arrival (δ) above the horizontal plane			Reference bandwidth
		0°–5°	**5°–25°**	**25°–90°**	
Relevant bands in the frequency band 22-26 GHz (if allocated)	Mobile-satellite service (space-to-Earth)	–125	–125 + 0.5(δ – 5)	–115	1 MHz

TABLE 4.2/1.10/4.3-2

Frequency band	Service	Limit in dB(W/m²) for angles of arrival (δ) above the horizontal plane			Reference bandwidth
		0°-5°	**5°-25°**	**25°-90°**	
Relevant bands in the frequency band 22-26 GHz (if allocated)	Mobile-satellite service (space-to-Earth)	–115	–115 + 0.5(δ – 5)	–105	1 MHz

One administration has noted a contradiction of the proposed −125 dB pfd mask with the current pfd limit in RR Article **21**, Table **21-4** required to protect the terrestrial services, and has also noted that there are more than 17 notified GSO satellites and more than 66 non-GSO satellites that have been operating in the frequency range under consideration without causing any harmful interference to terrestrial services. This administration has also noted that in the adjacent band, with the same characteristics of fixed stations and the same propagation environment, the mask of −115 dB is used to protect the terrestrial services without any interference.

4.2/1.10/4.3.2 MSS (Earth-to-space) to FS

In the case of new geostationary MSS allocations (E-s), a separation distance would be required between a GSO MSS earth station and an FS receiving station. RR Appendix **7** should be used to determine the separation distance between an MSS earth station (including land, aeronautical and maritime stations) and an FS receiving terrestrial station in relevant/selected bands within the

22-26 GHz frequency band. Application of RR No. **9.17** could provide protection for the receiving stations of FS from the transmitting MSS earth station. Taking into account the great number of existing FS stations in some frequency bands, for the uplink it is preferred to consider an MSS allocation where the number of FS stations is as low as possible.

Detailed assessment of the interference impact from existing FS stations to GSO MSS space stations was not performed, however, completely avoiding the interference impact from FS transmitting stations to MSS space stations require an FS antenna off-pointing from the geostationary-satellite orbit. RR No. **21.2** has envisaged small off-point of the FS transmitting antenna from the geostationary-satellite orbit only in the frequency band 25.25-27.5 GHz. Any method to provide MSS (Earth-to-space) should not require that FS stations avoid pointing toward the geostationary-satellite orbit.

4.2/1.10/4.4 Inter-satellite service

The inter-satellite service (ISS) is allocated on a worldwide primary basis in the frequency bands 22.55-23.55 GHz, 24.45-24.75 GHz, and 25.25-27.5 GHz. Inter-satellite systems in these bands are used by operational systems having multiple satellites.

Potential sharing of the ISS with MSS is addressed in sections 3.4.2.3, 3.4.3, 3.5.2.3, 3.5.3, 3.12.2.4, 3.12.3, 3.14.2.3, 3.14.3, 3.15.2.4, and 3.15.3 of PDN Report ITU-R M.[MSS SHARE].

To date, no sharing studies have been performed with respect to the ISS in the band 24.45-24.75 GHz.

The study given in the PDN Report ITU-R M.[MSS SHARE] shows that MSS operations in the bands 22.55-23.15 GHz, 23.15-23.55 GHz and 25.25-26 GHz will create a potential for harmful interference to ISS links supporting SRS, EESS and non-GSO MSS applications in the 22.55-23.15, 23.15-23.55 GHz and 25.25-27.5 GHz bands.

The bands 22.55-23.15 and 23.15-23.55 GHz are used for transmissions from data relay satellites in geostationary-satellite orbits to user spacecraft in non-geostationary-satellite orbits performing space research and EESS applications, and between satellites in the HIBLEO-2 non-GSO MSS constellation. The ISS allocation in the band 25.25-26 GHz is limited to the SRS and EESS applications by RR No. **5.536** and is used for transmissions from user spacecraft in non-geostationary-satellite orbit to data relays in geostationary-satellite orbits.

For the purposes of this sharing analysis, the technical parameters for MSS systems were gathered from Recommendation ITU-R S.1328, Report ITU-R M.2221, section 2 of PDN Report ITU-R M.[MSS SHARE] as well as correspondence from the responsible Working Party.

Six sharing scenarios were considered:

- MSS earth station uplinks into a SRS geostationary satellite receiving from a SRS non-geostationary satellite in the band 25.25-26 GHz.
- MSS earth station uplinks into a SRS non-geostationary satellite receiving from a SRS geostationary satellite in the band 22.55-23.55 GHz.
- MSS earth station uplinks into the ISS links of non-GSO MSS satellites of the HIBLEO-2 satellite system.
- A MSS geostationary satellite downlink into inter-satellite links of HIBLEO-2 non-geostationary satellite system.
- A MSS geostationary satellite downlink into a SRS non-geostationary satellite receiving from a SRS geostationary satellite in the band 22.55-23.55 GHz.

- A MSS geostationary satellite downlink into a SRS geostationary satellite receiving from a SRS non-geostationary satellite in the band 25.25-26 GHz.

4.2/1.10/4.4.1 Impact of MSS (space-to-Earth) into ISS receivers in the bands 22.55-23.15 GHz and 23.15-23.55 GHz

Study 1 showed:

Bands 22.55-23.15 GHz and 23.15-23.55 GHz:

For the case of MSS user terminal uplink interference into the data relay satellite (DRS) forward link (SRS GSO-to-SRS low Earth orbit (LEO)) in 22.55-23.15 GHz and 23.15-23.55 GHz, the interference exceeds the Recommendation ITU-R SA.1155 threshold by approximately 2 dB. The MSS user terminals uplink emissions to MSS GEOSATs far away from the DRS contribute the most interference.

For the case of MSS GSO satellite downlink interference into DRS forward link (SRS GSO-to-LEO), the Recommendation ITU-R SA.1155 protection threshold for an MSS availability of 99% can just barely be met as long as there is at least 2° orbital separation between the DRS and neighbouring MSS GEOSATs. The case of 99% availability in a low rain rate area considered in the baseline studies is the best case sharing scenario and may not be the only MSS implementation when considering a worldwide MSS allocation. As shown in PDN Report ITU-R M.[MSS SHARE], section 3.4.2.3.1.2.1, consideration of higher link availabilities or higher rain rate areas could necessitate an increase in MSS satellite equivalent isotropically radiated power (e.i.r.p.) in order to provide the desired quality of service. The analysis in PDN Report ITU-R M.[MSS SHARE] indicates that an increase in MSS satellite e.i.r.p. beyond that considered in the best case scenario would result in increased interference to the DRS satellite links, necessitating that larger orbital separations be maintained between the MSS satellites and the DRS geostationary satellites. In order to guarantee the protection of the DRS systems, it may be necessary to establish hard regulatory MSS satellite e.i.r.p. limits within the RR in any bands shared between the MSS and ISS. For the worst case assumed link availability of 99.9%, the individual spot beam e.i.r.p. values in the example studied ranged from 43.51 to 75.99 dBW/16.2 MHz compared to the baseline MSS e.i.r.p. of 44.21 dBW/16.2 MHz as given in Table 2.3-1 of PDN Report ITU-R M.[MSS Share].

The use of downlink power control on spacecraft to maintain a certain availability/quality of service is very common, although there are other mechanisms which could be used (such as over-designing the user terminal antenna or receiver low noise amplifier for the worst case rain situation). Alternatively, the MSS operator could choose to offer degraded or interrupted service during periods of high rain attenuation. It is recognized that the use of power control is not consistent with the fixed parameters provided in Table 2.3-1 of PDN Report ITU-R M.[MSS Share], however the parameters in Table 2.3-1 of PDN Report ITU-R M.[MSS Share] are only representative parameters for study and do not represent regulatory limitations on possible future MSS operations.

Bands 25.25-25.5 GHz and 25.5-26 GHz:

For the case of MSS GSO satellite downlink interference into DRS return link (SRS LEO-to-SRSGSO) in 25.25-25.5 GHz and 25.5-26 GHz, the interference into the DRS receiver on the return link is negligible even with a fully populated MSS orbit. Co-location of the MSS satellite with a DRS satellite in geostationary orbit, however, must be avoided.

For the case of MSS user terminal uplink interference into DRS return link (SRS LEO-to-SRSGSO) in 25.25-25.5 GHz and 25.5-26 GHz, a minimum orbital spacing of 8° between the DRS and adjacent MSS satellites is required to satisfy the Recommendation ITU-R SA.1155 threshold. Note that Recommendation ITU-R SA.1276-3 lists 32 possible orbital locations for DRS operating in the 25.25-27.5 GHz band. Thus, accounting for an 8° guard spacing on each side of the 32 DRS locations, leaves a total of 97.1° GSO orbital arc for placing MSS satellites (i.e. the orbital arc ranges are 152° W to147° W; 131° W to 70° W; 4° W to 2.6° E; 29.5° E to 39° E; 67° E to 69° E; 103° E to 105° E; 141° E to152° E).

The analysis result regarding interference from user terminals GSO MSS (i.e. operation of MSS uplink was considered) in the frequency band 23.15-23.55 GHz shows that for the HIBLEO-2 ISS links potential for very large I/N values to occur during co-frequency interference events in which an HIBLEO-2 satellite is within the main beam of the GSO MSS user terminal transmission.

It is obvious that the usage of MSS systems with different parameters/requirements, for example e.i.r.p. levels, earth station antenna sizes, link availability percentage, service area etc. will determine the orbital separation for protection of DRS systems. Therefore, the application of the current provisions of RR Article **9** for sharing of MSS with DRS systems will allow to determine the required restrictions for each specific case of MSS system usage, taking into account the usage of the considered band by existing services.

Currently not all 32 recommended positions for DRS (Recommendation ITU-R SA.1276-3) are notified in ITU in the frequency band 25.25-25.5 GHz. For example, for the frequency band 25.25-25.5 GHz, only 8 orbital locations are notified (41° W, 16.8° E, 21.5° E, 77° E, 80° E, 90.75° E, 167° E, 176.8° E) for DRS. It is noted that current data relay systems simultaneously support low earth-orbiting spacecraft in multiple frequency bands and thus all 32 orbital positions could be required in the future. These data relay systems are evolving to include the use of the 22.55-23.55 GHz and 25.25-27.5 GHz bands. Implementation of MSS systems in orbital locations that might preclude the possible use of those orbital positions, not currently in use in these bands, would unduly restrict the future use of this band by data relay operators.

Study 2 showed:

The analysis result regarding interference from space stations GSO MSS (i.e. operation of MSS downlink was considered) in the frequency band 23.15-23.55 GHz shows that operation of MSS downlink using e.i.r.p. limits indicated in Table 4.2/1.10/4.4-1 does not exceed the protection criterion from Recommendation ITU-R SA.1155 and Recommendation ITU-R S.1899 with respect to HIBLEO-2 system in the frequency band 23.15-23.55 GHz. The Working Party responsible for this criteria indicated that Recommendations ITU-R S.1899 and ITU-R SA.1155 were not applicable for protection of NGSO-NGSO inter-satellite links currently in use by the HIBLEO-2/-2FL system. Unfortunately, the responsible Working Party could not suggest any existing Recommendation addressing performance characteristics or protection criteria for the HIBLEO-2/-2FL inter-satellite links. In such a situation, protection criterion of I/N −10 dB in 0.1% of the time was taken from Recommendations ITU-R S.1899 and ITU-R SA.1155 in this study for co-channel case. The responsible Working Party also indicated that development of appropriate protection criteria for the HIBLEO-2 ISS receivers from the proposed MSS GSO system would require further study by them.

Also the analysis result regarding interference from space stations GSO MSS (i.e. operation of MSS downlink was considered) in the frequency band 23.15-23.55 GHz shows that excess of the protection criterion of I/N = −10 dB is not expected at 0.1% of time if the transmitting station of GSO MSS satellite and transmitting station of GSO ISS maintain an orbital separation of 2 degrees for a 99% MSS link availability.

Another study showed that when applying the revised e.i.r.p. mask in Table 1.10/4.4-1 below, the ensuing interference from a single GSO MSS satellite exceeds the out-of-band protection criterion I/N = −16 dB for 0.01% of time from Recommendation ITU-R S.1899 by 4.5 dB. Emissions from multiple GSO MSS satellites would increase the amount of interference received by the HIBLEO-2 ISS receiver.

In accordance to the simulation results based on typical parameters of envisioned MSS systems at least a 4 dB margin exists with reference to an I/N of −10 dB. In this case, the percentage of time issue is not critical because the I/N criterion is not exceeded. However, this percentage of time issue is critical when the I/N criterion is exceeded since there are 66 satellites in the HIBLEO-2 system, with each satellite having the potential to receive interference. The percentage of time that interference is received needs to be adjusted to take this into account by summing over time the interference events into each satellite. It is noted that there is no existing ITU-R methodology to properly characterize the interference into the HIBLEO-2 system.

To provide compatibility of the MSS in the frequency band 23.15-23.55 GHz with the receiving stations of ISS operating in the direction GSO-NGSO the current provisions of RR Article **9** can be applied and the following e.i.r.p. limits in Table 4.2/1.10/4.4-1 for protection of the receiving stations in the ISS operating in the NGSO-NGSO direction shall be met.

TABLE 4.2/1.10/4.4-1

Proposed mask of e.i.r.p. limit from envisioned MSS to performance criterion I/N = −10 dB in 0.1% of time

Off-nadir angle	*Maximum e.i.r.p. from MSS satellite**
0° ≤φ≤ 8.7°	46.5** dB(W/MHz)
8.7° <φ< 9,25°	46.5+62log(9.7-φ) dB(W/MHz)
φ≥ 9.25° (to 90 degrees)	25 dB(W/MHz)

* *This proposed mask of e.i.r.p. limit from envisioned MSS performance criterion I/N = −10 dB in 0.1% of time with 1.5 dB margin.*

** *It is noted that this maximum e.i.r.p. value is 14.4 dB greater than the MSS satellite e.i.r.p. value given in Table 2.3-1 and used in sharing analyses with all other services*

4.2/1.10/4.4.2 Impact of ISS emission into MSS (space-to-Earth) receiver in the bands 22.55-23.15 GHz and 23.15-23.55 GHz

The impact of incumbent services into MSS earth station receiver has not been studied.

4.2/1.10/4.4.3 Impact of MSS (Earth-to-space) into ISS in the band 25.25-25.5 GHz

The analysis result regarding interference from earth station GSO MSS (i.e. operation of MSS uplink was considered) in the frequency band 25.25-25.5 GHz shows that excess of the protection criterion of I/N = −10 dB is not expected at 0.1% of time if the receiving station of GSO MSS and receiving station of GSO ISS maintain an orbital separation of 7 degrees. To provide compatibility of the MSS with the receiving stations of ISS operating in the direction NGSO-GSO the current provisions of RR Article **9** (RR No. **9.7**) can be applied.

4.2/1.10/4.4.4 Impact of ISS emission into MSS (Earth-to-space) receiver in the band 25.25-25.5 GHz

The impact of incumbent services into MSS space station receiver has not been studied.

4.2/1.10/4.5 Mobile service

The MS is allocated on a worldwide primary basis in the frequency bands 22.5-23.6 GHz and 25.25-27 GHz, as well as in the frequency band 24.25-25.25 GHz in Region 3 only.

Potential sharing of the mobile service with MSS is addressed in sections 3.3.2.2, 3.4.2.2, 3.5.2.2, 3.5.3, 3.14.2.2, 3.14.3 of PDN Report ITU-R M.[MSS SHARE].

Results of these studies indicate that for operation of the envisioned MSS on the downlink in the frequency band 23.15-23.55 GHz, the protection of the receiving stations of land mobile service is ensured by meeting the pfd limits in Table 4.2/1.10/4.5-1:

TABLE 4.2/1.10/4.5-1

Frequency band, GHz	**Service**	**Limit in dB(W/m²) for angles of arrival (δ) above the horizontal plane**			**Reference bandwidth**
		0°–5°	**5°–40°**	**40°–90°**	
23.15-23.55	Mobile satellite (space-to-Earth)	–121 + 0.8*δ	–125 + 11*log(δ)	–107	1 MHz

In the operation of MSS on downlink in the frequency band 23.15-23.55 GHz the excess of the protection criterion with respect to the stations of the aeronautical mobile service is avoided.

The estimation results show that the required protection distance to the MS receiving station will range from 1.5 to 40 km. Application of RR No. **9.17** provides protection for the receiving stations of MS from the transmitting MSS earth station in the frequency band 25.25-25.5 GHz.

4.2/1.10/4.6 Radio astronomy service

The RAS is allocated on a worldwide primary basis in the frequency bands 22.21-22.5 GHz and 23.6-24 GHz. Additionally, RR No. **5.149** is also applicable to the bands 22.01-22.21 GHz, 22.21-22.5 GHz, 22.81-22.86 GHz and 23.07-23.12 GHz and RR No. **5.340** applies to the band 23.6-24 GHz.

Potential sharing of the RAS with MSS is addressed in section 3.7.2 of PDN Report ITU-R M.[MSS SHARE] for the band 23.6-24 GHz. For the 22.21-22.5 GHz band, or the 22.01-22.21 GHz, 22.21-22.5 GHz, 22.81-22.86 GHz and 23.07-23.12 GHz frequency bands, to date, no sharing or compatibility studies have been performed with respect to the RAS. For the 23.6-24 GHz band, section 3.7.2 of the PDN Report ITU-R M.[MSS SHARE] notes that “As a “passive band” protected by RR No. **5.340**, this band is not considered for allocation to the MSS under WRC-15 agenda item 1.10.” No out-of-band compatibility studies have been performed to ensure protection of RAS systems operating in 23.6-24 GHz from unwanted emissions as recognized in Resolution **234 (WRC-12)**.

4.2/1.10/4.7 Space research service (Earth-to-space)

The SRS (E-s) is allocated on a worldwide primary basis in the frequency band 22.55-23.15 GHz.

Potential sharing of the SRS (E-s) with MSS is addressed in sections 3.4.2.4 and 3.4.3 of PDN Report ITU-R M.[MSS SHARE]. The study given in the PDN Report ITU-R M.[MSS SHARE] shows that MSS operations in this band will create a potential for harmful interference to SRS links operating in the Earth-to-space direction. In addition, SRS links operating in the Earth-to-space direction will create a potential for harmful interference to MSS user terminal receivers and MSS spacecraft operating in geostationary-satellite orbits.

The band 22.55-23.15 GHz is used for geostationary and non-geostationary SRS applications.

For the purposes of this sharing analysis, the technical parameters for MSS systems were gathered from correspondence provided by the responsible Working Party, Recommendation ITU-R S.1328 and Report ITU-R M.2221.

Two sharing scenarios were considered to evaluate potential interference from the MSS into SRS links operating in the Earth-to-space direction.

- MSS earth station uplinks into a SRS non-geostationary satellite receiver operating with a SRS earth station.
- MSS earth station uplinks into a SRS geostationary satellite receiver operating with a SRS earth station.

In order to reduce computational complexity simplifying assumptions related to the distribution of users were made. These assumptions reduced MSS user density from the given characteristic of 8 users/square km to 0.1 users/square km. In the cases of SRS satellite receivers in geostationary and non-geostationary orbits, aggregate I/N exceeded the protection criteria by 28 dB and 31.6 dB, respectively. In the specific case of MSS earth station uplinks into SRS uplink receivers on-board spacecraft in geostationary-satellite orbit, exceedance of the interference criterion given in Recommendation ITU-R SA.1155 could only be avoided if the SRS and MSS satellites maintained an orbital separation on the order of 26 degrees. In the other sharing scenario, no methods for avoiding exceedance of the interference criterion could be identified.

Two sharing scenarios were also considered to evaluate potential interference from SRS links operating in the Earth-to-space direction into MSS user terminals and receivers on-board satellites operating in geostationary-satellite orbits.

- A SRS earth station uplink to a SRS non-geostationary satellite into a MSS user terminal receiver.
- A SRS earth station uplink to a SRS geostationary satellite into a MSS geostationary satellite.

In the case of potential interference into a MSS user terminal, aggregate I/N exceeded the interference threshold by 48.2 dB. This scenario involves interference from one earth station into another. In such a case, a coordination zone can be calculated to determine the minimum required separation distance between the MSS user terminal and the SRS earth station to avoid interference. Using a generic path calculated with Recommendation ITU-R P.452-14 and assuming a maximum sidelobe gain consistent with Recommendation ITU-R S.580, a coordination distance of over 330 km would be needed to avoid interference from an SRS earth station.

In the specific case of SRS earth station uplinks to SRS satellites operating in geostationary-satellite orbit into MSS satellites in geostationary-satellite orbit, aggregate I/N exceeded the interference threshold by 14.4 dB. However, in this specific case, exceedance of the interference criterion could be avoided if the SRS and MSS satellites maintained an orbital separation on the order of at least 3 degrees.

4.2/1.10/4.8 Space research service (passive)

The SRS (passive) is allocated on a worldwide primary basis in the frequency bands 22.21-22.5 GHz and 23.6-24.0 GHz. Additionally, RR No. **5.340** applies to the 23.6-24 GHz band.

Potential sharing of the SRS (passive) with MSS is addressed in section 3.7.2 of PDN Report ITU-R M.[MSS SHARE]. For the 22.21-22.5 GHz band, to date, no sharing studies have been performed with respect to the space research service (passive). For the 23.6-24 GHz band, the PDN Report ITU-R M.[MSS SHARE] notes that “As a “passive band” protected by RR No. **5.340**, this band is not considered for allocation to the MSS under WRC-15 agenda item 1.10." No out-of-band compatibility studies have been performed to ensure protection of space research service (passive) systems operating in 23.6-24 GHz from unwanted emissions as recognized in Resolution **234 (WRC-12)**.

4.2/1.10/4.9 Standard frequency and time signal-satellite service (Earth-to-space)

The standard frequency and time signal-satellite service is allocated on a worldwide secondary basis in the frequency bands 25.25-25.5 and 25.5-27.0 GHz.

To date, no sharing studies could be performed with respect to the standard frequency and time signal-satellite service. Currently the stations of the standard frequency and time signal-satellite service are not notified in the frequency band 25.25-25.5 GHz. No ITU-R Recommendation contains the technical characteristics of stations in the standard frequency and time signal-satellite service in the frequency band 25.25-25.5 GHz. Therefore, since there are no systems in the standard frequency and time signal-satellite service in the frequency band 25.25-25.5 GHz, no compatibility issue exists at this time; however, it may not be the case if in the future new standard frequency and time signal-satellite systems operate in this frequency band.

4.2/1.10/4.10 Summary of study results

TABLE 4.2/1.10/4.10-1

Status/Results of sharing studies by frequency band

Band segment (GHz)	Incumbent services (PRIMARY or Secondary)	Status/Results of sharing studies
22-22.21	FIXED MOBILE except aeronautical mobile	See section 4.2/1.10/4.3 No studies
22.21-22.5	EESS (passive) FIXED MOBILE except aeronautical mobile RAS SRS (passive)	No studies See section 4.2/1.10/4.3 No studies No studies No studies
22.5-22.55	FIXED MOBILE	See section 4.2/1.10/4.3 See section 4.2/1.10/4.5
22.55-23.15	FIXED INTER-SATELLITE MOBILE SRS (E-s)	See section 4.2/1.10/4.3 See section 4.2/1.10/4.4 See section 4.2/1.10/4.5 See section 4.2/1.10/4.7
23.15-23.55	FIXED INTER-SATELLITE MOBILE	See section 4.2/1.10/4.3 See section 4.2/1.10/4.4 See section 4.2/1.10/4.5
23.55-23.6	FIXED MOBILE	See section 4.2/1.10/4.3 See section 4.2/1.10/4.5
23.6-24	EESS (passive) RAS SRS (passive)	No studies / RR No. **5.340** * No studies / RR No. **5.340** * No studies / RR No. **5.340** * * no emissions allowed
24-24.05	AMATEUR AMATEUR-SATELLITE	No studies No studies

Band segment (GHz)	Incumbent services (PRIMARY or Secondary)	Status/Results of sharing studies
24.05-24.25	RADIOLOCATION Amateur EESS (active)	No studies No studies No studies
24.25-24.45	FIXED (R1 & R3) RADIONAVIGATION (R2 & R3) MOBILE (R3)	See section 4.2/1.10/4.3 No studies See section 4.2/1.10/4.5
24.45-24.65	FIXED (R1 & R3) INTER-SATELLITE MOBILE (R3) RADIONAVIGATION (R2 & R3)	See section 4.2/1.10/4.3 No studies in this band See section 4.2/1.10/4.5 No studies
24.65-24.75	FIXED (R1 & R3) FIXED-SATELLITE (E-s) (R1 & R3) INTER-SATELLITE MOBILE (R3) RADIOLOCATION-SATELLITE (E-s) (R2)	See section 4.2/1.10/4.3 No studies No studies in this band See section 4.2/1.10/4.5 No studies
24.75-25.25	FIXED (R1 & R3) FIXED-SATELLITE (E-s) MOBILE (R3)	See section 4.2/1.10/4.3 No studies See section 4.2/1.10/4.5
25.25-25.5	FIXED INTER-SATELLITE MOBILE Standard frequency and time signal-satellite (E-s)	See section 4.2/1.10/4.3 See section 4.2/1.10/4.4 See section 4.2/1.10/4.5 See section 4.2/1.10/4.9
25.5-26	EESS (s-E) FIXED INTER-SATELLITE MOBILE SRS (s-E) Standard frequency and time signal-satellite (E-s)	See section 4.2/1.10/4.2 See section 4.2/1.10/4.3 See section 4.2/1.10/4.4 See section 4.2/1.10/4.5 See section 4.2/1.10/4.2 See section 4.2/1.10/4.9

4.2/1.10/5 Method(s) to satisfy the agenda item

Note: Advantages and disadvantages were considered but not agreed so they are not included in this section.

4.2/1.10/5.1 Method A: There would be no allocation to the MSS within the 22-26 GHz band and, therefore, no change to the RR, and the requirements can be met in other allocations.

4.2/1.10/5.2 Method B: To allocate the frequency bands 23.15-23.55 GHz (space-to-Earth) and 25.25-25.5 GHz (Earth-to-space) to the MSS on the following conditions:

– MSS allocation shall be limited only to geostationary systems;

– Application of pfd limits (see Table 4.2/1.10/4.3-1) for MSS transmitting space stations in the frequency band 23.15-23.55 GHz;

– Application of e.i.r.p. limits (see Table 4.2/1.10/4.4-1) for MSS transmitting space stations in the frequency band 23.15-23.55 GHz;

– Coordination of MSS stations with ISS in accordance with RR No. **9.7** in the frequency bands 23.15-23.55 GHz (space-to-Earth) and 25.25-25.5 GHz (Earth-to-space);

– Coordination of MSS transmitting earth stations with FS and MS receiving stations under RR No. **9.17** in the frequency band 25.25-25.5 GHz.

4.2/1.10/5.3 Method C: Provide allocations to the MSS in the 22-26 GHz range.

Method C1: Allocations for the MSS in the space-to-Earth direction.

Option C1a: To allocate the frequency band 24.25-24.55 GHz for the MSS (space-to-Earth) with the following conditions:

- MSS allocation shall be limited only to geostationary systems;
- Application of pfd limits (see Table 4.2/1.10/4.3-2) for MSS transmitting space stations in the frequency band 24.25-24.55 GHz;
- Coordination of MSS space stations under RR No. **9.7**.

or

Option C1b: To allocate the frequency band 22.65-22.95 GHz for the MSS (space-to-Earth) with the following conditions:

- MSS allocation shall be limited only to geostationary systems;
- Application of pfd limits (see Table 4.2/1.10/4.3-2) for transmitting space stations in the frequency band 22.65-22.95 GHz;
- Coordination of MSS stations with the ISS in accordance with RR No. **9.7** in the frequency band 22.65-22.95 GHz (space-to-Earth).

Method C2: Allocations for the MSS in the Earth-to-space direction.

Option C2a: To allocate the frequency band 24.25-24.55 GHz for the MSS (Earth-to-space) with the following conditions:

- MSS allocation shall be limited only to geostationary systems;
- Coordination of MSS space stations under RR No. **9.7**;
- Apply RR No. **9.17** to ensure protection of the terrestrial services.

or

Option C2b: To allocate the frequency band 25.25-25.5 GHz for the MSS (Earth-to-space) with the following conditions:

- MSS allocation shall be limited only to geostationary systems;
- Coordination with the ISS under RR No. **9.7**;
- Apply RR No. **9.17** to ensure protection of the terrestrial services.

4.2/1.10/6 Regulatory and procedural considerations

Note: Coordination requirements and applicable provisions with respect to the various services involved need to be carefully examined.

4.2/1.10/6.1 Method A: No change to the Radio Regulations

SUP

RESOLUTION 234 (WRC-12)

4.2/1.10/6.2 Method B

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**
23.15-23.55	FIXED INTER-SATELLITE 5.338A MOBILE MOBILE-SATELLITE (space-to-Earth) ADD 5.A110 ADD 5.B110	

ADD

5.A110 In the frequency band 23.15-23.55 GHz, in order to protect inter-satellite links between non-geostationary space stations, the e.i.r.p. of any space station in the mobile-satellite service on geostationary-satellite orbit shall not exceed the following values:

Off-nadir angle	E.i.r.p.
$0° \leq \varphi \leq 8.7°$	46.5 dB(W/MHz)
$8.7° < \varphi < 9.25°$	$46.5 + 62\log(9.7 - \varphi)$ dB(W/MHz)
$\varphi \geq 9.25°$	25 dB(W/MHz)

ADD

5.B110 The use of the bands 23.15-23.55 GHz (space-to-Earth) and 25.25-25.5 GHz (Earth-to-space) by the mobile-satellite service and by the inter-satellite service is subject to coordination under No. **9.7**. Mobile-satellite service use is limited only to geostationary systems.

MOD

24.75-29.9 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
25.25-25.5	FIXED INTER-SATELLITE 5.536 MOBILE MOBILE-SATELLITE (Earth-to-space) Standard frequency and time signal-satellite (Earth-to-space) ADD 5.B110	

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section V − Limits of power flux-density from space stations

MOD

TABLE **21-4** (*continued*) (Rev.WRC-~~12~~15)

Frequency band	**Service***	**Limit in dB(W/m^2) for angles of arrival (δ) above the horizontal plane**			**Reference bandwidth**
		0°-5°	**5°-25°**	**25°-90°**	
23.15-23.55 GHz	Mobile-satellite (space-to-Earth) (geostationary-satellite orbit)	–125	–125 + 0.5(δ – 5)	–115	1 MHz

APPENDIX 5 (REV.WRC-12)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

TABLE 5-1

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 (*cont.*)		10) 23.15-23.55 GHz, 25.25-25.5 GHz	i) Bandwidths overlap; and ii) any network in the inter-satellite service (ISS) or MSS and any associated space operation functions (see No. **1.23**) with a GSO space station within an orbital arc of ±8° of the nominal orbital position of a proposed network in the MSS or ISS		Administration may request, pursuant to No. **9.41**, to be included in requests for coordination, indicating the networks for which the value [TBD (see Note)]

Note: It is required to develop the criterion and estimation method for defining the affected satellite networks under RR No. **9.41**. Consequential amendments to RR No. **9.41** may also be required.

4.2/1.10/6.3 Method C

Option C1a: Band 24.25-24.55 GHz

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**
24.25-24.45 FIXED MOBILE-SATELLITE (space-to-Earth) ADD 5.C110	**24.25-24.45** MOBILE-SATELLITE (space-to-Earth) ADD 5.C110 RADIONAVIGATION	**24.25-24.45** RADIONAVIGATION FIXED MOBILE MOBILE-SATELLITE (space-to-Earth) ADD 5.C110
24.45-24.~~65~~55 FIXED INTER-SATELLITE MOBILE-SATELLITE (space-to-Earth) ADD 5.C110	**24.45-24.~~65~~55** INTER-SATELLITE MOBILE-SATELLITE (space-to-Earth) ADD 5.C110 RADIONAVIGATION 5.533	**24.45-24.~~65~~55** FIXED INTER-SATELLITE MOBILE MOBILE-SATELLITE (space-to-Earth) ADD 5.C110 RADIONAVIGATION 5.533
24.~~45~~55-24.65 FIXED INTER-SATELLITE	**24.~~45~~55-24.65** INTER-SATELLITE RADIONAVIGATION 5.533	**24.~~45~~55-24.65** FIXED INTER-SATELLITE MOBILE RADIONAVIGATION 5.533

ADD

5.C110 Mobile-satellite service use is limited only to geostationary systems.

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section V − Limits of power flux-density from space stations

MOD

TABLE **21-4** (*continued*) (Rev.WRC-~~12~~15)

Frequency band	Service*	Limit in dB(W/m^2) for angles of arrival (δ) above the horizontal plane			Reference bandwidth
		0°-5°	5°-25°	25°-90°	
19.3-19.7 GHz 21.4-22 GHz (Regions 1 and 3) 22.55-23.55 GHz ~~24.45~~24.25-24.75 GHz 25.25-27.5 GHz 27.500- 27.501 GHz	Fixed-satellite (space-to-Earth) Broadcasting-satellite Earth exploration-satellite (space-to-Earth) Mobile-satellite (space-to-Earth) Inter-satellite Space research (space-to-Earth)	−115 [13A]	−115 + 0.5(δ − 5) [13A]	−105 [13A]	1 MHz

APPENDIX 5 (REV.WRC-12)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

TABLE 5-1

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 (*cont.*)		10) 24.25-24.55 GHz	i) Bandwidths overlap; and ii) any network in the inter-satellite service (ISS) or MSS and any associated space operation functions with a GSO space station within an orbital arc of ±8° of the nominal orbital position of a proposed network in the MSS or ISS		Administration may request, pursuant to No. **9.41**, to be included in requests for coordination, indicating the networks for which the value [TBD (see Note)]

Note: It is required to develop the criterion and estimation method for defining the affected satellite networks under RR No **9.41**. Consequential amendments to RR No. **9.41** may also be required.

Option C1b: Band 22.65-22.95 GHz

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**
22.55-~~23.15~~22.65	FIXED INTER-SATELLITE 5.338A MOBILE SPACE RESEARCH (Earth-to-space) 5.532A 5.149	
22.~~55~~65-~~23.15~~22.95	FIXED INTER-SATELLITE 5.338A MOBILE MOBILE-SATELLITE (space-to-Earth) ADD 5.D110 SPACE RESEARCH (Earth-to-space) 5.532A 5.149	
22.~~55~~95-23.15	FIXED INTER-SATELLITE 5.338A MOBILE SPACE RESEARCH (Earth-to-space) 5.532A 5.149	

ADD

5.D110 Mobile-satellite service use is limited only to geostationary systems.

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section V − Limits of power flux-density from space stations

MOD

TABLE **21-4** (*continued*) (Rev.WRC-~~12~~15)

Frequency band	Service*	Limit in dB(W/m^2) for angles of arrival (δ) above the horizontal plane			Reference bandwidth
		0°-5°	5°-25°	25°-90°	
19.3-19.7 GHz 21.4-22 GHz (Regions 1 and 3) 22.55-23.55 GHz 24.45-24.75 GHz 25.25-27.5 GHz 27.500-27.501 GHz	Fixed-satellite (space-to-Earth) Broadcasting-satellite Earth exploration-satellite (space-to-Earth) Mobile-satellite (space-to-Earth) Inter-satellite Space research (space-to-Earth)	−115 [13A]	−115 + 0.5(δ − 5) [13A]	−105 [13A]	1 MHz

APPENDIX 5 (REV.WRC-12)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

TABLE 5-1

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 (*cont.*)		10) 22.65-22.95 GHz	i) Bandwidths overlap; and ii) any network in the inter-satellite service (ISS) or MSS and any associated space operation functions with a GSO space station within an orbital arc of ±8° of the nominal orbital position of a proposed network in the MSS or ISS		Administration may request, pursuant to No. **9.41**, to be included in requests for coordination, indicating the networks for which the value [TBD (see Note)]

Note: It is required to develop the criterion and estimation method for defining the affected satellite networks under RR No **9.41**. Consequential amendments to RR No. **9.41** may also be required.

Option C2a: Band 24.25-24.55 GHz

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**
24.25-24.45 FIXED MOBILE-SATELLITE (Earth-to-space) ADD 5.E110	**24.25-24.45** MOBILE-SATELLITE (Earth-to-space) ADD 5.E110 RADIONAVIGATION	**24.25-24.45** RADIONAVIGATION FIXED MOBILE MOBILE-SATELLITE (Earth-to-space) ADD 5.E110
24.45-24.~~65~~55 FIXED INTER-SATELLITE MOBILE-SATELLITE (Earth-to-space) ADD 5.E110	**24.45-24.~~65~~55** INTER-SATELLITE MOBILE-SATELLITE (Earth-to-space) ADD 5.E110 RADIONAVIGATION 5.533	**24.45-24.~~65~~55** FIXED INTER-SATELLITE MOBILE MOBILE-SATELLITE (Earth-to-space) ADD 5.E110 RADIONAVIGATION 5.533
24.~~45~~55-24.65 FIXED INTER-SATELLITE	**24.~~45~~55-24.65** INTER-SATELLITE RADIONAVIGATION 5.533	**24.~~45~~55-24.65** FIXED INTER-SATELLITE MOBILE RADIONAVIGATION 5.533

ADD

5.E110 Mobile-satellite service use is limited only to geostationary systems.

APPENDIX 5 (REV.WRC-12)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

TABLE 5-1

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 (*cont.*)		10) 24.25-24.55 GHz	i) Bandwidths overlap; and ii) any network in the inter-satellite service (ISS) or MSS and any associated space operation functions with a GSO space station within an orbital arc of ±8° of the nominal orbital position of a proposed network in the MSS or ISS		Administration may request, pursuant to No. **9.41**, to be included in requests for coordination, indicating the networks for which the value [TBD (see Note)]

Note: It is required to develop the criterion and estimation method for defining the affected satellite networks under RR No **9.41**. Consequential amendments to RR No. **9.41** may also be required.

Option C2b: Band 25.25-25.5 GHz

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**
25.25-25.5	FIXED INTER-SATELLITE 5.536 MOBILE MOBILE-SATELLITE (Earth-to-space) ADD 5.F110 Standard frequency and time signal-satellite (Earth-to-space)	

ADD

5.F110 Mobile-satellite service use is limited only to geostationary systems.

APPENDIX 5 (REV.WRC-12)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

TABLE 5-1

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 (*cont.*)		10) 25.25-25.5 GHz	i) Bandwidths overlap; and ii) any network in the inter-satellite service (ISS) or MSS and any associated space operation functions with a GSO space station within an orbital arc of ±8° of the nominal orbital position of a proposed network in the MSS or ISS		Administration may request, pursuant to No. **9.41**, to be included in requests for coordination, indicating the networks for which the value [TBD (see Note)]

Note: It is required to develop the criterion and estimation method for defining the affected satellite networks under RR No **9.41**. Consequential amendments to RR No. **9.41** may also be required.

CHAPTER 5

Satellite regulatory issues

(Agenda items 7, 9.1 (issues 9.1.1, 9.1.2, 9.1.3, 9.1.5, 9.1.8), 9.3)

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AGENDA ITEM 7

(**WP 4A** (technical and regulatory aspects)**, SC** (regulatory and procedural aspects) / **WP 4C, WP 5A, WP 7B, WP 7C,** (WP 4B), (WP 7A))

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)*** *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*

5/7/1 Issue A – Informing the Bureau of a suspension under RR No. 11.49 beyond six months

5/7/1.1 Executive summary

Pursuant to RR No. **11.49**, when an administration suspends the use of an assignment and the suspension lasts longer than six months, the administration must inform the Radiocommunication Bureau (BR) of the suspension and then follow the procedures for bringing the assignment back into use within the three-year suspension period. Although WRC-12 established an obligation to report the suspension as soon as possible, the conference did not include specific regulatory procedures to address the possible situation of an administration failing to inform the BR of a suspension extending beyond the initial six-month period. To address this situation, two methods are provided to clarify application of RR No. **11.49**.

5/7/1.2 Background

WRC-12 modified RR No. **11.49** to expand the time an administration is allowed to suspend the use of frequency assignments to a space station from a two-year time period to three years. In addition, in the modified RR No. **11.49**, administrations do not need to inform the BR of suspensions lasting less than six months, but must inform the BR of suspensions lasting longer than six months as soon as possible, but in any case no later than six months from the start date of the suspension. Although WRC-12 made clear its intention that suspensions would be reported quickly, it did not specify the consequences for the assignments of an administration that failed to report a suspension by the six-month deadline. Upon considering how the results of WRC-12 would be implemented in practice, the BR proposed a Rule of Procedure (RoP) that would have cancelled the suspended frequency assignments if the BR did not receive a notification of the suspension before or at the end of the six-month period. Although this would have been a legitimate reading of the obligation, the suppression of frequency assignments for the reporting of a suspension beyond the six-month period could be viewed as inconsistent with the WRC-12 decision for administrations to have a maximum of three years from the suspension date to resume use of their frequency assignments.

5/7/1.3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

There are two methods (including NOC) proposed to satisfy this issue. Under the first method (Method A1) it is believed that if the suspension lasts longer than six months, the notifying administration, which has the accurate knowledge and information about the operational situation and is responsible for the satellite network, must notify the BR of the suspension of the assignment in accordance with the RR No. **11.49**, otherwise, the BR, based on reliable information that a recorded assignment is no longer in use, can apply the provisions of the RR No. **13.6** which establishes a procedure to clarify the situation. Despite the existence of an obligation to report any suspension within six month of the actual date of suspension in RR No. **11.49**, the non-compliance with this aspect of the provision does not lead to any consequence.

