



World Meteorological Organization (WMO)

PRELIMINARY WMO POSITION ON WRC-23 AGENDA

The Report of the International Telecommunication Union of the Radio-communications sector (ITU-R) RS.2178, referred to in Resolution ITU-R **673** on “The importance of Earth observation radiocommunication applications”, concluded that:

“Most of this societal value is incommensurable in financial terms, as it relates to preventing large losses of lives or threats to socio-political stability and security. Scientific use of spectrum has also a direct impact in many economic areas, which can be estimated, by producing spin-offs in technology and economic developments in energy, transportation, agriculture, communications, etc.”

The enclosed document reflects the preliminary WMO position on the agenda of the World Radiocommunication Conference 2023 (WRC-23) as given in Resolution **811 (WRC-19)** “Agenda for the 2023 World Radiocommunication Conference”.

APG23-2 is invited to take into consideration the preliminary WMO position elaborated in February 2021 when reviewing the WRC-23 Agenda.

Enclosure:

WMO Position for the ITU WRC-23

Preliminary WMO Position on the World Radiocommunication Conference 2023 (WRC-23) Agenda

1. Introduction

WMO Members through their National Meteorological and Hydrological Services (NMHSs) and supporting agencies, including operators of space-based observing systems, make available a wide range of essential services to observe weather, water, climate and related environmental events.

The information gathered through these observations is vital for the global community and contributes to ensuring safety of life and property and in the longer term to implementing the global development agendas, such as the 2030 Agenda for Sustainable Development, the Paris Climate Agreement and the Sendai Framework for Disaster Risk Reduction¹.

The observing networks provided by WMO Members form the backbone of the WMO Integrated Global Observing System (WIGOS) and are critically dependent on the use of radiofrequencies for the sensing and dissemination of data and information.

In this context, Resolution **673** of the International Telecommunication Union (ITU) World Radiocommunications Conference (Geneva, 2012)² observes that:

- Earth observation data are essential for monitoring and predicting climate changes, for disaster prediction, monitoring and mitigation, for increasing the understanding, modelling and verification of all aspects of climate change, and for related policy-making;
- many observations are performed over the entire world which require spectrum-related issues to be considered on a worldwide basis;
- Earth observations are performed for the benefit of the whole international community and the data are generally made available at no cost;

and resolves to:

- continue to recognize that the use of spectrum by Earth observation applications has a considerable societal and economic value;
- urge administrations to take into account Earth observation radio-frequency requirements and in particular protection of the Earth observation systems in the related frequency bands;
- encourage administrations to consider the importance of the use and availability of spectrum for Earth observation applications prior to taking decisions that would negatively impact the operation of these applications.

The development of new, mass-market and value-added radio applications is putting increasing pressure on the frequency bands used for meteorological purposes.

This presents potential risks of limiting meteorological and other related application, but also opportunities for enhancing observations.

WMO remains committed to work with ITU towards optimizing the use of the radiofrequency spectrum for the benefit of the global community.

¹ See <https://public.wmo.int/en/our-mandate/what-we-do/wmo-contributing-sustainable-development-goals-sdgs>.

² World Radiocommunication Conference Resolutions are contained in Volume 3 of the in-force version of the Radio Regulations. The Radio Regulations can be obtained at: https://www.itu.int/en/myitu/Publications/2020/09/02/14/23/Radio-Regulations-2020?sc_campaign=DD249A18F65340498C7674FA167CAC94.

This document reflects the preliminary WMO position on the agenda of the World Radiocommunication Conference 2023 (WRC-23)³.

2. General comments

The WMO Integrated Global Observing System (WIGOS) comprises components that make use of a wide number of different radio applications and services, some of which may be affected by WRC-23 decisions.

Space-borne sensing of the Earth's surface and atmosphere has an essential and increasing importance in operational and research meteorology, in particular for mitigating the impact of weather, water and climate-related disasters, and in the scientific understanding, monitoring and prediction of climate change and its impacts.

The impressive progress made in recent years in weather, water and climate analysis and forecasts, including warnings for dangerous weather phenomena (heavy rain, storms, cyclones) that affect all populations and economies, is to a great extent attributable to space-borne observations and their assimilation in numerical models.

2.1 Space-based Observations

Space-borne passive sensing for meteorological applications is performed in bands allocated to the Earth exploration-satellite (passive) and meteorological-satellite services. Passive sensing requires the measurement of naturally occurring radiation, usually of very low power levels, which contains essential information on the physical process under investigation.

The relevant frequency bands are determined by fixed physical properties (molecular resonance) that cannot hence be changed or ignored, nor are these physical properties able to be duplicated in other bands. Therefore, these frequency bands are an important natural resource. Even low levels of interference received by a passive sensor may degrade its data. In addition, in most cases these sensors are not able to discriminate between natural and man-made radiation.

For passive sensing bands shared with active services, the situation is becoming increasingly critical with an increased density of terrestrial active devices and serious cases of interference already being reported.

In the more critical passive sensing frequency bands, RR No 5.340⁴ stating that “all emissions are prohibited” enables in principle passive services to deploy and operate their systems with the highest reliability. However, in some cases this protection appears to be insufficient due to unregulated and potentially mass-market short-range devices allowed nationally to operate in these bands or unwanted emissions from not properly regulated adjacent bands. Several geophysical parameters contribute, at varying levels, to natural emissions, which can be observed at a given frequency which presents unique properties. Therefore, measurements at several frequencies in the microwave spectrum must be made simultaneously in order to isolate and to retrieve each individual contribution, and to extract the parameters of interest from the given set of measurements.

Consequently, interference that could impact a given “passive” frequency band could thus have an impact on the overall measurement of a given atmospheric component.

Each passive frequency band cannot hence be considered on its own but should be seen as a complementary component of a complete space-borne passive sensing system. Current scientific and meteorological-satellite payloads are not dedicated to one given band but include many different instruments performing measurements in the entire set of passive bands.