Although the BR can always request clarification from the notifying administration under RR No. **13.6** on the information relating to the suspension of recorded assignments, the provision RR No. **11.49** does not indicate any specific measure to be implemented for solely missing the six-month deadline. The BR can consider the information provided by the administration and in case of disagreement, the case can be submitted for the consideration by the Radio Regulations Board (RRB), which will take a decision taking into account all of the information provided. However, the only measures to be eventually implemented by the BR would be in relation to the expiry date of the suspension period or the cancellation of the frequency assignments. In the meantime the entry (the respective assignments recorded) will continue to be taken into account by the BR and administrations until the decision by the RRB.

Under Method A1, it is believed that the current regulatory procedures (RR No. **13.6**) are sufficient to ensure the compliance with the provisions in RR No. **11.49** especially those related to the period of suspension. The procedure under RR No. **13.6** respects the rights and the efforts made by the administrations and specifically guarantee the response rights of the administrations, noting that technical problems could have appeared or misunderstandings could have happened between an administration and a satellite operator responsible for the location and operation of the satellite system involved during the process of any notification to the BR probably detected beyond the regulatory deadlines, besides others circumstances.

Therefore, according to the reasons expressed there would be no particular need to modify the provision RR No. **11.49** given that if there is disagreement, the matter would be referred to the RRB and further addressed on a case-by-case basis.

A second method to address this issue (Method A2), and encourage both the prompt reporting of qualifying suspensions and the limitation of the total suspension period to three years from inception to resumption of use, supports creating an incentive to administrations to inform the BR as soon as possible within the initial six-month period of the suspension.

Under Method A2, if an administration informs the BR of a suspension beyond six months from the start of the suspension, then the maximum suspension period will be reduced by an amount related to the delay beyond six months in providing this information. The standard for bringing back into use in RR No. **11.49.1** would continue to apply unchanged.

Method A2 is meant to encourage a prompt reporting of qualifying suspensions. The implementation of this method will create an incentive for the notifying administration to report a suspension as soon as possible within the initial six-month period of the suspension. Under this method, two options are proposed (Options A and B). Under the first option, the non-compliance with the six-month deadline to report the suspension may result in a reduction of the suspension period or the initiation of the cancellation process of the recorded assignments depending on the period that elapsed since the end of the initial six-month period following the actual suspension. Under the second option, an increased incentive to comply is considered after the second six-months of non-compliance.

It is considered that the creation of an incentive for promptly informing the BR of a suspension is important because the increased number of suspended networks after the circulation of Circular Letter CR/301 entitled "Removal of unused frequency assignments (Space Services) from the Master Register" implicitly showed the existence of a number of unidentified suspended satellite networks. The creation of an incentive will reduce the number of unidentified suspended networks and contribute to the rational, efficient and economical use of radio frequencies and the geostationary-satellite orbit (GSO).

Views were expressed that reducing the 3-year suspension period due to failing to inform the BR within the required six-month period that was adopted at WRC-12 may cause serious consequences for the project of the administration and does not consider the reasonable time for administrations to bring back into use assignments for a new satellite.

The followings are illustrative and possible examples describing situations which may be applicable to the case of suspension and are included in this document for information only:

TABLE 5/7/1.3-1

Case	Subject
1	Satellite failure at the subject orbital position: The satellite lost its capability totally or partially to continue to use the subject frequency assignments at the subject orbital position.
2	Partial satellite failure at the subject orbital position and relocation to another orbital position: An administration and/or an operator decided to move the satellite to another orbital position after a partial failure because it was considered that the original location became inappropriate for its operation in terms of demands from users.
3	Launch failure and/or satellite failure as a result of launch of a replacement satellite: The replacement satellite could continue to use the frequency assignments of the original satellite and then the original satellite is de-orbited.
4	Replacement satellite is less capable than original satellite: When a replacement satellite does not have the capability to continue using all of the frequency assignments of the original satellite.
5	Relocation due to satellite failure at a different orbital position: An administration and/or an operator decides to move a satellite from orbital position A to orbital position B in order to restore the failed capability at position B.
6	Legitimate continuation of use: The continuation of use of an assignment which had not been suspended because an administration initially intended to resume it within the permitted six months but did not.

In most cases, it is quite unlikely that administrations and/or operators need more than 6 months to determine whether the application of suspension is really required, or not.

5/7/1.4 Analysis of the results of studies

Although in most cases, it is quite unlikely that administrations and/or operators need more than 6 months to determine whether the application of suspension is really required, or not, case 6 describes a situation in which administrations may not have timely informed. When an administration cannot decide the need for the application of suspension, it is possible to suspend the assignments, then bring the assignments back into use within the regulatory deadline (i.e. 3 years) and be required to follow the bringing back into use provisions of RR No. **11.49.1**. For these reasons, an incentive of application of suspension could be introduced.

It is further noted that application of RR No. **11.49** must continue to take into account that the notifying administration has the most accurate knowledge and information about the operational situation of a satellite system and is responsible for the satellite network. In this regard, it must inform the BR of the suspension of the assignment in accordance with RR No. **11.49**.

5/7/1.5 Methods to satisfy issue A

For each of the methods below, to allow a means of confirmation that the suspension information has been received in a timely manner, it is important that the BR regularly update the List of suspended satellite networks to include all RR No. **11.49** information promptly upon receipt, and to appropriately modify the format of the List to include a column with the deadline for resumption of operation determined by application of RR No. **11.49**.

5/7/1.5.1 Method A1

This method supports no change to the RR. Under this method, it is believed that the procedures are already provided in the RR. In particular, RR No. **13.6** provides a method for the BR to query an administration and address the situation for when it appears that an administration has not informed the BR of a suspension within the six-month period specified in RR No. **11.49**. Furthermore, in cases where a notifying administration informs the BR on its own initiative after the initial six months of suspending a frequency assignment, the BR will inform the administration that this request is not compliant with RR No. **11.49** and will ask whether the administration agrees with its proposed action.

It should be noted that, currently, if a notifying administration informs the BR on its own initiative or in response to a query under RR No. **13.6**, after the initial six months of suspending a frequency assignment, the BR records the assignment as being suspended as of the date indicated by the notifying administration and informs the RRB.

5/7/1.5.2 Method A2

This method modifies RR No. **11.49** to provide a regulatory mechanism that addresses the case of an administration informing the BR, after the initial six months, of a suspension of use of frequency assignments that is going to last longer than six months. Two options are considered.

5/7/1.5.2.1 Option A: Day-for-day reduction after 6 months

The three-year time period shall be reduced by the amount of time that has elapsed between the end of the six-month period and the date that the BR is informed of the suspension.

5/7/1.5.2.2 Option B: Day-for-day reduction after 6 months up to 12 months followed by two times reduction thereafter

If informed after the sixth month and prior to the twelfth month[29] the reduction to the three-year time period is the same as the first option. After the twelfth month, the three-year time period shall be reduced by twice the amount of time that has elapsed between the end of the six-month period and the date that the BR is informed of the suspension.

Note: It may be appropriate to modify section 5.2.10 of RR Appendices **30** and **30A** to determine if the method described here could be applied to suspensions of the use of frequency assignments under those Plans. This point could be considered as well in conjunction with any effort by WRC-15 to align section 8.17 of RR Appendix **30B** with the suspension provisions in RR No. **11.49** and the RR Appendices **30** and **30A** Plans.

[29] Rather than using 12 months other variations greater than 6 months and up to 21 months are mathematically possible. If using 21 months, option 2 would effectively be the same as option 1.

5/7/1.6 Regulatory and procedural considerations for issue A

For any of the methods, when a notifying administration fails to inform the BR about an assignment being suspended, the BR needs to follow the course of action prescribed in RR No. **13.6** to cancel the basic characteristics of the entry in the MIFR.

5/7/1.6.1 Method A1

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7*bis*] (WRC-12)

Section II − Examination of notices and recording of frequency assignments in the Master Register

NOC

11.49

5/7/1.6.2 Method A2

5/7/1.6.2.1 Option A: Day-for-day reduction after 6 months

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7*bis*] (WRC-12)

Section II − Examination of notices and recording of frequency assignments in the Master Register

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~~, as soon as possible, but no later than six months from the date on which the use was suspended,~~ 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. The date on which the recorded assignment is brought back into use[22] shall be not later than three years from the date on which the use of the 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 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. (WRC-~~12~~15)

NOC

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[22] **11.49.1**

5/7/1.6.2.2 Option B: Day-for-day reduction after 6 months up to 12 months followed by two times reduction thereafter

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7*bis*] (WRC-12)

Section II − Examination of notices and recording of frequency assignments in the Master Register

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, as soon as possible, but no later than six months from the date on which the use was suspended, 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. The date on which the recorded assignment is brought back into use[22] shall be not later than three years from the date on which the use of the 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 assignment was suspended, this three-year time period shall be reduced. In this case if prior to twelve months on which the use of the assignment was suspended, 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 after twelve months on which the use of the assignment was suspended, the amount by which the three-year period shall be reduced shall be equal to twice the amount of time that has elapsed between the end of the initial six-month period and the date that the Bureau is informed of the suspension. (WRC-1215)

NOC

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[22] **11.49.1**

5/7/2 Issue B – Publication of information on bringing into use of satellite networks at the ITU website

5/7/2.1 Executive summary

During consideration of WRC-12 agenda item 7, proposed changes to the regulatory provisions, including bringing into use and suspension of satellite networks, were received and adopted. As a result, actions of administrations were significantly clarified. However, the Radiocommunication Bureau (BR)'s actions regarding the publication of information were not considered. Three possible methods for addressing the issue of the BR's publication of such information are included below.

5/7/2.2 Background

This issue reviews the provisions in the Radio Regulations (RR) regarding the publication of information on bringing into use of satellite networks, and explores ways to clarify the action of the BR in order to increase the accessibility and transparency of information.

The efforts made by the BR in this regard must be supported by the provisions regulating the legal status of all published information.

5/7/2.3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Administrations provide information about the satellite networks to the BR in the procedures for effecting advance publication, coordination and notification of satellite networks.

In accordance with RR No. **9.2B**, the BR publishes the information sent under RR Nos. **9.1** and **9.2** in a Special Section API/A of its International Frequency Information Circular (BR IFIC). In accordance with RR No.**9.3**, the BR publishes the information about administrations which have sent comments to advance publication of information (API) on satellite networks that are not subject to the coordination procedure under Section II.

Requests for coordination, made under RR Nos. **9.7**-**9.14** and **9.21**, shall be sent by the requesting administration to the BR together with the appropriate information listed in RR Appendix **4**. After the examination of the information the BR publishes the complete information (request and results of examination) in accordance with RR No. **9.38** in Special Section CR/C of its BR IFIC.

In accordance with RR No.**9.53A** a Special Section CR/D is published with indication of the list of administrations and satellite networks requesting coordination.

Due diligence information is sent to the BR by administrations before the end of the period established as a limit to bringing into use and published in special section RES49 of the BR IFIC.

Notification requests for satellite networks are published in Part I-S.

The RR define the procedure for publications of API, coordination and notification requests, establish the time for consideration by the requests, deadline for submission of information, etc., providing a full pro-transparency of information on satellite networks and its availability to operators and administrations.

At the same time, there is no clarity in the provisions of the RR with regard to publication of information directly related to bringing into use of the satellite networks and the suspension of the use of frequency assignments.

It should be clearly understood that the bringing into use of the network is not only a technical but also a regulatory procedure and it is an integral part of the process of notification of the satellite network. This information has great importance to others, first of all to affected administrations.

During consideration of WRC-12 agenda item 7, the changes of regulatory provisions, including bringing into use and suspension of satellite networks, were received and adopted. As a result, significant clarification was done clearing up actions of administrations. However, the BR's actions regarding the publication of information were not considered.

It should be noted that the BR is bringing this information to the attention of the concerned administrations on the ITU website: http://www.itu.int/ITU-R/space/snl/index.html.

5/7/2.4 Analysis of the results of studies

A regulatory study has been conducted to examine how to bring full clarity to the BR's publication procedure of information relating to bringing into use and suspension of satellite networks frequency assignments. The intent of this study was to find a way to provide clarification of the regulatory status of such information.

In order to provide further assistance to administrations, it is proposed to study the possibility of unification of information, which is published in different special sections at the ITU website, in a common information space in relevant section of the ITU-R website: (http://www.itu.int/ITU-R/go/space/en).

5/7/2.5 Methods to satisfy issue B

5/7/2.5.1 Method B1

To clarify the BR's actions, one course of action could be to implement amendments to RR Nos. **11.44B**, **11.49** and **11.49.1** shown in section 5/7/2.6.1 below. The advantage to this course of action is that the procedures of the BR would be clearly documented within the RR. The consequence would be the requirement for changes to the RR.

5/7/2.5.2 Method B2

To clarify the BR's actions, one course of action could be to implement the amendments to RR Nos. **11.44B**, **11.49** and **11.49.1** shown in section 5/7/2.6.2 below. The information about bringing into use would be available at the ITU-R website and contained in a dedicated special section that could be combined with the data currently provided under Resolution **49 (Rev.WRC-12)**. The advantage to this course of action is that the procedures of the BR would be clearly documented within the RR. In addition, such an approach would not increase the workload of administrations and the BR and would ensure that the date of bringing into use appears in a dedicated special section, independently of the existence or not of the notification information associated to the satellite network. The consequence would be the requirement for changes to the RR.

5/7/2.5.3 Method B3

Another possible course of action would be to identify those actions of the BR that are required, in addition to the current actions, and to include specific instructions to the BR to implement these required additional actions in the minutes of a Plenary meeting of a WRC. The advantage to this course of action is that it would not require specific changes to the RR but would have the same effect as if changes to the RR were implemented. This practice has been used at past WRC's, including WRC-12, in which the results of Plenary decisions have been distributed via circular letter. Moreover, due to the heavy work load of WRC's, in particular WRC-15, every effort should be made to propose solutions that do not generate unnecessary discussions during WRC's thereby allowing the conference to deal with important subjects which require further or extensive deliberations and discussions.

5/7/2.6 Regulatory and procedural considerations for issue B

5/7/2.6.1 Method B1

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7*bis*] (WRC-12)

Section II − Examination of notices and recording of frequency assignments in the Master Register

MOD

11.44B A frequency assignment to a space station in the geostationary-satellite orbit shall be considered as having been brought into use when a space station in the geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained at the notified orbital position for a continuous period of ninety days. The notifying administration shall so inform the Bureau within thirty days from the end of the ninety-day period. On receipt of the information sent under this provision, the Bureau shall make available that information as soon as possible and shall publish it in the BR IFIC. (WRC-~~12~~15)

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, as soon as possible, but no later than six months from the date on which the use was suspended, 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. The date on which the recorded assignment is brought back into use[22] shall be not later than three years from the date of suspension. On receipt of the information sent under this provision, the Bureau shall make available that information as soon as possible and shall publish it in the BR IFIC. (WRC-~~12~~15)

NOC

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[22] **11.49.1**

5/7/2.6.2 Method B2

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7bis] (WRC-12)

Section II − Examination of notices and recording of frequency assignments in the Master Register

MOD

11.44B A frequency assignment to a space station in the geostationary-satellite orbit shall be considered as having been brought into use when a space station in the geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained at the notified orbital position for a continuous period of ninety days. The notifying administration shall so inform the Bureau within thirty days from the end of the ninety-day period. On receipt of the information sent under this provision, the Bureau shall make available that information on the ITU website as soon as possible and shall publish it in the BR IFIC[21bis]. (WRC-~~12~~15)

ADD

[21bis] **11.44B.1** For the publication of this information, see also Resolution **49 (Rev.WRC-15)**. (WRC-15)

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, as soon as possible, but no later than six months from the date on which the use was suspended, 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. The date on which the recorded assignment is brought back into use[22] shall be not later than three years from the date of suspension. On receipt of the information sent under this provision, the Bureau shall make available that information on the ITU website as soon as possible and shall publish it in the BR IFIC[22bis]. (WRC-~~12~~15)

NOC

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[22] **11.49.1**

ADD

[22bis] **11.49.2** For the publication of this information, see also Resolution **49 (Rev.WRC-15)**. (WRC-15)

Note: Consequential changes are required to Resolution **49 (Rev.WRC-12)** to insert a new data item “Date of bringing into use” as well as adding a new *decides* about the publication of this information. In case the information in accordance with Resolution **49 (Rev.WRC-12)** has already been provided or in case of satellite network currently not subject to Resolution **49 (Rev.WRC-12)**, only this new data item is required to be submitted to the BR.

5/7/2.6.3 Method B3

NOC

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7*bis*] (WRC-12)

5/7/3 Issue C – Review or possible cancellation of the advance publication mechanism for satellite networks subject to coordination under section II of Article 9 of the Radio Regulations

5/7/3.1 Executive summary

The required six-month period between the receipt by the Radiocommunication Bureau (BR) of an advance publication of information (API) and a related coordination request was originally intended for administrations to consider and potentially comment upon the API data as well as for the notifying administration to take into consideration the comments of other administrations before submitting the associated coordination request. However, as a consequence of the changes to the Radio Regulations (RR) made at WRC-95, APIs for satellite networks subject to coordination under Section II of RR Article **9** now contain very few information (i.e. orbital position and frequency bands). There is consequently almost no data for administrations to review and comment upon nowadays.

ITU-R studies have shown that the suppression of the six-month period would increase the time dedicated to coordination discussions during the 7-year period and that the suppression of comments under RR No. **9.5B** would decrease the administrative workload of administrations and the BR. However, some administrations only support the suppression of the six-month period between the API and the CR/C and would retain RR No. **9.5B**. Methods proposing to implement these various changes are consequently proposed.

This issue was discussed at previous WRCs and studied by ITU-R Study Groups in previous study cycles. WRC-15 is therefore invited to decide on the retention or otherwise of the API mechanism in a definitive manner.

5/7/3.2 Background

The required six-month period between the receipt by the BR of an API and a related coordination request was originally intended for administrations to consider and potentially comment upon the information contained in the API as well as for the administration responsible for the proposed satellite network to take into consideration the comments of other administrations before submitting the associated coordination request. Initially the API contained information on the planned types of carriers, associated power levels and earth stations characteristics.

As a consequence of the changes to the RR made at WRC-95, APIs for satellite networks subject to coordination under Section II of RR Article **9** now contain a much more limited number of information (e.g. orbital position and frequency bands). There is consequently much less data for administrations to review and comment upon.

Moreover, WRC-12 modified RR No. **9.36.2** to establish a definitive list of satellite networks to be coordinated with. As a consequence, there is now approximately 15-16 months between the receipt of API and the publication of the definitive list: 6 months between the API and coordination request (see RR No. **9.1**), 3-4 months to publish the coordination request (according to the Report to the 64th meeting of the Radio Regulations Board (RRB), see Document RRB13-3/3 and also RR No. **9.38**), 4 months to comment (see RR No. **9.52**) and approximately 2 months to publish the definitive list following the comments (time period estimated on the basis of publication of CR/D or CR/E since 1 January 2013). This period of 15-16 months is almost entirely dedicated to administrative work leading to the establishment of the coordination requirements and represents 18-19% of the seven-year period after the date of receipt of API to bring into use the frequency assignments to the satellite network.

This issue was discussed during WRC-07 where it was felt that it was premature to suppress the API mechanism and again very briefly during WRC-12, where it was agreed not to implement the suppression of the API mechanism because of insufficient time to address all issues raised in connection with this proposal.

5/7/3.3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

5/7/3.3.1 Usefulness of API for better selecting optimal orbital location and frequencies

Considering the difficulties in selecting an optimal orbital position and frequencies for a new satellite system, the six-month minimum period was considered beneficial for the notifying administration to evaluate and determine the most appropriate orbital position and corresponding frequencies. This period also gave an opportunity for the notifying administration to take into account the comments received from administrations reviewing the API in order to make the necessary adjustments to its satellite network before submitting the coordination request.

However, since the changes decided at WRC-95, APIs for satellite networks subject to coordination under Section II of RR Article **9** currently include very limited data, i.e. orbital position and frequency bands, and therefore provide little information for administrations to review and comment upon. In practice, it is extremely rare that an orbital position is chosen because of comments received following the API publication.

On the contrary, the six-month minimum period could result in the unavailability of an orbital position that was available at the time of submitting the API because another coordination request, associated to a previously submitted API, has been received by the Bureau during this six-month period.

5/7/3.3.2 Relation with cost recovery measures of coordination requests

Coordination requests are now subject to cost recovery. In this context, the six-month minimum period was indicated as assisting in the evaluation and determination of the final orbital position and frequencies so to avoid unnecessary expenses potentially resulting from the submission of coordination request information at an orbital position or in frequency bands already selected for another, previously submitted, coordination request.

Flexibility for the notifying administration to adjust the final orbital position and frequencies would, in such a case, be reduced because it would have to submit a modification to its coordination request that would entail additional cost recovery fees.

However it should be noted that Council Decision 482 (Modified 2013) "Implementation of cost recovery for satellite network filings" *decides* 10 reads:

> "10 that any subsequent cancellation received by the Radiocommunication Bureau within 15 days of the date of receipt of the filing shall remove the obligation to pay the fee;"

In addition, Resolution **55 (Rev.WRC-12)** *instructs the Radiocommunication Bureau*:

> "1 to make available coordination requests and notifications referred to in *resolves* 1, "as received", on its BR International Frequency Information Circular CD-ROM, within 30 days of receipt, and also on its website;"

A solution to this cost-recovery related issue could therefore consist in slightly modifying Resolution **55 (Rev.WRC-12)** to instruct the BR to make available coordination requests "as received" on its website within a number of days from the date of receipt that would be chosen to allow administrations to act according to *decides* 10 of Council Decision 482 (Modified 2013).

Although this solution may save an administration the obligation to pay the cost recovery fee for a coordination request which is found to be at the same orbital location as a previously submitted coordination request from another administration, the need to resubmit the coordination request will result in a later regulatory date of receipt.

5/7/3.3.3 Possibility of initiating coordination before the publication of the coordination request

It was also argued in the past that the six-month minimum period does not introduce any practical delay in the coordination process since the coordination can still be initiated informally between the concerned administrations, especially when the coordination information has been submitted to the BR. However, it is difficult to do so because administrations prefer to know the findings of the BR, as contained in the coordination request officially published by the Bureau, before entering into the coordination process.

If the six-month minimum period is eliminated, the coordination process of the satellite network with identified administrations may commence sooner than under the current situation.

5/7/3.3.4 Need for transitional measures

It should be noted that the suppression of the six-month minimum period between the date of receipt of an API and the date of receivability of the associated coordination request would not require any transitional measures since any coordination request could be sent from the date of entry into force of the revised provision.

However, should the API mechanism be completely suppressed, a provision will have to be inserted to maintain the computation of the 7-year period of RR No. **11.44** from the date of receipt of the API with regard to satellite networks and systems having been received before the date of entry into force of the new RR provisions.

Reducing the period before which an API expires may require transitional measures, for example, from 1 January 2016 all API notices with a date of receipt prior to 1 July 2017 are cancelled on 1 January 2018.

5/7/3.3.5 Impact of the suppression of RR No. 9.5B

It was recognized that in any method that includes the suppression of RR No. **9.5B**, this would remove the only formal mechanism established in the RR to allow comments from any administration on any filing of a satellite network subject to coordination with respect to potentially affected satellite networks not subject to coordination. By suppression of RR No. **9.5B** there is a need to address the case of an administration intending to comment on satellite networks subject to Section II of RR Article **9** with respect to their existing satellite networks which are not subject to Section II of RR Article **9**.

5/7/3.4 Analysis of the results of studies

Various changes made since WRC-95 to the API mechanism have significantly altered the usefulness of information contained in APIs for satellite networks subject to coordination under Section II of RR Article **9**. Such APIs currently include very limited data and therefore provide little information for administrations to review and comment upon. The suppression of the six-month period would reduce the initial period of 15-16 months almost entirely dedicated to administrative work leading to the establishment of the coordination requirements. No adverse impact has been identified in case the current API requirements would be suppressed for satellite networks subject to coordination.

5/7/3.5 Methods to satisfy issue C

5/7/3.5.1 Method C1: No change to the API mechanism

No change.

5/7/3.5.2 Method C2: Suppression of the API for satellite networks subject to coordination under Section II of RR Article 9

This method proposes to suppress the need for an API for satellite networks subject to coordination under Section II of RR Article **9**.

5/7/3.5.3 Method C3: Changing the period before expiry of the API for satellite networks subject to coordination under Section II of RR Article 9

This method proposes reducing the period before expiry of API for satellite networks subject to coordination under Section II of RR Article **9** and not covered by a coordination request. Also, due to the reduced period for which an API would remain valid, the requirement for the BR to remind administrations of the impending expiry is considered to be no longer necessary.

5/7/3.5.4 Method C4: Suppression of the current API mechanism and generation of API at the receipt of a coordination request

This method proposes that the current API mechanism would be suppressed and that an API would be automatically generated as soon as the BR would receive a new coordination request. This API would have the same receipt date as the first coordination request for a frequency band and would be used as a basis for the computation of the 7-year period of the satellite network. The six-month delay would disappear as well as the need and the opportunity for commenting this API. When the notifying administration wants to modify an existing coordination request, it will be able to refer to the API special section to indicate that it wants a modification to an existing satellite network and not the creation of a new one.

5/7/3.5.5 Method C5: Suppressing the six-month minimum period between the date of receipt of an API and the date of receivability of the associated coordination request

This method proposes to suppress the six-month minimum period between the date of receipt of an API and the date of receivability of the associated coordination request. This could include advantages of Methods C1, C2 and C4 since:

- Administrations who wish to retain API (Method C1) can submit their request for coordination (CR/C) data any time after submission of API but before 2 years as stipulated by the current RR.
- Administrations who wish to submit request for coordination (CR/C) data from the beginning (Methods C2 and C4) would have the opportunity to do so.
- RR No. **9.5B** is retained.

5/7/3.6 Regulatory and procedural considerations for issue C

5/7/3.6.1 Method C1: No change to the API mechanism

NOC

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6, 7, 8, 8*bis*] (WRC-12)

5/7/3.6.2 Method C2: Suppression of the API for satellite networks subject to coordination under Section II of RR Article 9

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6, 7, 8, 8*bis*] (WRC-12)

Section I − Advance publication of information on satellite networks or satellite systems

General

MOD

9.1 Before initiating any action ~~under this Article or~~ under Article **11** in respect of frequency assignments for a satellite network or a satellite system not subject to the coordination procedure described in Section II of Article **9** below, an administration, or one[9] acting on behalf of a group of named administrations, shall~~, prior to the coordination procedure described in Section II of Article **9** below, where applicable,~~ send to the Bureau a general description of the network or system for advance publication in the International Frequency Information Circular (BR IFIC) not earlier than seven years and preferably not later than two years before the planned date of bringing into use of the network or system (see also No. **11.44**). The characteristics to be provided for this purpose are listed in Appendix **4**. The ~~coordination or~~ notification information may also be communicated to the Bureau at the same time~~; it shall be considered as having been received by the Bureau not earlier than six months after the date of receipt of the information for advance publication where coordination is required by Section II of Article **9**. Where coordination is not required by Section II, notification~~ but shall be considered as having been received by the Bureau not earlier than six months after the date of publication of the advance publication information. (WRC-~~03~~15)

Reasons: To suppress the need for an API for satellite networks subject to coordination under Section II of RR Article 9.

ADD

9.1*bis* Before initiating any action under Article **11** in respect of frequency assignments for a satellite network or a satellite system subject to the coordination procedure described in Section II of Article **9** below, an administration, or one[9] acting on behalf of a group of named administrations, shall send to the Bureau requests for coordination in accordance with No. **9.30** not earlier than seven years before the planned date of bringing into use of the network or system (see also No. **11.44**).

Reasons: This addition is intended to clarify the computation of the 7-year period for satellite networks/systems subject to coordination.

ADD

Section IA − Advance publication of information on satellite networks or satellite systems that are not subject to coordination procedure under Section II

MOD

9.2 Amendments to the information sent in accordance with the provisions of No. **9.1** shall also be sent to the Bureau as soon as they become available. The use of an additional frequency band, ~~or~~ modification of the orbital location by more than ±6° for a space station using the geostationary-satellite orbit, the modification of the reference body or the modification of the direction of transmission for a space station using a non-geostationary-satellite orbit will require the application of the advance publication procedure~~ for this band or orbital location, as appropriate~~. ~~Furthermore, where coordination is not required by Section II of Article **9**, the modification of the reference body or the modification of the direction of transmission for a space station using a non-geostationary-satellite orbit will require the application of the advance publication procedure.~~ (WRC-~~12~~15)

Reasons: Consequential to the modification of RR No. **9.1**.

NOC

9.2A

NOC

9.2B

SUP

Sub-Section IA − Advance publication of information on satellite networks or satellite systems that are not subject to coordination procedure under Section II

NOC

9.3

NOC

9.4

NOC

9.5

NOC

9.5A

SUP

Sub-Section IB − Advance publication of information on satellite networks or satellite systems that are subject to coordination procedure under Section II

SUP

9.5B

SUP

9.5C

SUP

9.5D

Reasons: Consequential to the modification of RR No. **9.1**.

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7*bis*] (WRC-12)

Section II − Examination of notices and recording of frequency assignments in the Master Register

MOD

11.44 The notified date[20, 21] of bringing into use of any frequency assignment to a space station of a satellite network shall be not later than seven years following the date of receipt by the Bureau of the relevant complete information under No. **9.1**, **9.1*bis*** or **9.2**~~, as appropriate~~. 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-1~~2~~5)

Reasons: Consequential to the modification of RR No. **9.1**. These modifications are intended to clarify the computation of the 7-year period for the various types of satellite networks.

MOD

____

[20] **11.44.1** In the case of space station frequency assignments that are brought into use prior to the completion of the coordination process, and for which the Resolution **49 (Rev.WRC-~~12~~15)** or Resolution **552 (WRC-~~12~~15)** data, as appropriate, have been submitted to the Bureau, the assignment shall continue to be taken into consideration for a maximum period of seven years from the date of receipt of the relevant information under No. **9.1*bis***. If the first notice for recording of the assignments in question under No. **11.15** has not been received by the Bureau by the end of this seven-year period, the assignments shall be cancelled by the Bureau after having informed the notifying administration of its pending actions six months in advance.   (WRC-~~12~~15)

Reasons: Consequential to the addition of RR No. **9.1*bis***. This modification is intended to clarify the computation of the 7-year period for the satellite networks subject to coordination.

MOD

11.48 If, after the expiry of the period of seven years from the date of receipt of the relevant complete information referred to in No. **9.1, 9.1*bis*** or **9.2**~~, as appropriate,~~ the administration responsible for the satellite network has not brought the frequency assignments to stations of the network into use, or has not submitted the first notice for recording of the frequency assignments under No. **11.15**, or, where required, has not provided the due diligence information pursuant to Resolution **49 (Rev.WRC-~~12~~15)** or Resolution **552 (WRC-~~12~~15)**, as appropriate, the corresponding information published under Nos. **9.2B** and **9.38**, as appropriate, shall be cancelled, but only after the administration concerned has been informed at least six months before the expiry date referred to in Nos. **11.44** and **11.44.1** and, where required, § 10 of Annex 1 of Resolution **49 (Rev.WRC-~~12~~15)**.   (WRC-1~~2~~5)

Reasons: Consequential to the modification of RR No. **9.1**. These modifications are intended to clarify the computation of the 7-year period for the various types of satellite networks.

Note 1: Consequential modifications may also be required in RR Appendix **4** (deletion of "X" in the column "Notification or coordination of a geostationary-satellite network (including space operation functions under Article **2A** of Appendices **30** or **30A**)" for item A.13.a) and in RR Appendix **5** (modification of footnote "[3]" to remove references to the coordination of a satellite network in connection with RR No. **9.1**), as well as in Resolutions **49 (Rev.WRC-12)** (§ 4 of Annex 1) and **552 (WRC-12)** (§8 of Annex 1).

Note 2: Modifications to Resolution **55 (Rev.WRC-12)** may also be needed depending on the conclusions related to the issue discussed in section 5/7/3.3.2 above.

MOD

RESOLUTION 49 (REV.WRC-~~12~~15)

Administrative due diligence applicable to some satellite radiocommunication services

The World Radiocommunication Conference (Geneva, 20~~12~~15),

considering

...

considering further

...

resolves

...

ANNEX 1 TO RESOLUTION 49 (REV.WRC-~~12~~15)

...

4 An administration requesting coordination for a satellite network under §1 above shall send to the Bureau as early as possible before the end of the period established as a limit to bringing into use in No. **9.1*bis***, the due diligence information relating to the identity of the satellite network and the spacecraft manufacturer specified in Annex 2 to this Resolution.

...

MOD

RESOLUTION 552 (WRC-~~12~~15)

Long-term access to and development in the band 21.4-22 GHz in Regions 1 and 3

The World Radiocommunication Conference (Geneva, 20~~12~~15),

considering

...

resolves

...

ANNEX 1 TO RESOLUTION 552 (WRC-~~12~~15)

...

8 Within 30 days after the end of the seven-year period following the date of receipt by the Bureau of the relevant complete information under No. **9.1*bis*** ~~or **9.2**~~, as appropriate, and after the end of the three-year period following the date of suspension under No. **11.49**, if the complete information under this Resolution is not yet received by the bureau, the corresponding frequency assignments shall be cancelled by the Bureau, which subsequently informs the administration accordingly.

...

5/7/3.6.3 Method C3: Changing the period before expiry of the API for satellite networks subject to coordination under Section II of RR Article 9

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6, 7, 8, 8*bis*] (WRC-12)

Section I − Advance publication of information on satellite networks or satellite systems

General

MOD

9.1 Before initiating any action under this Article or under Article **11** in respect of frequency assignments for a satellite network or a satellite system, an administration, or one[9] acting on behalf of a group of named administrations, shall, prior to the coordination procedure described in Section II of Article **9** below, where applicable, send to the Bureau a general description of the network or system for advance publication in the International Frequency Information Circular (BR IFIC) not earlier than seven years and preferably not later than two years before the planned date of bringing into use of the network or system (see also No. **11.44**). The characteristics to be provided for this purpose are listed in Appendix **4**. The coordination or notification information may also be communicated to the Bureau at the same time; it shall be considered as having been received by the Bureau ~~not earlier than~~ six months after the date of receipt of the information for advance publication where coordination is required by Section II of Article **9**. Where coordination is not required by Section II, notification shall be considered as having been received by the Bureau not earlier than six months after the date of publication of the advance publication information. (WRC-~~03~~15)

Sub-Section IB − Advance publication of information on satellite networks or satellite systems that are subject to coordination procedure under Section II

MOD

9.5D If the information under No. **9.30** has not been received by the Bureau within a period of ~~24~~ six months after the date of receipt by the Bureau of the relevant complete information under No. **9.1** or **9.2**, as appropriate, the information published under No. **9.2B** and not covered by a coordination request under No. **9.30** shall be cancelled~~, after the administration concerned has been informed at least three months before the end of the 24-month period~~. The Bureau shall also publish the cancellation in its BR IFIC. (WRC-~~03~~15)

5/7/3.6.4 Method C4: Suppression of current API mechanism and generation of API at the receipt of a coordination request

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6, 7, 8, 8*bis*] (WRC-12)

Section I − Advance publication of information on satellite networks or satellite systems

General

MOD

9.1 Before initiating any action ~~under this Article or~~ under Article **11** in respect of frequency assignments for a satellite network or a satellite system not subject to the coordination procedure described in Section II of Article **9** below, an administration, or one[9] acting on behalf of a group of named administrations, shall~~, prior to the coordination procedure described in Section II of Article **9** below, where applicable,~~ send to the Bureau a general description of the network or system for advance publication in the International Frequency Information Circular (BR IFIC) not earlier than seven years and preferably not later than two years before the planned date of bringing into use of the network or system (see also No. **11.44**). The characteristics to be provided for this purpose are listed in Appendix **4**. The ~~coordination or~~ notification information may also be communicated to the Bureau at the same time~~; it shall be considered as having been received by the Bureau not earlier than six months after the date of receipt of the information for advance publication where coordination is required by Section II of Article **9**. Where coordination is not required by Section II, notification~~ but shall be considered as having been received by the Bureau not earlier than six months after the date of publication of the advance publication information. (WRC-~~03~~15)

Reasons: To suppress the need for sending an API for satellite networks subject to coordination under Section II of RR Article **9**.

ADD

9.1*bis* Upon receipt of a coordination request under No. **9.30**, the Bureau shall publish a general description of the network or system for advance publication in the International

Frequency Information Circular (BR IFIC). The characteristics to be published for this purpose are listed in Appendix **4**. Modifications to previous coordination requests shall not generate a new publication under this provision.

Reasons: To automatically generate an API at receipt of a coordination request.

MOD

9.2 Amendments to the information sent in accordance with the provisions of No. **9.1** shall also be sent to the Bureau as soon as they become available. The use of an additional frequency band, ~~or~~ modification of the orbital location by more than ±6° for a space station using the geostationary-satellite orbit, the modification of the reference body or the modification of the direction of transmission for a space station using a non-geostationary-satellite orbit will require the application of the advance publication procedure~~ for this band or orbital location, as appropriate~~. ~~Furthermore, where coordination is not required by Section II of Article **9**, the modification of the reference body or the modification of the direction of transmission for a space station using a non-geostationary-satellite orbit will require the application of the advance publication procedure.~~ (WRC-~~12~~15)

Reasons: Consequential to the modification of RR No. **9.1**.

SUP

Sub-Section IB − Advance publication of information on satellite networks or satellite systems that are subject to coordination procedure under Section II

SUP

9.5B

SUP

9.5C

SUP

9.5D

Reasons: Consequential to the modification of RR No. **9.1** and addition of RR No.***9.1bis***.

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7*bis*] (WRC-12)

Section II − Examination of notices and recording of frequency assignments in the Master Register

MOD

11.44 The notified date[20, 21] of bringing into use of any frequency assignment to a space station of a satellite network 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 case of satellite networks not subject to Section II of Article **9** or under No. ***9.1bis*** in case of satellite networks subject to Section II of Article **9**~~, as appropriate~~. 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-~~12~~15)

Reasons: Consequential to the modification of RR No. **9.1** and addition of RR No.***9.1bis***. These modifications are intended to clarify the computation of the 7-year period for the various types of satellite networks.

MOD

[20] **11.44.1** In the case of space station frequency assignments that are brought into use prior to the completion of the coordination process, and for which the Resolution **49 (Rev.WRC-12)** or Resolution **552 (WRC-12)** data, as appropriate, have been submitted to the Bureau, the assignment shall continue to be taken into consideration for a maximum period of seven years from the date of receipt of the relevant information under No. **9.1** or No. ***9.1bis***, as appropriate. If the first notice for recording of the assignments in question under No. **11.15** has not been received by the Bureau by the end of this seven-year period, the assignments shall be cancelled by the Bureau after having informed the notifying administration of its pending actions six months in advance. (WRC-~~12~~15)

Reasons: Consequential to the modification of RR No. **9.1** and addition of RR No.***9.1bis***. This modification is intended to clarify the computation of the 7-year period for the various types of satellite networks.

MOD

11.48 If, after the expiry of the period of seven years from the date of receipt of the relevant complete information referred to in No. **9.1** or **9.2** in case of satellite networks not subject to Section II of Article **9** or in No. ***9.1bis*** in case of satellite networks subject to Section II of Article **9**, ~~as appropriate,~~ the administration responsible for the satellite network has not brought the frequency assignments to stations of the network into use, or has not submitted the first notice for recording of the frequency assignments under No. **11.15**, or, where required, has not provided the due diligence information pursuant to Resolution **49 (Rev.WRC-12)** or Resolution **552 (WRC-12)**, as appropriate, the corresponding information published under Nos. **9.2B** and **9.38**, as appropriate, shall be cancelled, but only after the administration concerned has been informed at least six months before the expiry date referred to in Nos. **11.44** and **11.44.1** and, where required, § 10 of Annex 1 of Resolution **49 (Rev.WRC-12)**. (WRC-~~12~~15)

Reasons: Consequential to the modification of RR No. **9.1** and addition of RR No.***9.1bis***. These modifications are intended to clarify the computation of the 7-year period for the various types of satellite networks.

Note 1: Consequential modifications may also be required in RR Appendix **4** (deletion of “X” in the column “Notification or coordination of a geostationary-satellite network (including space operation functions under Article **2A** of RR Appendices **30** or **30A**)” for item A.13.a) and in RR Appendix **5** (modification of footnote “[3]” to remove references to the coordination of a satellite network in connection with RR No. **9.1**), as well as in Resolutions **49 (Rev.WRC-12)** (§ 4 of Annex 1) and **552 (WRC-12)** (§ 8 of Annex 1).

Note 2: Modifications to Resolution **55 (Rev.WRC-12)** may also be needed depending on the conclusions related to the issue discussed in section 5/7/3.3.2 above.

5/7/3.6.5 Method C5: suppressing the six-month minimum period between the date of receipt of an API and the date of receivability of the associated coordination request

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6, 7, 8, 8*bis*] (WRC-12)

Section I − Advance publication of information on satellite networks or satellite systems

General

MOD

9.1 Before initiating any action under this Article or under Article **11** in respect of frequency assignments for a satellite network or a satellite system, an administration, or one[9] acting on behalf of a group of named administrations, shall, prior to the coordination procedure described in Section II of Article **9** below, where applicable, send to the Bureau a general description of the network or system for advance publication in the International Frequency Information Circular (BR IFIC) not earlier than seven years and preferably not later than two years before the planned date of bringing into use of the network or system (see also No. **11.44**). The characteristics to be provided for this purpose are listed in Appendix **4**. The coordination or notification information may also be communicated to the Bureau at the same time~~; it shall be considered as having been received by the Bureau not earlier than six months after the date of receipt of the information for advance publication where coordination is required by Section II of Article~~ **9.** Where coordination is not required by Section II, notification shall be considered as having been received by the Bureau not earlier than six months after the date of publication of the advance publication information. (WRC-~~03~~15)

Reasons: To suppress the six-month period between the date of receipt of API and the date of receivability of the associated coordination request under Section II of RR Article **9**, in order to reduce the part dedicated to publication of special sections within the coordination process.