³ Resolution 811 (WRC-19) “Agenda for the 2023 World Radiocommunication Conference”

⁴ Radio Regulations footnotes are found in Volume 1 of the Radio Regulations. The Radio Regulations can be obtained at: https://www.itu.int/en/myitu/Publications/2020/09/02/14/23/Radio-Regulations-2020?sc_campaign=DD249A18F65340498C7674FA167CAC94.

It should also be noted that full global data coverage is of particular importance for most weather, water and climate applications and services.

Space-borne active sensing, performed by altimeters, rain and cloud radars, scatterometers and Synthetic Aperture Radars⁵ provides meteorological and climatology activities with important information on the state of the ocean, ice and land surfaces and atmospheric phenomena.

Also, of great importance is the availability of sufficient and well-protected Earth exploration and meteorological-satellite services radio-frequency spectrum for telemetry/telecommand as well as for satellite downlink of the collected data.

2.2 Surface-based and in-situ Observations

In addition, meteorological radars and wind-profiler radars are important surface-based instruments in the meteorological observation processes. Radar data are input to nowcasting and to the numerical weather prediction models for short-term and medium-term forecasting. There are currently about one hundred wind-profiler radars and several hundreds of meteorological radars worldwide that perform wind and precipitation measurements. These systems play a crucial role in the immediate meteorological and hydrological alert processes. Meteorological radar networks represent the last line of defense in a disaster warning strategy against loss of life and property in flash flood or severe storm events, such as in several recent dramatic cases.

Meteorological aids systems, mainly radiosondes, are the main source of atmospheric in situ measurements with high vertical resolution (temperature, relative humidity and wind speed) to provide real time vertical atmospheric profiles that are and will remain essential for operational meteorology, including weather analysis prediction and warnings, as well as for climate monitoring. In addition, these in situ measurements are essential for calibrating space-borne remote sensing, in particular passive sensors.

The Eighteenth World Meteorological Congress (Geneva, June 2019), attended by 193 Member countries, confirmed serious concern at the continuous threat to radio frequency bands allocated for meteorological and related environmental systems and adopted the Resolution 42 (Cg-18) – Radio frequencies for meteorological and related environmental activities, in which all WMO Member countries are urged to make all efforts to do their utmost to ensure the availability and protection of suitable radio frequency bands required for meteorological and related environmental operations and research.

2.3 WMO Actions

The Eighteenth World Meteorological Congress (Geneva, June 2019) “...stresses that some radio-frequency bands are a unique natural resource due to their special characteristics and natural radiation enabling spaceborne passive sensing of the atmosphere and the Earth’s surface, which deserve adequate allocation to the Earth exploration satellite service (passive) and absolute protection from interference”, and “...expresses its serious concern at the continuing threat to several radio-frequency bands allocated to the meteorological aids, meteorological-satellite, Earth-exploration satellite and radiolocation (weather and wind profiler radars) services posed by the development of other radiocommunication services.”

The dependency of observing systems on radio-frequency management has long-term ramifications on the sustainability and usability of essential climate variables and other weather, water and climate related observations that contribute to the Observations and Monitoring pillar of the Global Framework for Climate Services (GFCS) as identified at the Eighteenth World Meteorological Congress (Geneva, June 2019).

⁵ Synthetic Aperture Radars (SAR) provide complementary information, which is useful for flood disaster management and many other applications.

3. WMO preliminary position on WRC-23 Agenda Items

Among WRC-23 agenda items, 20 items or topics are related to frequency bands or issues of prime interest or concern for meteorology and related fields:

- Agenda item 1.2: Identification of bands, including possible mobile service allocations, for International Mobile Telecommunications (IMT)
- Agenda item 1.3: Primary allocation of the band 3 600-3 800 MHz to the mobile service within Region 1⁶
- Agenda item 1.4: High-altitude platform stations as IMT base stations (HIBS) in frequency bands below 2.7 GHz
- Agenda item 1.5: Possible regulatory actions in the frequency band 470-694 MHz in Region 1
- Agenda item 1.6: Regulatory provisions to facilitate radiocommunications for sub-orbital vehicles
- Agenda item 1.10: Possible new allocations for the aeronautical mobile service for the use of non-safety aeronautical mobile applications in 15.4-15.7 GHz and 22-22.21 GHz
- Agenda item 1.12: Possible new secondary allocation to the Earth exploration-satellite service (active) around 45 MHz
- Agenda item 1.13: Upgrade of the space research service allocation to primary in the frequency band 14.8-15.35 GHz
- Agenda item 1.14: Possible adjustments of the existing or possible new allocation to the EESS (passive) in 231.5-252 GHz
- Agenda item 1.15: Harmonization of the use of the frequency band 12.75-13.25 GHz (Earth-to-space) by earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service globally
- Agenda item 1.16: Use of the frequency bands 17.7-18.6 GHz (s-E), 18.8-19.3 GHz (s-E), 19.7-20.2 GHz (s-E), 27.5-29.1 GHz (E-s) and 29.5-30 GHz (E-s) by earth stations in motion (ESIMs)
- Agenda item 1.17: Regulatory actions for the provision of intersatellite links in specific frequency bands
- Agenda item 1.18: Potential new allocations to the MSS in the frequency bands 1695-1710 MHz, 2010-2025 MHz, 3300-3316 MHz and 3385-3400 MHz for future narrowband MSS systems
- Agenda item 7: Satellite regulatory procedures
- Agenda item 9.1a): Appropriate recognition and protection in the Radio Regulations for space weather sensors, without placing additional constraints on incumbent services
- Agenda item 9.1b): Amateur service and amateur-satellite service allocations in 1 240-1 300 MHz
- Agenda item 9.1c): Study use of IMT for fixed wireless access in bands allocated to the fixed Service

⁶ It has to be noted that any reference to Regions in this document refers to ITU-R regions outlined in Article 5.2 of the Radio Regulations, Volume 1.