Sub-Section IB − Advance publication of information on satellite networks or satellite systems that are subject to coordination procedure under Section II

MOD

9.5B If, upon receipt of the BR IFIC containing information published under No. **9.2B**, any administration considers its existing or planned satellite systems or networks or terrestrial stations[11] to be affected, it may send its comments to the publishing administration, so that the latter may take those comments into consideration~~ when initiating the coordination procedure~~. A copy of these comments may also be sent to the Bureau. Thereafter, both administrations shall endeavour to cooperate in joint efforts to resolve any difficulties, with the assistance of the Bureau, if so requested by either of the parties, and shall exchange any additional relevant information that may be available. (WRC-~~2000~~15)

Reasons: Consequential to the suppression of the six-month period because the coordination procedure can be initiated before the publication of the advance publication.

5/7/4 Issue D – General use of modern electronic means of communications in coordination and notification procedures

5/7/4.1 Executive summary

Increasing difficulties to make transmissions by fax generates in turn difficulties in communicating between administrations and with the Radiocommunication Bureau (BR) and hampers the implementation of coordination and notification procedures of satellite networks. Resolution **907 (WRC-12)** is directly related to this issue and could be amended to ensure that, wherever the words "telegram", "telex" or "fax" are inserted in provisions related to coordination and notification procedures of satellite networks (including Radio Regulations (RR) Appendices **30, 30A, 30B** and relevant Resolutions), modern electronic means can be used instead.

In a connected matter, Resolution **908 (WRC-12)** deals with electronic submission and publication of advance publication of information (API). Following the availability of SpaceWISC (see Circular Letter CR/363), the scope of this Resolution could be expanded to all kind of satellite network filings and the BR could be requested to analyse whether it is possible to have a single consolidated interface for both the submission of satellite network filings and the related correspondence.

5/7/4.2 Background

In the past years, transmissions by fax have become increasingly unreliable or difficult to perform. This situation generates difficulties in communicating between administrations and with the BR and slows down the appropriate conduct of coordination and notification procedures of satellite networks.

In 2010, the Plenipotentiary Conference envisaged in § 20 of Annex 2 to its Decision 5 (Rev. Guadalajara, 2010) that there should be a transition from fax to modern electronic communication methods for communications between ITU and its Member States:

> "20) Move, to the extent practicable, from present communications by fax between the Union and Member States to modern electronic communication methods."

WRC-12 adopted Resolution **907 (WRC-12)** directly related to this issue and, in a somewhat connected matter, Resolution **908 (WRC-12)** on electronic submission and publication of advance publication information.

5/7/4.3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

A number of regulatory provisions concerning coordination and notification procedures of satellite networks (including in RR Appendices **30, 30A, 30B** and relevant Resolutions) uses the words "telegram", "telex" or "fax". The actual use of telegram or telex has been discontinued for a while since these technologies are no longer provided. In a parallel manner, the provision of international fax is currently decaying. The reliability and quality of service of fax systems are sometimes too low to ensure an efficient implementation of provisions concerning satellite coordination and notification. On the counterpart, administrations are nowadays equipped with email systems and Internet access that have reached a level of reliability and quality of service compatible with a routine use for coordination and notification activities.

5/7/4.4 Analysis of the results of studies

Modern electronic means of communications can nowadays be used for implementing the various provisions of the RR related to satellite coordination and notification. The BR can be entrusted to devise a harmonized approach to implement this more general use of modern electronic means of communications.

In devising such approach, the aspects of security will have to be considered and properly implemented, both in the sense of reliability (i.e. to ensure that the BR has well received a message from an administration and vice-versa) and of authentication (i.e. to ensure that messages sent or received by an administration are indeed originating from, or addressed to, the responsible authority of the administration). WRC-12 already contemplated this aspect by including the word “secure” in the *instructs the Radiocommunication Bureau* 1 of both Resolutions **907 (WRC-12)** and **908 (WRC-12)**. WRC-15 may need to provide more detailed guidelines to the BR. The Director of the BR may include in his Report to WRC-15 the BR’s requests in this regard.

It should also be noted that this transition should not affect administrations that may experience difficulties in its implementation. Therefore, it is also proposed to maintain unchanged *resolves* 2 of Resolution **907 (WRC-12)** (“other, traditional means of communication can continue to be used if modern electronic means are not available”).

Furthermore, the availability of SpaceWISC (see Circular Letter CR/363) also suggests that Resolution **908 (WRC-12)** could be amended to expand its scope to all kind of satellite network filings.

The BR could finally be requested to analyse whether it is possible to have a single consolidated interface for both the submission of satellite network filings and the related correspondence (correspondence between the BR and the notifying administration, comments submitted following the publication of the special section, correspondence between administrations about the special section, etc…).

5/7/4.5 Method to satisfy issue D

Method D: Amendments to Resolutions 907 (WRC-12) and 908 (WRC-12)

Resolution **907 (WRC-12)** is proposed to be amended to ensure that, wherever the words “telegram”, “telex” or “fax” are used in provisions related to coordination and notification procedures of satellite networks (including RR Appendices **30, 30A, 30B** and relevant Resolutions), modern electronic means can be used instead. The BR would continue to be tasked to implement the *resolves* part and to report to administrations on such an implementation. It should be noted that this transition should not affect administrations that may experience difficulties in its implementation. Therefore, it is also proposed to maintain unchanged *resolves* 2 of Resolution **907 (WRC-12)** (“other, traditional means of communication can continue to be used if modern electronic means are not available”).

Building on the availability of SpaceWISC (see Circular Letter CR/363), Resolution **908 (WRC-12)** is also proposed to be amended to expand its scope to all kind of satellite network filings and to request the BR to analyse whether it is possible to have a single consolidated interface for both the submission of satellite network filings and the related correspondence (correspondence between the BR and the notifying administration, comments submitted following the publication of the special section, correspondence between administrations about the special section, etc.).

5/7/4.6 Regulatory and procedural considerations for issue D

Method D: Amendments to Resolutions 907 (WRC-12) and 908 (WRC-12)

MOD

RESOLUTION 907 (WRC-12)

Use of modern electronic means of communication for administrative correspondence related to advance publication, coordination and notification of satellite networks including that related to Appendices 30, 30A and 30B, earth stations and radio astronomy stations

The World Radiocommunication Conference (Geneva, 2012),

considering

that the use of electronic means of communication for administrative correspondence related to advance publication, coordination and notification of satellite networks, earth stations and radio astronomy stations would facilitate the tasks of the Radiocommunication Bureau and of administrations and has the potential to improve the coordination and notification process by reducing the amount of duplicated correspondence,

noting

that Decision 5 (Rev. Guadalajara, 2010) includes, in its Annex 2, paragraph 20, which proposes to "move, to the extent practicable, from present communications by fax between the Union and Member States to modern electronic communication methods",

recognizing

that administrations could use the time freed by a reduction of administrative correspondence to effect coordination,

resolves

1 that modern electronic means of communication shall be used whenever possible in the administrative correspondence between administrations and the Radiocommunication Bureau related to advance publication, coordination and notification, including correspondence related to Appendices **30**, **30A**, ~~and~~ **30B** and relevant Resolutions, ~~where applicable, to due diligence~~ for satellite networks, earth stations and radio astronomy stations;

2 that, wherever the words "telegram", "telex" or "fax" are inserted in provisions related to advance publication, coordination and notification of satellite networks, earth stations and radio astronomy stations, including the provisions contained in Appendices **30**, **30A**, **30B** and relevant Resolutions, modern electronic means shall be used instead, whenever possible;

~~2~~3 that other, traditional means of communication can continue to be used if modern electronic means are not available,

instructs the Radiocommunication Bureau

1 to provide administrations with the necessary technical means to ensure that the modern electronic correspondence between administrations and the Radiocommunication Bureau is secure;

2 to inform administrations of the availability of such means and of the associated schedule of implementation;

3 to automatically acknowledge receipt of all electronic correspondence;

4 to report to the next world radiocommunication conference on the experience gained in the application of this Resolution, with a view to making any necessary consequential amendments to the Radio Regulations,

urges administrations

to use, to the extent possible, modern electronic means of communication in the administrative correspondence between themselves related to advance publication, coordination and notification of satellite networks, including that related to Appendices **30**, **30A** and **30B**, and to earth stations and radio astronomy stations, recognizing that other means of communication may still be used if necessary (see also *resolves* ~~2~~<u>3</u>).

MOD

RESOLUTION 908 (WRC-12)

Electronic submission and publication of ~~advance publication information~~ <u>satellite network filings</u>

The World Radiocommunication Conference (Geneva, 2012),

considering

a) that the volume of advance publication information (API)<u>, coordination requests (CR/C), notification, application of Appendices **30**, **30A** and **30B**</u> ~~on~~ <u>for</u> satellite networks or systems ~~subject to the coordination procedure under Section II of Article **9** of the Radio Regulations~~ has been steadily increasing in recent years;

~~*b)* that this increasing trend may be due in part to the fact that there is no cost-recovery fee for these APIs;~~

~~*c)* that the Bureau has also observed that many of the APIs are not followed by a coordination request within the period of 24 months prescribed under No. **9.5D**;~~

~~d~~<u>b</u>) that a significant amount of effort is ~~therefore~~ required to ~~update~~ <u>maintain</u> the relevant databases ~~by deleting either in total or partially the obsolete APIs,~~<u>;</u>

~~*considering further*~~

~~a~~<u>c</u>) that a paperless electronic approach for the submission of ~~APIs on~~ satellite network~~s~~ <u>filings</u> would make ~~API~~ <u>this</u> information readily accessible to all, and would limit the workload for administrations and the Bureau in the processing of ~~APIs for satellite networks or systems subject to coordination~~<u>these filings</u>~~;~~<u>,</u>

~~*b)* that, at the end of 24-month period prescribed in No. **9.5D**, the entries will automatically be removed from the list;~~

~~*c)* that coordination requests that are submitted within the 24-month period, together with relevant API information (date of receipt, nominal orbital position), will then be processed and entered in the SNS database in the normal way,~~

noting

~~*a)* that the API requested under Section IB of Article **9** of the Radio Regulations contains only a limited amount of information, the most pertinent being the date of receipt of complete information, the frequency bands and, for GSO networks, the orbital position;~~

~~*b)* that the current API publication will continue to apply to the advance publication of information on satellite networks or systems which are not subject to coordination procedures under Section II of Article **9**,~~

a) that, through Circular Letter CR/363, the Bureau informed administrations that a web-based application (SpaceWISC) was developed for the submission and publication of API notices for satellite networks or systems subject to coordination and for the administrations' comments under No. **9.5B**;

b) that, through Circular Letter CR/360, the Bureau informed administrations that a web-based on-line distribution of the International Frequency Information Circular BR IFIC (Space services) on DVD-ROM in ISO format was developed, allowing the data to be available without delay on the BR IFIC publication date and administrations to get a secure local reproduction of the BR IFIC (Space services) DVD-ROM,

resolves

that administrations shall submit ~~API~~ all satellite network filings, under Articles **9** and **11** as well as Appendices **30**, **30A**, **30B** and relevant Resolutions, using a secure paperless electronic approach upon being advised that the means for such an electronic submission of ~~API~~ a satellite network filing for satellite networks or systems ~~subject to coordination~~ has been implemented and upon receiving assurances that such means are indeed secure,

instructs the Director of the Radiocommunication Bureau

1 to implement a secure paperless electronic approach for the electronic submission and publication of ~~API~~ satellite network filings for satellite networks or systems ~~subject to coordination~~, taking into account the conditions mentioned in the *resolves* of this resolution~~.~~;

2 to study and implement, as appropriate, a consolidated approach for both the electronic submission of satellite network filings and their related correspondence.

5/7/5 Issue E – Failure of a satellite during the ninety-day bringing into use period

5/7/5.1 Executive summary

WRC-12 discussed the issue of a satellite failure during the ninety-day bringing into use period that renders the satellite technically incapable of operating in a given frequency band (see section 9 of WRC-12 Document 554), and invited the ITU-R to study, as a matter of urgency, to determine what regulatory changes, if any, should be made to the Radio Regulations (RR) under WRC-15 agenda item 7 to address this issue. Furthermore, WRC-12 decided that in case of such failure, the notifying administration may submit the case to the Radio Regulations Board (RRB) for its consideration and decision on a case-by-case basis.

This issue was studied within ITU-R and three methods are included below to address this issue.

5/7/5.2 Background

WRC-12 introduced the additional provisions No. **11.44.2** and No. **11.44B** in the RR in order to better define the bringing into use of a frequency assignment to a space station in the geostationary-satellite orbit (GSO). According to RR No. **11.44B**, "A frequency assignment to a space station in the geostationary-satellite orbit shall be considered as having been brought into use when a space station in the geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained at the notified orbital position for a continuous period of ninety days. …".

However, the current provisions regarding the bringing into use (BIU) do not address a possible scenario of a satellite failure during the above mentioned period of ninety days. Because of this fact, consideration was given as to how this issue could be addressed.

5/7/5.3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The satellite network operator has a few possibilities to restore the services in case of a failure of a satellite during the ninety-day BIU period. Usually, the options are relocating a satellite from its existing fleet, purchasing or leasing a satellite already in orbit, or in the worst case procuring and launching a new satellite. However, the current situation results in an uncertainty for the notifying administration and the satellite network operator awaiting the RRB decision on the status of the frequency assignments in subject. Therefore, it may be important to have an RR provision that would define a clear applicable approach in a case of a failure of a satellite during the ninety-day period of BIU. Such provision would provide an administration with a clear understanding on the status of its frequency assignments before taking a decision on a replacement satellite.

Furthermore, it is believed that the intention of the current RR provisions is not to penalize genuine satellite network projects, but rather to prevent bringing into use of several satellite networks at different orbital positions by moving a single satellite from one position to another with brief stops at each position, declaring bringing of the networks into use and suspending the assignments, until the ultimate orbital position is reached. Launch of a satellite to operate one satellite network is certainly a genuine project and it would thus be appropriate to consider the assignments in case of a failure of such newly launched satellite during the 90-day period of RR No. **11.44B** as being brought into use, and consequently allowing the notifying administration to suspend the use of the corresponding recorded frequency assignments.

However, adding provisions to the RR to award BIU status to a satellite failure during the BIU/bringing back into use (BBIU) period could have the opposite effect and encourage abuse of the BIU rules by sanctioning the movement of aging and older satellites from one orbital location to another without worry about potential satellite failure. Since there have not been any demonstrable events of a satellite failure during the BIU period, it may be premature to modify the current regulatory procedures.

5/7/5.4 Analysis of the results of studies

In view of the summary of technical and operational studies above, one possible way to address this issue is to allow a frequency assignment to be considered as having been brought into use in case of a frequency assignment that could not be brought into use in accordance with RR No. **11.44B** due to a failure of a satellite during the ninety-day bringing into use period.

Another view is to continue to use the current procedures in the RR since the failure of any satellite during a 90-day BIU or BBIU period would be extremely rare. In the case of a newly-launched or in-orbit satellite failure during the 90-day BIU or BBIU period, administrations already have the possibility of petitioning the RRB for relief under the current procedures and if not successful at the

RRB then to petition a WRC. There is no regulatory difference between a newly launched satellite or an in-orbit satellite and to add provisions giving special treatment to a newly launched satellite penalizes operators conducting legitimate satellite fleet movements. Additionally, the proposed method could open the door for abuse of the BIU procedures by using aging satellites to move to different orbital locations for BIU/BBIU.

5/7/5.5 Methods to satisfy issue E

5/7/5.5.1 Method E1

Under this method, a possible addition of a footnote to RR No. **11.44B** is proposed, which would indicate that in case of a failure of a satellite during the ninety-day BIU period, the corresponding frequency assignments shall be considered as having been brought into use under RR No. **11.44B**.

5/7/5.5.2 Method E2

This is an optional, additional method to Method E1. Under this method, the same footnote to RR No. **11.44B**, as specified under Method E1, is proposed. Furthermore, another footnote to RR No. **11.49** is proposed, which would indicate that in case of a failure during the ninety-day BIU period of a satellite, used for bringing frequency assignments back into use, the corresponding frequency assignments will be considered as having been brought back into use under RR No. **11.49.1**.

5/7/5.5.3 Method E3

Under this method there would be no change to the RR.

5/7/5.6 Regulatory and procedural considerations for issue E

5/7/5.6.1 Method E1

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7*bis*] (WRC-12)

Section II − Examination of notices and recording of frequency assignments in the Master Register

MOD

11.44B A frequency assignment to a space station in the geostationary-satellite orbit shall be considered as having been brought into use when a space station in the geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained at the notified orbital position for a continuous period of ninety days. The notifying administration shall so inform the Bureau within thirty days from the end of the ninety-day period[21*bis*]. (WRC-~~12~~15)

ADD

[21bis] **11.44B.1** In the case of a space station in the geostationary-satellite orbit that experienced a failure during the ninety-day period of bringing a frequency assignment into use under No. **11.44B**, which renders the space station technically incapable of transmitting or receiving that frequency assignment, the frequency assignment shall be considered as having been brought into use. The notifying administration shall so inform the Bureau within thirty days from the end of the ninety-day period. Upon receipt of this information, the Bureau shall suspend the frequency assignment under No. **11.49**. (WRC-15)

5/7/5.6.2 Method E2

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7bis] (WRC-12)

Section II − Examination of notices and recording of frequency assignments in the Master Register

MOD

11.44B A frequency assignment to a space station in the geostationary-satellite orbit shall be considered as having been brought into use when a space station in the geostationary-satellite orbit with the capability of transmitting or receiving that frequency assignment has been deployed and maintained at the notified orbital position for a continuous period of ninety days. The notifying administration shall so inform the Bureau within thirty days from the end of the ninety-day period[21bis]. (WRC-~~12~~15)

ADD

[21bis] **11.44B.1** In the case of a space station in the geostationary-satellite orbit that experienced a failure during the ninety-day period of bringing a frequency assignment into use under No. **11.44B**, which renders the space station technically incapable of transmitting or receiving that frequency assignment, the frequency assignment shall be considered as having been brought into use. The notifying administration shall so inform the Bureau within thirty days from the date of the satellite failure. Upon receipt of this information, the Bureau shall suspend the frequency assignment under No. **11.49**. (WRC-15)

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, as soon as possible, but no later than six months from the date on which the use was suspended, 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. The date on which the recorded assignment is brought back into use[22, 22bis] shall be not later than three years from the date of suspension. (WRC-~~12~~15)

ADD

____

[22bis] **11.49.2** In the case of a space station in the geostationary-satellite orbit that experienced a failure during the ninety-day period of bringing a frequency assignment back into use under No. **11.49.1**, which renders the space station technically incapable of transmitting or receiving that frequency assignment, the frequency assignment shall be considered as having been brought back into use. The notifying administration shall so inform the Bureau within thirty days from the date of the satellite failure. Upon receipt of this information, the Bureau shall suspend the frequency assignment under No. **11.49**. (WRC-15)

5/7/5.6.3 Method E3

NOC

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7bis] (WRC-12)

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-12;

NOTE: Eight issues have been identified by CPM15-1 under this agenda item.

5/9.1.1 Resolution 205 (Rev.WRC-12)

Protection of the systems operating in the mobile-satellite service in the band 406-406.1 MHz

(**WP 4C** / **WP 5A, WP 5B, WP 5C, WP 7B, WP 7C**)

5/9.1.1/1 Executive summary

In accordance with Resolution **205 (Rev.WRC-12)**, ITU-R undertakes to conduct appropriate regulatory, technical and operational studies with a view to ensuring adequate protection of MSS systems operating in the frequency band 406-406.1 MHz as required by RR Nos. **4.22**, **5.267** and Appendix **15** (Table 15-2), taking into account the current and future services operating in the lower adjacent frequency bands (390-406 MHz) and upper adjacent frequency bands (406.1-420 MHz) or in separate parts of these frequency bands.

Permissible levels of interference for narrowband and wideband emissions were developed for three space segments (low Earth orbit (LEO), medium Earth orbit (MEO) and geostationary-satellite orbit (GSO)) in operation within the frequency band 406-406.1 MHz. Specified spurious emission levels indicate that the data collection platforms operating in the EESS do not produce in-band emissions exceeding the narrowband interference criteria. In addition, operation of radiosondes in the MetAids will not exceed the broadband measured sensitivity levels of the search-and-rescue receivers for LEO, MEO or GSO satellites.

Simulations run assuming deployment scenarios typical from CEPT countries show that the LEO component experiences interference due to mobile deployment from 406.1 to 407 MHz, while the MEO component receives interference up to 410 MHz depending on the constellation. The geostationary component shows severe interference due to mobile deployment within the 406.1-406.2 MHz frequency band.

Increased deployment of land mobile stations in the 406.1-420 MHz range may cause performance degradation for the LEOSAR Search and Rescue (SAR) processor, according to simulations run using characteristics of Canadian systems, which may not be representative of other Region 2 countries. The hypothetical deployment and growth rate scenario used, are not representative of current and may not represent future deployment in Region 2 countries. According to this study, MEOSAR (Galileo) within its larger footprint may be also affected by an increase of land mobile systems in the 406.1-406.2 MHz frequency band.

Two options have been identified to ensure the protection of MSS systems operating in the frequency band 406-406.1 MHz. Both consist in adding a footnote to the Table of Frequency Allocations of RR Article **5** and modifying Resolution **205 (Rev.WRC-12)**.

The difference between the two proposed options is the way Resolution **205 (Rev.WRC-12)** is modified.

5/9.1.1/2 Background

The 406-406.1 MHz frequency band is exclusively allocated to the MSS, which is currently used by the Cospas-Sarsat system for search and rescue space segment instruments. Since the introduction of the first elements of the Cospas-Sarsat system in 1982 (the LEO and GSO components), more than 36900 persons (end of 2013 data) have been rescued worldwide with the assistance of the information provided by the Cospas-Sarsat system.

Receivers for search and rescue signals are carried on satellites with three distinctive orbits: LEO, which are generally polar orbits for Cospas-Sarsat, MEO, at an orbit of about 20,000 km, and GSO. Satellite footprints vary (LEO, MEO and GSO): 6% of the Instantaneous Field of View (IFOV) of Earth for LEO (LEO satellites only pass over a beacon a limited number of times a day), 38-40% IFOV of Earth for MEO/GSO footprints.

In the LEOSAR system, localization of distress radio beacons[30] depends on Doppler processing, which is based on successive measurements of the beacon transmit frequency via one LEO satellite at a time. For the MEOSAR system, which is currently under deployment, localization depends on measurement of Time Difference of Arrival (TDOA) and Frequency Difference of Arrival (FDOA). These measurements will significantly reduce the latency associated with the location of distress signal and increase the accuracy of the location provided but require simultaneous detection of the same beacon transmissions via multiple MEO satellites, and good C/No transmissions between the beacon and the satellites in order to get accurate TDOA and FDOA measurements. Emissions from systems operating in the frequency bands adjacent to the 406-406.1 MHz frequency band cannot be entirely filtered by the Cospas-Sarsat space segment and therefore add noise to the signal received. The resulting reduced C/N_0 obtained at the satellite receivers reduces the detection rates of the beacon transmission of all LEO, MEO and GSO systems (increasing the time required to provide a location to search and rescue operators) and the accuracy of the locations obtained for MEO systems (increasing the time required to perform search and rescue operations). Hence, in order to ensure reliable SAR performance, it is necessary to establish protection criteria for all types of existing and future MSS satellites operating in the frequency band 406-406.1 MHz from wideband and narrowband emissions from adjacent frequency bands.

Many administrations have deployed commercial land mobile systems operating near the 406-406.1 MHz frequency band, and other terrestrial operators are expected to request for additional capacities near this frequency band in the future. The emissions in adjacent frequency bands, if not adequately controlled, could raise the level of noise captured by the Cospas-Sarsat systems and hinder their abilities to detect and/or relay signal, from beacons and/or degrade the accuracy of the positions reported for the distress signals. It is anticipated that land mobile systems will be more densely deployed in the future with higher powers than with previous analogue deployments in the frequency range between 300 MHz and 3 GHz. This densification and higher power levels enhance the concerns regarding possible harmful interference caused by adjacent frequency band emissions. RR No. **5.267** and Appendix **15**, Table **15-2** apply.

The set of paired frequency bands 380-385 MHz/390-395 MHz are dedicated to Public Protection and Disaster Relief (PPDR) and the corresponding systems have been extensively implemented in many European countries. PPDR radio solutions are essential for public safety operations. PPDR systems need to be effective and adequate in their operation, nationally, cross border and regionally.

For most of the locations on the Earth (mainly over oceans), a distress beacon can be correctly received. Spectrum monitoring activity as required by Resolution **205 (Rev.WRC-12)** indicates

[30] "Distress radio beacons" refers to emergency position indicating radio beacons (EPIRBs) for watercraft, emergency locator transmitters (ELTs) for aircraft, or personal locator beacons (PLBs) for individuals.

a significant level of radio noise within the satellite footprint, especially over Europe and Asia, where the level of noise is quite high. The spectrum monitoring data showed that interference near the 406-406.1 MHz frequency band originated in multiple regions of the world has impacted both the transponder automatic gain control (AGC) or automatic level control (ALC) as well as adversely affecting the effective noise floor for distress radio beacon transmissions. These measurements highlight the need for protection of the 406-406.1 MHz frequency band in order to ensure that distress signals from all 406 MHz beacons (including weaker signals which are sometimes generated in challenging environments) could continue to be detected and successfully processed by the Cospas-Sarsat system.

5/9.1.1/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The relevant ITU-R Recommendations: ITU-R F.758-5, ITU-R M.478-5, ITU-R M.1478-2, ITU-R M.1808-0, ITU-R M.1823-0, ITU-R M.2014-0, ITU-R M.2015-0, ITU-R SA.1627-0

The relevant ITU-R Reports: Report ITU-R M.319-7, PDN Report ITU-R M.[AGENDA ITEM 9.1.1].

Permissible levels of interference for both narrowband and wideband emissions have been developed for the three space segments (LEO, MEO and GSO) in operation within the frequency band 406-406.1 MHz. Those levels represent the maximum amount of narrowband and wideband emissions within the frequency bands 390-406 MHz and 406.1-420 MHz. Those levels do take into account the passband filtering capabilities on board, valid for each of the space components of the Cospas-Sarsat system.

The background noise of the SAR receivers is the aggregate from several services in the adjacent frequency bands. The contribution of these services has been assessed separately.

Analyses have shown that for data collection platforms operating in the EESS within the frequency band 401 to 403 MHz, the aggregate transmitter power does not exceed the broadband interference threshold, assuming a maximum load of the EESS systems. The operation of these systems would contribute only with a small fractional to the wideband interference budget for the LEO satellites (0.01564%). It contributes as much as 0.673 % to the geostationary satellite receiver.

The results are significantly different between the two MEO satellites systems. It was calculated that the data collection platforms only contribute up to 1.84% of the wideband interference threshold for the Galileo satellite. The data collection platforms contribute 93.48% of the wideband interference value of the GLONASS receiver, which has a higher sensitivity.

In addition, it should be noted that if the threshold value of interference density is taken into account for the entire frequency range, then, the percentage of interference of the total allowable level will be the following: 0.258% of the threshold power value in the frequency band 390-405.05 MHz for Galileo; 0.00068% of the threshold power value in the frequency band 390-402.05 MHz and 10.91% of the threshold power value in the frequency band 402.05-405.05 MHz for GLONASS. These values are valid only when there is no interference from other systems operating in these frequency bands.

In addition, specified spurious emission levels indicate that the data collection platforms will not produce in-band emissions exceeding the narrowband interference criteria.

Operation of radiosondes in the MetAids will not exceed the broadband measured sensitivity levels of the search and rescue receivers for LEO, MEO or GSO satellites. In all cases the percentage of interference power to the SAR receivers is less than 6×10^{-3} percent of the interference threshold.

Older, less-stable, radiosondes operating above 405 MHz could have the carrier drift into the SAR receiver band. However, this does not contribute to the overall increase in the SAR receiver noise background.

The impact of the operation of mobile systems in operation above 406.1 MHz has been assessed performing simulation using realistic deployment within the CEPT countries. Simulations show that the LEO component experiences interference due to mobile deployment from 406.1 to 407 MHz, while the MEO component receives interference up to 410 MHz depending on the constellation. The geostationary component shows severe interference due to mobile deployment within the 406.1 to 406.2 MHz frequency band. Concerning the impact of spurious emissions in the 406-406.1 MHz frequency band, no impact has been demonstrated.

A compatibility analysis using the characteristics of land mobile services deployed in China in the frequency band 406.1-406.2 MHz shows that LEO satellites may be impacted.

The effect of increased land mobile system deployment in the 406.1-420 MHz frequency band on the Cospas-Sarsat systems was studied by assuming land mobile system characteristics from Canada. Although the Canadian land mobile system characteristics are not representative of other Region 2 countries and the hypothetical baseline deployment and growth rate scenario are not representative of current and may not be representative of future deployment and growth rate in Canada or other parts of the Americas, this study provides an estimation of potential increase of interference level in the 406-406.1 MHz frequency band due to increased deployment of land mobile systems under the hypothetical scenario:

– LEOSAR would receive unwanted emissions in excess of the maximum permissible level from land mobile stations as simulated (i.e. uniform distribution with 122 base stations and 3,096 mobiles) operating in the 406.1-407 MHz frequency band. Stations in the 406.1-406.2 MHz frequency band in this simulation were most likely to exceed the maximum permissible levels.
– Increased deployment of the land mobile stations in the 406.1-420 MHz range may cause performance degradation for the LEOSAR SAR processor.
– MEOSAR (Galileo) within its larger footprint may be affected by an increase of land mobile systems in the 406.1-406.2 MHz frequency band.

5/9.1.1/4 Regulatory and procedural considerations

5/9.1.1/4.1 General considerations

In order to protect the MSS systems in the 406-406.1 MHz, the following protection measures and mitigation techniques may be required:

– Concerning radiosondes (also called metaids), it is recognized that they are not a significant contributor to the broadband interference levels to Cospas-Sarsat receivers. However, it is acknowledged that a frequency drift of older less stable radiosondes could be a cause of narrowband interference to the SAR receiver for radiosondes operating above 405 MHz. It is therefore proposed that administrations have to take into account frequency drift characteristics of radiosondes when selecting their operating frequencies above 405 MHz to avoid transmitting in the 406-406.1 MHz frequency band.
– LEOSAR, GEOSAR and MEOSAR systems space receivers could be designed with improved filters, which are planned for future generation of satellites.
– The use of more efficient forward error-correction (FEC) in the data transmission from the beacons is a possible mitigation technique. However, this technique has its

limitations and implies longer distress messages leading to higher collision rates and decreasing of the overall system capacity. More efficient FEC in the data transmission will nevertheless be implemented on the next generation of 406 MHz beacons currently under development. The new beacons should have more resilient beacon-to-satellite transmissions which will potentially reduce the impact from systems operating in adjacent frequency bands. This mitigation technique cannot be envisaged for the 1.4 million beacons currently deployed and of which many are expected to remain in service for the next decade or so.

– A mitigation technique is to establish a guardband of 100 kHz just above the frequency band 406-406.1 MHz, and this mitigation technique provides protection according to the calculations in section 8.3 of the PDN Report ITU-R M.[AGENDA ITEM 9.1.1] based on assumptions that apply to CEPT countries. The implementation of a guardband would likely require regulatory measures and administrations should consider applying the guardband to new frequency assignments. However, some administrations are of the view that they may consider the guardband to eliminate the potential for interference. It is recognized that a too small guardband may not ensure the protection of the 406-406.1 MHz frequency band from unwanted emissions, while a too large guardband may not be feasibly implemented by administrations.

– Reduction in e.i.r.p. to space from terrestrial FS and MS systems in adjacent frequency bands may, in some limited cases, be another measure to protect Cospas-Sarsat. If possible and with respect to terrestrial systems, the method would be to adjust antennas or to reduce the power at the antenna port. However, taking into account that there are already thousands of terrestrial systems already in use in adjacent frequency bands to 406-406.1 MHz, it is not realistic to expect that the operators/users of these systems would/could modify their existing networks. Thus, this mitigation measure is not feasible due to the high number of existing systems operating in the 406.1-410 MHz frequency band, but might be considered for existing systems operating over a very limited portion of that frequency band such as 406.1-406.2 MHz in geographical locations where terrestrial deployment is low. Depending on the design of adjusted antenna pattern, the Cospas-Sarsat system may not entirely benefit from the e.i.r.p. reduction, since this mitigation technique may not be applied in every direction, so some MSS systems may still receive interfering signals from other directions that do not take advantage of the antenna pattern improvement.

– Mobile systems in the adjacent frequency bands may be able to operate in other mobile channels nearby but further away from the 406-406.1 MHz frequency band. Therefore, there may be some regulatory measures that could be further explored. These measures could include voluntary temporary measures, such as encouraging administrations to authorize new stations starting from channels that are further away from the frequency band edges of 406-406.1 MHz or reducing the power at the antenna port of mobile systems, using mobile antenna patterns having reduced antenna gains at high elevation angles, or more permanent and stable measures through regulation.

5/9.1.1/4.2 Regulatory considerations

Resolution **205 (Rev.WRC-12)** could be revised with a view of having an adequate protection of the MSS in the frequency band 406-406.1 MHz in order to detect and successfully process 406 MHz distress signals, taking into account the current and future deployment of services in adjacent frequency bands.

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See. item **2.1**)

MOD

335.4-410 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
390-399.9	FIXED MOBILE 5.254 ADD 5.A911	
399.9-400.05	MOBILE-SATELLITE (Earth-to-space) 5.209 5.224A RADIONAVIGATION-SATELLITE 5.222 5.224B 5.260 5.220 ADD 5.A911	
400.05-400.15	STANDARD FREQUENCY AND TIME SIGNAL-SATELLITE (400.1 MHz) 5.261 5.262 ADD 5.A911	
400.15-401	METEOROLOGICAL AIDS METEOROLOGICAL-SATELLITE (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) 5.208A 5.208B 5.209 SPACE RESEARCH (space-to-Earth) 5.263 Space operation (space-to-Earth) 5.262 5.264 ADD 5.A911	
401-402	METEOROLOGICAL AIDS SPACE OPERATION (space-to-Earth) EARTH EXPLORATION-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Fixed Mobile except aeronautical mobile ADD 5.A911	
402-403	METEOROLOGICAL AIDS EARTH EXPLORATION-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Fixed Mobile except aeronautical mobile ADD 5.A911	
403-406	METEOROLOGICAL AIDS Fixed Mobile except aeronautical mobile ADD 5.A911	
406-406.1	MOBILE-SATELLITE (Earth-to-space) 5.266 5.267 ADD 5.A911	
406.1-410	FIXED MOBILE except aeronautical mobile RADIO ASTRONOMY 5.149 ADD 5.A911	

MOD

410-460 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
410-420	FIXED MOBILE except aeronautical mobile SPACE RESEARCH (space-to-space) 5.268 ADD 5.A911	

ADD

5.A911 The use of the frequency band 390-420 MHz is subject to the application of Resolution **205 (Rev.WRC-15)**.

MOD

RESOLUTION 205 (REV.WRC-1~~2~~5)

Protection of the systems operating in the mobile-satellite service in the band 406-406.1 MHz

The World Radiocommunication Conference (Geneva, ~~2012~~2015),

considering

a) that WARC-79 allocated the frequency band 406-406.1 MHz to the mobile-satellite service (MSS) in the Earth-to-space direction;

b) that No. **5.266** limits the use of the frequency band 406-406.1 MHz to low-power satellite emergency position-indicating radiobeacons (EPIRBs);

c) that WARC Mob-83 made provision in the Radio Regulations for the introduction and development of a global distress and safety system;

d) that the use of satellite EPIRBs is an essential element of this system;

e) that, like any frequency band reserved for a distress and safety system, the frequency band 406-406.1 MHz is entitled to full protection against all harmful interference;

f) that Nos. **5.267** and **4.22** and Appendix **15** (Table **15-2**) require the protection of the ~~mobile-satellite service (~~MSS~~)~~ within the frequency band 406-406.1 MHz from all emissions of systems, including systems operating in the lower and upper adjacent frequency bands~~ (390-406 MHz) and in the upper adjacent bands (406.1-420 MHz)~~;

g) that Recommendation ITU-R M.1478 provides protection requirements for the various types of instruments mounted on board operational satellites receiving EPIRB signals in the frequency band 406-406.1 MHz against both broadband out-of-band emissions and narrowband spurious emissions;

h) that ~~studies are needed to adequately address the consequence of aggregate emissions from a large number of transmitters operating in adjacent bands and the consequent risk to space receivers intended to detect low-power distress-beacon transmissions~~the PDN Report ITU-R M.[AGENDA ITEM 9.1.1] provides the results of studies covering various scenarios between the

MSS and other relevant active services operating in the frequency bands 390-406 MHz and 406.1-420 MHz or in separate parts of these frequency bands,;

i) that unwanted emissions from services outside 406-406.1 MHz have the potential to cause interference to the MSS receivers within 406-406.1 MHz;

j) that long-term protection against harmful interference of the Cospas-Sarsat satellite system operating in the MSS in the frequency band 406-406.1 MHz is vital to the response times of emergency services;

k) that in most cases, the frequency bands adjacent or nearby to Cospas-Sarsat will continue to be used for various service applications,

considering further

a) that some administrations have initially developed and implemented an operational low-altitude, near-polar orbiting satellite system (Cospas-Sarsat) operating in the frequency band 406-406.1 MHz to provide alerting and to aid in the locating of distress incidents;

b) that thousands of human lives have been saved through the use of spaceborne distress-beacon detection instruments, initially on 121.5 MHz and 243 MHz, and subsequently in the frequency band 406-406.1 MHz;

c) that the 406 MHz distress transmissions are relayed through many instruments mounted on geostationary, low-Earth and medium-Earth satellite orbits;

d) that the digital processing of these emissions provides accurate, timely and reliable distress alert and location data to help search and rescue authorities assist persons in distress;

e) that the International Maritime Organization (IMO) has decided that satellite EPIRBs operating in the Cospas-Sarsat system form part of the Global Maritime Distress and Safety System (GMDSS);

f) that observations of the use of frequencies in the frequency band 406-406.1 MHz show that they are being used by stations other than those authorized by No. **5.266**, and that these stations have caused harmful interference to the ~~mobile-satellite service~~MSS, and particularly to the reception of satellite EPIRB signals by the Cospas-Sarsat system,;

g) that observations detailed in the PDN Report ITU-R M.[AGENDA ITEM 9.1.1] of the use of frequencies in the frequency band 406-406.1 MHz show that out-of-band emissions from stations in the frequency bands 405.7-406 MHz and 406.1-406.4 MHz have caused harmful interference to the MSS, and particularly to the reception of satellite EPIRB signals by the Cospas-Sarsat system;

h) that the results of ITU-R Region 1 studies indicate that out-of-band emissions from stations operating in the frequency bands 405.9-406 MHz and 406.1-406.2 MHz have the potential to severely impact the performance of the MSS systems in the frequency band 406-406.1 MHz;

i) that the results of ITU-R studies indicate that increased deployment of land mobile systems operating in the vicinity of the 406-406.1 MHz frequency band may degrade the receiver performance of the mobile-satellite systems operating in the frequency band 406-406.1 MHz;

j) that the maximum permissible level of interference in the 406-406.1 MHz frequency band may be exceeded due to frequency drift of the radiosondes operating above 405 MHz,

recognizing

a) that it is essential for the protection of human life and property that frequency bands allocated exclusively to a service for distress and safety purposes be kept free from harmful interference;

b) that the deployment of mobile systems near the frequency band 406-406.1 MHz is currently envisaged in many countries;

c) that this deployment raises significant concerns on the reliability of future distress and safety communications since the global monitoring of the 406 MHz search and rescue system already shows a high level of noise measured in many areas of the world for the frequency band 406-406.1 MHz;

d) that it is essential to preserve the MSS frequency band 406-406.1 MHz free from out-of-band emissions that would degrade the operation of the 406 MHz satellite transponders and receivers, with the risk that satellite EPIRB signals would go undetected,

noting

a) that the 406 MHz search and rescue system will be enhanced by placing 406-406.1 MHz transponders on global navigation satellite systems such as Galileo, GPS and GLONASS, relaying search and rescue emissions at 406 MHz, in addition to existing low-Earth orbiting and geostationary satellites already in operation, thus providing a large constellation of satellites relaying search and rescue messages;

b) that this enhanced constellation of spaceborne search and rescue instruments ~~will~~ was designed to improve geographic coverage and reduce distress-alert transmission delays because of larger uplink footprints, ~~and an~~ increased number of satellites and improvement in the accuracy of the location of the distress signal;

c) that the characteristics of these spacecraft with larger footprints, and the low power available from satellite EPIRB transmitters, means that aggregate levels of electromagnetic noise, including noise from transmissions in adjacent frequency bands, may present a risk of satellite EPIRB transmissions being undetected, or delayed in reception, or lead to reduced accuracy of the calculated locations, thereby putting lives at risk,

noting further

a) that the mobile-satellite systems contributing to the emergency location system "Cospas-Sarsat" provide a worldwide emergency location system that benefit all countries, even if those mobile-satellite systems are not operated by their country;

b) that many Cospas-Sarsat satellites implement efficient out-of-band filtering, which would be further improved in upcoming satellites,

~~*resolves to invite ITU-R*~~

~~1 to conduct, and complete in time for WRC-15, the appropriate regulatory, technical and operational studies with a view to ensuring the adequate protection of MSS systems in the frequency band 406-406.1 MHz from any emissions that could cause harmful interference (see No. **5.267**), taking into account the current and future deployment of services in adjacent bands as noted in *considering f)*;~~

~~2 to consider whether there is a need for regulatory action, based on the studies carried out under *resolves* 1, to facilitate the protection ofMSS systems in the frequency band 406-406.1 MHz,~~

or whether it is sufficient to include the results of the above studies in appropriate ITU-R Recommendations and/or Reports,

Option A:

resolves

that administrations should consider frequency drift characteristics when selecting an operating frequency in the 405-406 MHz range and take all practical steps to avoid frequency drifting in the 405.9-406 MHz frequency band, where unwanted emissions may cause interference to the MSS systems operating in the 406-406.1 MHz frequency band,

instructs the Director of the Radiocommunication Bureau

1 to include the results of these studies in his Report to WRC-15 for the purposes of considering adequate actions in response to *resolves to invite ITU-R* above;

2 to continue to organize monitoring programmes in the frequency band 406-406.1 MHz in order to identify the source of any unauthorized emission in that frequency band and to report to subsequent world radiocommunication conferences, as appropriate,

urges administrations

1 to take into account the potential increased aggregate interference level into the 406-406.1 MHz frequency band when making new assignments in the 406.1-406.2 MHz frequency band to ensure protection of the mobile-satellite systems operating in the 406-406.1 MHz frequency band;

2 to take all practical steps to limit the levels of unwanted emissions of stations operating within the 390-406 MHz and 406.1-420 MHz frequency ranges in order not to cause harmful interference to mobile-satellite systems operating in the 406-406.1 MHz frequency band;

31 to take part in monitoring programmes requested by the Bureau in accordance with No. **16.5**, in the frequency band 406-406.1 MHz, with a view to identifying and locating stations of services other than those authorized in the frequency band;

42 to ensure that stations other than those operated under No. **5.266** abstain from using frequencies in the frequency band 406-406.1 MHz;

53 to take the appropriate measures to eliminate harmful interference caused to the distress and safety system;

6 when providing Cospas-Sarsat satellite receiver payloads in the 406-406.1 MHz frequency band, to improve out-of-band filtering of such receivers, in order to reduce constraints to adjacent services while preserving the ability of the Cospas-Sarsat system to detect all kinds of emergency beacons and to maintain an acceptable rate of detection, which is vital to search and rescue missions;

47 to work with the administrations participating countries of the systemin the monitoring programme and ITU the Bureau to resolve reported cases of interference to the Cospas-Sarsat system;.

5 to participate actively in the studies by submitting contributions to ITU-R.

Option B:

resolves

1 to strongly recommend to administrations not to make new frequency assignments within the frequency band 406.1-406.2 MHz;

2 that administrations shall take into account frequency drift characteristics of radiosondes when selecting their operating frequencies above 405 MHz to avoid transmitting in the 406-406.1 MHz frequency band and take all practical steps to avoid frequency drifting close to 406 MHz, where unwanted emissions may cause interference to the MSS systems operating in the 406-406.1 MHz frequency band,

instructs the Director of the Radiocommunication Bureau

~~1 to include the results of these studies in his Report to WRC-15 for the purposes of considering adequate actions in response to *resolves to invite ITU-R* above;~~

~~2~~ to continue to organize monitoring programmes in the frequency band 406-406.1 MHz in order to identify the source of any unauthorized emission in that frequency band and to report to subsequent world radiocommunication conferences, as appropriate~~;~~,

encourages administrations

to take measures such as authorizing new mobile stations starting from channels that are further away from the 406-406.1 MHz frequency band, reducing the power at the antenna port of mobile systems, and using mobile antenna patterns having reduced antenna gains at high elevation angles,

urges administrations

1 to take part in monitoring programmes requested by the Bureau in accordance with No. **16.5**, in the frequency band 406-406.1 MHz, with a view to identifying and locating stations of services other than those authorized in the frequency band;

2 to ensure that stations other than those operated under No. **5.266** abstain from using frequencies in the frequency band 406-406.1 MHz;

3 to take the appropriate measures to eliminate harmful interference caused to the distress and safety system;

4 when providing Cospas-Sarsat satellite receiver payloads in the 406-406.1 MHz frequency band, to improve out-of-band filtering of such receivers, in order to reduce constraints to adjacent services while preserving the ability of the Cospas-Sarsat system to detect all kinds of emergency beacons and to maintain an acceptable rate of detection, which is vital to search and rescue missions;

5 to take all practical steps to limit the levels of unwanted emissions of stations operating within the 390-420 MHz frequency range in order not to cause harmful interference to mobile-satellite systems operating in the 406-406.1 MHz frequency band, such as authorizing new stations starting from channels that are further away from the 406-406.1 MHz frequency band;

~~4~~6 to work with the administrations participating ~~countries of the system~~ in the monitoring programme and ~~ITU~~ the Bureau to resolve reported cases of interference to the Cospas-Sarsat system~~;~~.

~~5 to participate actively in the studies by submitting contributions to ITU-R.~~

5/9.1.2 Resolution 756 (WRC-12)

Studies on possible reduction of the coordination arc and technical criteria used in application of No. ***9.41*** *in respect of coordination under No.* ***9.7***

(**WP 4A** (technical and regulatory aspects), **SC** (regulatory and procedural aspects) / -)

5/9.1.2/1 Executive summary

The use of orbit spectrum resources is increasing and the difficulties in getting access to spectrum for new satellite networks is increasing accordingly. For these reasons, improved ways to accommodate new networks and facilitating more efficient use of the spectrum resources are sought while at the same time ensuring adequate protection of existing networks operating in accordance with the Radio Regulations (RR).

WRC-12 decided to reduce the coordination arc in the 6/4 GHz and 14/10/11/12 GHz frequency ranges, but also decided to further study the issue in accordance with Resolution **756 (WRC-12)**. It calls for studies regarding additional reductions in the coordination arcs in RR Appendix **5 (Rev.WRC-12)**, as well as to examine the effectiveness and appropriateness of the current criterion ($\Delta T/T > 6\%$) used in the application of RR No. **9.41** and consider any other possible alternatives, in order to facilitate coordination between FSS networks. Ultimately, WRC-15 agenda item 9.1, issue 9.1.2 is aiming to eliminate cases of “unnecessary coordination”, limit the number of administrations/networks involved in the coordination process, and reduce administrative correspondence.

In response to Resolution **756 (WRC-12)**, options have been developed which include:

– reduction of the size of the coordination arc in selected frequency bands;

– replacement of the ΔT/T criterion used under RR No. **9.41** with a C/I criterion;

– replacement of the ΔT/T criterion used under RR No. **9.7** with a C/I criterion for frequency bands under item 9) of Table **5-1** of RR Appendix **5**;

– replacement of the C/I criterion used under RR No. **11.32A** with a pfd threshold in the 6/4 GHz and 14/10/11/12 GHz frequency ranges;

– increasing the level of permissible interference used in RR Nos. **9.41** and **11.32A** in selected frequency bands.

Various combinations of these options may be implemented and should be considered by WRC-15.

5/9.1.2/2 Background

The use of orbit spectrum resources is increasing and the difficulties in getting access to spectrum for new satellite networks is increasing accordingly. The situation is in particular severe in some frequency bands that are commonly used by many operational satellites, but there are also difficulties due to many submissions for satellite networks in other frequency bands.

The orbit spectrum resources are limited natural resources and, as such, they must be used rationally, efficiently and economically. For these reasons, improved ways to accommodate new satellite networks are sought while at the same time ensuring adequate protection of networks operating in accordance with the RR.

As part of the effort to improve the coordination process, WRC-12 decided to reduce the coordination arc in the 6/4 GHz, 14/10/11/12 GHz and 21.4-22 GHz frequency ranges. Furthermore, WRC-12 decided that these two issues would be further studied in preparation for WRC-15 and in its Resolution **756 (WRC-12)** *resolves to invite ITU-R*:

"1 to carry out studies to examine the effectiveness and appropriateness of the current criterion ($\Delta T/T$ > 6%) used in the application of No. **9.41** and consider any other possible alternatives (including the alternatives outlined in Annexes 1 and 2 to this Resolution), as appropriate, for the bands referred to in *recognizing e)*;

2 to study whether additional reductions in the coordination arcs in RR Appendix **5 (Rev.WRC-12)** are appropriate for the 6/4 GHz and 14/10/11/12 GHz frequency bands, and whether it is appropriate to reduce the coordination arc in the 30/20 GHz band,"

In addition to the studies specifically called for in *resolves to invite ITU-R* 1 and 2 of Resolution **756 (WRC-12)**, consideration should also be given to the need to keep the same criteria used in application of RR No. **9.41** and RR No. **9.7** for the frequency bands and services covered in item 9) of the frequency band column of Table 5-1 of RR Appendix **5** under provision RR No. **9.7**. Consideration should also be given to the impact of such an approach on RR Article **11** (e.g. RR No. **11.32A**)

5/9.1.2/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The relevant ITU-R Recommendations: ITU-R S.465, ITU-R S.466, ITU-R S.483, ITU-R S.523, ITU-R S.524, ITU-R S.580, ITU-R S.728, ITU-R S.735, ITU-R S.739, ITU-R S.740, ITU-R S.741, ITU-R S.1323, ITU-R S.1432, ITU-R BO.1213.

The relevant Reports: PDN Report ITU-R S.[RES756], Report ITU-R S.2280, CCIR Report 455-5[31].

It is noted that the issues to be considered under *resolves to invite ITU-R* 1 and 2 of Resolution **756 (WRC-12)** are principally different and for this reason, they are addressed separately.

However, the goal of both *resolves to invite ITU-R* 1 and 2 are similar, i.e. to reduce the number of cases of coordination that may be unnecessary in order to increase orbit use. In addition, it should be recognized that there is an interconnection between the issue of reducing the coordination arc and modifying the type and value of the coordination trigger, the level of interference, and therefore the implications of this interconnection should be considered while deciding on these issues. Table 5/9.1.2/3-1 provides an overview of the current coordination triggers and protection criteria used in the RR for the cases studied.

[31] Note that CCIR (Consultative Committee on International Radio) is the predecessor to the ITU-R. CCIR became known as ITU-R in 1992.

TABLE 5/9.1.2/3-1

Current coordination triggers and protection criteria used in the RR for GSO networks subject to coordination under RR No. 9.7

<table>
<tr><th></th><th colspan="3">Identification of affected administrations by the Bureau</th><th>Self-identification under RR No. 9.41</th><th>Probability of harmful interference under RR No. 11.32A</th></tr>
<tr><th></th><th>Coordination Arc Approach
(Studies under resolves 2 of Resolution 756 (WRC-12))</th><th>Pfd approach</th><th>ΔT/T Approach</th><th>ΔT/T Approach
(Studies under resolves 1 of Resolution 756 (WRC-12))</th><th>C/I approach
(Studies under resolves 1 of Resolution 756 (WRC-12))</th></tr>
<tr><td>6/4 GHz band</td><td>±8
FSS vs FSS</td><td rowspan="5">N/A</td><td rowspan="6">N/A</td><td rowspan="6">ΔT/T of 6%</td><td rowspan="8">C/I = C/N + 12.2 dB</td></tr>
<tr><td>14/10/11/12 GHz band</td><td>±7
FSS or BSS vs FSS or BSS</td></tr>
<tr><td rowspan="4">30/20 GHz band</td><td>±8
FSS vs FSS
As per items 3) & 7) under RR No. 9.7 in Table 5-1, Appendix 5</td></tr>
<tr><td>±8
FSS vs BSS vs FSS
As per items 4) & 5) under RR No. 9.7 in Table 5-1, Appendix 5</td></tr>
<tr><td>±8
FSS vs METSAT vs FSS
As per item 6) under RR No. 9.7 in Table 5-1, Appendix 5</td></tr>
<tr><td>±16
FSS or BSS vs FSS or BSS
As per item 8) under RR No. 9.7 in Table 5-1, Appendix 5</td><td>N/A</td></tr>
<tr><td></td><td>±12
BSS vs BSS
As per item 6bis) under RR No. 9.7 in Table 5-1, Appendix 5</td><td>Pfd mask
(Resolution 554 (WRC-12))</td><td></td><td rowspan="2">N/A</td></tr>
<tr><td></td><td>±9
BSS vs BSS
(see Resolution 553 (WRC-12))</td><td>Pfd mask
(Resolution 553 (WRC-12))</td><td></td></tr>
</table>

	Identification of affected administrations by the Bureau			Self-identification under RR No. 9.41	Probability of harmful interference under RR No. 11.32A
	Coordination Arc Approach *(Studies under resolves 2 of Resolution **756 (WRC-12)**)*	***Pfd approach***	***ΔT/T Approach***	***ΔT/T Approach*** *(Studies under resolves 1 of Resolution **756 (WRC-12)**)*	***C/I approach*** *(Studies under resolves 1 of Resolution **756 (WRC-12)**)*
Other bands (see item 9) of Table **5-1** of RR Appendix **5**)	N/A	N/A	ΔT/T of 6%		

Some effects of the above mechanisms to be noted are:

1) Unnecessary coordination may be required inside the arc when there is no probability of harmful interference (e.g. non-overlapping coverages).

2) Networks at great orbital separations can request to be included in the coordination process even though these networks will have had to accept much higher interference levels from more nearby networks.

3) Special sensitive characteristics (possibly unrealistic parameters) for submissions may cause additional coordination requirements for later submissions for far away networks and hinder coordination of these.

4) Unnecessary coordination requirements together with the requirement to submit the notification within 7 years after submission of the API, in particular when real satellite projects are involved, force administrations to use RR No. **11.41** in order to be able to initiate the notification process within the seven-year regulatory period.

In preparation for WRC-12, proposals were made wherein coordination requirements outside the coordination arc were based upon more precise assessment of the interference into a network. The criterion used to trigger coordination could be either in the form of a pfd criterion or a C/I criterion.

WRC-12 decided that these mechanisms should be further studied as potential replacement to the technical criterion (ΔT/T of 6%) used in the application of RR No. **9.41** (see Annexes 1 and 2 to Resolution **756 (WRC-12)**).

5/9.1.2/3.1 Technical and operational studies in respect of *resolves* 1

5/9.1.2/3.1.1 What interfering levels should be considered for coordination triggers/protection criteria

The objective is to discuss what could constitute appropriate interference levels used as coordination triggers and protection criteria and what would be the impact for practical satellite networks in the 6/4 GHz and 14/10/11/12 GHz frequency ranges (see PDN Report ITU-R S.[RES756]).

All current relevant ITU-R Recommendations, regardless of ΔT/T, I/N, I/(N+I) or C/I criterion being used, are based on one and the same interference level, equivalent to 6% of thermal noise increase for single entry interference and 20%–25% for aggregate interference from geostationary-satellite orbit (GSO) FSS networks. These values were adopted many years ago with satellites with very low power, earth station front-end receivers with very high noise temperature, using a small number of large earth station antennas and a small number of operating FSS and BSS networks with wide orbital separation. Under such conditions, link design was determined by C/N requirements. Allowable interference, which, due to the few satellites and large earth station antennas, at that time in practice was low, was set as a marginal degradation of the C/N.

Currently, the power resources of satellites have increased considerably. At the same time, earth station front-end receiver noise temperature is seen to have been reduced significantly. These factors have allowed use of large numbers of small earth station antennas. Moreover, the number of satellites and the spectrum occupation by communication satellites operating in the 6/4 and 10/11/12/14 GHz frequency ranges has drastically increased. As a result, link designs today are much more limited by adjacent satellite interference than before, in some cases to the extent that C/I becomes comparable to C/N. Furthermore, the transition from analogue to digital modulation has significantly changed the interference potential and the protection requirements for satellite networks.

There is an obvious difference between interference levels for triggering coordination, and levels of interference to be accepted in practical coordination. Nevertheless, in a situation with a large number of satellite networks sharing the orbit spectrum resources, significantly higher levels of interference are seen to be accepted in practical coordination; both by the incumbent and the incoming networks.

A study[32] was performed in order to assess the appropriateness of the current 6% $\Delta T/T$ criterion in an operational environment consisting of practical co-frequency, co-coverage and co-polarized satellites typically spaced about 2 to 3 degrees apart along the GSO arc in the C and Ku bands. This study demonstrates that in such an operational environment, the calculated interference level from adjacent satellite networks will correspond to an increase of the system noise temperature by much more than 6%. In fact the study shows that the calculated interference will indeed correspond to a minimum increase of the $\Delta T/T$ in the order of 20% in C band and 40% in Ku band.

Studies[33] have also shown that increasing $\Delta T/T$ from the current 6% to 12, 20 and 50% allows the angular separation between adjacent FSS satellites to be decreased by a factor of 1.3, 1.6 and 2.3 respectively. This makes it possible to accommodate additional FSS networks in the GSO and to facilitate coordination of new networks.

A consequence of increasing the interference level is that each network would lose energy margin equal to 0.66, 1.42 and 3.45 dB respectively (for links with initial ratio C/(N+I) = 10.5 dB, see Figure 5/9.1.2/3-1) or capacity of each network would decrease by 5.5%, 12% and 28% respectively. Using modern engineering techniques, energy margin losses up to 1.5-2 dB may be compensated for most of networks without capacity losses.

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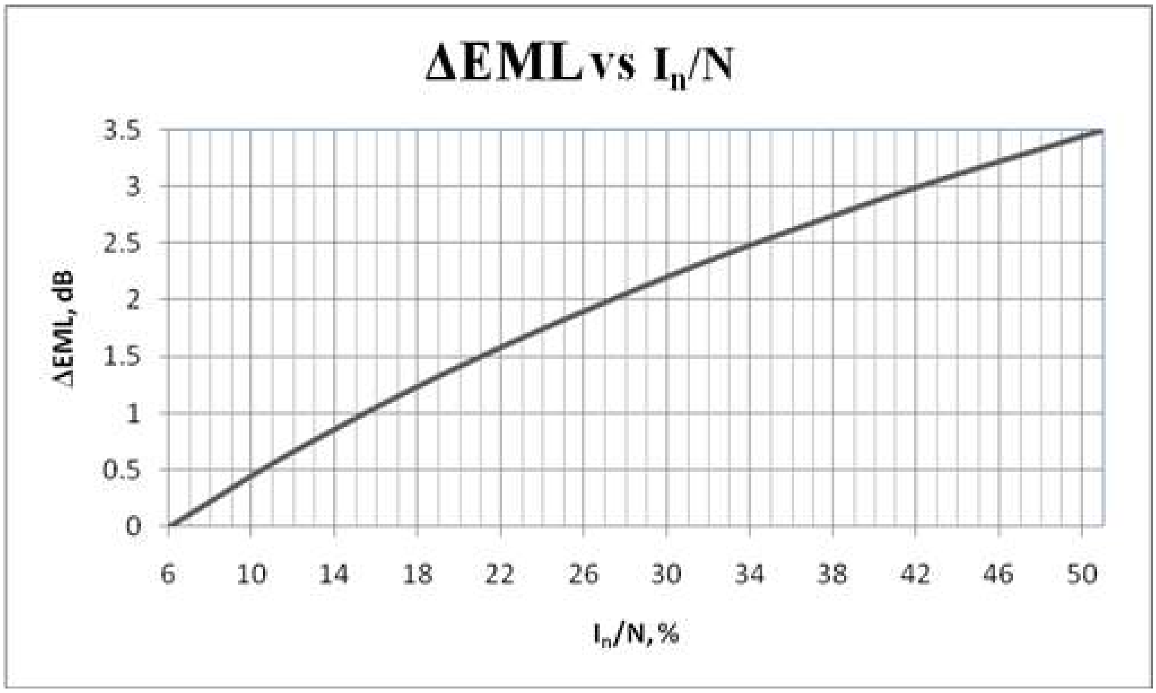
[32] See PDN Report ITU-R S.[RES756].

[33] See PDN Report ITU-R S.[RES756].

FIGURE 5/9.1.2/3-1



Another study[34] was conducted to gain an understanding of the relationship between the current single-entry and aggregate interference criteria for the case of homogeneous occupancy of the GSO with equal power satellites spaced uniformly every 2-3° and the aggregate interference from neighbouring satellites limited to 20 or 25% ΔT/T. The results of this study suggest that, under the given assumptions, the ratio between single-entry and aggregate interference could be increased by a factor of about 1.6. However, it was recognized that practical cases can differ from the assumed case.

In preparation for WRC-12, prospective pfd downlink masks and uplink levels to be used in respect of protection of unplanned FSS in the 4/6 and 10/11/12/14 GHz ranges were studied. The pfd masks/levels were generated to provide a protection equivalent to that afforded by a ΔT/T of 6% to a range of key technical parameters. By doing so, protection is afforded to a specified level of interference, determined from a defined range of key parameters, which is independent of specific parameters of individual submissions. As a result, combinations of parameters in submissions which today would be more sensitive to interference from new networks would no longer retain such protection.

For other levels of permissible interference, the pfd masks/levels would need to be adjusted accordingly by a factor 10log(X%/6%) dB. In considering replacement of some of the current protection criteria by pfd masks/levels, consideration also needs to be given as to if these should be in the form of hard or soft limits.

5/9.1.2/3.1.2 The nature of different types of coordination triggers / protection criteria

In addition to the coordination arc, mainly three different types of coordination triggers or protection criteria are used in the RR; ΔT/T, C/I and pfd. Table 5/9.1.2/3-1 provides examples of the current application of these criteria in the RR.

34 See PDN Report ITU-R S.[RES756].

ΔT/T

This is the traditional coordination trigger used for the unplanned frequency bands. Although used to trigger coordination, ΔT/T considerations are not commonly used in practical frequency coordination. This criterion has the same value for links with different carrier-to-noise ratios and different parameters, such as antenna size, pfd, etc. and does not contain any assessment of whether or not the parameters or the combinations of these represent realistic link designs. Furthermore, the ΔT/T method does not encourage use of homogeneous parameters to foster efficient spectrum usage and facilitating access for new satellite networks.

C/I

C/I, or variants of C/I, are used in the frequency bands contained in RR Appendices **30**, **30A** and **30B** as well as in the Bureau's examination under RR No. **11.32A**. C/I or C/(N+I) are also commonly used in practical frequency coordination between satellite networks. Depending on its implementation, C/I criteria may or may not encourage use of homogeneous parameters. If C/I criteria are used without any limitations on the technical parameters, either allowed in a filing or used in conducting the C/I analyses, the C/I criteria, just like ΔT/T, will provide no encouragement to use homogeneous parameters and can also lead to artificially high protection of some links.

If such limits are included, these will limit such adverse effects. Introducing a limit on the range of technical parameters that are allowed to be contained in a filing is something that is currently not used for satellite networks in the RR and may be seen as refusing administrations to submit filings describing the parameters of their planned satellite networks. Moreover, *C/I* criteria might have difficulties capturing submissions for satellite networks that can operate within a regular interference environment, but with very different technical characteristics (e.g. spread spectrum networks).

C/I or *ΔT/T* criteria will give similar permissible interference value irrespective of *C/N* ratio value. However, in case of partial overlap of the interfering and the wanted signal frequency bandwidths, since it takes into account the actual frequency and bandwidth of the wanted and the interfering signals as well as an apportionment of excess margin[35] to the adjacent satellite interference[36], the number of affected satellite networks will be reduced when using the *C/I* approach compared to the results obtained using the *ΔT/T* approach (see Recommendation ITU-R S.741, Rules of Procedure (RoP), Section B3).

Application of *C/I* together with a limitation on the range of technical parameters allowed in submissions or used in the examination by the Bureau would facilitate the:

– elimination of cases of "unnecessary coordination";

– reduction of the networks/administrations involved in the coordination process;

– reduction of administrative correspondence.

Use of the *C/I* criterion at application of the provisions of RR Articles **9** and **11** would lead to uniformity at these two stages of filing examination:

– justifying the inclusion of additional affected administration/network outside the coordination arc in case of application RR No. **9.41**;

[35] The margin between the minimum C/(N+I) calculated from RR Appendix **4** data and the C/N objective (RR Appendix **4**, Annex 2, item C.8.e.1) should be a positive value (equal to or more than 0 dB). In this document, this margin is referred to as the "excess margin".

[36] See PDN Report ITU-R S.[RES756].

– in the coordination process; and

– in application RR No. **11.32A**.

Pfd masks/levels

To provide a criteria that is easy to apply and at the same time provides an adequate protection for a representative range of technical parameters, i.e. encouraging use of homogeneous parameter which facilitate efficient use of orbit spectrum resources, pfd downlink masks and uplink levels were introduced by WRC-2000 when revising RR Appendices **30** and **30A** and by WRC-12 when revising the coordination procedures for the 21.4-22 GHz unplanned BSS frequency band.

Pfd masks and levels define an interference environment that satellite networks need to adapt to and wherein satellite networks can be introduced in a flexible manner without the need for strict limits on particular technical parameters. The pfd masks and levels are determined based upon a range of key technical parameters. Networks with parameters which would lead to higher interference sensitivity using the current criteria which are based upon the parameters contained in the submissions for individual satellite networks will not enjoy a higher degree of protection against interference than other networks. On the other hand, networks with parameters resulting in lower sensitivity to interference than that resulting from the range used to determine the pfd mask will be more protected using the pfd mask than using the current criteria. It should also be noted that application of the pfd mask-based method does not exclude specific calculations in respect to the affected networks during the coordination process.

Introducing the pfd mask method would encourage administrations to ensure that the sensitivity to interference of networks, requested for coordination, should not exceed the sensitivity of the reference network to avoid interference from networks submitted later which will also be examined under the pfd mask method. The pfd mask method thus facilitates gradual standardization of FSS network parameters with regard to its interference sensitivity, i.e. homogeneity of these networks. In certain cases, application of the pfd mask method may also make it possible to avoid the coordination with satellite networks which are located inside the coordination arc, but where the mask is satisfied due to sufficient separation between networks service areas.

The downlink pfd mask is the value of permissible pfd at the Earth's surface, depending on the angular separation between satellites of two networks. The pfd values are derived from:

– interference threshold level (e.g. equivalent to a given $\Delta T/T$ value);

– the system noise temperature of the receiving earth station;

– the range of antenna sizes to be taken into account;

– the off-axis reference antenna diagram.

Similarly, the maximum uplink pfd produced at the GSO at the location of the interfered with satellite is derived from:

– interference threshold level (e.g. equivalent to a given $\Delta T/T$ value);

– the range of the G/T of the receiving space station.

The maximum value within the range of reasonable G/T values to be taken into account will determine the uplink pfd level. For satellite networks with national coverage, higher levels of protection from uplinks towards other satellites can be provided by that administration as a part of their national legislation through the licensing of uplink earth stations by requiring lower off-axis e.i.r.p.'s towards that satellite network from earth stations located in that country.

It should be borne in mind that the pfd criterion is considered for introduction in congested frequency bands where satellites already today are operating co-frequency, co-coverage, co-polarized with 2-3° orbital separation and where practical satellites out of necessity have been required to adapt to a certain interference environment. If different applications and satellite networks have very different characteristics, efficient spectrum usage is infeasible. If the pfd values aim at encompassing the entire range in such cases, including even the submissions for the most sensitive satellite networks, they could become overprotective, not serving the purpose of facilitating access for new satellite networks.

5/9.1.2/3.1.3 Representative range of technical parameters

It is seen that submissions for satellite networks often contain a wide range of technical parameters. Some of the combinations of these parameters may lead to unrealistic links that are either very sensitive to interference (i.e. trigger coordination very easily) or create unrealistic high levels of interference.

The latter case is addressed by requiring coordination when exceeding certain limits. Since protection is based upon single entry criteria, this has no implications in respect of later submissions.

However, very sensitive links will not require any additional coordination, yet they have the capability of requiring unreasonable coordination from later incoming submissions, thus unreasonably blocking access to orbit spectrum resources for newcomers[37]. To avoid this, the coordination requirements of new submissions would need to be determined on what is deemed a reasonable range of technical parameters, either through defining pfd masks based upon a standardized range of parameters or through C/I assessments using a standardized range of parameters. But the use of homogeneous (with standard range of parameters) networks will limit design flexibility and creation of non-standard networks by administrations.

An important part of this is that a reasonable range of technical parameters shall be given an adequate protection. However, and this is also a part of the aim, some submissions may still contain link combinations outside this range, but these should not lead to unreasonable levels of protection and hindrance of coordination of new satellite networks.

On the other hand, existing (and brought into use) networks with technical parameters outside "a reasonable range of technical parameters", which may occur to be more sensitive to interference, shall also have a right for protection. This may require to create a special set of technical parameters for such networks.

For the development of pfd masks and levels, it is seen that in particular uplink G/T and downlink system noise temperature, range of antenna sizes and off-axis antenna pattern are the important technical parameters to define (see PDN Report ITU-R S.[RES756]).

5/9.1.2/3.1.4 Use of provision RR No. 9.41

Statistics on the use of RR No. 9.41

Statistics of ITU-R[38] have observed a steady increase of the use of RR No. **9.41** and show that after WRC-12 reduced the coordination arc in the 6/4 and 14/10/11/12 GHz frequency ranges and made

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[37] A study by the Bureau (see PDN Report ITU-R S.[RES756]) showed that because of too wide range of characteristics of assignments submitted by administrations and recorded in the MIFR, the identification of the affected administration and networks, even using C/I criterion, leads to extreme coordination requirements with the identified networks located at very large orbital separation. These studies also showed that without addressing the range of representative technical parameters, a change from $\Delta T/T$ to C/I would not significantly reduce the coordination requirements.

[38] See PDN Report ITU-R S.[RES756] for further statistics.

the list of networks under RR No. **9.36.2** definitive, the average number of networks requested for inclusion under RR No. **9.41** per CR/C had increased from 20 to 34. Furthermore, while previously about 1/5 of the submissions did not receive comments in respect of RR No. **9.41**, after the changes by WRC-12 practically all networks now receive such comments. It is important to note that in practice, the number of satellite networks that are used by administrations to self-identify under RR No. **9.41** is less than the number of satellite networks eligible to this provision. Furthermore, the satellite network for which a request under RR No. **9.41** is submitted to the Bureau may sometimes already have been identified by the Bureau.

Implications on the use of RR No. 9.41 by changes to the criteria and the value

Two studies[39] have shown that an increase in the value of the technical criterion used in application of RR No. **9.41** could reduce the number of potentially affected networks outside the coordination arc (i.e. networks which may be included into the list of affected networks under RR No. **9.41**). Increasing the value of the technical criterion used in the application of RR No. **9.41** might also increase the number of networks inside the coordinated arc subject to possible exclusion from the list by a notifying administration, and thereby would reduce the total number of affected networks.

The issues identified above should also be considered when determining the value of the coordination arc in frequency bands allocated to the FSS.

5/9.1.2/3.1.5 Impact on the workload of the Bureau

Since the decisions of WRC-12, where the list of identified affected networks under RR No. **9.36.2** became definitive and the coordination arc was reduced in the 6/4 GHz and 14/10/11/12 GHz frequency ranges, the Bureau, as shown in the previous section, has been observing a steady increase in the number of requests submitted under RR No. **9.41** per coordination request (CR/C).

The percentage of the CR/Cs for which RR No. **9.41** comments are received has increased from 80% for the CR/Cs received between 1.09.2010 and 1.01.2013 to almost 100% for CR/Cs received after 1.01.2013.

The Bureau has not received so far any RR No. **9.41** requests for exclusion. However, with the introduction of other criteria, e.g. C/I, the situation may change if administrations would choose to exclude the networks identified under coordination arc at the coordination stage. However, it could be expected that administrations would rather do it at the notification stage through the application of RR No. **11.32A**, since the examination under RR No. **11.32A** would also be favourable in the case coordination is not completed. In this case the change may not be significant and as a result, there may be little need for administrations to request exclusion under RR No. **9.41** and the impact on the workload of the Bureau may not be significant.

5/9.1.2/3.2 Technical and operational studies in respect of *resolves* 2

In preparation for WRC-12, the CPM report for “issue 2A” under agenda item 7 was only addressing the value of the coordination arc to trigger coordination in the 6/4 and 14/10/11/12GHz frequency ranges. With Resolution **756 (WRC-12)**, WRC-12 resolves to invite ITU-R to study whether additional reductions in the coordination arcs in RR Appendix **5 (Rev.WRC-12)** are appropriate for the 6/4 GHz and 14/10/11/12 GHz frequency ranges and whether it is appropriate to reduce the coordination arc in the 30/20 GHz frequency range.

In association with the studies conducted under *resolves* 2 the following view was expressed. The reduction of the coordination arc alone as a means to address the difficulty of coordination is not a

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[39] See PDN Report ITU-R S.[RES756].

sufficient solution for the current coordination procedures. It is a temporary and partial solution and only will be beneficial to some Member States including big satellite operators, while the Member States in the developing countries and small satellite operators will not get the benefit from that action. On the contrary, reduction of the coordination arc alone would increase the burden on administrations to self-identify under RR No. **9.41**. Taking into account that there is no consensus on the applicability of ΔT/T or C/I or pfd at the stage of RR Articles **9** and **11** to the cases outside the coordination arc, the results become more difficult to manage. Reduction of the coordination arc should be considered together with reviewing other coordination provisions, for example reviewing provision RR No. **9.41**.

Under this view it was emphasized that the issue of reduction of coordination arc was discussed at the last three WRCs. A piecemeal and temporary approach was taken and the issue sent back to the ITU-R Study Groups for further study, which took considerable time and effort of membership in particular of developing countries, some of which did not have sufficient manpower and resources to attend these meetings and to examine the text produced. Consequently, WRC-15 is invited to seriously consider the matter and decide upon the issue definitively in an appropriate, logical, manageable, and practical manner.

The following view was also expressed. While the reduction of the coordination arc alone will not resolve all the difficulties of coordination, it should be considered as part of a series of improvements to the satellite coordination procedures, that are considered under both WRC-15 agenda items 7 and 9.1, issue 9.1.2. There is no reason to prevent the consideration of this issue just because all the other issues under WRC-15 agenda items 7 and 9.1, issue 9.1.2 are not yet resolved. The reduction of the coordination arc is especially aiming at decreasing the amount of coordination requirements, some of which may be triggered even in some cases where the technical and operational environment shows that they may be unnecessary. As this issue is included in the WRC-15 agenda, the Conference will consider the matter and decide upon the issue.

5/9.1.2/3.2.1 Studies on the reduction of coordination arc

Table 5/9.1.2/3-1 provides an overview of the current coordination arcs used in application of RR No. **9.7**.

One study[40] in ITU-R demonstrated that a reduction of 2º in the coordination arc sizes would reduce the number of satellite networks identified for the 6/4 GHz, 14/10/11/12 GHz and 30/20 GHz frequency ranges by 27%, 50% and 19%, respectively. Furthermore, to evaluate the technical impact of a potential reduction of coordination arc values, a study was conducted to determine the minimum orbital separation between neighbouring satellite networks. The results of the study indicate that reducing the coordination arc values in the 6/4 GHz, 14/10/11/12 GHz and 30/20 GHz frequency ranges to 6º, 5º and 4º, respectively, would afford protection to existing satellite networks in at least 80% of all cases.

In a second study[41], an analysis was done comparing the actual 30/20 GHz satellites in operation with the number of 30/20 GHz networks filed at the ITU. It was noted that, while the data from the ITU-R website indicates an enhanced interest in the use of these frequency bands, publically available data indicates that the current deployment of satellites in these frequency bands is not uniformly dense throughout the orbit. This suggests that the 8 degrees coordination trigger is still appropriate. Thus, it does not seem appropriate from an evaluation of the current operational

[40] See PDN Report ITU-R S.[RES756].

[41] See PDN Report ITU-R S.[RES756].

situation to reduce the coordination arc in the 29.5-30.0 GHz / 19.7-20.2 GHz frequency bands from its current value as contained in RR Appendix **5**.

It is worth mentioning that a conclusion on a decision to reduce the coordination arc in the Ka-band should not be merely based on the operational networks but also on the results of studies of representative technical elements of Ka-band satellite networks. Further, the smaller number of satellite networks brought into use in the frequency range 30/20 GHz is not the only element to be considered in the establishment of the coordination requirements.

5/9.1.2/3.2.2 Potential impacts of the reduction of the coordination arc on the use of RR No. 9.41

Under *resolves* 2 of Resolution **756 (WRC-12)**, consideration has been given to a further reduction of the coordination arc values in the 6/4 GHz and the 14/10/11/12 GHz frequency ranges and whether it is appropriate to reduce the coordination arc value in the 30/20 GHz frequency range. Any reduction of the coordination arc may have an impact on the use of RR No. **9.41** which is being considered under *resolves* 1 of Resolution **756 (WRC-12)**. By reducing the coordination arc value, the number of satellite networks inside the arc which would be identified as potentially affected by a proposed incoming network would decrease. This reduction of the number of satellite networks identified by the Bureau through the application of the coordination arc approach could lead to an increase of the use of RR No. **9.41** by administrations willing to self-identify or to have some of their satellite networks not identified by the Bureau included in the list of satellite networks to be considered when effecting coordination. However, in practice, it is expected that the number of satellite networks that are actually used by an administration to self-identify under RR No. **9.41** will be less than the number of satellite networks that are eligible to be used to self-identify under this provision. This can be explained by the fact that several administrations did choose to rely strictly on the coordination arc approach for the identification of the coordination requirements.

Two studies[42] have shown that an increase in the value of the technical criterion used in application of RR No. **9.41** could reduce the number of potentially affected networks inside the coordination arc (i.e. networks identified by the Bureau as affected for which the $\Delta T/T$ criterion is not exceeded could be excluded of the coordination process upon request by the notifying administration under RR No. **9.41**) or outside the coordination arc (i.e. networks which may be included into the list of affected network under RR No. **9.41**). In one of these studies, an assessment of the impact of the reduction of the coordination arc versus an increase of the $\Delta T/T$ criterion has been provided. The result of this assessment suggests that in practice, a reduction of the coordination arc would have a greater impact in reducing the number of satellite network to be considered when effecting coordination under RR No. **9.7** than an increase of the $\Delta T/T$ criterion used in application of RR No. **9.41**.

The reduction of the coordination arc would increase the burden on administrations to self-identify under RR No. **9.41** their affected satellite networks not within the coordination arc, if any. In particular, the non-submission of the appropriate comments within the four month period of the date of publication of the coordination request may leave these networks unprotected. However, in practice, the protection of any satellite networks of an administration outside the coordination arc may be achieved by the successful coordination of those within the coordination arc. Furthermore, although the use of RR No. **9.41** involves the submission of specific information (see the Rule of Procedure (RoP) on RR No. **9.41**) and as such additional efforts from administrations, it is worth mentioning that, at least for the current technical criterion used in application of this provision, the Bureau provides software (The Tab named “Appendix 8” of GIBC software) that allows

[42] See PDN Report ITU-R S.[RES756].

administrations to identify satellite networks that are eligible for the application of RR No. **9.41** as well as some sample calculations. This information can be found in proper folder in two different files named “NTW_OPT.LST” and “APP8_OPT.LST”, respectively.

5/9.1.2/4 Regulatory and procedural considerations

Concerns were expressed that the variety of coordination triggers and criteria being considered, different assumptions and including some arbitrary selected values would add more complexity, in some cases if not all, to the already existing complex procedures in application of RR Articles **9** and **11**. This could adversely affect the rights of some administrations in particular those of developing countries. Moreover, the workload of administrations could be increased as a result of application of selected options referred to in this document. The Bureau’s workload in terms of application of new procedures and development of associated software would certainly be increased. Backlog in processing of submitted networks, which no longer exists, may reappear as a result of application of new procedures.

5/9.1.2/4.1 Transitional measures

Satellite networks to which the new rules/criteria apply should be studied. In other words, the possibility of prescribing the new rules/criteria in RR Articles **9**, **11**, and/or **14** respectively should be studied.

It should be noted that, while the number of satellite networks with which newly filed networks need to seek coordination would be reduced, the number of satellite networks with which previously filed networks need to seek coordination under the current rules/criteria would not be changed if the scope of the new rules/criteria is limited to newly examined networks. Furthermore, as for the existing (affected) satellite network, it would be forced to accept the interference from newly filed network while it might still need to coordinate with previously filed networks with date precedence.

Therefore, transition regulations will need to be carefully considered in order to protect existing networks from additional unplanned interference from new networks that use different criteria to establish coordination requirements. Given that decisions of the WRC would not be applicable retroactively, one possible option would be to apply the new regulatory arrangements in this regard to satellite networks the request for coordination of which are received by the Bureau after the date of application of these new procedures. With respect to the satellite networks the request for coordination of which are received by the Bureau before that date, the regulatory regime in force before that date shall continue to apply. In addition, the current RR provide some flexibility in the reporting of C/N, and some networks may have not provided this figure. Furthermore, the current instruction is to report the greater of either the carrier-to-noise ratio required to meet the performance of the link under clear-sky conditions or the carrier-to-noise ratio required to meet the short-time objectives of the link inclusive of necessary margins. However, if the coordination trigger level is changed, and if the coordination criterion becomes C/I, the required C/N provided for existing networks may no longer be correct. Thus, if a C/I criterion is adopted that is based on C/N, and if the coordination trigger value is changed from 6% $\Delta T/T$, existing networks should be given the opportunity to revise their currently published C/N, without penalty, in order ensure adequate protection from new networks.