Agenda item 9.1d): Protection of EESS (passive) in the frequency band 36-37 GHz from non-GSO FSS space stations

Agenda item 9 on Article 21: Applicability of Article 21.5 for IMT base stations that use an antenna that consists of an array of active elements and notification of such systems

Agenda item 10: Preliminary agenda for WRC-27

3.1 Agenda item 1.2

“to consider identification of the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz for International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 245 (WRC-19)”

Footnote RR No 5.458 indicates that administrations should bear in mind the needs of the Earth exploration-satellite (passive) and space research (passive) services in their future planning of the bands 6 425-7 075 MHz and 7 075-7 250 MHz as passive microwave sensor measurements are carried out in these frequency bands. The frequency range 6425-7250 MHz is unique for Earth exploration-satellite service (EESS) (passive) sensor measurements, since it corresponds to the peak sensitivity to sea surface temperature (SST). Thus, the use of this band by International Mobile Telecommunications (IMT) could have an impact on SST measurements specifically in coastal areas. The WMO OSCAR Space database⁷ lists some existing and planned satellite missions that include operation of a passive sensor in these bands.

Similarly, the WMO OSCAR database lists numerous existing and planned satellite missions that include operation of a passive sensor in the 10.6-10.7 GHz frequency range, noting that the 10.68-10.7 GHz is a footnote RR No 5.340 band. WMO recognizes that a 100 MHz guard-band exists between the EESS (passive) frequency band and the 10.0-10.5 GHz frequency band proposed for IMT but stresses the fact that IMT studies in other frequency bands have shown that guard-bands alone do not necessary ensure protection of the EESS (passive).

In addition, the potential identification of the 10.0-10.5 GHz band for IMT could result in interference to EESS (active) at 10-10.4 GHz.

The abovementioned potential interference issues in 10.0-10.4 GHz and 10.6-10.7 GHz require study in the ITU-R under this agenda item.

Working Party 5D is the responsible group for studies with Working Party 7C contributing to the studies with regard to the EESS (passive) and EESS (active).

⁷ See <http://oscar.wmo.int/space>.

WMO Position on WRC-23 agenda item 1.2

WMO is concerned regarding:

- the continued use of EESS (passive) in the 6425-7075 MHz and 7075-7250 MHz frequency bands. WMO understands that footnote RR No 5.458 does not provide an allocation to this service. Nevertheless, WMO encourages Administrations to bear in mind the needs of the EESS (passive) service in their future planning of the bands 6425-7075 MHz and 7075-7250 MHz when considering identification for IMT in these frequency bands,
- the protection of EESS (passive) in the 10.6-10.7 GHz frequency band from unwanted emissions from IMT, operating within the 10.0-10.5 GHz band. WMO supports studies to determine the necessary limits to protect passive sensing operations in 10.6-10.7 GHz,
- the protection of EESS (active) in the band 10-10.4 GHz.

3.2 Agenda item 1.3

“to consider primary allocation of the band 3 600-3 800 MHz to mobile service within Region 1 and take appropriate regulatory actions, in accordance with Resolution 246 (WRC-19)”

Since an IMT identification in the 3600-3800 MHz could lead to a shift of current fixed satellite service (FSS) usage in the band above 3800 MHz, the possible impact on the FSS (space-to-Earth) above 3800 MHz could be a concern as the distribution of meteorological data is facilitated by the use of commercial communication satellites in the framework of GEONETCast, which is a global network of sustained and cost-effective satellite-based dissemination systems using commercial satellites with more than 6000 user stations in 169 countries.

WMO Position on WRC-23 agenda item 1.3

Since an IMT identification in the 3600-3800 MHz could lead to a shift of current FSS usage in the band above 3800 MHz, WMO is concerned regarding the possible impact on future usage of the existing FSS (space-to-Earth) allocation in the frequency band 3.8-4.2 GHz used for the distribution of meteorological data in the framework of the GEONETCast network.

3.3 Agenda item 1.4

“to consider, in accordance with Resolution 247 (WRC-19), the use of high-altitude platform stations as IMT base stations (HIBS) in the mobile service in certain frequency bands below 2.7 GHz already identified for IMT, on a global or regional level”

Operational experience of at least one WMO Member shows that ground-based broadband wireless base stations operating below 2690 MHz can cause interference to meteorological radars operating above 2700 MHz. The interference was due to unwanted emissions falling into the radar band and not due to the radar receiver selectivity extending into the broadband wireless band. Interference mitigation could only be achieved through reducing the broadband wireless base station out-of-band emissions. Report ITU-R M.2316⁸ provides additional details. This WRC-23 agenda item considers operation of broadband wireless base stations on airborne platforms, which will place a potential source of unwanted emissions in and near the radar antenna main beam, increasing the

⁸ <https://www.itu.int/pub/R-REP-M.2316>

antenna gain in the interference path by as much as 35 dB relative to the above-mentioned real interference cases.

Also, studies carried out in Europe (ECC Report 309) conclude that interference can occur in the meteorological satellite service (MetSat) allocation in the adjacent band (1675-1710 MHz) if the band 1710-1855 MHz, already identified for IMT, is used for UAV communications without additional conditions (tighter unwanted emissions limits). Similar potential impacts can be expected from HIBS and protection of MetSat service in the 1675-1710 MHz band needs then to be ensured, as the band is globally used by geostationary and non-geostationary MetSat systems for the downlink of the measured data as well as the global dissemination of the data directly to the users.

Finally, as the EESS/MetSat satellite systems are using the band 2025-2110 MHz for telecommanding and uplinking instrument data, WMO is concerned with the protection of the allocations of the EESS/Space Operation Service (SOS) in the 2025-2110 MHz band.