5/9.1.2/4.2 Consistency between RR Articles 9 and 11

Consideration should be given to if it is necessary or desirable to use the same criteria in RR Articles **9** and **11** when both of them are modified with new conditions.

On one hand, it could seem to be a good idea to align the clauses with each other to avoid the waste of time and energy. Moreover, using a single criterion with respect to RR Articles **9** and **11** could provide a more precise criterion in different coordination stages and that may reduce undue protection requirements and shorten the list of affected networks determined in application of RR No. **9.41** and RR No. **9.7** in cases when the coordination arc criterion is not applicable.

However, it is worth noting that the time to be spent on the examination with respect to RR Article **9** should generally be limited due to the large number of submissions and that the number of applications of RR No. **11.32A** would be less than those of RR Article **9** because a certain number of networks coordination would be complete or they do not reach the stage of RR Article **11**. In both cases, the application of RR No. **11.32A** would not be necessary.

Therefore, it could be considered reasonable to apply more protective but simpler and easier procedures to RR Article **9** compared with RR Article **11**. Furthermore, it should be noted that, since WRC-12 decided to reduce the coordination arc by 2 degrees in the 6/4 GHz and 14/10/11/12 GHz frequency ranges, comments under RR No. **9.41** have gotten more important and that the Bureau would subsequently study the comments and publish a definitive list of administrations and corresponding satellite networks with which coordination would be required.

With software tools used by the Bureau for all considered criteria, use of different criteria at different stages of the coordination process would seem not to pose any practical problems.

5/9.1.2/4.3 Examples of regulatory solutions

The specific values included in each of the options below were those used during the development of each option. Other specific values could be used for any of these options.

5/9.1.2/4.3.1 Regulatory and procedural considerations in respect of *resolves* 1

5/9.1.2/4.3.1.1 Option 1A

This option would involve retention of RR Nos. **9.7**, **9.41** and **11.32A** essentially as today. However, the technical criteria associated with the various provisions would be modified as follows:

– For the identification of coordination requirements by the Bureau under RR No. **9.7**, the use of the coordination arc and other criteria as contained in RR Appendix **5** would be retained.

– For inclusion/exclusion in the coordination under RR No. **9.41**, the current $\Delta T/T > 6\%$ criterion would be replaced by a $C/I < C/N+X$ dB criterion. This criterion would be used for the FSS in all frequency bands. In the 6/4 and 10/11/12/14 GHz frequency ranges, X = 7.0[43] dB (corresponding to $\Delta T/T = 20\%$[44]). In all other frequency bands X = 12.2 dB (corresponding to an interference level equivalent to $\Delta T/T = 6\%$).

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[43] The numerical values for identification under RR No. **9.41** and assessment of the probability of harmful interference under RR No. **11.32A** in this option are based upon an interference level to trigger coordination equivalent to $\Delta T/T = 20\%$ for the 6/4 GHz and 10/11/12/14 GHz frequency ranges. If different levels of interference are determined as the triggering level, these levels should be adjusted as follows:

$$\text{New value } (\Delta T/T = Y\%) = \text{Above value } (\Delta T/T = 20\%) + 10\cdot\log(Y/20)$$

[44] Consequential aggregate effect of this increase in single-entry interference criterion has not yet been fully evaluated.

– Examination of probability of harmful interference under RR No. **11.32A** would generally be based upon the same C/I criterion as that used under RR No. **9.41**, but would be transferred from the RoP to the RR. However, in the 6/4 GHz and 10/11/12/14 GHz frequency ranges, downlink pfd masks and uplink pfd levels would be used instead. These pfd masks/levels would be based upon providing permissible interference levels equivalent to $\Delta T/T = 20\%$. The application of RR No. **9.41** will not preclude the successful notification of frequency assignments which satisfy the pfd thresholds.

The pfd thresholds considered under this option require a certain level of homogeneity over the applications. If there are a large number of satellites operating close to each other, networks tend to adapt comparable technical parameters. Also, if the frequency band has been in use for a long period, applications and usage tend to become harmonized and technical characteristics such as TVRO antenna sizes and VSAT characteristics tend to stabilize and align with harmonized use.

The 6/4 GHz and 14/10/11/12 GHz frequency ranges have been in widespread use globally for several decades and there are a very large number of operational satellites in these frequency bands typically spaced about 2-3 degrees along the GSO arc. These frequency bands therefore are considered well suited for the introduction of pfd thresholds.

The 30/20 GHz frequency range already sees a large number of submissions for satellite networks. However, in terms of practical networks in regular operation, the number is still relatively small. Moreover, the technical characteristics seen used in practical implementation varies from network to network. For these reasons, it seems that for the time being it might be best to limit the introduction of pfd thresholds under RR No. **11.32A** to just the 6/4 GHz and 10/11/12/14 GHz frequency ranges.

Table 5/9.1.2/4-1 summarizes the changes introduced by this option compared to the current procedures.

TABLE 5/9.1.2/4-1

		Coordination stage		Application of RR No. **11.32A** at notification stage
		First step: Bureau identification of potentially affected administrations	Second step: possible application of RR No. **9.41**	
Current	Type of criterion	Coordination arc	ΔT/T	C/I
	Criterion value	±8° in C band, ±7° in Ku-band, ±8° in Ka-band and above	ΔT/T > 6%	Part B, Section B3 of the RoP
Possible new criteria	Type of criterion	Coordination arc	C/I	C/I + pfd levels (Note 1)
	Criterion value	TBD (see section 5/9.1.2/4.2 above)	C/I < C/N(Note 2)+X(Note 3) dB	C/I or pfd masks/limits (Note 4)

Notes:

1 For all frequency bands except the 6/4 GHz and 10/11/12/14 GHz frequency ranges: C/I for the 6/4 GHz and 10/11/12/14 GHz frequency ranges: Downlink pfd mask, uplink pfd level.

2 C/N should be calculated in accordance with the RoP Section B3.

3 X = 12.2 dB (corresponding to an interference level equivalent to ΔT/T = 6%) for frequency bands in items 3), 4), 5), 6), 7) and 8) in Table 5-1 of RR Appendix **5**.

X = 7.0* dB (corresponding to an interference level equivalent to ΔT/T = 20%) for the 6/4 and 10/11/12/14 GHz frequency ranges.

4 For frequency bands in item 3), 4), 5), 6), 7) and 8) in Table 5-1 of RR Appendix **5**: C/I criterion and calculations as proposed under RR No. **9.41** (see footnotes 15 and 16).

For the 6/4 GHz and 10/11/12/14 GHz frequency bands*

Uplink pfd level	6 GHz	14 GHz	
pfd level (dBW/m^2 · Hz)	−198.8**	−202.8**	(dBW/m^2 · Hz)

Downlink pfd masks

Downlink pfd mask at 4 GHz						
		θ	≤	0.09	−238.3**	(dBW/m^2 · Hz)
0.09	<	θ	≤	3	−238.3** + 20log(θ/0.09)	(dBW/m^2 · Hz)
3	<	θ	≤	5.5	−214.6** + 0.75·θ^2	(dBW/m^2 · Hz)
5.5	<	θ	≤	20.9	−191.6** + 25log(θ/5.6)	(dBW/m^2 · Hz)
20.9	<	θ			−177.3**	(dBW/m^2 · Hz)
Downlink pfd mask at 10/11/12 GHz						
		θ	≤	0.05	−232.8**	(dBW/m^2 · Hz)
0.05	<	θ	≤	3	−232.8** + 20log(θ/0.05)	(dBW/m^2 · Hz)
3	<	θ	≤	5	−204.8** + 0.95·θ2	(dBW/m^2 · Hz)
5	<	θ	≤	20.9	−181.9** + 25log(θ/5)	(dBW/m^2 · Hz)
20.9	<	θ			−166.6**	(dBW/m^2 · Hz)

where θ denotes nominal geocentric separation (degrees) between interfering and interfered with satellite networks.

*The table below provides values of the parameters to determine the up- and downlink pfd thresholds under this option.

Downlink	**4 GHz**	**12 GHz**
Earth station antenna diameter	1.2-18 m	0.45-11 m
Earth station antenna diagram	Main lobe: According to Appendix 8, Section III Sidelobes: 29-25logθ dBi (Recommendation ITU-R BO.1213, which implements these main and sidelobe characteristics, was used for the calculations)	
Earth station noise temperature	95 K	125 K
Earth station antenna efficiency	70%	70%
Equivalent $\Delta T/T$	20%	20%
Uplink	**6 GHz**	**14 GHz**
Maximum satellite G/T	0 dB/K	11 dB/K
Equivalent $\Delta T/T$	20%	20%

NOTE: Based on the assumptions to derive the pfd thresholds, other values could be considered and other options developed.

**NOTE: These numerical values are based upon an interference level to trigger coordination equivalent to $\Delta T/T$ = 20% for the 6/4 GHz and 10/11/12/14 GHz frequency ranges. If different levels of interference are determined as the triggering level, these levels should be adjusted as follows:

$$\text{New value } (\Delta T/T = Y\%) = \text{Above value } (\Delta T/T = 20\%) + 10\cdot\log(Y/20)$$

NOTE: FSS and BSS networks are also subject to other relevant limits of the RR, including RR Nos. **21.16** and **21.17**.

EXAMPLE OF REGULATORY TEXT IN RESPECT OF OPTION 1A

NOC

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6, 7, 8, 8*bis*] (WRC-12)

Reasons: No changes to the provisions of RR Article **9** in respect of Option 1A.

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7*bis*] (WRC-12)

Section II − Examination of notices and recording of frequency assignments in the Master Register

MOD

11.32A *c)* with respect to the probability of harmful interference that may be caused to or by assignments recorded with a favourable finding under Nos. **11.36** and **11.37** or **11.38**, or recorded in application of No. **11.41**, or published under Nos. **9.38** or **9.58** but not yet notified, as appropriate, for those cases for which the notifying administration states that the procedure for coordination under Nos. **9.7**, **9.7A**, **9.7B**, **9.11**, **9.12**, **9.12A**, **9.13** or **9.14**, could not be successfully completed (see also No. **9.65**); [14, 14*bis*] or (WRC-2000)

NOC

---

[14] **11.32A.1**

ADD

[14*bis*] **11.32A.2** The calculation method to determine the probability of harmful interference and the criteria for the formulation of the findings of the Bureau for the coordination under No. **9.7** are contained in Appendix **8** or Resolution **[A912] (WRC-15)**, as appropriate. (WRC-15)

APPENDIX 5 (REV.WRC-12)

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-~~12~~15)

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 13.75-14.5 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 ±8° 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 ±7° of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan		With respect to the space services listed in the threshold/condition column in the bands in 1), 2), 3), 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 ~~ΔT/T~~C/I calculated by the method in § [XXX] ~~2.2.1.2 and 3.2~~ of Appendix **8** ~~exceeds 6%~~ is lower than the appropriate criterion (C/I < C/N+X dB, where X = 7 dB for bands listed in 1) and 2) and 12.2 dB for bands listed in 3), 4), 5), 6), 7) and 8)). When the Bureau, on request by an affected administration, studies this information pursuant to No. **9.42**, the calculation method given in § [XXX] ~~2.2.1.2 and 3.2~~ of Appendix **8** shall be used.

NOTE: Depending upon decisions of WRC-15 in respect of *resolves* 2 of Resolution **756 (WRC-12)**, the numerical values for the size of the coordination arc in one or more of the listed frequency bands of Table 5-1 may change. This option is neutral in respect of the size of the coordination arc and decisions on the size of the coordination arc will not lead to a need for consequential changes in respect of this option or vice-versa.

APPENDIX 8 (REV.WRC-03)

Method of calculation for determining if coordination is required between geostationary-satellite networks sharing the same frequency bands

ADD

[XXX] Calculation methodology for calculating *C*/*I* ratios in respect of probability of harmful interference between space networks

Note: The regulatory text of this new section is intended to be extracted from the RoP for Section B3.

ADD

RESOLUTION [A912] (WRC-15)

Application of pfd criteria to assess the potential for harmful interference under No. 11.32A for fixed-satellite and broadcasting-satellite service networks in the 4/6 GHz and 10/11/12/14 GHz bands not subject to a Plan

The World Radiocommunication Conference (Geneva, 2015),

considering

a) that the 4/6 GHz and 10/11/12/14 GHz frequency ranges, not subject to a Plan, are extensively used with operational satellites about every 2-3° around the geostationary arc;

b) that there currently are a very large number of satellite networks submitted to ITU-R for these frequency bands;

c) that these above factors have led to significant difficulties for administrations to introduce new satellite networks;

d) that more precise criteria to assess the probability of harmful interference under No. **11.32A** have the potential to reduce undue protection requirements for assignments in respect of incoming assignments;

e) that reduction of undue protection requirements will facilitate coordination of submissions of new networks;

f) that due to the congestion in these frequency bands and due to the maturity of the technology and applications in these frequency bands, practical satellite implementations are seen to in practice use relatively homogeneous technical parameters;

g) that use of more homogeneous technical parameters will facilitate efficient spectrum usage and support introduction of new networks;

h) that the use of pfd thresholds will encourage use of more homogeneous technical parameters and support efficient spectrum usage, *resolves*

1 that in the frequency band 3 400-4 200 MHz (space-to-Earth), assignments for a fixed-satellite service (FSS) space station with respect to other FSS networks do not have the potential to cause harmful interference if 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:

		θ	≤	0.09°	−238.3	(dBW/m² · Hz)
0.09°	<	θ	≤	3°	−238.3 + 20log(θ/0.09)	(dBW/m² · Hz)
3°	<	θ	≤	5.5°	−214.6 + 0.75·θ²	(dBW/m² · Hz)
5.5°	<	θ	≤	20.9°	−191.6 + 25log(θ/5.6)	(dBW/m² · Hz)
20.9°	<	θ			−177.3	(dBW/m² · Hz)

where θ is the minimum nominal geocentric orbital separation, in degrees, between the wanted and interfering space stations, taking into account the respective East-West station-keeping accuracies;

2 that in the frequency bands 5 725-5 850 MHz (Region 1), 5 850-6 725 MHz and 7 025-7 075 MHz (Earth-to-space), assignments for a FSS earth station with respect to other FSS networks do not have the potential to cause harmful interference if the pfd produced at the geostationary orbit location of the other FSS network under assumed free space propagation conditions, does not exceed −198.8 dBW/m²·Hz, taking into account the respective East-West station-keeping accuracies;

3 that in the frequency bands 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz (Region 2), 12.2-12.5 GHz (Region 3), 12.5-12.7 GHz (Regions 1 and 3) and 12.7-12.75 GHz (space-to-Earth), assignments for a FSS or broadcasting-satellite service (BSS) space station with respect to other FSS or BSS networks do not have the potential to cause harmful interference if 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:

		θ	≤	0.05°	−232.8	(dBW/m² · Hz)
0.05°	<	θ	≤	3°	−232.8 + 20log(θ/0.05)	(dBW/m² · Hz)
3°	<	θ	≤	5°	−204.8 + 0.95·θ2	(dBW/m² · Hz)
5°	<	θ	≤	20.9°	−181.9 + 25log(θ/5)	(dBW/m² · Hz)
20.9°	<	θ			−166.6	(dBW/m² · Hz)

where θ is the minimum nominal geocentric orbital separation, in degrees, between the wanted and interfering space stations, taking into account the respective East-West station-keeping accuracies;

4 that in the frequency band 13.75-14.5 GHz (Earth-to-space), assignments for a FSS earth station with respect to other FSS networks do not have the potential to cause harmful interference if the pfd produced at the geostationary orbit location of the other FSS network under assumed free space propagation conditions, does not exceed −202.8 dBW/m² · Hz, taking into account the respective East-West station-keeping accuracies;

5 that when the Bureau, under No. **11.32A**, conducts its examination of the probability of harmful interference in accordance with this Resolution, the above criteria shall be used.

NOTE: FSS and BSS networks are also subject to other relevant limits of the RR, including, but limited to, RR Nos. **21.16** and **21.17**.

5/9.1.2/4.3.1.2 Option 1B

This option would involve retention of RR Nos. **9.7**, **9.41** and **11.32A** essentially as today. However, the technical criteria associated with the various provisions would be modified as follows:

– For the identification of coordination requirements by the Bureau under RR No. **9.7**, the use of the coordination arc would be retained where currently applicable. In frequency bands where the coordination arc criterion is not applicable, the current ΔT/T > 6% criterion would be replaced by a C/I < C/N+7[45] dB criterion.

– For inclusion/exclusion in/from the coordination under RR No. **9.41**, the current ΔT/T > 6% criterion would be replaced by a C/I < C/N+7 dB criterion as currently in Section B3 of the RoP. This criterion would be used for all services in all frequency bands covered by RR No. **9.41**.

– Examination of probability of harmful interference under RR No. **11.32A** would generally be based upon the same C/I criterion as that used under RR No. **9.41** and RR No. **9.7** (in frequency bands where the coordination arc criterion is not applicable), but would be transferred from the RoP to the RR.

Table 5/9.1.2/4-2 summarizes the changes introduced by this option compared to the current procedures.

TABLE 5/9.1.2/4-2

		Coordination stage			Application of RR No. **11.32A** at notification stage
		First step: Bureau identification of potentially affected administrations		Second step: possible application of RR No. **9.41**	
Current	Type of criterion	Coordination arc	ΔT/T	ΔT/T	C/I
	Criterion value	±8° in C band, ±7° in Ku-band, ±8° in Ka-band, ±16° in Ka-band and above	–	ΔT/T > 6%	Part B, Section B3 of the RoP
	Criterion value	–	ΔT/T > 6%	–	
Possible new criteria	Type of criterion	Coordination arc	C/I	C/I	C/I
	Criterion value	To be further studied (see section 5/9.1.2/4.2 above)	–	C/I < C/N[46]+ 7 dB	MOD RR Appendix **8** Based on Part B, Section B3 of the RoP
	Criterion value	–	C/I < C/N+7 dB	–	

NOTE: RoP related to RR Nos. **9.41** and **11.32A** need to be corrected.

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[45] This is equivalent to an interference level equivalent to ΔT/T < 20%. Consequential aggregate effect of this increase in single-entry interference criterion has not yet been fully evaluated. If other levels of interference are to be considered, this value may be adjusted by $C/I_{X\%} = C/I_{20\%} + 10\log(X/20)$.

[46] C/N should be calculated in accordance with the RoP Section B3. C/N should be calculated based upon filed parameters and it is proposed to modify BR's Space Capture software in such a way that it would calculate and show the calculated C/N value and include it in the notice database.

EXAMPLE OF REGULATORY TEXT IN RESPECT OF OPTION 1B

NOC

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6, 7, 8, 8*bis*] (WRC-12)

Reasons: No changes to the provisions of RR Article **9** in respect of Option 1B.

ARTICLE 11

Notification and recording of frequency assignments[1, 2, 3, 4, 5, 6, 7, 7*bis*] (WRC-12)

Section II − Examination of notices and recording of frequency assignments in the Master Register

MOD

11.32A *c)* with respect to the probability of harmful interference that may be caused to or by assignments recorded with a favourable finding under Nos. **11.36** and **11.37** or **11.38**, or recorded in application of No. **11.41**, or published under Nos. **9.38** or **9.58** but not yet notified, as appropriate, for those cases for which the notifying administration states that the procedure for coordination under Nos. **9.7**, **9.7A**, **9.7B**, **9.11**, **9.12**, **9.12A**, **9.13** or **9.14**, could not be successfully completed (see also No. **9.65**); [14, 14*bis*] or (WRC-2000)

NOC

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[14] **11.32A.1**

ADD

[14*bis*] **11.32A.2** The calculation method to assess harmful interference and the criteria for the formulation of the findings of the Bureau for the coordination under No. **9.7** are contained in Appendix **8**.

MOD

APPENDIX 5 (REV.WRC-~~12~~15)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9[47]

TABLE 5-1 (REV.WRC-~~12~~15)

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 13.75-14.5 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 ±8° 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 ±7° of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan		With respect to the space services listed in the threshold/condition column in the bands in 1), 2), 3), 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 ~~*ΔT/T*~~*C/I* calculated by the method in § [XXX] ~~2.2.1.2 and 3.2~~ of Appendix **8** ~~exceeds 6%~~ is lower than the appropriate criterion (C/I < C/N+7 dB). When the Bureau, on request by an affected administration, studies this information pursuant to No. **9.42**, the calculation method given in § [XXX] ~~2.2.1.2 and 3.2~~ of Appendix **8** shall be used.

[47] See Resolution **[B912] (WRC-15)**.

TABLE 5-1 (*continued*) (REV.WRC-~~12~~15)

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.*)		3) 17.7-20.2 GHz, (Regions 2 and 3), 17.3-20.2 GHz (Region 1) and 27.5-30 GHz	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 ±8° of the nominal orbital position of a proposed network in the FSS		
		4) 17.3-17.7 GHz (Regions 1 and 2)	i) Bandwidth overlap, and 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 ±8° 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. **1.23**) with a space station within an orbital arc of ±8° of the nominal orbital position of a proposed network in the FSS		

TABLE 5-1 (*continued*) (REV.WRC-~~12~~15)

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. **1.23**) with a space station within an orbital arc of ±8° 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. **1.23**) with a space station within an orbital arc of ±8° of the nominal orbital position of a proposed network in the FSS NOTE – No. **5.517** 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. **1.23**) with a space station within an orbital arc of ±8° of the nominal orbital position of a proposed network in the FSS or the meteorological-satellite service		

TABLE 5-1 (*continued*) (REV.WRC-~~12~~15)

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.*)		6*bis*) 21.4-22 GHz (Regions 1 and 3)	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 ±12° of the nominal orbital position of a proposed network in the BSS (see also Resolutions **554 (WRC-12)** and **553 (WRC-12)**).		No. **9.41** does not apply.
		7) Bands above 17.3 GHz, except those defined in § 3) and 6)	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 ±8° of the nominal orbital position of a proposed network in the FSS (see also Resolution **901 (Rev.WRC-07)**)		
		8) Bands above 17.3 GHz except those defined in § 4), 5) and 6*bis*)	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 ±16° 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)**)		

TABLE 5-1 (*continued*) (REV.WRC-~~12~~15)

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), 3), 4), 5), 6), 6*bis)*, 7) and 8), allocated to a space service, and the bands in 1), 2), 3), 4), 5), 6), 6*bis)*, 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 C/I < C/N+7 dB~~Δ*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 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 bands in 7) applies

NOTE: Depending upon decisions of WRC-15 in respect of *resolves* 2 of Resolution 756 (WRC-12), the numerical values for the size of the coordination arc in one or more of the listed frequency bands of Table 5-1 may change. This option is neutral in respect of the size of the coordination arc and decisions on the size of the coordination arc will not lead to a need for consequential changes in respect of this option or vice-versa.

APPENDIX 8 (REV.WRC-03)

Method of calculation for determining if coordination is required between geostationary-satellite networks sharing the same frequency bands

ADD

[XXX] Calculation methodology for calculating C/I ratios in respect of determination of probability of harmful interference between space networks

This method would be the same as Option 1C, but based upon C/I = C/N + 7 dB.

5/9.1.2/4.3.1.3 Option 1C

This option would be the same as Option 1B, but the value of the C/I criterion prescribed under RR Nos. **9.7**, **9.41** and **11.32A** would be C/I < C/N+12.2[48] dB which is equivalent to an interference level equivalent to ΔT/T < 6%.

APPENDIX 8 (REV.WRC-03)

Method of calculation for determining if coordination is required between geostationary-satellite networks sharing the same frequency bands

ADD

[XXX] Calculation methodology for calculating C/I ratios in respect of determination of probability of harmful interference between space networks

1 Introduction

The criterion based on calculation of C/I ratios is used for identification of coordination requirements in application of the provisions:

– No. **9.7** in cases where the coordination arc criterion is not applicable;

– No. **9.41** when including in the requests for coordination of satellite networks not identified under No. **9.36.2**;

– No. **11.32A** with respect to the probability of harmful interference.

The description of the calculation method and criteria to be used for the interference assessment as well as the findings to be formulated with respect to coordination of networks under No. **9.7** are as follows.

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[48] If other levels of interference are to be considered, this value may be adjusted by $C/I_{X\%} = C/I_{6\%} + 10\log(X/6)$.

2 Probability of harmful interference

The Bureau, in performing its mandatory tasks relating to the application of the above-mentioned provisions, shall proceed as follows:

2.1 Recommendation ITU-R S.741-2, should be used to examine the subject assignments with respect to the provisions of No. **9.7**, No. **9.41** and No. **11.32A**.

2.2 The Bureau, when determining the probability of harmful interference shall use either the single-entry limits or the mutually agreed criteria provided by the administrations concerned for accepted interference, as appropriate.

2.2.1 To examine the subject assignments with respect to the provisions of No. **9.7** and No. **9.41**, the Bureau should use the single-entry limits defined in Table 2 of § 3.2 below, which is derived from Table 2 of Recommendation ITU-R S.741-2, together with the information submitted in accordance with Appendix **4**.

a) the probability of harmful interference is considered to be negligible if the interference is less than or equal to the single-entry interference limits indicated in Table 2 of § 3.2 below. In this case the finding shall be favourable, and coordination is not required;

b) the probability of harmful interference is considered not to be negligible if the interference is greater than the single-entry interference limits indicated in Table 2 of § 3.2 below. In this case the finding shall be unfavourable, and frequency assignments shall be taken into account in effecting coordination.

2.2.2 To examine the subject assignments with respect to the provisions of No. **11.32A** the Bureau shall use the mutually agreed criteria provided by the administrations concerned for accepted interference in the format appearing in Table 2 of Recommendation ITU-R S.741-2, or, in the absence of such information, the Bureau should use the single-entry limits defined in Table 2 of § 3.2 below, which is derived from Table 2 of Recommendation ITU-R S.741-2, together with the information submitted in accordance with Appendix **4**.

2.2.2.1 In the case where this information is provided by the administrations concerned:

a) the probability of harmful interference is considered to be negligible if the C/I calculation shows that the applicable criteria for a particular examination between two networks concerned are satisfied. In this case the finding in respect of No.**11.32A** shall be favourable and the assignment shall be recorded in the Master Register;

b) the probability of harmful interference is considered not to be negligible, if the C/I calculation shows that the applicable criteria for a particular examination between two networks concerned are not satisfied. Accordingly the finding shall be unfavourable and the notice shall be returned with an indication of the appropriate action.

2.2.2.2 In the case where this information is not provided by the administrations concerned:

a) the probability of harmful interference is considered to be negligible if the interference is less than or equal to the single-entry interference limits indicated in Table 2 of § 3.2 below. In this case the finding in respect of No.**11.32A** shall be favourable and the assignment shall be recorded in the Master Register;

b) the probability of harmful interference is considered not to be negligible, if the interference is greater than the single-entry interference limits indicated in Table 2 of § 3.2 below. Accordingly the finding shall be unfavourable and the notice shall be returned with an indication of the appropriate action.

3 Methodology

The RoP for Section B3 to be converted into regulatory text.

4 Calculations of additional margins

The RoP for Section B3 to be converted into regulatory text.

Note: Further studies are required whether it is necessary to retain the methodology of ΔT/T calculations in the modified RR Appendix **8**. However, it is exactly useful to retain some sections of RR Appendix **8 (Rev.WRC-03)**, because they contain useful information concerning calculation methodology.

5/9.1.2/4.3.1.4 Option 1D

No changes to the RR.

5/9.1.2/4.3.1.5 Regulatory solutions in respect of procedure of transition to new criterion

This Resolution may apply to Options 1A, 1B and/or 1C above.

ADD

RESOLUTION [B912] (WRC-15)

Procedure and timeframe for the transition to the new criterion of permissible single-entry interference established by WRC-15

TBD

5/9.1.2/4.3.2 Regulatory and procedural considerations in respect of *resolves* 2

Currently, coordination triggers such as the coordination arc are used to identify administrations with which coordination is to be effected and the associated satellite networks to be considered.

In certain frequency bands allocated to the FSS, where the coordination arc applies, a new satellite network will likely be required to effect coordination with a large number of existing and proposed satellite networks, with an orbital separation less than the associated coordination arc. Studies conducted by ITU-R have demonstrated that a reduction to the coordination arc may be possible while concurrently ensuring adequate protection to other existing and proposed satellite networks. If the coordination arc values are selected such that they more accurately reflect the operational satellite environment, this might also have the effect of reducing the need for provisional recording under RR No. **11.41**.

5/9.1.2/4.3.2.1 Option 2A

- In the frequency bands under item 1) of Table 5-1 of RR Appendix **5**, reduce the coordination arc from ±8º to ±6º;
- In the frequency bands under item 2) of Table 5-1 of RR Appendix **5** , reduce the coordination arc from ±7º to ±5º;
- In the frequency bands under the other items of Table 5-1 of RR Appendix **5**, no change to the current coordination arc.

The further reduction of the size of the coordination arc requires a certain level of homogeneity over the applications. If there are a large number of satellites operating close to each other, networks tend to adapt comparable technical parameters. Also, if the frequency band has been in use for a long period, applications and usage tend to become harmonized and technical characteristics such as TVRO antenna sizes and VSAT characteristics tend to stabilize and align with harmonized use.

As opposed to the 30/20 GHz frequency range, the 6/4 GHz and 14/10/11/12 GHz frequency ranges have been in widespread use globally for several decades and there are a very large number of operational satellites in these frequency ranges typically spaced about 2-3 degrees along the GSO arc. Therefore, the 6/4 GHz and 14/10/11/12 GHz frequency ranges are considered well suited for a reduction of the size of the coordination arc, but not the 30/20 GHz frequency range. As applications and technical characteristics in the 30/20 GHz frequency range develop, the appropriate size of the coordination arc could be further studied.

Any administration, not identified by the Bureau under RR No. **9.36**, having satellite networks outside the coordination arcs can still be included in the coordination process through the application of RR No. **9.41**.

This option can be implemented by modifying the FSS coordination arc values for the 6/4 GHz and 14/10/11/12 GHz frequency ranges in Table 5-1 of RR Appendix **5**. An example of regulatory text is shown below.

APPENDIX 5 (REV.WRC-12)

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-~~12~~15)

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 13.75-14.5 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 ±~~8~~6° 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 ±~~7~~5° of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan		With respect to the space services listed in the threshold/condition column in the bands in 1), 2), 3), 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

5/9.1.2/4.3.2.2 Option 2B

– In the frequency bands under item 1) of Table 5-1 of RR Appendix **5**, reduce the coordination arc from ±8º to ±6º;
– In the frequency bands under item 2) of Table 5-1 of RR Appendix **5**, reduce the coordination arc from ±7º to ±5º;
– In the frequency bands under items 3) and 7) of Table 5-1 of RR Appendix **5**, reduce the coordination arc from ±8º to ±6º;
– In the frequency bands under items 4), 5), 6) and 8) of Table 5-1 of RR Appendix **5**, no change.

Any administration, not identified by the Bureau under RR No. **9.36**, having satellite networks outside the coordination arcs can still be included in the coordination process through the application of RR No. **9.41**.

This option can be implemented by modifying Table 5-1 of RR Appendix **5**. An example of regulatory text is shown below.

APPENDIX 5 (REV.WRC-12)

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-~~12~~15)

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 13.75-14.5 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 ±~~8~~6° 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 ±~~7~~5° of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan		With respect to the space services listed in the threshold/condition column in the bands in 1), 2), 3), 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-~~12~~15)

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.*)		3) 17.7-20.2 GHz, (Regions 2 and 3), 17.3-20.2 GHz (Region 1) and 27.5-30 GHz 4) 17.3-17.7 GHz (Regions 1 and 2)	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 ±~~8~~6° of the nominal orbital position of a proposed network in the FSS i) Bandwidth overlap, and 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 ±8° 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. **1.23**) with a space station within an orbital arc of ±8° of the nominal orbital position of a proposed network in the FSS		

TABLE 5-1 (*continued*) (REV.WRC-~~12~~15)

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. **1.23**) with a space station within an orbital arc of ±8° 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. **1.23**) with a space station within an orbital arc of ±8° of the nominal orbital position of a proposed network in the FSS NOTE – No. **5.517** 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. **1.23**) with a space station within an orbital arc of ±8° of the nominal orbital position of a proposed network in the FSS or the meteorological-satellite service		

TABLE 5-1 (*continued*) (REV.WRC-~~12~~15)

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.*)		6*bis*) 21.4-22 GHz (Regions 1 and 3)	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 ±12° of the nominal orbital position of a proposed network in the BSS (see also Resolutions **554 (WRC-12)** and **553 (WRC-12)**).		No. **9.41** does not apply.
		7) Bands above 17.3 GHz, except those defined in § 3) and 6)	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 ±~~8~~6° of the nominal orbital position of a proposed network in the FSS (see also Resolution **901 (Rev.WRC-07)**)		
		8) Bands above 17.3 GHz except those defined in § 4), 5) and 6*bis*)	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 ±16° 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)**)		

5/9.1.2/4.3.2.3 Option 2C

No changes to the RR.

5/9.1.3 Resolution 11 (WRC-12)

Use of satellite orbital positions and associated frequency spectrum to deliver international public telecommunication services in developing countries

(**WP 4A** (technical and regulatory aspects), **SC** (regulatory and procedural aspects) / **-**)

5/9.1.3/1 Executive summary

WRC-15 agenda item 9.1, issue 9.1.3, was established in order to address Resolution **11 (WRC-12)**, which resolves that ITU-R undertake studies to determine whether it might be necessary to apply additional regulatory measures to enhance the availability of public international telecommunication services delivered through satellite technology. ITU Member States and Sector Members were invited to contribute to the implementation of Resolution **11 (WRC-12)**.

5/9.1.3/2 Background

To examine the importance of satellite telecommunications for delivering international public telecommunications services in developing countries, WRC-12 adopted Resolution **11 (WRC-12)**.

ITU-R has conducted many analyses to provide for guaranteed access to the geostationary orbit (GSO), and adopted Reports and Recommendations which promote efficient use of the GSO. However, it should be noted that both ITU-R and ITU-D have roles and responsibilities in the implementation of this Resolution.

In Resolution **11 (WRC-12)**, WRC-12 recognized the important and strategic role of satellite communications in both developed and developing countries as captured in the resolutions and decisions of several United Nations and ITU Conferences stated in the '*considering*' part. Importantly, satellite services can help with reduction of the digital divide and fulfilment of the United Nations' Millennium Development Goals (MDGs), noting the correlation between broadband satellite technologies and the reduction of the broadband divide particularly in remote and rural areas. The efficient use of orbital resources and associated frequency spectrum further helps to ensure global coverage as well as direct connectivity of countries at affordable prices.

5/9.1.3/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

In light of the increased demand for satellite services, including those services that may help fulfil universal broadband access and the MDGs, and an increased interest of developing countries to develop and launch national or regional satellites, several ITU, ITU-R and ITU-D Resolutions have been adopted to provide direction for ITU activities in support of developing countries in their development of telecommunications/ICTs infrastructures and services, including in the areas of spectrum management and use of the orbital resource. The results have been activities including workshops, seminars and training in the area of spectrum management, satellite telecommunications, disaster communications, and satellite regulatory procedures.

Furthermore, Resolution **11 (WRC-12)** calls for studies and collaboration between ITU-R and ITU-D to provide information on satellite technologies and applications as defined in ITU-R Recommendations and Reports and on satellite regulatory procedures in the Radio Regulations

(RR) that will help developing countries with development and implementation of satellite networks and services, including through the organization of workshops, seminars and training courses.

The World Telecommunication Development Conference (WTDC-14) reinforced such joint ITU-D and ITU-R activities through the update of Resolution **37 (Rev. Dubai, 2014)** "Bridging the Digital Divide" by calling upon the Director of the BDT to:

- promote the implementation of studies or projects and activities, in collaboration with the ITU-R, with a view, on the one hand, to complementing national radiocommunication systems, including satellite systems, and, on the other, to increasing knowledge and capacities thereof, in order to achieve optimum utilization of the orbit spectrum resource, with the aim of stimulating the development and coverage of satellite broadband for bridging the digital divide;
- analyse the adoption of measures for collaboration with ITU-R, in order to support studies, projects or systems and, at the same time, to implement joint activities which seek to build capacities in efficient use of the orbit/spectrum resource for the provision of satellite services, with a view to achieving affordable access to satellite broadband and facilitating network connectivity between different areas, countries and regions, especially in the developing countries,

On the other hand, regarding studies required to determine whether it might be necessary to apply additional regulatory measures to enhance the availability of public international telecommunication services delivered through satellite technology, some administrations are of the view that these types of service are neither identified nor defined in the RR or have been recognized for satellite networks registered in the ITU Master International Frequency Register.

This section provides an overview of relevant ITU, ITU-R and ITU-D Resolutions, ITU-R Recommendations and Reports, as well as information on ITU-R and ITU-D activities held in support of this agenda item.

5/9.1.3/3.1 Existing relevant ITU, ITU-R and ITU-D Resolutions

Resolution 15 (Rev.WRC-03) instructs the Director of the Radiocommunication Bureau (BR) to include activities in support of developing countries participating effectively in international space communication systems as part of the Operational Plan, and invites Council to consider how to best utilize the resources of the Union in support of these objectives.

Resolution 11 (WRC-12) invites the ITU-D to organize workshops, seminars and training courses that address sustainable and affordable access to satellite telecommunications and resolves that the ITU-R continues to collaborate with ITU-D in the area of satellite technologies and applications as defined in ITU-R Recommendations and Reports and on satellite regulatory procedures that will help developing countries with development and implementation of satellite networks and services and for ITU-R to "undertake studies to determine whether it might be necessary to apply additional regulatory measures to enhance the availability of public international telecommunication services delivered through satellite technology".

Resolution ITU-R 7-2 resolves that, pursuant to No. 224 of the Convention, the Director of the BR shall assist the Director of the BDT in organizing worldwide and/or regional information meetings, seminars and workshops that will provide developing countries with the required information on ITU-R activities.

BDT Objective 2 "Foster an enabling environment for ICT development and foster the development of telecommunication/ICT networks as well as relevant applications and services, including bridging the standardization gap" of the Dubai Action Plan adopted by WTDC-14 directs the work of the BDT in providing support for developing countries in utilization of new technologies for the development of their information and communication infrastructures and services, by taking due account of broadband deployment, spectrum management and radio monitoring, including satellite telecommunications.

WTDC Resolution 11 (Rev. Dubai 2014) "Telecommunication/information and communication technology services in rural, isolated and poorly served areas and indigenous communities" instructs the Director of the BDT to continue efforts to promote the optimum use by developing countries of all available new telecommunication/ICT services, including satellite, to serve these areas and communities.

WTDC Resolution 37 (Rev. Dubai, 2014) on Bridging the Digital Divide highlights the role of satellite communications in bridging the digital divide and requests the Director of the BDT to continue to assist the Member States and Sector Members in developing a pro-competition policy and regulatory framework for information and communication technologies, including online services and electronic commerce, as well as capacity building in connectivity and accessibility, taking into account the special needs of women and disadvantaged groups;

Resolution 139 (Rev. Guadalajara, 2010) "Telecommunications/information and communication technologies to bridge the digital divide and build an inclusive information society" instructs the Director of the BDT, in coordination with the Directors of the other Bureaux, as appropriate (1) to continue to assist the Member States and Sector Members in developing a pro-competitive policy and regulatory framework for ICTs and ICT applications; (2) to continue to assist Member States and Sector Members with strategies that expand access to telecommunication infrastructure, particularly for rural areas; (3) to evaluate models for affordable and sustainable systems for rural access to information, communications and ICT applications on the global network, based on studies of these models.

5/9.1.3/3.2 Existing relevant ITU-R Recommendations, Reports and Handbooks

The relevant ITU-R Recommendations: ITU-R S.1001-2, ITU-R S.1782-0, ITU-R BO.1774-1, ITU-R M.1854-1.

The relevant ITU-R Reports: ITU-RS.2151-1, ITU-R M.2149-1

Handbooks

– Satellite communications, which gives a comprehensive description of all issues relative to satellite communication systems operating in the FSS.

– Specifications of transmission systems for the broadcasting-satellite service (BSS).

– Mobile-satellite service (MSS), which provides a brief survey and introduction to MSS operations.

5/9.1.3/3.3 New relevant ITU-R and ITU-D Recommendations and Reports

PDN Report ITU-R S.[BROADBAND BY FSS] includes the technical and operational characteristics of FSS systems that facilitate the delivery of affordable, high speed broadband applications as well as implementation examples.

ITU-D Study Group Reports for the 2010-2014 study period which provide technology descriptions, implementation guidance, and developing country case study examples of satellite broadband deployment, as well as use of satellite connections for mobile backhaul:

– Final Report on Question 10-3/2: Telecommunications/ICTs for rural and remote areas (http://www.itu.int/pub/D-STG-SG02.10.3-2014).

– Final Report for Question 25/2: Access technology for broadband telecommunications including IMT, for developing countries (http://www.itu.int/pub/D-STG-SG02.25-2014).

5/9.1.3/3.4 Workshops, Seminars and Training Programs

ITU-R, in collaboration with ITU-D, delivered several workshops, seminars and training programs specifically targeted at providing support to developing countries in the area of satellite telecommunications.

– ITU-R Regional Radiocommunication Seminars.
– ITSO/ITU Satellite Seminars at the ITU Global Symposium for Regulators (2012 and 2013).
– ITU Academy Satellite Seminars and Training Workshops.
– ITU Workshop on the efficient use of the spectrum / orbit resource (Cyprus, 2014).
– Prospects for use of the Ka-band by satellite communication systems (2012).
– ITU Training on Satellite Launching and Monitoring (2012).
– BR/BDT - Training Workshop on Satellite (2010).
– BR/BDT Regional Seminar "Management of radio-frequency spectrum and satellite orbits at international level" (2010).
– BR/BDT regional workshop on SpaceCom (2010).
– BR/BDT Seminar on Regional Satellite Communication Systems, Yerevan (2006).

5/9.1.3/3.5 Current situation

Over the past several years there has been great growth and innovation in the development and deployment of satellite telecommunications services for the benefit of developed and developing countries. The introduction of competition into the international satellite telecommunication sector has led to an increase in the availability of diverse and innovative services in both developed and developing countries, including the availability of such public services as e-government and disaster relief. Governments and international and regional organizations have been fostering innovation, affordability, and broader availability of satellite services through ITU registration and deployment of their own satellite systems. Furthermore, efficient use of the orbital resource and associated frequency spectrum helps to ensure global coverage and to connect countries directly, instantly and reliably at an affordable price.

One view is that global connectivity and global coverage provide non-discriminatory access to international public telecommunication services when implemented, provide one of the cornerstones for the achievement of global connectivity and coverage; and hence the criticality of the availability of satellite orbital positions and associated frequency spectrum to deliver international public telecommunication services. This view is of the belief that studies are needed to resolve the challenges faced by various stakeholders involved in ensuring the provision of international public telecommunication services through use of satellite technology. Additionally, competition as an instrument may not be adequate on its own to ensure the availability of international public telecommunications services to various parts of the world, considering the need to continue assisting developing countries in using satellite telecommunications to enable sustainable and affordable access to information and telecommunication services mentioned in Resolution **11 (WRC-12)**.

Another view is of the belief that competition is adequate and that public service obligations are not defined in the RR. Also, no technical evidence was provided to ensure universal access was granted for Member States. Further, this view is of the belief that the current practices and situation do not require any additional regulatory measures in order to ensure provisions of international public telecommunication satellite services because this can be effectively provided by existing commercial satellites considering the fact that current competition offers affordable prices for satellite services. In order to realize this it may be advised that the national regulatory authorities accommodate these commercial satellites through a proper national regulatory regime.

5/9.1.3/3.5.1 Evolving satellite marketplace – Increased availability of satellite services

As also recognized in Resolution **11 (WRC-12)**, the introduction of competition into the international satellite telecommunication sector has led to an increase in the availability of diverse and innovative international telecommunication services in both developed and developing countries.

The satellite sector over the past 15 years has been marked by the introduction of competition leading to the emergence of diverse new satellite operators, including national and regional operators in developing countries. Since Intelsat's privatization in 2001, there has been tremendous growth in the number of satellites providing telecommunications capacity and services globally. While initially only a handful of countries had the financial and technical capabilities to develop satellites, the industry has grown to include a more diverse set of nations, and currently many emerging markets are seeking to increase their level of space activity. Some developing countries have already invested in multiple generations of satellites. Others plan to drastically extend their established space programs to include new capabilities. Increased demand for space services has further led to increased diversity in the number of operators providing services in developing countries. There are now over 300 commercial communications satellites in orbit[49]. This growth in capacity has enabled developing countries to benefit from higher bandwidth links and at increasingly lower costs.

Increased competition also has led to more innovative broadband and public telecommunications services including those supporting e-Government, disaster communications, e-education and e-health. Importantly, such services are available through multiple service providers, driven by customer and market demand and not by public service obligations.

Additionally, policy priorities for bridging the digital divide and ensuring broadband access for all, including those in remote and rural areas, has led to growth in demand and availability of broadband services by diverse means. For example, there has been growth of availability in developing countries of high-capacity transoceanic submarine fibre optic cables. Such competition in the marketplace ultimately leads to decreases in costs. Despite this diversity of service platforms, satellite services remain critical, providing real-time broadcasting, distributing video programming, providing backhaul to other services like cellular systems and providing emergency back-up links, and in some geographic areas is often the only viable option for telecommunication services.

Importantly, the increased demand for broadband in rural and remote areas has also led to innovative public policy strategies, service offerings, and business models, including public private partnerships to stimulate universal broadband deployment including a role for satellite services. For example, Argentina' National Telecommunications Plan "Argentina Conectada" includes a component that will help bring connectivity to the country's rural and border area schools. The intention is to provide schools with satellite Internet connections using satellite antennas (very small

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[49] The Satellite Industry Association (SIA) 2012 State of the Satellite Industry Report states that there are over 1,000 operating satellites as of year-end 2012 – more than half of those are communications satellites; more than one-third are <u>commercial</u> communications satellites.

aperture terminals (VSAT))[50]. Viet Nam's Strategic Plan on Information and Communications Development from now to 2020 includes objectives for increasing broadband connectivity, including in rural and remote areas, through diverse means of access including fibre optical cable systems, satellite transmission, wireless broadband network, as per the geographical, economical and social conditions[51].

5/9.1.3/3.5.2 Efficient use of the orbital resource – Availability of satellite orbital resources

Telecommunications/ICT services are increasingly considered an essential component of overall economic growth and development, making efficient use of spectrum and orbital resources a similarly critical component of national economic growth and development strategies and plans.

For example, social programs to ensure universal connectivity in Argentina, Bolivia, and Mexico all include satellite resources as a key component, and each country is developing its own national satellite program. 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 GSO, are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the provisions of the RR, so that countries or groups of countries may have equitable access to those orbits and frequencies, taking into account the special needs of the developing countries and the geographical situation of particular countries." Moreover, in Resolution 71 (Rev. Guadalajara 2010) of the Plenipotentiary Conference, ITU adopted its strategic plan for the period 2012-2015, which contains, as one of the strategic goals of ITU-R: "To seek ways and means to ensure rational, equitable, efficient and economical use of the radio-frequency spectrum and satellite-orbit resources and to promote flexibility for future expansion and new technological developments."

In fulfilling the provisions stipulated in the ITU Constitution, the RR in their Appendices **30**, **30A**, and **30B** provide for a guarantee of access to the GSO for all Member States of the ITU. RR Appendices **30** and **30A** were designed to provide for the guaranteed use of frequencies from GSO positions for the transmissions of BSS. RR Appendix **30B** specifically provides a guarantee of access to spectrum allocated to the FSS for use from orbital positions on the GSO. Within the RR Appendix **30B** Plan, there is 1 600 MHz of spectrum (800 MHz uplink/800 MHz downlink) for each Member State of the ITU.

Moreover, during the past 30 years, ITU Members have undertaken numerous studies and actions, including at WRC's, to review and improve provisions in the RR to allow for more efficient use of radio frequencies and associated satellite orbital resources.

Most recently, WRC-12 adopted several new or modified regulatory measures to ensure broader access to the orbit-spectrum resource including:

– new rules for bringing into use, effective 1 January 2013;

– suspension period for unplanned services extended from two to three years, effective 1 January 2013.

Importantly, these regulatory measures were adopted taking into account the first-come, first-served principle of use of the satellite orbit in ways that will make orbit-spectrum resource more broadly and efficiently available to all. Studies underway in ITU-R under WRC-15 agenda item 7 allow for

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[50] ITU-D Study Group 2, Document 2/160-E – prepared by Argentina.

[51] ITU-D Study Group 2, Document 2/100-E – prepared by Viet Nam.

ongoing review of how to improve these procedures and to respond to new and evolving challenges of the satellite telecommunications sector.

The international organizations that deal with the oversight of the satellite industry have a similar objective of affording public and universal services obligation coverage by satellite system, and to ensure that a specific satellite operator provides non-discriminatory access to its space assets. ITU-R studies may help determine if there is a need to change satellite regulatory provisions to ensure international public telecommunication services through global coverage and connectivity by satellites. It would therefore be very helpful to bear in mind such scenarios when responding to Resolution **11 (WRC-12)**.

5/9.1.3/4 Regulatory and procedural considerations

The current satellite regulatory procedures in the RR, coupled with privatization and competition in the global telecommunications environment, have provided developing countries an increase in the number of satellite operators, an increase in the number of satellites under development, an increase in demand for higher bandwidth satellite services and an increase in the diversity of services available to the public. While some challenges remain in building developing country capacities in order to fully take advantage of satellite services and the orbital resource, the current situation demonstrates availability of international public telecommunication services for developing countries through application of existing regulatory procedures.

After taking into account the tremendous success by the satellite sector to meet the growing and evolving needs of developed and developing countries under the current regulatory regime, it is the view of developing countries to receive greater benefits from satellite communications. ITU-R recommends, in accordance with Resolution **11 (WRC-12)** and WTDC-14 Resolution **37 (Rev. Dubai, 2014)**, that priority be placed on implementation of joint ITU-R and ITU-D activities to further support capacity building and knowledge sharing in the area of satellite telecommunications. Such activities should particularly focus on use of satellite technologies and applications as defined in ITU-R Recommendations and Reports and on satellite regulatory procedures in the RR that will help developing countries with development and implementation of satellite networks and services.

5/9.1.3/4.1 Examples of regulatory text, conclusions and/or general considerations, as appropriate

5/9.1.3/4.1.1 Option A

No changes are required to the RR.

Reasons: A great amount of information has been gathered during the study cycle between WRC-12 and WRC-15 regarding the ITU-R and ITU-D achievements, practices and current activities that relates to Resolution **11 (WRC-12)**.

Since no studies have been submitted to ITU-R to address *resolves* 2 of Resolution **11 (WRC-12)**, it may be inferred that the current activities and practices of the ITU-R and the ITU-D are ensuring the enhancement of the availability of satellite services. As a result, some views are of the belief that current regulatory measures are adequate to ensure such availability, and that no additional regulatory measures are required for this particular issue. Moreover, the proposed elements of studies listed in Option B may require further analysis, as they may appear to be outside the scope of Resolution **11 (WRC-12)**.

The current satellite deployment in the GSO should satisfy the demand of international telecommunication public services and that the issue faced by the satellite operators is effectively the market access in the different countries, rather than the lack of orbital resources, and to urge administrations to develop a suitable national regulatory regime to accommodate international telecommunication public services.

Administrations should support the implementation of the Resolutions in section 5/9.1.3/3.1, in partnership with the ITU-D, including through more targeted support for developing countries in navigating the satellite filing process and to invite reporting by the BR and BDT on the capacity building activities undertaken in association with these Resolutions.

5/9.1.3/4.1.2 Option B

It is believed that studies should still need to be done in ITU-R in order to adequately respond to Resolution **11 (WRC-12)** before WRC-15, and a provision should be made to revise Resolution **11 (WRC-12)** in order to continue with the studies as it may be required for *resolves* 2 of Resolution **11 (WRC-12)** to continue even after WRC-15 which may be performed through ITU inter-sectorial activities. All conducted studies in ITU-R would be performed within the current framework of the RR, and the satellite network filings should be treated in the same manner and equal basis. In this context, possible study elements are elaborated further in the paragraph below.

The study elements may include, but are not limited to the following: the evolution of demand for international public telecommunication services provided through the use of satellite technology; identification of the orbital resources required to guarantee the provision of the international telecommunication services versus those that are currently being used for delivering these services; identification of the measures and conditions that are applicable to the use of these resources and how these resources have been recognized and registered at the international level; problems that may have arisen or been experienced as a result of the measures currently in place; whether there is a need for change, and if so what change and what evolution path for the change should be followed; how such changes in regulation can affect the competition in the telecommunication sector.

5/9.1.5 Resolution 154 (WRC-12)

Consideration of technical and regulatory actions in order to support existing and future operation of fixed-satellite service earth stations within the band 3 400-4 200 MHz, as an aid to the safe operation of aircraft and reliable distribution of meteorological information in some countries in Region 1

(**WP 4A** (technical and regulatory aspects), **SC** (regulatory and procedural aspects) / **-**)

5/9.1.5/1 Executive summary

Resolution **154 (WRC-12)** invites the ITU-R to study possible technical and regulatory measures in some countries in Region 1 to support the existing and future FSS earth stations in the 3 400-4 200 MHz frequency band used for satellite communications related to safe operations of aircraft and reliable distribution of meteorological information, considering that where an adequate terrestrial communication infrastructure is not available, FSS earth stations are the only viable option to augment the communication infrastructure in order to satisfy the overall communications infrastructure requirement of the International Civil Aviation Organization (ICAO) and to ensure distribution of meteorological information under the auspices of the World Meteorological Organization (WMO).

5/9.1.5/2 Background

The efficient provision of air navigation services requires the implementation and operation of ground communications infrastructure with high availability, reliability and integrity. In some countries in Africa, the difficulty of fulfilling these requirements, given the extent of the airspace and weakness in terrestrial communication infrastructure, has led to the extensive deployment of an aeronautical communication infrastructure based on very small aperture terminal (VSAT) systems operating in the FSS. The frequency band of operation is 3 400-4 200 MHz (with the standard C-band frequency range being 3 700-4 200 MHz and the extended C-band frequency range being 3 400-3 700 MHz), which, due to more pronounced rain attenuation at higher frequency bands, is the most viable option for satellite links with high availability in tropical regions. This infrastructure currently spans the entire region and is crucial to ensure the continued growth of traffic while maintaining safe operation of aircraft. The same frequency band is also used for the distribution of meteorological data via satellites under the auspices of the WMO.

WRC-07 allocated the frequency band 3 400-3 600 MHz to the MS, except aeronautical mobile, on a primary basis in 81 countries in Region 1, subject to regulatory and technical restrictions (see RR No. **5.430A**). The deployment of MS systems in the vicinity of airports has led to an increased number of cases of interference into FSS (VSAT) receivers. Consequently, some additional measures are needed to improve the protection of the FSS links supporting aeronautical and meteorological communications. Depending on whether the interference cases are between two stations in the same country (domestic case) or between two stations in neighbouring countries (cross-border case), the consideration of such measures is either a national spectrum-regulatory matter, or an issue of international spectrum regulation between countries.

WRC-12 adopted Resolution **154 (WRC-12)**, and invited the ITU-R to study possible technical and regulatory measures in some countries in Region 1 to support the existing and future FSS earth stations in the 3 400-4 200 MHz frequency band used for satellite communications related to safe operations of aircraft and reliable distribution of meteorological information referred to in *considering c)*.

Regional coordination was carried out between African Civil Aviation Authorities, air navigation service providers (ANSPs) and the African Telecommunication Union (ATU) in preparation for WRC-15. As a result, the first ATU preparatory meeting to ITU WRC-15 held in Dakar (Senegal), from 18 to 20 March 2013 recommended ATU Member States to “reinforce their support to the existing and future FSS earth stations in the 3 400-4 200 MHz frequency band used for satellite communications related to safe operation of aircraft and reliable distribution of meteorological information by participating in the studies for possible technical and regulatory measures called upon by ITU Resolution 154 (WRC-12).”

5/9.1.5/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Report ITU-R M.2109 contains sharing studies between IMT-Advanced systems and geostationary-satellite orbit (GSO) networks in the FSS in the 3 400-4 200 and 4 500-4 800 MHz frequency bands.

Report ITU-R S.2199 contains studies on compatibility of broadband wireless access systems and FSS networks in the 3 400-4 200 MHz frequency band.

Recommendation ITU-R SF.1486 contains a sharing methodology between fixed wireless access systems in the FS and VSATs in the FSS in the 3 400-3 700 MHz frequency band.

Recommendation ITU-R S.1856 contains methodologies for determining whether an IMT station at a given location operating in the frequency band 3 400-3 600 MHz would transmit without exceeding the power flux-density limits in RR Nos. **5.430A**, **5.432A**, **5.432B** and **5.433A**.

These studies show a potential for interference from IMT and broadband wireless access stations into FSS earth stations at distances of up to several hundred kilometers. Such large separation distances would impose substantial constraints on deployments of both mobile and earth stations. The studies also show that interference can occur when IMT systems are operated in the adjacent frequency band.

5/9.1.5/4 Regulatory and procedural considerations

Resolution **154 (WRC-12)** could be modified, calling for relevant administrations in Region 1 to use special care in the coordination, assignment, and management of frequencies taking into consideration the potential impact on the FSS earth stations used for satellite communications related to safe operation of aircraft and reliable distribution of meteorological information in the frequency band 3 400-4 200 MHz.

In parallel to the modification of Resolution **154 (WRC-12)**, consideration may be given to modifying RR No. **5.430A** to include a reference to the modified Resolution.

An example of modification of Resolution **154 (WRC-12)** follows.

MOD

RESOLUTION 154 (REV.WRC-~~12~~15)

~~Consideration of t~~Technical and regulatory actions in order to support existing and future operation of fixed-satellite service earth stations within the band 3 400-4 200 MHz, as an aid to the safe operation of aircraft and reliable distribution of meteorological information in some countries in Region 1

The World Radiocommunication Conference (Geneva, ~~2012~~2015),

considering

a) that the band 3 400-4 200 MHz is allocated worldwide to the fixed-satellite service (FSS) in the space-to-Earth direction and to the fixed service on a primary basis;

b) that the band 3 400-3 600 MHz is allocated on a primary basis to the mobile, except aeronautical mobile, service in the countries in Region 1 specified in No. **5.430A** and identified for International Mobile Telecommunications (IMT) in those countries;

c) that in Region 1 the allocation to the mobile, except aeronautical mobile, service in the band 3 400-3 600 MHz is subject to the technical and regulatory limitations listed in No. **5.430A**, aimed at ensuring compatibility with co-primary services of neighbouring countries;

d) that a number of developing countries rely, to a great extent, on FSS systems using very small aperture terminals (VSAT) in the band 3 400-4 200 MHz for provision of communications related to safe operation of aircraft and reliable distribution of meteorological information;

~~a~~e) that, in some cases ~~remote and rural areas often still lack a terrestrial communication infrastructure that meets the evolving requirements of modern civil aviation;~~

~~*b)* that the cost of providing and maintaining such an infrastructure could be expensive, particularly in remote regions;~~

~~*c)*~~ where an adequate terrestrial communication infrastructure is not available, ~~fixed-satellite service (FSS) earth stations~~VSAT networks referred to in *considering d)* above are the only viable option to ~~augment the communication infrastructure in order to satisfy the overall communications infrastructure~~ meet the safety requirements of the International Civil Aviation Organization (ICAO) and to ensure distribution of meteorological information under the auspices of the World Meteorological Organization (WMO);

f) that the relevant ITU-R studies showed a potential for interference from fixed wireless access and IMT stations into FSS receiving earth stations at distances from tens of kilometres up to hundreds of kilometres, depending on the parameters and deployment of stations of these services;

g) that WRC-12 recognized these sharing difficulties and decided to study technical and regulatory measures to support the FSS earth stations referred to in *considering e)* above,

~~*d)* that the use of FSS earth stations deployed in some countries in Region 1 for aeronautical communications has the potential to significantly enhance communications between air traffic control centres as well as with remote aeronautical stations,~~

noting

~~*a)* that the FSS is not a safety service;~~

~~*b)* that, by its Resolution **20 (Rev.WRC-03)**, WRC resolved to instruct the Secretary-General "to encourage ICAO to continue its assistance to developing countries which are endeavouring to improve their aeronautical telecommunications ...";~~

~~*c)* Recommendation ITU-R SF.1486 on sharing methodology between fixed wireless access systems in the fixed service (FS) and very small aperture terminals (VSATs) in the FSS in the 3 400-3 700 MHz band;~~

~~*d)* Report ITU-R S.2199 on studies on compatibility of broadband wireless access systems and FSS networks in the 3 400-4 200 MHz band;~~

~~*e)* Report ITU-R M.2109 on sharing studies between International Mobile Telecommunications-Advanced (IMT-Advanced) systems and geostationary-satellite networks in the fixed-satellite service in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands,~~

a) that by the date of WRC-15 several cases of harmful interference to the FSS VSATs used for aeronautical safety communications from fixed wireless access or IMT stations of the same administration were reported;

b) that these reported cases of interference revealed some national difficulties in the coordination of frequencies between the respective national telecommunication regulators responsible for licensing fixed wireless access or IMT systems and national aviation authorities responsible for the management of frequencies for aeronautical purposes, including assignments for VSATs;

c) that in many countries FSS VSAT earth stations are not subject to individual licencing and not registered as specific stations in national frequency databases and in the ITU Master International Frequency Register (MIFR) due to considerable administrative work;

d) that the knowledge of the location and operational frequencies of VSAT stations used for communications related to the safe operation of aircraft and/or distribution of meteorological information is critically important for ensuring compatibility with applications of other services,

recognizing

a) that ITU-R conducted comprehensive studies of compatibility between the FSS on the one hand and the fixed wireless access systems and IMT applications on the other hand in the band 3 400-4 200 MHz and summarized the results of the studies in Recommendation ITU-R SF.1486 as well as Reports ITU-R S.2199 and ITU-R M.2109;

b) that the Recommendation and Reports identified in *recognizing a)* offer a set of mitigation techniques that could be employed for international coordination and at a national level and to facilitate coexistence of FSS, fixed service and mobile service systems;

c) that Recommendation ITU-R S.1856 contains methodologies for verification of the power flux-density (pfd) limit set forth in No. **5.430A**,

resolves

1 that administrations shall ensure the compliance of the IMT stations subject to No. **5.430A** with the pfd limit set forth therein and apply the relevant coordination procedures before bringing these applications into use;

2 to urge administrations, when planning and licensing fixed point-to-point, fixed wireless access, and IMT systems in bands referred to in *considering b)* above, to take into account the protection needs of existing and planned FSS VSAT earth stations by coordinating the deployment of the systems mentioned above with the respective aviation and meteorological authorities at a national level;

3 to invite administrations, taking into account the number of earth stations involved for this particular type of usage, to consider the possibility of licensing the FSS VSAT earth stations used for communications related to the safe operation of aircraft and/or distribution of meteorological information on an individual basis and registering them in the MIFR as specific earth stations;

4 to encourage administrations to employ the appropriate mitigation techniques described in the ITU-R publications referred to in *recognizing a)* above;

5 to invite administrations to ensure that the application of these technical and regulatory measures to the FSS and mobile service does not limit the use of the band 3 400-4 200 MHz by other existing and planned systems and services in other countries,

~~*resolves to invite ITU-R*~~

~~to study possible technical and regulatory measures in some countries in Region 1 to support the existing and future FSS earth stations in the 3 400-4 200 MHz band used for satellite communications related to safe operation of aircraft and reliable distribution of meteorological information referred to in *considering c)*,~~

~~*invites*~~

~~all members of the Radiocommunication Sector, ICAO and WMO to contribute to these studies,~~

~~*instructs the Director of the Radiocommunication Bureau*~~

~~to include the results of these studies in his Report to WRC-15 for the purposes of considering adequate actions in response to *resolves to invite ITU-R* above,~~

instructs the Secretary-General

to bring this Resolution to the attention of ICAO and WMO.

5/9.1.8 Resolution 757 (WRC-12)

Regulatory aspects for nanosatelltes and picosatellites

(**WP 7B** / **WP 4A**, **SC**, (WP 5A), (WP 6A))

5/9.1.8/1 Executive summary

Resolution **757 (WRC-12)** called for studies by ITU-R "to examine the procedures for notifying space networks and consider possible modifications to enable the deployment and operation of nanosatellites and picosatellites, taking into account the short development time, short mission time and unique orbital characteristics".

Efforts should be undertaken to help increase knowledge and raise awareness about the applicable regulatory procedures for satellite networks among those entities involved in development and launch of nanosatellites and picosatellites.

The existing provisions of the Radio Regulations (RR) related to the coordination and notification of satellite network filings may need to be modified to take into account the short time scales and orbital parameter uncertainties prior to launch for many nanosatellite and picosatellite missions. This work could be carried out as an explicit item under the standing agenda item of a future WRC for the consideration of regulatory procedures for notifying satellite networks. Given that nanosatellites and picosatellites use the same frequency bands as those of other space services, it is important that any changes to the RR do not lead to the potential for harmful interference to other services, and that the accommodation of nanosatellite and picosatellite systems should not inadvertently affect the regulatory procedures for other satellite systems.

5/9.1.8/2 Background

WRC-12 adopted Resolution **757 (WRC-12)** which *resolves* to invite WRC-18 to consider whether modifications to the regulatory procedures for notifying satellite networks are needed to facilitate the deployment and operation of nanosatellites and picosatellites, and to take the appropriate actions, and *invites* ITU-R to examine the procedures for notifying space networks and consider possible modifications to enable the deployment and operation of nanosatellites and picosatellites, taking into account the short development time, short mission time and unique orbital characteristics.

The work was allocated to Working Party 7B as the responsible group. Working Party 4A and the Special Committee are contributing groups, and Working Parties 5A and 6A are interested groups.

Nanosatellites and picosatellites are being used for a wide variety of missions and applications, including remote sensing, space weather research, upper atmosphere research, astronomy, communications, technology demonstration, amateur radio and education, as well as commercial applications, and therefore may operate under various radiocommunication services.

There is an interest in utilizing the potential benefits offered by small satellites, including those referred to as nanosatellites or picosatellites. These technologies allow many projects to be developed quickly and deployed with lower cost than with traditional satellites. Because these technologies introduce new entrants to the space sector, such as universities and research institutions, there is a risk that a lack of knowledge or familiarity with the existing ITU satellite filing rules and procedures (RR Articles **9** and **11**) and their applicability to nanosatellites and picosatellites will contribute to difficulties such as harmful interference which could be difficult to resolve if the BR are unaware of the satellite operation.

Recent system developer experiences have shown that the development, deployment and launch arrangement timelines for some nanosatellite and picosatellite systems may be much shorter than for traditional satellite systems. This creates a challenge for providing the mission specific orbital parameters which are required for compiling the Advance Publication Information (API) in a timely fashion.

Furthermore, some nanosatellites and picosatellites currently use spectrum allocated to the amateur satellite service and the meteorological satellite service although they are not strictly designed for these services.

5/9.1.8/3 Summary of technical and operational studies and relevant ITU-R Recommendations

PDN Report ITU-R SA.[NANO/PICOSAT CHARACTERISTICS] addresses the characteristics of nanosatellites and picosatellites and, for each characteristic, indicates both the differences and commonalities with traditional satellites. This Report provides answers to the 3 questions asked as part of Question ITU-R 254/7. Nanosatellite and picosatellite technologies have provided unprecedented access to space by way of their reduced deployment timelines and costs. Further, standardization of certain physical aspects allows increased flexibility for their deployment as secondary payloads.

While nanosatellites and picosatellites are most often recognized by their small physical dimensions and mass, there are several other technical aspects which make them different from more traditional satellite technologies. These may include short development times, short operational life, lower available electrical power, and a lack of on board propulsion. It should be noted that most of these characteristics, as well as physical dimensions and mass, are not part of the information to be submitted under RR Appendix 4. Therefore, it is difficult to distinguish this class of satellites from others from the perspective of the **RR**.

Nevertheless, nanosatellites and picosatellites may be used for a variety of applications in a number of different satellite services. Currently, these applications are often, but not always, experiments, tests or technology demonstrations. As new concepts are continually being developed for nanosatellite and picosatellite applications, the differences between these satellites and traditional satellites become less distinct.

PDN Report ITU-R SA.[NANO/PICOSAT CURRENT PRACTICE] addresses the current regulatory practice for nanosatellites and picosatellites, and identifies the difficulties encountered in applying the RR. This Report is in response to the invitation to examine procedures for notifying space networks as called for in Resolution **757 (WRC-12)**.

This Report presents an overview of the current practice from various administrations, the BR, the International Amateur Radio Union as well as nanosatellite and picosatellite developers in the application of ITU satellite filing rules and procedures (RR Articles **9** and **11**) to nanosatellites and picosatellites.

It is found that one of the largest challenges in the current practice of filing satellites is the late knowledge of orbital parameters.

For the initiation of an advance publication of information (API) the orbital parameters are mandatory. Even when the required parameters are known, the schedule and pace at which many nanosatellite and picosatellite programs currently proceed may be more rapid than the regulatory timelines associated with the existing advance publication, coordination and notification process.

The minimum time required for the ITU filing procedures to process the API and corresponding comments before a network can be brought into use is typically about 8 months. In practice, the overall time needed to file a satellite network until entry into the Master International Frequency

Register and launch can vary widely from one administration to another. Furthermore, the time to modify the satellite system parameters to address comments on the API has to be taken into account as well. On some occasions, nanosatellites and picosatellites have not been able to complete the regulatory procedures before launch.

Additionally, more familiarity with the applicable rules and procedures also is needed by some of those involved in developing and launching nanosatellites and picosatellites, for whom it may be the first time they have had to apply the filing procedures.

5/9.1.8/4 Regulatory and procedural considerations

In response to Resolution **757 (WRC-12)**, ITU-R developed two Reports on nanosatellite and picosatellite characteristics and current practice. These Reports conclude that while nanosatellites and picosatellites have a number of distinctive characteristics, the differences between these satellites and traditional satellites become less distinct when considering their spectrum requirements and the services under which these satellites can operate.

The ITU-R Study Groups have concluded that additional efforts should be undertaken by the BR, administrations, and others to help increase knowledge and raise awareness about the applicable regulatory procedures for satellite networks among those entities involved in development and launch of nanosatellites and picosatellites. Increased familiarity with the applicable rules could help ameliorate some of the regulatory challenges that operators have experienced with many nanosatellite and picosatellite operations.

Some administrations have taken steps domestically to advise nanosatellite and picosatellite operators of the applicable ITU filing requirements, and it could be explored how ITU may be able to provide additional support.

Another relevant response to this issue could be to consider modifications to the regulatory procedures for notifying satellite networks to accommodate nanosatellite and picosatellite missions. The existing provisions of the RR related to the coordination and notification of satellite network filings may need to be modified to take into account the short time scales and orbital parameter uncertainties prior to launch for many nanosatellite and picosatellite missions. This work could be carried out as an explicit item under the standing agenda item of a future WRC for the consideration of regulatory procedures for notifying satellite networks.

Additionally, given that nanosatellites and picosatellites use the same frequency bands as those of other space services, it is important that any changes to the RR do not lead to the potential for harmful interference to other services. Placing nanosatellites and picosatellites under a different regulatory regime could add complexity and an unnecessary burden to the regulatory procedures. Finally, any changes to the RR to accommodate nanosatellites and picosatellite systems should not inadvertently affect the regulatory procedures for other satellite systems.

AGENDA ITEM 9.3

(Depending on contributions from administrations / **WP 4A**)

9 to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:

*9.3 on action in response to Resolution **80 (Rev.WRC-07)**;*

Resolution **80** (**Rev.WRC-07**): *Due diligence in applying the principles embodied in the Constitution*

5/9.3/1 Executive summary

WRC-15 agenda item 9.3 references Resolution **80 (Rev.WRC-07)**. *Resolves 1* of this Resolution instructs the Radiocommunication Sector to, *inter alia*, conduct studies on procedures for measurement and analysis of the basic principles contained in Article 44 of the Constitution.

The scope of ITU-R has been to conduct its work with a view to fulfilling the referenced principles in Article 44 of the Constitution. In this respect it has conducted many analyses to 1) provide for equitable access to the geostationary-satellite orbit (GSO), and 2) adopt Reports and Recommendations which promote efficient use of the GSO.

5/9.3/2 Background

Resolution **80**, *Due Diligence in Applying the Principles Embodied in the Constitution*, was first adopted by WRC-97 and subsequently revised by WRC-2000 and WRC-07. Each version of Resolution **80** has instructed the Radio Regulations Board (RRB) either to develop Rules of Procedure, conduct studies, or consider and review possible draft recommendations related to linking the principles contained in No. **0.3** of the Preamble to the Radio Regulations (RR) to the notification, coordination and registration procedures in the RR and to report to a subsequent WRC. In the case of Resolution **80 (Rev.WRC-07)**, these linkages were extended to include the principles contained in Article 44 of the Constitution. The 2007 revision of this Resolution pointed out that some of the issues identified in the RRB report to WRC-2000 had been resolved before WRC-07. Throughout its existence, Resolution **80** has related to the use of the radio-frequency spectrum and the satellite orbital resources.

5/9.3/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

5/9.3/3.1 Equitable access to the GSO

The RR, in general, have been developed so as to enable all administrations to apply the provisions pertaining to access to the GSO in a uniform manner. In addition, due to concerns that some administrations may be somehow disadvantaged in the application of these provisions, the RR Appendices **30**, **30A**, and **30B** are intended to provide for a guarantee of access to the GSO by all Member States of the ITU. RR Appendices **30** and **30A** were designed to provide for the guaranteed use of frequencies from GSO positions for the transmissions of BSS. Similarly, RR Appendix **30B** was designed to provide a guarantee of access to spectrum allocated to the FSS for use from orbital positions on the GSO. Within the RR Appendix **30B** Plan, there is 1 600 MHz of spectrum (800 MHz uplink/800 MHz downlink) for each Member State of the ITU.

5/9.3/3.2 Efficient use of the GSO

During the last 30 years WP 4A and its predecessor IWP 4/1 has carried out numerous analyses to improve the efficient use of the GSO spectrum resource. As a testimony to the success of these efforts, there are today over 200 communication satellites operating in orbit. This has been accomplished through a variety of techniques and through approval of numerous ITU-R Recommendations and Reports. These include, for example:

a. Station Keeping tolerance of +/-0.1 degrees, see Recommendation ITU-R S.484 "Station keeping in longitude of geostationary satellites in the fixed-satellite service".

b. Earth station off-axis antenna gain patterns, see Recommendations ITU-R S.465 "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" and ITU-R S.1855 "Alternative reference radiation pattern for earth station antennas used with satellites in the geostationary-satellite orbit for use in coordination and/or interference assessment in the frequency range from 2 to 31 GHz".

c. Implementation of a coordination arc in RR Appendix **5**. Study being conducted to analyze impact of reduction in coordination arc to further simplify coordination.

d. Specification of earth station off-axis power levels, see Recommendation ITU-R S.524 "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".

e. Adaptive power control standards, see Recommendation ITU-R S.1255 "Use of adaptive uplink power control to mitigate codirectional interference between geostationary-satellite orbit/fixed-satellite service (GSO/FSS) networks and feeder links of non-geostationary satellite orbit/mobile satellite service (non-GSO/MSS) networks and between GSO/FSS networks and non-GSO/FSS networks".

f. Sharing methodologies, see Recommendation ITU-R S.1593 "Methodology for frequency sharing between certain types of homogeneous highly-elliptical orbit non-geostationary fixed-satellite service systems in the 4/6 GHz and 11/14 GHz frequency bands".

g. Polarization standards, see Recommendation ITU-R S.736 "Estimation of polarization discrimination in calculations of interference between geostationary-satellite networks in the fixed-satellite service".

h. Updates on service requirements for newer digital modulation techniques, see Recommendation ITU-R S.1782 "Possibilities for global broadband internet access by fixed-satellite service systems".

5/9.3/3.3 Seminars/Workshops

In addition to the above, the ITU-R Sector has sponsored a number of Workshops and Seminars such as the one held in June 2013 which addressed the prevention of harmful interference to the FSS. These events organised by the Radiocommunication Bureau (BR) provide opportunities for disseminating knowledge of the coordination and notification procedures and for sharing best practices among administrations.

5/9.3/4 Regulatory and procedural considerations

The Plans contained in RR Appendices **30**, **30A** and **30B** have been analysed and updated since their inception. For example, in WRC-2000 and WRC-03, RR Appendices **30** and **30A** were significantly revised to increase the capacity that is available to each ITU Member State. In

WRC-07, the technical characteristics of the RR Appendix **30B** Plan were modified to improve efficiency of the Plan. If the guarantee of access to the GSO has not been fulfilled by these Plans, then perhaps the Plans should be modified to better achieve such an objective.

Furthermore, the activities described in sections 5/9.3/3.2 and 5/9.3/3.3 reflect the other technical actions related to improving equitable access to the GSO/spectrum and it is expected that similar work will continue in the future for constantly improving the efficient use of the GSO.

Views were expressed that Resolution **80 (Rev.WRC-07)** has been assigned to various groups such as the Radiocommunication Advisory Group, RRB, Working Party of the Special Committee, Working Party 4A and previous WRCs without specific results to address the issue raised in this Resolution. As such, it may be time to decide on the retention or otherwise of this Resolution.

CHAPTER 6

General issues

(Agenda items 2, 4, 9.1 (issues 9.1.4, 9.1.6, 9.1.7), 10)

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AGENDA ITEM 2

(**CPM15-2** / -)

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-03)****, 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-03)**: *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-03)** and **27 (Rev.WRC-12),** the Director of the Radiocommunication Bureau is preparing a Report to the second session of CPM-15.

AGENDA ITEM 4

(**CPM15-2** / -)

*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-15.

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-12;

NOTE: Eight issues have been identified by CPM15-1 under this agenda item.

6/9.1.4 Resolution 67 (WRC-12)

Updating and rearrangement of the Radio Regulations

(**WP 1B, SC**[52]) / **-**)

6/9.1.4/1 Executive summary

In accordance with Resolution **67 (WRC-12)**, ITU-R carried out studies during this study period and considered the issue of possible updating, review and possible revision of outdated information, and rearrangement of certain parts of the Radio Regulations (RR), except for Articles **1, 4, 5, 6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 18, 21, 22, 23** and **59** and those parts which are being revised on a regular basis.

On the basis of input contributions and documents for the meetings of the ITU-R responsible group, the following issues have been developed:

– Issue A: Modification to RR Article **2**, and

– Issue B: Modification to the titles of some RR Articles for the purpose of better reflecting in the title the scope of these articles.

For Issue A, two options are proposed: Option A1 to keep unchanged RR Article **2** and Option A2 to modify RR No. **2.1** in order to delete the unused abbreviations provided in this provision.

For Issue B, two options are proposed: Option B1 to keep unchanged the RR and Option B2 to modify the title of RR Articles **37, 39, 40, 42, 43, 44, 47, 49, 50, 52** and **53**.

6/9.1.4/2 Background

WRC-12 adopted Resolution **67** on the updating and rearrangement of the Radio Regulations, which

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[52] The Special Committee (SC) activities consist of two categories:

a) work assigned directly to the SC by CPM15-1, for which the SC or its Working Party may initiate its studies as appropriate; and

b) tasks related to regulatory aspects of work assigned by CPM15-1 to the Study Groups and their Working Parties, for which the SC and its Working Party initiate studies on procedural and regulatory text based on inputs from the Study Groups/Working Parties and contributions from the membership; the initial meeting of the SC or its Working Party on this category b) will be held in consultation with the CPM Chairman and the Study Groups and their Working Parties.

"resolves to invite ITU-R

1 to initiate studies for possible updating, review and possible revision of outdated information, and rearrangement of certain parts of the Radio Regulations, except for Articles **1, 4, 5, 6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 18, 21, 22, 23** and **59** and those parts which are being revised on a regular basis, as appropriate;

2 to submit the results of these studies for consideration by a future world radiocommunication conference in accordance with this Resolution,"

It is important to note that it was recognized that all proposed modifications should not affect the work under other agenda items of WRC-15.

6/9.1.4/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

6/9.1.4/3.1 Issue A: Modification of RR Article 2

The analysis of the RR has shown that there are certain abbreviations in RR Article **2** that are not used anywhere else in the texts of the RR and ITU-R Recommendations incorporated in by reference in the RR.

More specifically, the last column of the Table of RR No. **2.1** contains metric abbreviations for the bands, which are not used anywhere else.

While some administrations supported deleting these abbreviations, some other administrations noticed that the above-mentioned information existed in the RR for many years and that it would be better to keep it. For these reasons, the following two Options are proposed:

– Option A1: No change to the RR (NOC);

– Option A2: Delete the Abbreviation column in the Table of RR No. **2.1** (MOD).

An example of modifications to RR No. **2.1** is given in Section 6/9.1.4/4.1.

6/9.1.4/3.2 Issue B: Modification of the titles of some RR Articles

– Option B1: No change to the RR (NOC);

– Option B2: Modify the title RR Articles **37, 39, 40, 42, 43, 44, 47, 49, 50, 52** and **53**.

Taking into account the analysis performed, it is proposed to make the following changes listed in the table below to the titles of some RR Articles in order to improve the understanding, ease of use and readability of the RR texts.

Changes in the titles of some RR Articles

RR Articles	Proposed changes to the title
Article **37**	Operator's certificates in the aeronautical services
Article **47**	Operator's certificates in the maritime services
Article **39**	Inspection of stations in the aeronautical services
Article **49**	Inspection of stations in the maritime services
Article **40**	Working hours of stations in the aeronautical services
Article **50**	Working hours of stations in the maritime services
Article **42**	Conditions to be observed by stations in the aeronautical services The above change is proposed to be in line with the change made in the title of Article 51 – Conditions to be observed in the maritime services
Article **43**	Special rules relating to the use of frequencies in the aeronautical services
Article **52**	Special rules relating to the use of frequencies in the maritime services
Article **44**	Order of priority of communications in the aeronautical services
Article **53**	Order of priority of communications in the maritime services

Examples of possible proposals to modify these RR Articles are given in Section 6/9.1.4/4.2.

6/9.1.4/4 Regulatory and procedural considerations

6/9.1.4/4.1 Issue A: Modification to RR Article 2

An example of modifications to RR No. **2.1** under Option A2 is given below:

ARTICLE 2

Nomenclature

Section I – Frequency and wavelength bands

MOD

2.1 The radio spectrum shall be subdivided into nine frequency bands, which shall be designated by progressive whole numbers in accordance with the following table. As the unit of frequency is the hertz (Hz), frequencies shall be expressed:

– in kilohertz (kHz), up to and including 3 000 kHz;

– in megahertz (MHz), above 3 MHz, up to and including 3 000 MHz;

– in gigahertz (GHz), above 3 GHz, up to and including 3 000 GHz.