Working Party 5D is the responsible group for conducting studies, with Working Party 5B contributing to the studies with regard to meteorological radar, Working Party 7C contributing to the studies with regard to EESS (passive) and Working Party 7B contributing to the studies with regard to MetSat service.

WMO Position on WRC-23 agenda item 1.4

WMO is of the opinion that studies must be conducted to specify the HIBS out-of-band unwanted emissions to prevent interference:

- to meteorological radars in the 2700-2900 MHz band from HIBS operated in the 2500-2690 MHz band,
- to MetSat service in the 1675-1710 MHz from HIBS operated in the 1710-1885 MHz band. This is important to ensure the protection of the downlink of the measured data as well as the global dissemination of the data directly to the users,
- to the EESS/SOS in the 2025-2110 MHz band.

3.4 Agenda item 1.5

“to review the spectrum use and spectrum needs of existing services in the frequency band 470-960 MHz in Region 1 and consider possible regulatory actions in the frequency band 470-694 MHz in Region 1 on the basis of the review in accordance with Resolution 235 (WRC-15)”

In some countries, the frequency band 470-494 MHz is allocated to the radiolocation service on a secondary basis, with a limited use to the operation of wind profiler radars in accordance with article footnote RR No 5.291A.

It has to be noted that wind profiler radars are deployed and operational in this frequency band.

WMO Position on WRC-23 agenda item 1.5

WMO would appreciate the development of a solution to ensure the effective operation of the wind profiler radars in the 470-494 MHz frequency band.

3.5 Agenda item 1.6

“to consider, in accordance with Resolution 772 (WRC-19), regulatory provisions to facilitate radiocommunications for sub-orbital vehicles”

This agenda item addresses spectrum needs for sub-orbital vehicles that operate in both the aeronautical and space domains, with communications requirements spanning both aviation and satellite operations. While this agenda item does not permit changes to Article 5 of the Radio Regulations (no changes to frequency allocations), other regulatory changes permitted under this agenda item could affect regulatory provisions that are applicable to the meteorological satellite (MetSat) and Earth exploration-satellite services (EESS) and could increase congestion in the corresponding frequency bands.

It should be noted that sub-orbital vehicle technology may have the potential to support missions of interest to WMO in the future.

Working Party 5B is the responsible group for studies, with Working Party 7B contributing to the studies with regard to MetSat and EESS systems.

WMO Position on WRC-23 agenda item 1.6

WMO supports studies on the development of regulatory provisions to meet the requirements of sub-orbital vehicle operations but would be opposed to provisions that have a negative impact to current and future MetSat and EESS operations.

3.6 Agenda item 1.10

“to conduct studies on spectrum needs, coexistence with radiocommunication services and regulatory measures for possible new allocations for the aeronautical mobile service for the use of non-safety aeronautical mobile applications, in accordance with Resolution 430 (WRC-19);”

This agenda item considers allocation changes to allow non-safety aeronautical mobile operations for air-to-air, air-to-ground and ground-to-air communications. The frequency band 15.4-15.7 GHz is under consideration for a new aeronautical mobile allocation whereas removal of the “except aeronautical mobile” restriction is being considered for the 22-22.21 GHz frequency band.

The 22-22.21 GHz frequency band under consideration is adjacent to the 22.21-22.5 GHz frequency band allocated to the EESS (passive).

It has also to be noted that the 15.4-15.7 GHz frequency band is adjacent to the band 15.35-15.4 GHz (footnote RR No 5.340), however there is no documented use of the frequency band by the EESS (passive).

Adjacent band study is required to ensure protection of these EESS (passive) in the 22.21-22.5 GHz frequency bands.

Working Party 5B is the responsible group for studies, with Working Party 7C contributing to the studies with regard to EESS (passive) systems.

WMO Position on WRC-23 agenda item 1.10

WMO supports studies to ensure protection of the EESS (passive) in the adjacent frequency band 22.21-22.5 GHz. WMO is also concerned that adjacent band interference may limit usability of passive sensing in the 15.35-15.4 GHz band, however ensuring protection may not be possible due to the lack of operational characteristics and sharing criteria.

3.7 Agenda item 1.12

“to conduct, and complete in time for WRC-23, studies for a possible new secondary allocation to the Earth exploration-satellite (active) service for spaceborne radar sounders within the range of frequencies around 45 MHz, taking into account the protection of incumbent services, including in adjacent bands, in accordance with Resolution 656 (Rev. WRC-19)”

This agenda was originally developed and placed on the WRC-23 Preliminary Agenda by WRC-15. WRC-19 reviewed the status of the work and retained the item on the final WRC-23 agenda to consider a secondary allocation to the EESS (active) around 45 MHz.

This agenda item is of interest to WMO to, on the one hand, ensure protection of oceanographic radars operating in 41.015-42 MHz and 42.5-44 MHz under footnote RR No 5.161A and wind profiler radars operating in 46-68 MHz under footnote RR No 5.162A, and, on the other hand, consider the future use of this EESS (active) allocation for meteorological/climate purposes.

Working Party 7C is the responsible group for studies, with Working Party 5B contributing to the studies with regard to oceanographic radars and wind profiler radars.

WMO Position on WRC-23 agenda item 1.12

WMO supports completion of studies to ensure compatibility of incumbent radio services with a view to creating secondary allocation to the EESS (active) at WRC-23.

3.8 Agenda item 1.13

“to consider a possible upgrade of the allocation of the frequency band 14.8-15.35 GHz to the space research service, in accordance with Resolution 661 (WRC-19)”

Agenda Item 1.13 calls for consideration of upgrading the existing space research service (SRS) secondary allocation in 14.8-15.35 GHz to primary status. A primary allocation to the EESS (passive) exists in the adjacent band 15.35-15.4 GHz, however no use of the frequency band for passive operations has been identified.

Working Party 7B is the responsible group for studies, with Working Party 7C contributing to the studies with regard to EESS (passive).

WMO Position on WRC-23 agenda item 1.13

WMO is not opposed to the upgrading the existing space research service (SRS) secondary allocation in 14.8-15.35 GHz to primary status.

3.9 Agenda item 1.14

“to review and consider possible adjustments of the existing or possible new primary frequency allocations to EESS (passive) in the frequency range 231.5-252 GHz, to ensure alignment with more up-to-date remote-sensing observation requirements, in accordance with Resolution 662 (WRC-19)”

This WRC-23 Agenda item was initiated by MetSat operators with the goal of better aligning or adding possible new allocations to the EESS (passive) in the 231.5-252 GHz frequency range with passive sensor design requirements. Allocations to the EESS (passive) within the 231.5-252 GHz frequency range were created 20 years ago at a time when operational requirements were unclear. Realigning the allocations will result in better protection of future MetSat operations

within the 231.5-252 GHz frequency range. With the latest scientific and technological developments for passive microwave sensors, measurements of ice clouds, which cover more than 33% of Earth's surface, will close a gap in the measurement's portfolio of the atmosphere. Ice clouds have important effects on Earth's climate and hydrological cycle by affecting precipitation, atmospheric structure, and cloud processes. Global measures of ice cloud properties including ice water path, ice particle size distribution, are therefore critically needed. There is a requirement for two 3000 MHz bands at 239.2-242.2 GHz and 244.2-247.2 GHz for ice cloud imaging passive sensors currently under development globally.

Working Party 7C is the responsible group for conducting studies.

WMO Position on WRC-23 agenda item 1.14

WMO supports conducting studies to align or add possible new allocations to the EESS (passive) in the 231.5-252 GHz frequency range with current and future operational requirements. For covering ice cloud measurements, the assessment of the bands 239.2-242.2 GHz and 244.2-247.2 GHz is supported.

3.10 Agenda item 1.15

“to harmonize the use of the frequency band 12.75-13.25 GHz (Earth-to-space) by earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service globally, in accordance with Resolution 172 (WRC-19)”

This agenda item deals with the operation of earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service in the frequency band 12.75-13.25 GHz (Earth-to-space). Sharing and compatibility issues between earth stations on aircraft and vessels communicating with geostationary-satellite orbit (GSO) space stations in the FSS, have to be studied. In addition, studies of the current and planned stations of existing services, as well as services in adjacent frequency bands will also have to be conducted.

These studies will have to address the potential impact from Earth stations on aircraft and vessels into the EESS (active) in the adjacent band 13.25-13.75 GHz, which is used by a number of altimeter instruments. Radar altimeters are used for a variety of applications, such as measuring sea surface heights for global sea level rise monitoring.

Working Party 7C is a contributing group with regard to EESS (active) in 13.25-13.75 GHz.

WMO Position on WRC-23 agenda item 1.15

WMO supports studies to ensure that earth stations on aircraft and vessels communicating with geostationary space stations in the FSS in the frequency band 12.75-13.25 GHz (Earth-to-space) will protect the EESS (active) instruments operating in the adjacent band 13.25-13.75 GHz.

3.11 Agenda item 1.16

“to study and develop technical, operational and regulatory measures, as appropriate, to facilitate the use of the frequency bands 17.7-18.6 GHz and 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by non-GSO FSS earth stations in motion, while ensuring due protection of existing services in those frequency bands, in accordance with Resolution 173 (WRC-19)”

This agenda item calls for the study and development of technical, operational and regulatory measures to facilitate use of several frequency bands by non-GSO fixed satellite service (FSS)

earth stations in motion (ESIMs). This agenda item includes consideration of frequency bands for ESIM operation adjacent to the 18.6-18.8 GHz frequency band used for passive sensing, as well as potential ESIM operation in the 28.5-30 GHz where a secondary allocation to the EESS exists for transmission of data.

The frequency band 17.7-18.6 GHz is also overlapping with GSO MetSat allocation 18-18.3 GHz (ITU Region 2) and 18.1-18.4 GHz (ITU Regions 1 and 3) in accordance with footnote RR **No 5.519**.

With regard to the frequency band 18.6-18.8 GHz, it should be noted that ITU-R Working Party 7C is currently addressing existing interference received by EESS (passive) sensors in the 18.6-18.8 GHz band. In this context, studies are required to determine if ESIM operations in the adjacent bands would result in changes to the interference environment to EESS (passive).

With regard to ESIM operation in the 28.5-30 GHz frequency range, Resolution **173 (WRC-19)** states that no additional constraints should be imposed on the EESS. However, the EESS allocation is secondary whereas the FSS allocation is primary. It is unclear at this stage how no additional constraints to the EESS can be ensured without contravening a basic principle of the Radio Regulations.

Working Party 4A is the responsible group for studies, with Working Party 7B contributing with regard to the EESS in 28.5-30 GHz, and working Party 7C contributing with regard to EESS (passive) in 18.6-18.8 GHz.

WMO Position on WRC-23 agenda item 1.16

WMO supports studies, as necessary, to ensure non-GSO FSS ESIM deployment will protect the co-frequency band MetSat allocation and that the operation of non-GSO FSS ESIM in the frequency bands adjacent to 18.6-18.8 GHz will not result in increased adjacent band interference to EESS (passive) operations.

3.12 Agenda item 1.17

“to determine and carry out, on the basis of the ITU-R studies in accordance with Resolution 773 (WRC-19), the appropriate regulatory actions for the provision of inter-satellite links in specific frequency bands, or portions thereof, by adding an inter-satellite service allocation where appropriate”

This agenda item calls for studies on provisions to allow satellite-to-satellite links to be operated in several frequency bands allocated to the FSS (e.g. 11.7-12.7 GHz, 18.1-18.6 GHz, 18.8 20.2 GHz and 27.5-30 GHz).