However, where adherence to these provisions would introduce serious difficulties, for example in connection with the notification and registration of frequencies, the lists of frequencies and related matters, reasonable departures may be made[1]. (WRC-07)

Band number	Symbols	Frequency range (lower limit exclusive, upper limit inclusive)	Corresponding metric subdivision	~~Metric abbreviations for the bands~~
4	VLF	3 to 30 kHz	Myriametric waves	~~B.Mam~~
5	LF	30 to 300 kHz	Kilometric waves	~~B.km~~
6	MF	300 to 3 000 kHz	Hectometric waves	~~B.hm~~
7	HF	3 to 30 MHz	Decametric waves	~~B.dam~~
8	VHF	30 to 300 MHz	Metric waves	~~B.m~~
9	UHF	300 to 3 000 MHz	Decimetric waves	~~B.dm~~
10	SHF	3 to 30 GHz	Centimetric waves	~~B.cm~~
11	EHF	30 to 300 GHz	Millimetric waves	~~B.mm~~
12		300 to 3 000 GHz	Decimillimetric waves	

NOTE 1: “Band N” (N = band number) extends from 0.3×10^N Hz to 3×10^N Hz.
NOTE 2: Prefix: k = kilo (10^3), M = mega (10^6), G = giga (10^9).

6/9.1.4/4.2 Issue B: Modification to the titles of some RR Articles

An example of modifications to the titles of some to RR Articles under Option B2 is given below:

MOD

ARTICLE 37

Operator’s certificates <u>in the aeronautical services</u>

MOD

ARTICLE 39

Inspection of stations <u>in the aeronautical services</u>

MOD

ARTICLE 40

Working hours of stations <u>in the aeronautical services</u>

MOD

ARTICLE 42

Conditions to be observed by stations in the aeronautical services

MOD

ARTICLE 43

Special rules relating to the use of frequencies in the aeronautical services

MOD

ARTICLE 44

Order of priority of communications in the aeronautical services

MOD

ARTICLE 47

Operator's certificates in the maritime services

MOD

ARTICLE 49

Inspection of stations in the maritime services

MOD

ARTICLE 50

Working hours of stations in the maritime services

MOD

ARTICLE 52

Special rules relating to the use of frequencies in the maritime services

MOD

ARTICLE 53

Order of priority of communications in the maritime services

6/9.1.6 Resolution 957 (WRC-12)

Studies towards review of the definitions of fixed service, fixed station and mobile station

(**WP 1B / WP 4A, WP 4C, WP 5A, WP 5C, WP 5D, WP 7B, WP 7C, WP 7D**)

6/9.1.6/1 Executive summary

ITU-R carried out studies in accordance with Resolution **957 (WRC-12)**. During this study period, definitions of *fixed service, fixed station and mobile station* have been carefully reviewed, together with the study of the potential impact on regulatory procedures in the Radio regulations (RR) (coordination, notification and recording) and of the impact on current frequency assignments and other services resulting from possible changes to the definitions.

The responsible group discussed contributions and proposals from administrations and organizations, and timely informed concerned groups of up-to-date progress on this issue. Responses from the concerned groups were taken into account.

According to the contributions and liaison statements, after thorough discussions, ITU-R developed one regulatory and procedural consideration, i.e. to suppress Resolution **957 (WRC-12)** to satisfy issue 9.1.6 of agenda item 9.1, with the consideration that retaining the current definitions for the *fixed service*, *fixed station* and *mobile station* in RR Article **1** is able to adapt to technology evolution and that there is sufficient flexibility within the present RR.

Furthermore, it was concluded that there was no need to develop a new ITU-R Report under this issue.

6/9.1.6/2 Background

WRC-12 considered certain revisions to the definitions of the *fixed service, fixed station* and *mobile station* in RR Article **1** based on studies undertaken to address fixed and mobile convergence under WRC-12 agenda item 1.2, but decided that this issue should be reviewed and studied further for consideration by WRC-15 under the Report of the Director of the Radiocommunication Bureau. While WRC-12 agenda item 1.2 examined the much broader context of enhancing the international regulatory framework, WRC-15 agenda item 9.1, issue 9.1.6 has been adopted to focus specifically on the possible modifications to these three definitions to address convergence and support the implementation of efficient spectrum management practices and spectrum use.

6/9.1.6/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The contributing working parties in charge of satellite and terrestrial services have indicated that

– proposed modifications to the definitions of fixed service, fixed station and mobile station was extensively discussed at the two previous WRCs;

– such modification would have adverse impact on the operation of various satellite radiocommunication services/systems due to the fact that such changes would totally modify the sharing and interference environment for space services and make the task of administrations very difficult, if not impossible, in the coordination process between satellite networks and terrestrial services;

– not being aware of any issues with the current definitions, there is no necessity for any changes to the definition of the fixed service, fixed station and mobile station in response to this agenda item.

6/9.1.6/4 Regulatory and procedural considerations

No change to the radio regulations apart from the suppression of Resolution **957 (WRC-12)**.

SUP

RESOLUTION 957 (WRC-12)

Studies towards review of the definitions of fixed service, fixed station and mobile station

6/9.1.7 Resolution 647 (Rev.WRC-12)

Spectrum management guidelines for emergency and disaster relief radiocommunication

(**WP 1B** / **-**)

6/9.1.7/1 Executive summary

ITU-R carried out studies in accordance with Resolution **647 (Rev.WRC-12)**. During this study period, the issue of spectrum management guidelines for emergency and disaster relief radiocommunication was reviewed, under WRC-15 agenda item 9.1, issue 9.1.7.

According to the contributions from administrations and organizations as well as the liaison statements from other Working Parties, the ITU-R responsible group developed three options of regulatory and procedural considerations to satisfy this issue.

The three options are:

– **Option A**: modification to Resolution **647 (Rev.WRC-12)** and consequential suppression of Resolution **644 (Rev.WRC-12)**;

– **Option B**: modification of Resolution **647 (Rev.WRC-12)** only;

– **Option C**: suppression of Resolution **647 (Rev.WRC-12)** and the consequential modification of Resolution **644 (Rev.WRC-12)**;

Work on this issue of WRC-15 agenda item 9.1 concluded that a new ITU-R deliverable was unnecessary.

6/9.1.7/2 Background

Resolution **647 (Rev.WRC-12)** deals with emergency and disaster relief radiocommunications. Studies with respect to this issue were identified by CPM15-1 as issue 9.1.7 under agenda item 9.1. The Director of the Radiocommunication Bureau (BR) is expected to report on the studies and the progress of this Resolution at WRC-15.

The Director's report may address the following issues, among others, from the resolution:

– resolves to encourage administrations to communicate to the BR, as soon as possible, the frequencies available for use in emergency and disaster relief and reiterate to administrations the importance of having frequencies available for use in the very early stages of humanitarian assistance intervention for disaster relief[53]; and,

– invites ITU-R to conduct studies as necessary, and as a matter of urgency, in support of the establishment of appropriate spectrum management guidelines applicable in emergency and disaster relief operations.

It is important to note that all proposed modifications should not affect the work under agenda item 1.3 of WRC-15.

6/9.1.7/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

6/9.1.7/3.1 Summary of technical and operational studies

Databases of frequencies available for use in emergency and disaster relief:

ITU-R considered the issue together with the number of available frequencies within the terrestrial and space databases maintained by the BR. Only some administrations had provided information about available frequencies for use in emergency situations. This limited number information[54] seems not appropriate to satisfy the need of spectrum harmonisation and coordination in emergency situations as outlined in Resolution **647 (Rev.WRC-12)**.

Mindful of the requirement that fast and effective response is essential in emergency situations, which leads also to the requirement of interoperable and seamless communication to allow efficient disaster relief operations, ITU-R concluded that the further developments in that regard should also encourage administrations to provide up-to-date point(s) of contact within the administration and information about spectrum planning for emergency and/ or disaster relief operations to the BR.

ITU-R considered some regulatory considerations how this could be implemented, which are outlined in Section 6/9.1.7/4 and noted that consequential changes of Resolution ITU-R 53 may be required regarding the databases of available frequencies for disaster relief radiocommunication.

[53] The database may be accessed at http://www.itu.int/ITU R/go/res647.

[54] As of April 30th, 2014, 26 administrations have provided more than 650 frequencies/frequency bands for use in Emergency and Disaster Relief situations, and 6 administrations have provided 72 available frequencies/frequency bands in space services emergency database.

ITU-R Documentation providing information on spectrum management guidelines applicable in emergency and disaster relief operations:

ITU-R has developed a Handbook as well as many Recommendations and Reports within Study Groups relating to emergency and disaster relief (see Section 6/9.1.7/3.2).

No additional guidelines have been developed by the responsible group for agenda item 9.1, issue 9.1.7. Consequently, it may be appropriate to revise Resolution **647 (Rev.WRC-12)** to reflect the current status of available ITU-R documentation relating to emergency and disaster relief operations and the need to keep this information up-to-date and only develop additional information as needed.[55]

Proposed consolidation of Resolutions 644 and 647:

Noting that Resolution **647 (Rev.WRC-12)** is used within and outside ITU-R (e.g. ITU-R website, UN specialized agencies on emergency and disaster relief) and contains elements which are still relevant, Resolution **647 (Rev.WRC-12)** should be retained and updated. In reviewing Resolutions related to emergency and disaster relief, similarities were noted between Resolution **644 (Rev.WRC-12)** and **647 (Rev.WRC-12)** and therefore there may be an opportunity to combine them. This may also help to avoid any duplication or overlap in studies. The suggested approach for consolidation is to incorporate required elements from Resolution **644 (Rev.WRC-12)** into an updated Resolution **647 (Rev.WRC-12)**.

Proposed modification of Resolution 647:

The proposed modification to Resolution **647 (Rev.WRC-12)** encourages administrations to provide relevant up-to-date information to the database. While Resolution **644 (Rev.WRC-12)** deals with the radiocommunication resources for early warning and disaster relief operations, Resolution **647 (Rev.WRC-12)** is concerned with the spectrum management guidelines for emergency and disaster relief radiocommunication. Therefore, this option proposes to only revise Resolution **647 (Rev.WRC-12)**.

Proposed suppression of Resolution 647:

It is noted that Resolutions **644** and **647** overlap in many areas. Consequently, it is possible to combine the activities requested and outlined into a single consolidated resolution and suppress the other one. For option C, noting the importance of Resolution **644 (Rev.WRC-12)** which is in particular explicitly referenced in the Tamper Convention (Tampere, 1998)[56], the preferred solution is to use Resolution **644 (Rev.WRC-12)** as the main starting point and then include within this any necessary items that will be lost in the suppression of Resolution **647 (Rev.WRC-12)**.

6/9.1.7/3.2 List of relevant ITU-R Recommendations, ITU-R Reports, and Handbook

Recommendations: ITU-R F.1105, ITU-R M.1042, ITU-R M.1637, ITU-R M.1826, ITU-R M.1854, ITU-R M.2009, ITU-R M.2015, ITU-R S.1001 and ITU-R RS.1859.

Reports: ITU-R M.2033, ITU-R M.2085, ITU-R M.2149, ITU-R S.2151 and ITU-R BT.2299

Handbook: *ITU-R Emergency and Disaster relief*

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[55] The ITU-R Emergency Radiocommunications webpage may be accessed at http://www.itu.int/ITU-R/go/emergency.

[56] However, a number of countries have not ratified the Tampere Convention.

6/9.1.7/4 Regulatory and procedural considerations

6/9.1.7/4.1 Option A: Modification to Resolution 647 (Rev.WRC-12) and consequential suppression of Resolution 644 (Rev.WRC-12)

MOD

RESOLUTION 647 (REV.WRC-~~12~~15)

Radiocommunication resources and ~~S~~spectrum management guidelines for early warning, mitigation and relief operations relating to emergency and disaster ~~relief radiocommunication~~[1]

The World Radiocommunication Conference (Geneva, 20~~12~~15),

considering

a) that natural disasters have underscored the importance of utilizing effective measures to mitigate their effects, including prediction, detection and alerting through the coordinated and effective use of radio-frequency spectrum;

b) ITU's comprehensive role in emergency communications, not only in the field of radiocommunications, but also in the area of technical standards to facilitate interconnection and interoperability of networks for monitoring and management at the onset of and during emergency and disaster situations, and as an integral part of the telecommunication development agenda through the Hyderabad Action Plan;

c) that administrations have been urged to take all practical steps to facilitate the rapid deployment and effective use of telecommunication resources for early warning, emergency, disaster mitigation and relief operations by reducing and, where possible, removing regulatory barriers and strengthening global, regional and transborder cooperation between States;

d) that effective use of telecommunications/information and communication technologies (ICTs), at the onset of and during critical emergencies, are essential for disaster prediction, detection, early-warning, mitigation, management, and relief strategies and operations play a vital role in the safety and security of relief workers in the field;

e) the particular needs of developing countries and the special requirements of the inhabitants living in high-risk areas exposed to disasters, as well as those living in remote areas;

f) the work carried out by the Telecommunication Standardization Sector in standardizing the common alerting protocol (CAP), through the approval of the relevant CAP Recommendation,

~~*c)* that Resolution **644 (Rev.WRC-12)**, on radiocommunication resources for early warning, disaster mitigation and relief operations, resolves that ITU-R continue to study, as a matter~~

1 ~~The term "~~Radiocommunication for mitigation and relief operations relating to emergency and disaster ~~relief radiocommunication"~~ refers to radiocommunications used by agencies and organizations dealing with a serious disruption of the functioning of society, posing a significant widespread threat to human life, health, property or the environment, whether caused by accident, natural phenomena or human activity, and whether occurring suddenly or as a result of complex, long-term processes.

of urgency, those aspects of radiocommunications/ICT that are relevant to early warning, disaster mitigation and relief operations;

d) that Resolution **646 (Rev.WRC-12)** addresses the broader category of public protection and disaster relief (PPDR) and encourages administrations to consider identified frequency bands/ranges or parts thereof when undertaking their national planning for the purposes of achieving regionally harmonized frequency bands/ranges for advanced public protection and disaster relief solutions;

e) that Resolution 36 (Rev. Guadalajara, 2010) addresses the role of telecommunications/ICTs in the service of humanitarian assistance, Resolution 136 (Rev. Guadalajara, 2010) addresses the use of ICTs for monitoring and management in emergency and disaster situations for early warning, prevention, mitigation and relief, and Resolution 34 (Rev. Hyderabad, 2010) addresses the role of telecommunications/ICTs in disaster preparedness, early warning, rescue, mitigation, relief and response,

recognizing

a) that the Tampere Convention on the Provision of Telecommunications Resources for Disaster Mitigation and Relief Operations (Tampere, 1998)[2], an international treaty deposited with the United Nations Secretary-General, calls on the States Parties, when possible, and in conformity with their national law, to develop and implement measures to facilitate the availability of telecommunication resources for such operations;

b) Article 40 of the Constitution, on priority of telecommunications concerning safety of life;

c) Article 46 of the Constitution, on distress calls and messages;

d) Resolution 34 (Rev. Dubai, 2014) of the World Telecommunication Development Conference, on the role of telecommunications/information and communication technology in disaster preparedness, early warning, rescue, mitigation, relief and response, as well as ITU-D Question 22-1/2 "Utilization of telecommunications/ICTs for disaster preparedness, mitigation and response";

e) Resolution 36 (Rev. Guadalajara, 2010) of the Plenipotentiary Conference, on telecommunications/ICTs in the service of humanitarian assistance;

f) Resolution 136 (Rev. Guadalajara, 2010) of the Plenipotentiary Conference, on the use of telecommunications/ICTs for monitoring and management in emergency and disaster situations for early warning, prevention, mitigation and relief;

g) Resolution ITU-R 53, on the use of radiocommunications in disaster response and relief;

h) Resolution ITU-R 55, on the ITU-R studies of disaster prediction, detection, mitigation and relief;

i) that Resolution **646 (Rev.WRC-12)** addresses the broader category of public protection and disaster relief (PPDR) and encourages administrations to consider identified frequency bands/ranges or parts thereof when undertaking their national planning for the purposes of achieving regionally harmonized frequency bands/ranges for advanced public protection and disaster relief solutions;

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2 However, a number of countries have not ratified the Tampere Convention.

~~b~~j) that some administrations may have different operational needs and spectrum requirements for emergency and disaster-relief applications, depending on their circumstances;

~~c~~k) that the immediate availability of spectrum and relevant contact information to support emergency radiocommunication equipment is important for successful telecommunications in the very early stages of humanitarian assistance intervention for disaster relief,

aware

of the progress made in regional organizations around the world, and in particular in regional telecommunication organizations, on matters related to emergency communications planning and response,

recognizing further

that the ITU-R has developed a Handbook on Emergency and Disaster Relief as well as various Reports and Recommendations relating to emergency and disaster relief operations and radiocommunication resources,

~~*a)* Resolution ITU-R 55, which invites the ITU-R Study Groups to take into consideration the scope of ongoing studies/activities outlined in the annex to the Resolution, and to develop guidelines related to the management of radiocommunications in disaster prediction, detection, mitigation and relief, collaboratively and cooperatively, within ITU and with organizations external to the Union, in order to avoid duplication of effort;~~

~~*b)* Resolution ITU-R 53, which instructs the Director of the Radiocommunication Bureau to assist Member States with their emergency radiocommunication preparedness activities such as the listing of currently available frequencies for use in emergency situations for inclusion in a database maintained by the Bureau,~~

noting

a) the close relation of this Resolution with Resolution **646 (Rev.WRC-12)**, on public protection and disaster relief, and the need to coordinate activities under these Resolutions in order to prevent any possible overlap;

~~a~~b) that when a disaster occurs, the disaster relief agencies are usually the first on the scene using their day-to-day communication systems, but that in most cases other agencies and organizations may also be involved in disaster relief operations;

~~b~~c) that there is a critical requirement to perform immediate spectrum management actions, including frequency coordination, sharing and spectrum reuse, within a disaster area;

~~c~~d) that national spectrum planning for emergency and disaster relief should take into account the need for cooperation and bilateral consultation with other concerned administrations, which can be facilitated by spectrum harmonization, as well as agreed spectrum management guidelines pertaining to disaster relief and emergency planning;

~~d~~e) that in times of disasters, radiocommunication facilities may be destroyed or impaired ~~and the national regulatory authorities may not be able to provide the necessary spectrum management services for the deployment of radio systems for relief operations~~;

~~e~~f) that the availability of information, such as the identification of administration focal points, frequency availability within individual administrations within which equipment could operate, and any relevant instructions or procedures, may ease the interoperability and/or interworking, with mutual cooperation and consultation, especially in national, regional and cross-border emergency situations and disaster relief activities,

noting further

a) that flexibility must be afforded to disaster relief agencies and organizations to use current and future radiocommunications, so as to facilitate their humanitarian operations;

b) that it is in the interest of administrations and disaster relief agencies and organizations to have access to updated information on national spectrum planning for emergency and disaster relief,

taking into account

a) ~~BR Circular Letters CR/281 (13 March 2008), CR/283 (6 May 2008) and its Corrigendum 1 (13 May 2008), CR/288 (17 July 2008) and CR/291 (9 October 2008), concerning the preparatory steps towards the~~ that the Bureau has established and maintains~~ment of~~ a database ~~of~~ containing administration contact information, available frequencies/frequency bands for use by terrestrial and space services~~ in emergency situations~~, and any additional information or instructions relevant to emergency situations within these administrations~~as well as the data formats for their submission~~;

b) that, ~~pursuant to BR Circular Letter CR/323 (31 March 2011),~~ the Bureau has advised ~~all administrations~~ that only limited information had been received from administrations for both the terrestrial and space services databases,

resolves

1 that the ITU Radiocommunication Sector (ITU-R) continue to study those aspects of radiocommunications/ICT that are relevant to early warning, disaster mitigation and relief operations;

2 to urge the ITU-R Study Groups, taking into account the scope of ongoing studies/activities appended to Resolution ITU-R 55, to accelerate their work, particularly in the areas of disaster prediction, detection, mitigation and relief;

~~1~~3 to encourage administrations to communicate ~~to BR,~~ as soon as possible to the BR, at the very minimum, focal point contact information and any relevant instructions or procedures, and, where possible, the frequencies available for use in emergency and disaster relief, and in particular, the relevant up-to-date contact information;

~~2~~4 to reiterate to administrations the importance of having up-to-date information referred to *resolves* 3 above ~~frequencies~~ available for use in the very early stages of humanitarian assistance intervention for disaster relief,

instructs the Director of the Radiocommunication Bureau

1 to continue to assist Member States with their emergency communication preparedness activities by maintaining the database[3] of ~~currently available frequencies~~ information from administrations for use in emergency situations, which includes contact information and ~~are~~ optionally includes~~not limited to~~ available frequencies~~those listed in Resolution **646 (Rev.WRC-12)**, and by issuing an appropriate listing, taking into account Resolution ITU-R 53~~;

2 to ~~maintain the database and~~ facilitate online access to the database ~~thereto~~ by administrations, national regulatory authorities, disaster relief agencies and organizations, in particular the United Nations Emergency Relief Coordinator, in accordance with the operating procedures developed for disaster situations;

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[3] The database may be accessed at http://www.itu.int/ITU-R/go/res647.

3 to collaborate with the United Nations Office for the Coordination of Humanitarian Affairs and other organizations, as appropriate, in the development and dissemination of standard operating procedures and relevant spectrum management practices for use in the event of a disaster situation;

4 to collaborate, as appropriate, with the United Nations Working Group on Emergency Telecommunications (WGET) and the radio frequency and radio standards group under the UN Emergency Telecommunications Cluster (ETC) for which the WFP (World Food Programme) is the cluster lead;

~~4~~5 to take into consideration, and collaborate as appropriate, all relevant activities in ITU's other two Sectors and General Secretariat;

~~5~~6 to report ~~on the progress on this Resolution~~ to subsequent World Radiocommunication Conferences on the status and progress of updates to the ITU database for emergency and disaster relief operations,

invites ITU-R

to continue conducting studies, as necessary, ~~and as a matter of urgency,~~ in support of ~~the establishment~~ developing and maintaining ~~of~~ appropriate spectrum management guidelines applicable in emergency and disaster relief operations,

invites the Director of the Telecommunication Standardization Bureau and the Director of the Telecommunication Development Bureau

to collaborate closely with the Director of the Radiocommunication Bureau to ensure that a consistent and coherent approach is adopted in the development of strategies in response to emergency and disaster situations,

urges administrations

1 to participate in the emergency communication preparedness activities described above and to provide ~~the relevant information~~ to the Bureau ~~concerning their national frequency allocations and spectrum management practices for~~ their information and, in particular, up-to-date contact information related to emergency and disaster relief radiocommunications for inclusion in the database, taking into account Resolution ITU-R 53;

2 to assist in keeping the database up to date by advising the Bureau on an ongoing basis of any modifications to the information requested above.

SUP

RESOLUTION 644 (REV.WRC-12)

Radiocommunication resources for early warning, disaster mitigation and relief operations

6/9.1.7/4.2 Option B: modification of Resolution 647 (Rev.WRC-12) only

MOD

RESOLUTION 647 (REV.WRC-1215)

Spectrum management guidelines for emergency and disaster relief radiocommunication[1]

The World Radiocommunication Conference (Geneva, 20122015),

considering

a) that natural disasters have underscored the importance of utilizing effective measures to mitigate their effects, including prediction, detection and alerting through the coordinated and effective use of radio-frequency spectrum;

b) ITU's comprehensive role in emergency communications, not only in the field of radiocommunications, but also in the area of technical standards to facilitate interconnection and interoperability of networks for monitoring and management at the onset of and during emergency and disaster situations, and as an integral part of the telecommunication development agenda through the Hyderabad Action Plan;

c) that Resolution **644 (Rev.WRC-12)**, on radiocommunication resources for early warning, disaster mitigation and relief operations, resolves that ITU-R continue to study, as a matter of urgency, those aspects of radiocommunications/ICT that are relevant to early warning, disaster mitigation and relief operations;

d) that Resolution **646 (Rev.WRC-12)** addresses the broader category of public protection and disaster relief (PPDR) and encourages administrations to consider identified frequency bands/ranges or parts thereof when undertaking their national planning for the purposes of achieving regionally harmonized frequency bands/ranges for advanced public protection and disaster relief solutions;

e) that Resolution 36 (Rev. Guadalajara, 2010) addresses the role of telecommunications/ICTs in the service of humanitarian assistance, Resolution 136 (Rev. Guadalajara, 2010) addresses the use of ICTs for monitoring and management in emergency and disaster situations for early warning, prevention, mitigation and relief, and Resolution 34 (Rev. Hyderabad Dubai, 2010 2014) addresses the role of telecommunications/ICTs information and communication technology in disaster preparedness, early warning, rescue, mitigation, relief and response,

[1] The term "emergency and disaster relief radiocommunication" refers to radiocommunications used by agencies and organizations dealing with a serious disruption of the functioning of society, posing a significant widespread threat to human life, health, property or the environment, whether caused by accident, natural phenomena or human activity, and whether occurring suddenly or as a result of complex, long-term processes.

recognizing

a) that the Tampere Convention on the Provision of Telecommunications Resources for Disaster Mitigation and Relief Operations (Tampere, 1998)[2], an international treaty deposited with the United Nations Secretary-General, calls on the States Parties, when possible, and in conformity with their national law, to develop and implement measures to facilitate the availability of telecommunication resources for such operations;

b) that some administrations may have different operational needs and spectrum requirements for emergency and disaster-relief applications, depending on their circumstances;

c) that the immediate availability of spectrum <u>and relevant contact information </u>to support emergency radiocommunication equipment is important for successful telecommunications in the very early stages of humanitarian assistance intervention for disaster relief,

aware

of the progress made in regional organizations around the world, and in particular in regional telecommunication organizations, on matters related to emergency communications planning and response,

recognizing further

a) Resolution ITU-R 55, which invites the ITU-R Study Groups to take into consideration the scope of ongoing studies/activities outlined in the annex to the Resolution, and to develop guidelines related to the management of radiocommunications in disaster prediction, detection, mitigation and relief, collaboratively and cooperatively, within ITU and with organizations external to the Union, in order to avoid duplication of effort;

b) Resolution ITU-R 53, which instructs the Director of the Radiocommunication Bureau to assist Member States with their emergency radiocommunication preparedness activities such as the listing of currently available frequencies for use in emergency situations for inclusion in a database maintained by the Bureau,

noting

a) that when a disaster occurs, the disaster relief agencies are usually the first on the scene using their day-to-day communication systems, but that in most cases other agencies and organizations may also be involved in disaster relief operations;

b) that there is a critical requirement to perform immediate spectrum management actions, including frequency coordination, sharing and spectrum reuse, within a disaster area;

c) that national spectrum planning for emergency and disaster relief should take into account the need for cooperation and bilateral consultation with other concerned administrations, which can be facilitated by spectrum harmonization, as well as agreed spectrum management guidelines pertaining to disaster relief and emergency planning;

d) that in times of disasters, radiocommunication facilities may be destroyed or impaired and the national regulatory authorities may not be able to provide the necessary spectrum management services for the deployment of radio systems for relief operations;

e) that the identification of frequency availability within individual administrations within which equipment could operate may ease the interoperability and/or interworking, with mutual

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[2] However, a number of countries have not ratified the Tampere Convention.

cooperation and consultation, especially in national, regional and cross-border emergency situations and disaster relief activities,

noting further

a) that flexibility must be afforded to disaster relief agencies and organizations to use current and future radiocommunications, so as to facilitate their humanitarian operations;

b) that it is in the interest of administrations and disaster relief agencies and organizations to have access to updated information on national spectrum planning for emergency and disaster relief,

taking into account

a) BR Circular Letters CR/281 (13 March 2008), CR/283 (6 May 2008) and its Corrigendum 1 (13 May 2008), CR/288 (17 July 2008) and CR/291 (9 October 2008), concerning the preparatory steps towards the establishment of a database of available frequencies/frequency bands for use by terrestrial and space services in emergency situations, as well as the data formats for their submission;

b) that, pursuant to BR Circular Letter CR/323 (31 March 2011), the Bureau advised all administrations that only limited information had been received for both terrestrial and space services,

resolves

1 to encourage administrations to communicate to BR, as soon as possible, the frequencies available for use in emergency and disaster relief, and in particular, the relevant up-to-date contact information;

2 to reiterate to administrations the importance of having frequencies available for use in the very early stages of humanitarian assistance intervention for disaster relief,

instructs the Director of the Radiocommunication Bureau

1 to continue to assist Member States with their emergency communication preparedness activities by maintaining the database[3] of information from administrations for use in emergency situations, which includes contact information and optionally include available frequencies~~of currently available frequencies for use in emergency situations, which are not limited to those listed in Resolution **646 (Rev.WRC-12)**, and by issuing an appropriate listing, taking into account Resolution ITU-R 53~~;

2 to maintain the database and facilitate online access thereto by administrations, national regulatory authorities, disaster relief agencies and organizations, in particular the United Nations Emergency Relief Coordinator, in accordance with the operating procedures developed for disaster situations;

3 to collaborate with the United Nations Office for the Coordination of Humanitarian Affairs and other organizations, as appropriate, in the development and dissemination of standard operating procedures and relevant spectrum management practices for use in the event of a disaster situation;

4 to take into consideration all relevant activities in ITU's other two Sectors and General Secretariat;

[3] The database may be accessed at http://www.itu.int/ITU R/go/res647.

5 to report ~~on the progress on this Resolution~~ to subsequent World Radiocommunication Conferences<u> on the status and progress of updates to the ITU database for emergency and disaster relief operations</u>,

invites ITU-R

to <u>continue </u>conduct<u>ing</u> studies as necessary~~, and as a matter of urgency~~, in support of the establishment of appropriate spectrum management guidelines applicable in emergency and disaster relief operations,

invites the Director of the Telecommunication Standardization Bureau and the Director of the Telecommunication Development Bureau

to collaborate closely with the Director of the Radiocommunication Bureau to ensure that a consistent and coherent approach is adopted in the development of strategies in response to emergency and disaster situations,

urges administrations

1 to participate in the emergency communication preparedness activities described above and to provide the relevant information to the Bureau concerning their national frequency allocations and spectrum management practices <u>and up-to-date contact information </u>for emergency and disaster relief radiocommunications, taking into account Resolution ITU-R 53;

2 to assist in keeping the database up to date by advising the Bureau on an ongoing basis of any modifications to the information requested above.

6/9.1.7/4.3 Option C: suppression of Resolution 647 (Rev.WRC-12) and the consequential modification of Resolution 644 (Rev.WRC-12)

MOD

RESOLUTION 644 (REV.WRC-1~~2~~<u>5</u>)

Radiocommunication resources for early warning, disaster mitigation and relief operations

The World Radiocommunication Conference (Geneva, 201~~2~~<u>5</u>),

considering

a) that administrations have been urged to take all practical steps to facilitate the rapid deployment and effective use of telecommunication resources for early warning, disaster mitigation and disaster relief operations by reducing and, where possible, removing regulatory barriers and strengthening global, regional and transborder cooperation between States;

b) that modern telecommunication technologies are an essential tool for disaster mitigation and relief operations and the vital role of telecommunications and ICT for the safety and security of relief workers in the field;

c) the particular needs of developing countries and the special requirements of the inhabitants living in high risk areas exposed to disasters, as well as those living in remote areas;

d) the work carried out by the Telecommunication Standardization Sector in standardizing the common alerting protocol (CAP), through the approval of the relevant CAP Recommendation;

e) that, under the Strategic Plan of the Union 2012-2015, "the need for effective use of telecommunications/ICTs and modern technologies during critical emergencies, as a crucial part of disaster prediction, detection, early-warning, mitigation, management and relief strategies" is considered a priority for ITU in this period;

f) that the majority of terrestrial networks in affected areas were damaged during recent disasters,

recognizing

a) Article 40 of the Constitution, on priority of telecommunications concerning safety of life;

b) Article 46 of the Constitution, on distress calls and messages;

c) No. 91 of the Tunis Agenda for the Information Society adopted by the second phase of the World Summit on the Information Society and in particular provision c): "Working expeditiously towards the establishment of standards-based monitoring and worldwide early-warning systems linked to national and regional networks and facilitating emergency disaster response all over the world, particularly in high-risk regions";

d) Resolution 34 (Rev. ~~Hyderabad~~ Dubai, ~~2010~~ 2014) of the World Telecommunication Development Conference, on the role of telecommunications/information and communication technology~~ies~~ in disaster preparedness, early warning, rescue, mitigation, relief and response, as well as ITU-D Question 22-1/2 "Utilization of telecommunications/ICTs for disaster preparedness, mitigation and response";

e) Resolution 36 (Rev. Guadalajara, 2010) of the Plenipotentiary Conference, on telecommunications/information and communication technology in the service of humanitarian assistance;

f) Resolution 136 (Rev. Guadalajara, 2010) of the Plenipotentiary Conference, on the use of telecommunications/information and communication technologies for monitoring and management in emergency and disaster situations for early warning, prevention, mitigation and relief;

g) Resolution ITU-R 53, on the use of radiocommunications in disaster response and relief;

h) Resolution ITU-R 55, on the ITU-R studies of disaster prediction, detection, mitigation and relief,

noting

the close relation of this Resolution with Resolution **646 (Rev.WRC-12)**, on public protection and disaster relief, and Resolution **647 (Rev.WRC-12),** on spectrum management guidelines for emergency and disaster relief radiocommunication, and the need to coordinate activities under these Resolutions in order to prevent any possible overlap,

resolves

1 that the ITU Radiocommunication Sector (ITU-R) continue to study, as a matter of urgency, those aspects of radiocommunications/ICT that are relevant to early warning, disaster mitigation and relief operations, such as decentralized means of telecommunications that are

appropriate and generally available, including amateur terrestrial and satellite radio facilities, mobile and portable satellite terminals, as well as the use of passive space-based sensing systems;

2 to urge the ITU-R Study Groups, taking into account the scope of ongoing studies/activities appended to Resolution ITU-R 55, to accelerate their work, particularly in the areas of disaster prediction, detection, mitigation and relief,

instructs the Director of the Radiocommunication Bureau

1 to support administrations in their work towards the implementation of both Resolutions 36 (Rev. Guadalajara, 2010) and 136 (Rev. Guadalajara, 2010), as well as the Tampere Convention;

2 to collaborate, as appropriate, with the United Nations Working Group on Emergency Telecommunications (WGET);

3 to participate in, and contribute to, the Telecommunications for Disaster Relief and Mitigation − Partnership Coordination Panel (PCP-TDR);

4 to synchronize activities between this Resolution and~~,~~ Resolution **646 (Rev.WRC-12)** ~~and Resolution **647 (Rev.WRC-12)**~~ to prevent a possible overlap.

SUP

RESOLUTION 647 (REV.WRC-12)

Spectrum management guidelines for emergency and disaster relief radiocommunication[1]

AGENDA ITEM 10

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 **808 (WRC-12)**: *Preliminary agenda for the 2018 World Radiocommunication Conference*

2.1 to consider regulatory actions, including spectrum allocations, to support GMDSS modernization and implementation of e-navigation in accordance with Resolution ***359 (WRC-12)****;*

Resolution **359 (WRC-12**): *Consideration of regulatory provisions for modernization of the Global Maritime Distress and Safety System and studies related to e-navigation*

(**WP5B** / -)

2.2 to consider the appropriate regulatory procedures for notifying satellite networks needed to facilitate the deployment and operation of nanosatellites and picosatellites, in accordance with Resolution ***757 (WRC-12)****;*

Resolution **757 (WRC-12)**: *Regulatory aspects for nanosatellites and picosatellites*

(- / -)

6/10/1 WRC-18 preliminary agenda item 2.1 – Resolution 359 (WRC-12)

No draft CPM text has yet been developed on this part of the draft CPM Report.

6/10/2 WRC-18 preliminary agenda item 2.2 – Resolution 757 (WRC-12)

See Section 5/9.1.8 in Chapter 5 of this draft CPM Report to WRC-15.

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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* Reference(s) used in the the Draft CPM Report.