The frequency band 18.1-18.6 GHz overlaps with the GSO MetSat allocations in the frequency bands 18-18.3 GHz (ITU Region 2) and 18.1-18.4 GHz (ITU Regions 1 and 3), in accordance with footnote RR **No 5.519**.

With regard to the frequency band 18.6-18.8 GHz, it should be noted that ITU-R Working Party 7C is currently addressing existing interference received by EESS (passive) sensors in the 18.6-18.8 GHz band. In this context, it is to be studied if the operation of satellite-to-satellite links in the adjacent bands would result in changes to the interference environment to EESS (passive).

The frequency band 27.5-30 GHz is partly overlapping with the secondary EESS (Earth-to-space) allocation in the 28.5-30 GHz frequency band in accordance with footnote RR **No 5.541**. It is unclear at this stage whether protecting this secondary allocation needs to be addressed.

Working Party 4A is the responsible group for studies, with Working Party 7B contributing with regard to the MetSat service in 18-18.4 GHz and Working Party 7C contributing with regard to EESS (passive) in 18.6-18.8 GHz.

WMO Position on WRC-23 agenda item 1.17

WMO supports studies, as necessary, to ensure satellite-to-satellite links will protect the co-frequency band MetSat allocation and that the operation of satellite-to-satellite links in the frequency bands adjacent to 18.6-18.8 GHz will not result in increased adjacent band interference to EESS (passive) operations.

3.13 Agenda item 1.18

“to consider studies relating to spectrum needs and potential new allocations to the mobile-satellite service for future development of narrowband mobile-satellite systems, in accordance with Resolution 248 (WRC-19)”

This agenda item initiates studies for consideration of new allocations to the mobile satellite service in several frequency bands, including consideration of the frequency band 1695-1710 MHz (in Region 2 only). The frequency band 1695-1710 MHz is allocated to the MetSat service and is primarily used for non-GSO MetSat data downlinks to earth stations around the world.

Also, as EESS/MetSat satellite systems are using the band 2025-2110 MHz for telecommanding and uplinking instrument data, WMO is concerned with the protection of the allocations of the EESS/SOS in the 2025-2110 MHz band.

Working Party 4C is the responsible group for studies, with Working Party 7B contributing with regard to the EESS/MetSat services. Working Party 7C is a contributing group with regard to the MetAids service in the band 1668.4-1700 MHz.

WMO Position on WRC-23 agenda item 1.18

WMO supports compatibility studies to ensure the protection of current and future MetSat operations in the band 1695-1710 MHz. This is important to ensure the protection of the downlink of the measured data as well as the global dissemination of the data directly to users.

WMO requests the protection of the EESS/SOS in the adjacent band 2025-2110 MHz.

3.14 Agenda item 7

“to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution 86 (Rev. WRC-07), in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the geostationary satellite orbit.”

This standing agenda item deals with any possible changes to the Radio Regulations affecting the advance publication, coordination, notification and recording of satellite networks and requires WMO consideration.

Working Party 4A is the responsible group for conducting studies.

WMO Position on WRC-19 agenda item 7

WMO does not support changes to the Radio Regulations that would impose unnecessary constraints on MetSat and EESS systems or that would overcomplicate the regulatory procedures for the corresponding ITU filings for the frequency bands that are used by these systems. WMO will follow the development of Agenda Item 7 issues as they are identified and studied.

3.15 Agenda item 9.1, Topic a)

“In accordance with Resolution 657 (Rev. WRC-19), review the results of studies relating to the technical and operational characteristics, spectrum requirements and appropriate radio service designations for space weather sensors with a view to describing appropriate recognition and protection in the Radio Regulations without placing additional constraints on incumbent services”

Work began in the ITU-R and WMO in 2014 to determine the radio spectrum requirements for space weather sensors that use the radio spectrum for acquiring data. WRC-2015 placed an item on the Preliminary Agenda of WRC-23 calling for regulatory changes to provide protection to space weather sensors that use radio spectrum. WRC-19 reviewed the work on the topic and included the issue on the WRC-23 agenda as a Topic under Agenda item 9.1, and placed a subsequent item of the Preliminary Agenda for WRC-27 to resolve any remaining regulatory issues.

Space weather sensors that use the radio spectrum currently do not have any regulatory protection in the radio regulations. It is of vital importance to WMO members that this effort be completed to ensure protection of sensor operations in the future.

Under WRC-23 Agenda item 9.1 Topic a), the following issues need to be completed for consideration by WRC-23:

- Determine the appropriate radiocommunication service or services that these sensors should fall under;
- Conduct sharing studies with incumbent systems operating in frequency bands used by space weather sensors with the objective of determining potential regulatory provisions that can be provided to receive-only operational space weather sensors for their appropriate recognition in the Radio Regulations, while not placing additional constraints on incumbent service;
- Develop potential solutions to describe in the Radio Regulations, Articles 1 and 4, and/or as a WRC resolution, if deemed appropriate space weather sensor systems and their corresponding usage, as well as protection requirements for receive-only space weather sensors.

Working Party 7C is the responsible group for conducting studies.

WMO Position on WRC-23 agenda item 9.1 Topic a)

WMO supports ensuring the protection of space weather sensors that use radio spectrum and will contribute to the corresponding studies.

3.16 Agenda item 9.1 Topic b)

“Studies on technical and operational measures to be applied in the frequency band 1 240-1 300 MHz to ensure the protection of the radionavigation-satellite service (space-to-Earth);”

Topic b) under Agenda Item 9.1 calls for studies on technical and operational measures to be applied in the frequency band 1 240-1 300 MHz to ensure the protection of the radionavigation-satellite service (space-to-Earth).

Wind profiler radars are operating in the band 1270-1295 MHz in accordance with Resolution **217 (WRC-97)**.

Working Parties 4C and 5A are jointly responsible for conducting studies.

WMO Position on WRC-23 agenda item 9.1 Topic b)

WMO will monitor and, if necessary, contribute to the work on this Topic to ensure that wind profiler radar will not be affected.

3.17 Agenda item 9.1 Topic c)

“Study the use of International Mobile Telecommunication system for fixed wireless broadband in the frequency bands allocated to the fixed services on primary basis, in accordance with Resolution 175 (WRC-19);”

Topic c) under Agenda Item 9.1 calls for studies on the use of existing frequency bands allocated to the fixed service. As an issue under Agenda item 9.1 no regulatory changes can be made but other changes to the Radio Regulations may be accomplished. This item is of concern since any frequency band allocated to the fixed service is open for consideration and has hence the potential to change coexistence conditions for services allocated in-band or adjacent to frequency bands allocated to the fixed service.

This agenda item could then affect a number of meteorological applications including EESS, MetSat and MetAids frequency bands either in-band or adjacent frequency bands. It needs to be stressed that this also includes a number of EESS (passive) bands in which footnote RR **No 5.340** applies.

Working Parties 5A and 5C are jointly responsible for conducting studies with Working Parties 7B and 7C contributing.

WMO Position on WRC-23 agenda item 9.1 Topic c)

WMO is concerned about this Topic c) under Agenda item 9.1 that is very broad in scope and could hence potentially affect many meteorological operations and applications, including EESS (passive) under footnote RR **No 5.340**.

WMO will monitor the work on this Topic and contribute as necessary.

3.18 Agenda item 9.1 Topic d)

“Protection of EESS (passive) in the frequency band 36-37 GHz from non-GSO FSS space stations;”

Under studies considered for WRC-19 Agenda item 1.6, a preliminary study on the protection of EESS (passive) sensors operating in the band 36-37 GHz from non-GSO FSS space stations in the band 37.5-38 GHz was submitted to the ITU-R. This preliminary study indicated that it may be

necessary to apply to FSS non-GSO space stations an unwanted e.i.r.p. of -34 dBW/100 MHz, for all angles greater than 71.4 degrees from nadir. In addition, interference into the cold calibration channel of the EESS (passive) sensor operating in the frequency band 36-37 GHz was not studied.

On this basis, WRC-19 invited ITU-R to conduct further study of this topic and develop recommendations and/or reports, as appropriate, and report back to WRC-23 to take action, if necessary. Furthermore, WRC-19 agreed that modifications to Resolution **750 (Rev WRC-19)** should not be considered under these studies since the frequency band 36-37 GHz is not referenced in footnote RR **No 5.340**.

Working Party 7C is the responsible group for conducting studies.

WMO Position on WRC-23 agenda item 9.1 Topic d)

WMO supports studies to further evaluate the impact of non-GSO FSS operations in the band 37.5-38 GHz on EESS (passive) sensors in the band 36-37 GHz, in particular the interference impact on the cold-sky calibration of passive sensors.

3.19 Agenda item 9 on Article 21

“ITU-R is invited to study, as a matter of urgency, the applicability of the limit specified in No. 21.5 of the Radio Regulations to IMT stations, that use an antenna that consists of an array of active elements, with a view to recommend ways for its possible replacement or revision for such stations, as well as any necessary updates to Table 21-2 related to terrestrial and space services sharing frequency bands. Furthermore, the ITU-R is invited to study, as a matter of urgency, verification of No. 21.5 regarding the notification of IMT stations that use an antenna that consists of an array of active elements, as appropriate.”

In line with the decision taken for WRC-19 agenda item 1.13, WRC-19 Document 550 invited ITU to study the applicability of the limit specified in **No 21.5** of the RR to IMT stations in the 26 GHz band that use an antenna that consists of an array of active elements.

WRC-19 identified the frequency band 24.25-27.5 GHz for IMT. WMO’s concern is in relation with the existing EESS (space-to-Earth) allocation in the 25.5-27 GHz frequency band.

WMO considers there is a need:

- to update Table 21-2 related to terrestrial and space services sharing frequency bands,
- to study the impact of the existing limits specified in RR **No 21.5** to IMT base stations using an array of active elements, and
- to ensure that deployment, under the provision of RR (2020 Edition), of such IMT base stations will not impact EESS (space-to-Earth) operations in the 25.5-27 GHz frequency band.

Working Party 5D is the responsible group for conducting studies.

WMO Position on WRC-23 agenda item 9 on Article 21

WMO supports studies to ensure that no impact will occur in the band 25.5-27 GHz on EESS (space-to-Earth) operations due to the future deployment of co-frequency IMT systems that use an antenna that consists of an array of active elements. Regarding the notification of such IMT systems, WMO Supports that a temporary approach be developed for the notification and verification for IMT stations with AAS with respect to RR **No 21.5** in the frequency band 25.5-27 GHz before an appropriate competent WRC decision will be taken.

3.20 Agenda item 10

“to recommend to the Council items for inclusion in the Agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, in accordance with Article 7 of the Convention, (Resolution 810 (WRC-15)).”

WRC-19 established the Preliminary Agenda for WRC-27. The preliminary agenda will be reconsidered at WRC-23 where each preliminary agenda item will be evaluated for inclusion in the final WRC-27 agenda.