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S.1255		Rec. ITU-R S.1255-0	Use of adaptive uplink power control to mitigate co-directional interference between geostationary satellite orbit/fixed-satellite service (GSO/FSS) networks and feeder links of non-geostationary satellite orbit/mobile satellite service (non-GSO/MSS) networks and between GSO/FSS networks and non-GSO/FSS networks	9.3	5
RA.1272		Rec. ITU-R RA.1272-1	Protection of radio astronomy measurements above 60 GHz from ground-based interference	1.18	3
SA.1276		Rec. ITU-R SA.1276-4	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	1.10	4.2
SA.1277		Rec. ITU-R SA.1277-0	Sharing in the 8 025-8 400 MHz frequency band between the Earth exploration-satellite service and the fixed, fixed-satellite, meteorological-satellite and mobile services in Regions 1, 2 and 3	1.9.2	4.2
RS.1280		Rec. ITU-R RS.1280-0	Selection of active spaceborne sensor emission characteristics to mitigate the potential for interference to terrestrial radars operating in frequency bands 1-10 GHz	1.12	2
M.1318		Rec. ITU-R M.1318-1	Evaluation model for continuous interference from radio sources other than in the radionavigation-satellite service to the radionavigation-satellite service systems and networks operating in the 1 164-1 215 MHz, 1 215-1 300 MHz, 1 559-1 610 MHz and 5 010-5 030 MHz bands	1.1	1

ITU-R Series	Recommendation number*	Latest publication (as of August 2014)	Recommendation title	Agenda item	CPM chapter
S.1323		Rec. ITU-R S.1323-2	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 co-directional FSS networks below 30 GHz	1.10	4.2
S.1323				9.1, issue 9.1.2	5
S.1329		Rec. ITU-R S.1329-0	Frequency sharing of the bands 19.7-20.2 GHz and 29.5-30.0 GHz between systems in the mobile-satellite service and systems in the fixed-satellite service	1.10	4.2
F.1336		Rec. ITU-R 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	1.12	2
F.1336				1.6.1 1.9.1	4.1
S.1340		Rec. ITU-R S.1340-0	Sharing between feeder links for the mobile-satellite service and the aeronautical radionavigation service in the Earth-to-space direction in the band 15.4-15.7 GHz	1.6.1	4.1
S.1342		Rec. ITU-R S.1342-0	Method for determining coordination distances, in the 5 GHz band, between the international standard microwave landing system stations operating in the aeronautical radionavigation service and non-geostationary mobile-satellite service stations providing feeder uplink services	1.7	4.1
M.1371		Rec. ITU-R M.1371-5	Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile frequency band	1.16	3
M.1372		Rec. ITU-R M.1372-1	Efficient use of the radio spectrum by radar stations in the radiodetermination service	1.12	2
M.1372				1.5	3
P.1410		Rec. ITU-R P.1410-5	Propagation data and prediction methods required for the design of terrestrial broadband radio access systems operating in a frequency range from 3 to 60 GHz	1.10	4.2

ITU-R Series	Recommendation number*	Latest publication (as of August 2014)	Recommendation title	Agenda item	CPM chapter
SA.1414		Rec. ITU-R SA.1414-1	Characteristics of data relay satellite systems	1.6.1	4.1
SA.1414				1.10	4.2
S.1432		Rec. ITU-R S.1432-1	Apportionment of the allowable error performance degradations to fixed-satellite service (FSS) hypothetical reference digital paths arising from time invariant interference for systems operating below 30 GHz	1.1	1
S.1432				1.5	3
S.1432				1.6.1 9.1, issue 9.1.2	4.1 5
M.1450		Rec. ITU-R M.1450-5	Characteristics of broadband radio local area networks	1.15	3
M.1457-11		Rec. ITU-R M.1457-11	Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)	1.2	1
M.1461		Rec. ITU-R M.1461-1	Procedures for determining the potential for interference between radars operating in the radiodetermination service and systems in other services	1.12	2
M.1464		Rec. ITU-R M.1464-1	Characteristics of radiolocation radars, and characteristics and protection criteria for sharing studies for aeronautical radionavigation and meteorological radars in the radiodetermination service operating in the frequency band 2 700-2 900 MHz	1.1	1
M.1465		Rec. ITU-R M.1465-1	Characteristics of and protection criteria for radars operating in the radiodetermination service in the frequency band 3 100-3 700 MHz	1.1	1
M.1478		Rec. ITU-R M.1478-2	Protection criteria for Cospas-Sarsat search and rescue instruments in the band 406-406.1 MHz	9.1, issue 9.1.1	5
SF.1486		Rec. ITU-R SF.1486-0	Sharing methodology between fixed wireless access systems in the fixed service and very small aperture terminals in the fixed-satellite service in the 3 400-3 700 MHz band	9.1, issue 9.1.5	5

ITU-R Series	Recommendation number*	Latest publication (as of August 2014)	Recommendation title	Agenda item	CPM chapter
F.1494		Rec. ITU-R F.1494-0	Interference criteria to protect the fixed service from time varying aggregate interference from other services sharing the 10.7-12.75 GHz band on a co-primary basis	1.5	3
F.1495		Rec. ITU-R F.1495-2	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	1.5	3
RA.1513		Rec. ITU-R RA.1513-1	Levels of data loss to radio astronomy observations and percentage-of-time criteria resulting from degradation by interference for frequency bands allocated to the radio astronomy on a primary basis	1.12	2
RA.1513				1.10	4.2
P.1546, 1546-4		Rec. ITU-R P.1546-5	Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3 000 MHz	1.2	1
P.1546				1.10	4.2
F.1565		Rec. ITU-R F.1565-0	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	1.5	3
M.1583		Rec. ITU-R M.1583-1	Interference calculations between non-geostationary mobile-satellite service or radionavigation-satellite service systems and radio astronomy telescope sites	1.12	2
S.1587		Rec. ITU-R S.1587-2	Technical characteristics of earth stations on board vessels communicating with FSS satellites in the frequency bands 5 925-6 425 MHz and 14-14.5 GHz which are allocated to the fixed-satellite service	1.8	4.1
S.1593		Rec. ITU-R S.1593-0	Methodology for frequency sharing between certain types of homogeneous highly-elliptical orbit non-geostationary fixed-satellite service systems in the 4/6 GHz and 11/14 GHz frequency bands	9.3	5

ITU-R Series	Recommendation number*	Latest publication (as of August 2014)	Recommendation title	Agenda item	CPM chapter
P.1623		Rec. ITU-R P.1623-1	Prediction method of fade dynamics on Earth-space paths	1.10	4.2
SA.1626		Rec. ITU-R SA.1626-1	Feasibility of sharing between the space research service (space-to-Earth) and the fixed and mobile services in the band 14.8-15.35 GHz	1.6.1	4.1
SA.1627		Rec. ITU-R SA.1627-0	Telecommunication requirements and characteristics of EESS and MetSat service systems for data collection and platform location	9.1, issue 9.1.1	5
RA.1631		Rec. ITU-R RA.1631-0	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	1.12	2
RA.1631				1.10	4.2
M.1637		Rec. ITU-R M.1637-0	Global cross-border circulation of radiocommunication equipment in emergency and disaster relief situations	1.3	1
M.1637				9.1, issue 9.1.7	6
M.1643		Rec. ITU-R M.1643-0	Technical and operational requirements for aircraft earth stations of aeronautical mobile-satellite service including those using fixed-satellite service network transponders in the band 14-14.5 GHz (Earth-to-space)	1.5	3
M.1644		Rec. ITU-R M.1644-0	Technical and operational characteristics, and criteria for protecting the mission of radars in the radiolocation and radionavigation service operating in the frequency band 13.75-14 GHz	1.5	3
M.1644				1.6.1	4.1
SF.1650		Rec. ITU-R SF.1650-1	The minimum distance from the baseline beyond which in-motion earth stations located on board vessels would not cause unacceptable interference to the terrestrial service in the bands 5 925-6 425 MHz and 14-14.5 GHz	1.5	3
SF.1650				1.8	4.1

ITU-R Series	Recommendation number*	Latest publication (as of August 2014)	Recommendation title	Agenda item	CPM chapter
S.1716		Rec. ITU-R S.1716-0	Performance and availability objectives for fixed-satellite service telemetry, tracking and command systems	1.10	4.2
M.1730		Rec. ITU-R M.1730-1	Characteristics of and protection criteria for the radiolocation service in the frequency band 15.4-17.3 GHz	1.5	3
M.1730				1.6.2	4.1
M.1732		Rec. ITU-R M.1732-1	Characteristics of systems operating in the amateur and amateur-satellite services for use in sharing studies	1.12	2
M.1732				1.15, 1.18	3
SA.1743		Rec. ITU-R SA.1743-0	Maximum allowable degradation to radiocommunication links of the space research and space operation services arising from interference from emissions and radiations from other radio sources	1.10	4.2
BO.1774		Rec. ITU-R BO.1774-1	Use of satellite and terrestrial broadcast infrastructures for public warning, disaster mitigation and relief	9.1, issue 9.1.3	5
S.1782		Rec. ITU-R S.1782-0	Possibilities for global broadband Internet access by fixed-satellite service systems	9.1, issue 9.1.3 9.3	5
M.1796		Rec. ITU-R M.1796-2	Characteristics of and protection criteria for terrestrial radars operating in the radiodetermination service in the frequency band 8 500-10 680 MHz	1.12	2
M.1796				1.6.1	4.1
M.1808		Rec. ITU-R 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	1.15, 1.16	3
M.1808				9.1, issue 9.1.1	5
RS.1813		Rec. ITU-R RS.1813-1	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	1.10	4.2

ITU-R Series	Recommendation number*	Latest publication (as of August 2014)	Recommendation title	Agenda item	CPM chapter
M.1823		Rec. ITU-R M.1823-0	Technical and operational characteristics of digital cellular land mobile systems for use in sharing studies	1.15	3
M.1823				9.1, issue 9.1.1	5
M.1824		Rec. ITU-R M.1824-0	System characteristics of television outside broadcast, electronic news gathering and electronic field production in the mobile service for use in sharing studies	1.12	2
M.1824				1.15	3
M.1826		Rec. ITU-R M.1826-0	Harmonized frequency channel plan for broadband public protection and disaster relief operations at 4 940-4 990 MHz in Regions 2 and 3	1.3	1
M.1826				9.1, issue 9.1.7	6
M.1827		Rec. ITU-R M.1827-0	Technical and operational requirements for stations of the aeronautical mobile (R) service (AM(R)S) limited to surface application at airports and for stations of the aeronautical mobile service (AMS) limited to aeronautical security (AS) applications in the band 5 091-5 150 MHz	1.7	4.1
M.1842		Rec. ITU-R M.1842-1	Characteristics of VHF radio systems and equipment for the exchange of data and electronic mail in the maritime mobile service RR Appendix 18 channels	1.16	3
M.1851		Rec. ITU-R M.1851-0	Mathematical models for radiodetermination radar systems antenna patterns for use in interference analyses	1.12	2
M.1854		Rec. ITU-R M.1854-1	Use of mobile-satellite service in disaster response and relief	9.1, issue 9.1.3	5
M.1854				9.1, issue 9.1.7	6
S.1855		Rec. ITU-R S.1855-0	Alternative reference radiation pattern for earth station antennas used with satellites in the geostationary-satellite orbit for use in coordination and/or interference assessment in the frequency range from 2 to 31 GHz	1.6.1 9.3	4.1 5

ITU-R Series	Recommendation number*	Latest publication (as of August 2014)	Recommendation title	Agenda item	CPM chapter
S.1856		Rec. ITU-R S.1856-0	Methodologies for determining whether an IMT station at a given location operating in the band 3 400-3 600 MHz would transmit without exceeding the power flux-density limits in the Radio Regulations Nos. 5.430A, 5.432A, 5.432B and 5.433A	9.1, issue 9.1.5	5
RS.1859		Rec. ITU-R RS.1859-0	Use of remote sensing systems for data collection to be used in the event of natural disasters and similar emergencies	1.12	2
RS.1859				9.1, issue 9.1.7	6
RS.1861		Rec. ITU-R RS.1861-0	Typical technical and operational characteristics of Earth exploration-satellite service (passive) systems using allocations between 1.4 and 275 GHz	1.12	2
RS.1861				1.6.1	4.1
RS.1861				1.10	4.2
SA.1862		Rec. ITU-R SA.1862-0	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)	1.10	4.2
TF.1876		Rec. ITU-R TF.1876-0	Trusted time source for time stamp authority	1.14	2
SA.1882		Rec. ITU-R SA.1882-0	Technical and operational characteristics of space research service (Earth-to-space) systems for use in the 22.55-23.15 GHz band	1.10	4.2
RS.1883		Rec. ITU-R RS.1883-0	Use of remote sensing systems in the study of climate change and the effects thereof	1.12	2
S.1899		Rec. ITU-R S.1899-0	Protection criteria and interference assessment methods for non-GSO inter-satellite links in the 23.183-23.377 GHz band with respect to the space research service	1.10	4.2
M.2008		Rec. ITU-R M.2008-1	Characteristics and protection criteria for radars operating in the aeronautical radionavigation service in the frequency band 13.25-13.40 GHz	1.5	3
M.2012-0		Rec. ITU-R M.2012-1	Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications Advanced (IMT-Advanced)	1.2	1

ITU-R Series	Recommendation number*	Latest publication (as of August 2014)	Recommendation title	Agenda item	CPM chapter
M.2014		Rec. ITU-R M.2014-0	Global circulation of IMT-2000 satellite terminals	9.1, issue 9.1.1	5
RS.2017		Rec. ITU-R RS.2017-0	Performance and interference criteria for satellite passive remote sensing	1.12	2
RS.2043		Rec. ITU-R RS.2043-0	Characteristics of synthetic aperture radars operating in the Earth exploration-satellite service (active) around 9 600 MHz	1.12	2
M.2057		Rec. ITU-R M.2057-0	Systems characteristics of automotive radars operating in the frequency band 76-81 GHz for intelligent transport systems applications	1.18	3
M.2059		Rec. ITU-R M.2059-0	Operational and technical characteristics and protection criteria of radio altimeters utilizing the band 4 200-4 400 MHz	1.1	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 (as of August 2014)	Draft Recommendation title	Agenda item	CPM chapter
M. 2009		PDR Rec. ITU-R M.2009-0 (Doc. 5A/543 Annex 13)	Radio interface standards for use by public protection and disaster relief operations in some parts of the UHF band in accordance with Resolution 646 (WRC-03)	1.3	1
M. 2009				9.1, issue 9.1.7	6

ITU-R Series	Recommendation draft number *	Available document / status (as of August 2014)	Draft Recommendation title	Agenda item	CPM chapter
M.	2015	WDPDR Rec. ITU-R M.2015-0 (Doc. 5A/543 Annex 14)	Frequency arrangements for public protection and disaster relief radiocommunication systems in UHF bands in accordance with Resolution 646 (Rev.WRC-12)	1.3	1
M.	2015			9.1, issue 9.1.1	5
M.	2015			9.1, issue 9.1.7	6
M.	[BSMS700]	PDN Rec. ITU-R [BSMS700] (Doc. 4-5-6-7/715 Annex 21)	Out-of-band emission limit of IMT mobile stations operating in the frequency band 694-790 MHz in Region 1	1.2	1
RS.	[EESS 9GHZ-RAS-MITIGATION]	PDN Rec. ITU-R RS.[EESS 9GHZ-RAS-MITIGATION] (Doc. 7C/258 Annex 5)	Protection of the radio astronomy service in the frequency band 10.6-10.7 GHz from unwanted emissions of synthetic aperture radars operating in the Earth exploration-satellite service (active) around 9 600 MHz	1.12	2
RS.	[EESS9GHz-SRS-Mitigation]	PDN Rec. ITU-R RS.[EESS 9GHz-SRS-Mitigation] (Doc. 7C/258 Annex 6)	Protection of space research service (SRS) space-to-Earth links in the 8 400-8 450 MHz and 8 450-8 500 MHz bands from unwanted emissions of synthetic aperture radars operating in the earth exploration-satellite service (active) around 9 600 MHz	1.12	2
M.	[VDES]	WDPDN Rec. ITU-R M [VDES] (Doc. 5B/475 Annex 24)	Technical characteristics for a VHF data exchange system in the VHF maritime mobile band	1.16	3
M.	[WAIC]	PDN Rec. ITU-R M.[WAIC] (Doc. 5B/636 Annex 20)	Technical characteristics and protection criteria for Wireless Avionics Intra-Communications systems	1.17	3
M.	[WAIC CONDITIONS]	WDPDN Rec. ITU-R M [WAIC CONDITIONS] (Doc. 5B/636 Annex 32)	Definition and technical conditions for the use of the aeronautical mobile (R) service to support Wireless Avionics Intra-Communication systems	1.17	3

5 List of existing ITU-R Reports

ITU-R Series	Report number *	Latest publication (as of August 2014)	Report title	Agenda item	CPM chapter
M.319		Rep. ITU-R M.319-7	Characteristics of equipment and principles governing the assignment of frequency channels between 25 and 1 000 MHz for land mobile services	9.1, issue 9.1.1	5
M.2033		Report ITU-R M.2033-0	Radiocommunication objectives and requirements for public protection and disaster relief	1.3	1
M.2033				9.1, issue 9.1.7	6
M.2039		Rep. ITU-R M.2039-2	Characteristics of terrestrial IMT-2000 systems for frequency sharing/interference analyses	1.15	3
M.2050		Rep. ITU-R M.2050-0	Test results illustrating the susceptibility of maritime radionavigation radars to emissions from digital communication and pulsed systems in the bands 2 900-3 100 MHz and 9 200-9 500 MHz	1.12	2
M.2076		Rep. ITU-R M.2076-0	Factors that mitigate interference from radiolocation and Earth exploration-satellite service/space research service (active) radars to maritime and aeronautical radionavigation radars in the 9.0-9.2 and 9.3-9.5 GHz bands and between Earth exploration-satellite service/ space research service (active) radars and radiolocation radars in the 9.3-9.5 and 9.8-10.0 GHz bands	1.12	2
M.2081		Rep. ITU-R M.2081-0	Test results illustrating compatibility between representative radionavigation systems and radiolocation and EESS systems in the band 8.5-10 GHz	1.12	2
M.2084		Rep. ITU-R M.2084-0	Satellite detection of automatic identification system messages	1.16	3
M.2085		Rep. ITU-R M.2085-1	Role of the amateur and amateur-satellite services in support of disaster mitigation and relief	9.1, issue 9.1.7	6

ITU-R Series	Report number *	Latest publication (as of August 2014)	Report title	Agenda item	CPM chapter
SM.2091		Rep. ITU-R SM.2091-0	Studies related to the impact of active space services allocated in adjacent or nearby bands on radio astronomy service	1.16	3
RS.2094		Rep. ITU-R RS.2094-0	Studies related to the compatibility between Earth exploration-satellite service (active) and the radiodetermination service in the 9 300-9 500 MHz and 9 800-10 000 MHz bands and between Earth exploration-satellite service (active) and the fixed service in the 9 800-10 000 MHz band	1.12	2
M.2109		Rep. ITU-R M.2109-0	Sharing studies between IMT Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3 400-4 200 and 4 500-4 800 MHz frequency bands	1.1	1
M.2109				9.1, issue 9.1.5	5
M.2110		Rep. ITU-R M.2110-0	Sharing studies between radiocommunication services and IMT systems operating in the 450-470 MHz band	1.15	3
M.2116		Rep. ITU-R M.2116-2	Characteristics of broadband wireless access systems operating in the land mobile service for use in sharing studies	1.15	3
M.2128		Rep. ITU-R M.2128-0	Test results and simulations illustrating the effective duty cycle of frequency modulated pulsed radiolocation and EESS system waveforms in marine radionavigation receivers	1.12	2
M.2149		Rep. ITU-R M.2149-1	Use and examples of mobile-satellite service systems for relief operation in the event of natural disasters and similar emergencies	1.10	4.2
M.2149				9.1, issue 9.1.3	5
M.2149				9.1, issue 9.1.7	6
S.2151		Rep. ITU-R S.2151-1	Use and examples of systems in the fixed-satellite service in the event of natural disasters and similar emergencies for warning and relief operations	9.1, issue 9.1.3	5
S.2151				9.1, issue 9.1.7	6

ITU-R Series	Report number *	Latest publication (as of August 2014)	Report title	Agenda item	CPM chapter
SA.2162		Rep. ITU-R SA.2162-0	Sharing conditions between space research service extra vehicular activities (EVA) links and fixed and mobile service links in the 410-420 MHz band	1.13	2
M.2169		Rep. ITU-R M.2169-0	Improved satellite detection of AIS	1.16	3
M.2170		Rep. ITU-R M.2170-0	Compatibility analysis and results for radiolocation systems planned to operate in the 15.4 to 17.3 GHz band and aircraft landing system operating in the 15.4-15.7 GHz band as well as the radio astronomy service operating in the adjacent band 15.35-15.40 GHz, FSS systems and aeronautical radionavigation systems	1.6.1	4.1
M.2171		Rep. ITU-R M.2171-0	Characteristics of unmanned aircraft systems and spectrum requirements to support their safe operation in non-segregated airspace	1.5	3
RS.2178		Rep. ITU-R RS. 2178-0	The essential role and global importance of radio spectrum use for Earth observations and for related applications	1.12	2
SA.2192		Rep. ITU-R SA.2192-0	Compatibility between the space research service (Earth-to-space) and the non-GSO-to-non-GSO systems on the inter-satellite service in the band 22.55-23.55 GHz	1.10	4.2
S.2199		Rep. ITU-R S.2199-0	Studies on compatibility of broadband wireless access (BWA) systems and fixed-satellite service (FSS) networks in the 3 400-4 200 MHz band	1.1	1
S.2199				9.1, issue 9.1.5	5
M.2231		Rep. ITU-R M.2231-0	Use of Appendix 18 to the Radio Regulations for the maritime mobile service	1.16	3
M.2233		Rep. ITU-R M.2233-0	Examples of technical characteristics for unmanned aircraft control and non-payload communications links	1.5	3
M.2243		Rep. ITU-R M.2243-0	Assessment of the global mobile broadband deployments and forecasts for International Mobile Telecommunications	1.1	1

ITU-R Series	Report number *	Latest publication (as of August 2014)	Report title	Agenda item	CPM chapter
SA.2271		Rep. ITU-R SA.2271-0	Sharing conditions between space research service proximity operations links and fixed and mobile service links in the 410-420 MHz band	1.13	2
SA.2272		Rep. ITU-R SA.2272-0	Spectrum requirements for future EESS missions operating under a potential new EESS uplink allocation in the 7-8 GHz range	1.11	2
RS.2274		Rep. ITU-R RS.2274-0	Spectrum requirements for spaceborne synthetic aperture radar applications planned in an extended allocation to the Earth exploration-satellite service around 9 600 MHz	1.12	2
SA.2275		Rep. ITU-R SA.2275-0	Sharing between the EESS (Earth-to-space) and the fixed service in the 7-8 GHz range	1.11	2
S.2280		Rep. ITU-R S.2280-0	Assessment of the orbital-frequency resource used by a geostationary satellite communication network	9.1, issue 9.1.2	5
M.2283		Rep. ITU-R M.2283-0	Technical characteristics and spectrum requirements of Wireless Avionics Intra-Communications systems to support their safe operation	1.17	3
M.2286		Rep. ITU-R M.2286-0	Operational characteristics of aeronautical mobile telemetry	1.1	1
M.2287		Rep. ITU-R M.2287-0	Automatic identification system VHF data link loading	1.15	3
M.2290		Rep. ITU-R M.2290-0	Future spectrum requirements estimate for terrestrial IMT	1.1	1
M.2291		Report ITU-R M.2291-0	The use of International Mobile Telecommunications for broadband public protection and disaster relief applications	1.3	1
BT.2299		Rep. ITU-R BT.2299-0	Broadcasting for public warning, disaster mitigation and relief	9.1, issue 9.1.7	6
BT.2302		Rep. ITU-R BT.2302-0	Spectrum requirements for terrestrial television broadcasting in the UHF frequency band in Region 1 and the Islamic Republic of Iran	1.1 1.2	1

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 (as of August 2014)	Report title	Agenda item	CPM chapter
BT.	[MBB_DTTB_470_694]	DN Report ITU-R BT.[MBB_DTTB_470_694] (Doc. 4-5-6-7/715 Annex 5 - 5/112 - 6/256)	Sharing and compatibility studies between digital terrestrial television broadcasting and terrestrial mobile broadband applications, including IMT, in the frequency band 470-694/698 MHz	1.1	1
BT.	[SAB_SAP]	DN Report ITU-R BT.[SAB_SAP] (Doc. 4-5-6-7/715 Annex 8 - 5/115 - 6/257)	SAB/SAP spectrum use in Region 1 and the implication of a co-primary allocation for the mobile service in the frequency band 694-790 MHz	1.1 1.2	1
	[FSS-IMT C-BAND DOWNLINK]	DN Report ITU-R [FSS-IMT C-BAND DOWNLINK] (Doc. 4-5-6-7/715 Annex 17 - 4/78 - 5/126)	Sharing studies between IMT-Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands	1.1	1
	[FSS-IMT C-BAND UPLINK]	DN Report ITU-R [FSS-IMT C-BAND UPLINK] (Doc. 4-5-6-7/715 Annex 19 - 4/77 - 5/123)	Sharing and compatibility between IMT systems and fixed-satellite service networks in 5 850-6 425 MHz frequency range	1.1	1
RA.	[RAS-IMT]	DN Report ITU-R RA.[RAS-IMT] (Doc. 4-5-6-7/715 Annex 7 - 5/113 - 7/75)	Compatibility and sharing studies between the radio astronomy service and IMT systems in the frequency bands 608-614 MHz, 1 330 1 400 MHz, 1 400-1 427 MHz, 1 610.6-1 613.8 MHz, 1 660 1 670 MHz, 2 690-2 700 MHz, 4 800-4 990 MHz and 4 990-5 000 MHz	1.1	1
SA.	[METSAT-IMT 1.7 GHz]	DN Report ITU-R SA.[METSAT-IMT 1.7 GHz] (Doc. 4-5-6-7/715 Annex 13 - 5/116 - 7/76)	Sharing assessment between meteorological satellite systems and IMT stations in the 1 695-1 710 MHz frequency band	1.1	1

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SA.	[EESS-IMT 2 025-2 290 MHz]	DN Report ITU-R SA.[EESS-IMT 2 025-2 290 MHz] (Doc. 4-5-6-7/715 Annex 15 - 5/124 - 7/77)	Sharing between space-to-space links in space research, space operation and Earth exploration-satellite services and IMT systems in the frequency bands 2 025-2 110 MHz and 2 200 2 290 MHz	1.1	1
BS.	[BS_IMT]	DN Report ITU-R BS.[BS_IMT] (Doc. 4-5-6-7/715 Annex 13 - 5/119 - 6/259)	Sharing between the mobile service (MS) and the broadcasting service (BS) in the 1 452-1 492 MHz frequency band	1.1	1
F.	[IMT-FS 470-694/698 MHz SHARING]	DN Report ITU-R F.[IMT-FS 470-694/698 MHz SHARING] (Doc. 4-5-6-7/715 Annex 6 - 5/114)	Sharing and compatibility between IMT systems and fixed service systems in the 470-694/698 MHz frequency range	1.1	1
M.	[ARNS-MS]	WDPDN Report ITU-R M.[ARNS-MS] (Doc. 4-5-6-7/715 Annex 23)	Compatibility studies of the mobile service with the aeronautical radionavigation service in the frequency band 694-790 MHz in Region 1	1.1 1.2	1
M.	[RADAR1300]	WDPDN Report ITU-R M.[RADAR1300] (Doc. 4-5-6-7/715 Annex 25)	Studies on the impact of IMT use on radar systems in the frequency range 1 300-1 400 MHz	1.1	1
F.	[FS-IMT 1 350-1 530 MHz CO-CHANNEL SHARING]	DN Report ITU-R F.[FS-IMT 1 350-1 530 MHz CO-CHANNEL SHARING] (Doc. 4-5-6-7/715 Annex 10 - 5/117)	Sharing and compatibility study between IMT and the fixed service	1.1	1
M.	[AMT-IMT.SHARING.L-BAND]	DN Report ITU-R M.[AMT-IMT.SHARING.L-BAND] (Doc. 4-5-6-7/715 Annex 12 - 5/125)	Sharing studies between potential IMT systems and aeronautical mobile telemetry systems in the frequency band 1 429-1 535 MHz	1.1	1

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M.	[RADAR2700]	WDPDN Report ITU-R M.[RADAR2700] (Doc. 4-5-6-7/715 Annex 30)	Studies on the impact of IMT use on radar systems in the frequency band 2 700-2 900 MHz	1.1	1
M.	[RADAR2900]	WDPDN Report ITU-R M.[RADAR2900] (Doc. 4-5-6-7/715 Annex 31)	Studies on the impact of IMT use on radar systems in the frequency band 2 900-3 100 MHz	1.1	1
M.	[RADAR3300]	PDN Report ITU-R M.[RADAR3300] (Doc. 4-5-6-7/715 Annex 32)	Sharing between indoor IMT systems and radar systems in the frequency band 3 300-3 400 MHz	1.1	1
F.	[IMT-FS 3 400-4 200 MHz SHARING]	DN Report ITU-R F.[IMT-FS 3 400-4 200 MHz SHARING] (Doc. 4-5-6-7/715 Annex 16 - 5/120)	Sharing and compatibility between IMT systems and fixed service systems in the 3 400-4 200 MHz frequency range	1.1	1
M.	[AERO-IMT.SHARING.C-BAND]	PDN Report ITU-R M.[AERO-IMT.SHARING.C-BAND] (Doc. 4-5-6-7/715 Annex 33)	Sharing and compatibility studies between aeronautical mobile[/ground mobile] applications and potential IMT systems in the 4 400-4 990 MHz band	1.1	1
F.	[FS-IMT 4 400-4 990 MHz SHARING AND COMPATIBILITY]	DN Report ITU-R F. [FS-IMT 4 400-4 990 MHz SHARING AND COMPATIBILITY] (Doc. 4-5-6-7/715 Annex 18 - 5/121)	Sharing and compatibility study between IMT systems and point-to-point fixed wireless systems in the frequency band 4 400-4 990 MHz	1.1	1
M.	[RLAN5GHz.SHAR]	WDPDN Report ITU-R M.[RLAN5GHz.SHAR] (Doc. 4-5-6-7/715 Annex 34)	Compatibility studies between radio local area network systems and radiodetermination systems in the 5 350-5 470 MHz frequency band	1.1	1

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F.	[IMT-FS 5 925-6 425 MHz SHARING]	DN Report ITU-R F.[IMT-FS 5 925-6 425 MHz SHARING] (Doc. 4-5-6-7/715 Annex 20 - 5/122)	Sharing and compatibility study between indoor IMT small cells and fixed service stations in the 5 925-6 425 MHz frequency band	1.1	1
M.	[BSS-MS]	WDPDN Report ITU-R M.[BSS-MS] (Doc. 4-5-6-7/715 Annex 27)	Sharing and compatibility studies between IMT systems and BSS systems in the frequency band 1 452-1 492 MHz	1.1	1
	Annex 29 of … (Document 4-5-6-7/715)	WDPDN Report ITU-R […] (Doc. 4-5-6-7/715 Annex 29)	Sharing studies of IMT-Advanced systems in the mobile service with respect to systems in the mobile-satellite service in the frequency bands 1 518-1 559 MHz, 1 626.5-1 660.5 MHz and 1 668-1 675 MHz	1.1	1
	Annex 28 of … (Document 4-5-6-7/715)	WDPDN Report ITU-R […] (Doc. 4-5-6-7/715 Annex 28)	Adjacent band compatibility studies of IMT-Advanced systems in the mobile service in the band below 1 518 MHz with respect to systems in the mobile-satellite service in the frequency band 1 518-1 559 MHz	1.1	1
RS.	[EESS-IMT 1.4 GHz]	DN Report ITU-R RS.[EESS-IMT 1.4 GHz] (Doc. 4-5-6-7/715 Annex 11 - 5/111 - 7/74)	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 (EESS) within the 1 400-1 427 MHz frequency band	1.1	1
RS.	[EESS RLAN 5 GHz]	PDN Report ITU-R RS.[EESS-RLAN 5 GHz] (Doc. 4-5-6-7/715 Annex 35)	Sharing studies between RLAN and EESS (active) systems in the frequency range 5 350-5 470 MHz	1.1	1

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F.	[IMT 1 350-1 530 MHz ADJACENT CHANNEL SHARING]	WDPDN Report ITU-R F.[IMT 1 350-1 530 MHz ADJACENT CHANNEL SHARING] (Doc. 4-5-6-7/715 Annex 26)	[Adjacent channel / adjacent band coexistence between IMT systems and fixed service point-to-point links currently operating in 1 350-1 527 MHz]	1.1	1
M.	[5 350 MHz AERO]	PDN Report ITU-R M. [5 350 MHz AERO] (Doc. 4-5-6-7/715 Annex 36)	Compatibility studies between radio local area network systems and aeronautical airborne radar systems in the 5 350-5 470 MHz frequency band	1.1	1
M.	[PPDR]	WDPDN Rep. ITU-R M.[PPDR] (Doc. 5A/543 Annex 15)	Public protection and disaster relief communications	1.3	1
SA.	[EESS-SPACE-7GHz]	PDN Report ITU-R [EESS-SPACE-7GHz] (Doc. 7B/293 Annex 2)	Compatibility between EESS (Earth-to-space) and the space research service or the space operation service in the band 7 100-7 235 MHz	1.11	2
S.	[FSS 7/8 GHz Compatibility]	WDPDN Rep. ITU-R [FSS 7/8 GHz Compatibility] (Doc. 4A/468 Annex 13)	Compatibility studies between the fixed-satellite service and the terrestrial and other space services in the frequency bands 7 150-7 250 MHz (space-to-Earth) and 8 400- 8 500 MHz (Earth-to-space)	1.11	2
RS.	[EESS-9GHz_RDS]	WDPDN Rep. ITU-R RS[EESS-9GHz_RDS] (Doc. 7C/258 Annex 8)	Sharing analyses of very wideband EESS SAR transmissions with stations in the radio determination service operating in the frequency bands 8 700-9 300 MHz and 9 900-10 500 MHz	1.12	2
RS.	[EESS-9 GHz_FS/MS/AS]	PDN Report ITU-R RS.[EESS-9 GHz_FS/MS/AS] (Doc. 7C/258 Annex 4)	Sharing analyses of very wideband EESS SAR transmissions with stations in the fixed, mobile, amateur, and amateur-satellite services operating in the frequency bands 8 700-9 300 MHz and 9 900-10 500 MHz - WRC-15 agenda item 1.12	1.12	2

ITU-R Series	Report draft number *	Available document / status (as of August 2014)	Report title	Agenda item	CPM chapter
RS.	[EESS-9GHz_OOBE]	DN Report ITU-R RS.[EESS-9GHz_OOBE] (Doc. 7/72)	RF compatibility of unwanted emissions from 9 GHz EESS synthetic aperture radars (SAR) with the EESS (passive), SRS (passive), SRS and RAS operating in the frequency bands 8 400-8 500 MHz and 10.6-10.7 GHz, respectively	1.12	2
TF.	[ITU-BIPM WORKSHOP]	WD PDN Report ITU-R [ITU-BIPM WORKSHOP] (Doc. 7A/56 Annex 2)	ITU BIPM Workshop on the future of the International Time Scale	1.14	2
M.	[Channel sounding]	WDPDN Rep. ITU-R M.[CHANNEL SOUNDING] (Doc. 5B/636 Annex 28)	VDES channel sounding campaign	1.16	3
M.	[AIS.PROTECTION]	WDPDN Rep. ITU-R M.[AIS.PROTECTION] (Doc. 5B/636 Annex 30)	Technical assessment of RR Appendix 18	1.16	3
M.	[VDES-SELECT]	WDPDN Rep. ITU-R M.[VDES-SELECT] (Doc. 5B/636 Annex 29)	Selection of the channel plan for a VHF data exchange system VDES) under WRC-15 agenda item 1.16	1.16	3
M.	[VDES]	WDPDN Rep. ITU-R M [VDES] (Doc. 5B/475 Annex 24)	Technical characteristics for a VHF data exchange system in the VHF maritime mobile band	1.16	3
M.	[MAR.MSS]	WDPDN Rep. ITU-R M.[MAR.MSS] (Doc. 5B/636 Annex 27)	Use of non-GSO MSS satellite systems to enhance maritime safety	1.16	3
M.	[WAIC_SHARING_4 200-4 400 MHz]	PDN Rep. ITU-R M.[WAIC_SHARING_4 200-4 400 MHz] (Doc. 5B/636 Annex 22)	Compatibility analysis between wireless avionics intra-communication systems and systems in the existing services in the frequency band 4 200-4 400 MHz	1.17	3

ITU-R Series	Report draft number *	Available document / status (as of August 2014)	Report title	Agenda item	CPM chapter
M.	[WAIC BANDS]	PDN Rep. ITU-R M.[WAIC BANDS] (Doc. 5B/636 Annex 26)	Consideration of the aeronautical mobile (route), aeronautical mobile and aeronautical radionavigation services allocations to accommodate wireless avionics intra-communications	1.17	3
M.	[WAIC_SHARING_ 22/23 GHZ]	WDPDN Rep. ITU-R M.[WAIC_SHARING_22/23 GHZ] (Doc. 5B/636 Annex 31)	Sharing studies between wireless avionics intra-communication systems and systems in the 22.5-22.55 GHz and 23.55 23.6 GHz frequency bands and compatibility studies with systems allocated to the passive services in the 22.21-22.5 GHz and 23.6-24.0 GHz.	1.17	3
M.	[AUTOMOTIVE RADARS]	PDN Rep. ITU-R M. [AUTOMOTIVE RADARS] (Doc.5B/636 Annex 24)	Systems characteristics and compatibility of automotive radars operating in the frequency band 77.5-78 GHz for sharing studies	1.18	3
M.	[UAS-FSS]	WDPDN Rep. ITU-R M.[UAS-FSS] (Doc. 5B/636 Annex 40)	Technical and operational characteristics, interference and regulatory environments associated with the use of frequency bands allocated to the fixed-satellite service not subject to Appendices 30, 30A, and 30B for the control and non-payload communications of unmanned aircraft systems in non-segregated airspace	1.5	3
S.	[R1.FSS]	PDN Report ITU-R [R1.FSS] (Doc. 4A/591 Annex 18)	Assessment on use of spectrum in the 10-17 GHz band for the GSO fixed-satellite service in Region 1	1.6.1	4.1
S.	[FSS.DEPLOYMENT]	PDN Rep. ITU-R [FSS.DEPLOYMENT] (Doc. 4A/591 Annex 20)	Fixed-satellite service parameters and deployment in the 10-17 GHz band for the GSO fixed-satellite service	1.6.1 1.6.2	4.1
S.	[R2R3.FSS]	PDN Rep. ITU-R [R2R3.FSS] (Doc. 4A/591 Annex 19)	Assessment on use of spectrum in the 13-17 GHz range for the GSO fixed-satellite service in Regions 2 and 3	1.6.2	4.1
S.	[ESV]	WDPDN Rep. ITU-R [ESV] (Doc. 4A/591 Annex 26)	Interference effect of transmissions from earth stations on board vessels operating in fixed-satellite service networks on terrestrial co-frequency stations	1.8	4.1

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S.	[FSS 7/8GHz Compa tibility]	PDN Rep. ITU-R [FSS 7/8GHz Compatibility] (Doc. 4A/591 Annex 17)	Compatibility studies between the fixed-satellite service and the terrestrial and other space services in the frequency bands 7 150-7 250 MHz (space-to-Earth) and 8 400-8 500 MHz (Earth-to-space)	1.9.1	4.1
M.	[MSS SHARE]	PDN Report ITU-R [MSS SHARE] (Doc. 4C/369 Annex 8)	Sharing between GSO MSS and other services in the allocations in the 22-26 GHz range	1.10	4.2
M.	[MSS KA REQ]	WDPDN Rep. ITU-R [MSS KA REQ] (Doc. 4C/239 Annex 6)	Traffic forecasts and estimated spectrum requirements for future development of broadband applications of the mobile-satellite service in the range 22-26 GHz	1.10	4.2
M.	[MMSS 7/8 GHz SHARING]	PDN Report ITU-R [MMSS 7/8 GHz SHARING] (Doc. 4C/369 Annex 6)	Possible allocations to the maritime mobile-satellite service in the 7/8 GHz range	1.9.2	4.2
SA.	[NANO/PICOSAT Characteristics]	PDN Report ITU-R [NANO/PICOSAT Characteristics] (Doc. 7B/293 Annex 6)	Characteristics, definitions and spectrum requirements of nanosatellites and picosatellites, as well as systems composed of such satellites	9.1.8	5
SA.	[NANO/PICOSAT CURRENT PRACTICE]	PDN Report ITU-R [NANO/PICOSAT CURRENT PRACTICE] (Doc. 7B/293 Annex 7)	Current practice and procedures for notifying space networks currently applicable to nanosatellites and picosatellites	9.1.8	5
M.	[AGENDA ITEM 9.1.1]	PDN Report ITU-R [AGENDA ITEM 9.1.1] (Doc. 4C/369 Annex 7)	Protection of the 406-406.1 MHz band	9.1, issue 9.1.1	5
S.	[RES756]	PDN Rep. ITU-R [RES756] (Doc. 4A/591 Annex 16)	Studies on possible reduction of the coordination arc and technical criteria used in application of RR No. 9.41 in respect of coordination under RR No. 9.7	9.1, issue 9.1.2	5
S.	[BROADBAND BY FSS]	PDN Rep. ITU-R [BROADBAND BY FSS] (Doc. 4A/591 Annex 22)	Broadband access by fixed-satellite service systems	9.1, issue 9.1.3	5

7 Other ITU publications

Reference*	Publication	Title	Agenda item	CPM chapter
CCIR Report 455-5	CCIR Report 455-5	Frequency sharing between networks of the fixed-satellite service	9.1, issue 9.1.2	5
GE06	GE06 Agreement	Regional Agreement relating to the planning of the digital terrestrial broadcasting service in Region 1 (parts of Region 1 situated to the west of meridian 170° E and to the north of parallel 40° S, except the territory of Mongolia) and in the Islamic Republic of Iran, in the frequency bands 174-230 MHz and 470-862 MHz (Geneva, 2006)	1.1 1.2	1
Handbook: ITU-R *Emergency and Disaster relief*	**Handbook -** ITU-R *Emergency and Disaster relief* Edition of 2006	Emergency and Disaster relief	9.1, issue 9.1.7	6
ITU-D Q.10-3/2 Report	ITU-D Q.10-3/2 Report	Telecommunications/ICTs for rural and remote areas	9.1, issue 9.1.3	5
ITU-D Q.25/2 Report	ITU-D Q.25/2 Report	Access technology for broadband telecommunications including IMT, for developing countries	9.1, issue 9.1.3	5
ITU-R Handbook	ITU-R Handbook - Satellite Time and Frequency Transfer and Dissemination	Satellite Time and Frequency Transfer and Dissemination	1.14	2
ITU-R Handbook	ITU-R Handbook - Selection and Use of Precise Frequency and Time Systems	Selection and Use of Precise Frequency and Time Systems	1.14	2
ITU-R Handbook	ITU-R Handbook - satellite communications (FSS) – 3rd edition	Handbook on satellite communications (FSS) – 3rd edition	9.1, issue 9.1.3	5
ITU-R Handbook	ITU-R Handbook - specifications of transmission systems for the broadcasting-satellite service	Handbook on specifications of transmission systems for the broadcasting-satellite service	9.1, issue 9.1.3	5
ITU-R Handbook	ITU-R Handbook - Mobile-satellite service (MSS)	Handbook on Mobile-satellite service (MSS)	9.1, issue 9.1.3	5

Reference*	Publication	Title	Agenda item	CPM chapter
No. 91 of the Tunis Agenda for the Information Society	TUNIS AGENDA FOR THE INFORMATION SOCIETY (www.itu.int/wsis/index.html)	Tunis Agenda for the Information Society	9.1, issue 9.1.7	6
Resolution 36 (Rev. Guadalajara, 2010)	PP-10 Resolution 36 (Rev. Guadalajara, 2010)	Telecommunications/information and communication technology in the service of humanitarian assistance	9.1, issue 9.1.7	6
Resolution 136 (Rev. Guadalajara, 2010)	PP-10 Resolution 136 (Rev. Guadalajara, 2010)	The use of telecommunications/information and communication technologies for monitoring and management in emergency and disaster situations for early warning, prevention, mitigation and relief	9.1, issue 9.1.7	6
Resolution 34 (Rev. Hyderabad, 2010)	WTDC-10 Resolution 34 (Rev. Hyderabad, 2010)	The role of telecommunications/information and communication technology in disaster preparedness, early warning, rescue, mitigation, relief and response	9.1, issue 9.1.7	6
Resolution 34 (Rev. Dubai, 2014)	WTDC-14 Resolution 34 (Rev. Dubai, 2014)	The role of telecommunications/information and communication technology in disaster preparedness, early warning, rescue, mitigation, relief and response	9.1, issue 9.1.7	6

8 Non-ITU publications

Reference*	Publication	Title	Agenda item	CPM chapter
ECC Report 199	ECC Report 199	“User requirements and spectrum needs for future European broadband PPDR systems (Wide Area Networks) May 2013”. (http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP199.PDF)	1	1.3
Phoenix Center Policy Bulletin No. 26	Phoenix Center Policy Bulletin No. 26	“Public Safety or Commercial Use? A Cost/Benefit Framework for the D Block”, March 2011	1	1.3

Reference*	Publication	Title	Agenda item	CPM chapter
		(http://www.phoenix-center.org/PolicyBulletin/PCPB26Final.pdf)		
Defence Research and Development Canada	-	"700 MHz Spectrum Requirements for Canadian Public Safety Interoperable Mobile Broadband Data Communications", February 2011. (http://cradpdf.drdc-rddc.gc.ca/PDFS/unc122/p535072_A1b.pdf)	1	1.3
APT Report on	APT/AWG/REP-27	"PPDR Applications Using IMT-Based Technologies and Networks", April 2012	1	1.3
APT Report on	APT/AWG/REP-38	"Technical Requirements for Mission Critical Broadband PPDR Communications", September 2013	1	1.3
TRPC	-	"Public Protection and Disaster Relief (PPDR) Services and Broadband in Asia and the Pacific: A Study of Value and Opportunity Cost in the Assignment of Radio Spectrum" May 2013 (http://trpc.biz/wp-content/uploads/PPDR-_Report_June-2013_FINAL.pdf)	1	1.3
Satellite Industry Association (SIA) Report	The Satellite Industry Association (SIA) Report	The Satellite Industry Association (SIA) 2012 State of the Satellite Industry Report (http://www.sia.org/wp-content/uploads/2012/06/Final-2012-State-of-Satellite-Industry-Report.pdf)	9.1, issue 9.1.3	5
Tampere Convention	Tampere Convention on the Provision of Telecommunications Resources for Disaster Mitigation and Relief Operations (Tampere, 1998)	Tampere Convention on the Provision of Telecommunications Resources for Disaster Mitigation and Relief Operations	9.1, issue 9.1.7	6

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