The current WRC-27 preliminary agenda has a number of items of interest and/or concern to WMO:

- **Preliminary Agenda item 2.1** - *to consider, in accordance with Resolution 663 (WRC-19), additional spectrum allocations to the radiolocation service on a co-primary basis in the frequency band 231.5-275 GHz and identification for radiolocation applications in frequency bands in the range 275-700 GHz for millimetre and sub-millimetre wave imaging systems;*
The frequency ranges specified in this agenda item overlap some frequency bands allocated to, or identify for use by, the EESS (passive). Protection of the EESS (passive) must be ensured.
- **Preliminary Agenda item 2.2** - *study and develop technical, operational and regulatory measures, as appropriate, to facilitate the use of the frequency bands 37.5-39.5 GHz (space-to-Earth), 40.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by aeronautical and maritime earth stations in motion communicating with geostationary space stations in the fixed-satellite service, in accordance with Resolution 176 (WRC-19);*

This preliminary agenda item considers regulatory provisions to facilitate deployment of earth stations in motion (ESIMs) operating in the fixed satellite service. This preliminary agenda item introduces a potential for increased interference to the EESS (passive) in the 50.2-50.4 GHz frequency band.

- **Preliminary Agenda Item 2.5** - *the conditions for the use of the 71-76 GHz and 81-86 GHz frequency bands by stations in the satellite services to ensure compatibility with passive services in accordance with Resolution 776 (WRC-19);*

This preliminary agenda item calls for studies of regulatory provisions that could be implemented to ensure protection of passive services including the EESS (passive) in the frequency band 86-92 GHz, from satellite operations in 71-76 GHz and 81-86 GHz. The protection of the EESS (passive) in 86-92 GHz through implementation of mandatory limits in Resolution 750 (WRC-19) is a priority for WMO.

- **Preliminary Agenda item 2.6** - *to consider regulatory provisions for appropriate recognition of space weather sensors and their protection in the Radio Regulations, taking into account the results of ITU R studies reported to WRC-23 under agenda item 9.1 and its corresponding Resolution 657 (Rev. WRC-19);*

This preliminary agenda item is intended as a follow-on to WRC-23 Agenda Item 9.1, Topic A. Under Agenda Item Topic A, regulatory changes are not permitted. This follow-on preliminary agenda item for WRC-27 will address any required regulatory changes.

- ***Preliminary Agenda item 2.7*** - *to consider the development of regulatory provisions for non-geostationary fixed-satellite system feeder links in the frequency bands 71-76 GHz (space-to-Earth and proposed new Earth-to-space) and 81-86 GHz (Earth-to-space), in accordance with Resolution 178 (WRC-19);*

This preliminary agenda item is related to the same topic covered under Preliminary Agenda item 2.5. This agenda item calls for studies to address the protection of the EESS (passive) in the 86-92 GHz frequency band. The protection of the EESS (passive) in 86-92 GHz through implementation of mandatory limits in Resolution 750 (WRC-19) is a priority for WMO. From a WMO perspective, either Preliminary Agenda item 2.5 or this agenda item should be retained, but both are not needed to address WMO concerns.

- ***Preliminary Agenda item 2.11*** - *to consider a new EESS (Earth-to-space) allocation in the frequency band 22.55-23.15 GHz, in accordance with Resolution 664 (WRC-19);*

This preliminary agenda item calls for consideration of creating a new EESS (Earth-to-space) allocation in the frequency band 22.55-23.15 GHz frequency band to be paired with the existing 25.5-27 GHz (space-to-Earth) EESS frequency allocation. The creation of the new allocation to the EESS would benefit WMO interests.

- ***Preliminary Agenda item 2.13*** - *to consider a possible worldwide allocation to the mobile satellite service for the future development of narrowband mobile-satellite systems in frequency bands between the range 1.5-5 GHz, in accordance with Resolution 248 (WRC-19),*

This preliminary agenda item appears to be a duplicate of Agenda item 1.18 on the WRC-23 agenda. The reason for inclusion on the WRC-27 preliminary agenda is unclear.

See WRC-23 Agenda item 1.18 for discussion and WMO position.

WMO Position on WRC-23 agenda item 10

WMO supports studies on the WRC-27 preliminary agenda items to ensure meteorological interests are protected. If work in the ITU-R is conducted on any of the WRC-27 Preliminary agenda items during the preparatory period for WRC-23 WMO will contribute to ensure WMO interests are protected.

ANNEX

WMO concerns on the issue of ITU-R Resolution 731 currently addressed in ITU-R as a follow-up of WRC-19

WMO is observing and following discussions in the ITU on topics outside of WRC-23 preparatory activities that concerns frequency bands essential for the meteorological community. Those issues are identified in this section and a WMO position is expressed.

ITU-R Resolution 731

ITU-R Resolution **731 (Rev. WRC-19)** deals with the consideration of sharing and adjacent-band compatibility between passive and active services above 71 GHz.

In this context the ITU-R is invited:

- 1) to continue its studies to determine if and under what conditions sharing is possible between active and passive services in the frequency bands above 71 GHz, such as, but not limited to, 100-102 GHz, 116-122.25 GHz, 148.5-151.5 GHz, 174.8-191.8 GHz, 226-231.5 GHz and 235-238 GHz;
- 2) to conduct studies to determine the specific conditions to be applied to the land-mobile and fixed-service applications to ensure the protection of EESS (passive) applications in the frequency bands 296-306 GHz, 313-318 GHz and 333-356 GHz.

WMO recognises the recent trend for broadband applications with growing bandwidth requirements expressed by industry and the migration of those applications into higher frequency bands intensively exploited by passive microwave sensors. Triggered by regulatory consideration in individual countries, this resulted in first considerations of studying the sharing conditions in bands above 71 GHz at the level of the ITU-R under *invites 1* of this ITU-R Resolution **731**, including in bands covered by footnote RR No **5.340** (where all emissions are prohibited).

WMO recognises further that *invites 2* is a continuation of the discussion under WRC-19 agenda item 1.15 on sharing conditions for some bands for which sharing conditions could not be identified at WRC-19 that would render sharing with passive sensors feasible. Although no new elements are available for possibly reassessing the situation that led to the conclusions of WRC-19, it is realised that the discussion is immediately going on in the relevant ITU-R Working Parties, which is of concern to WMO.

WMO Position on ITU-R Resolution 731

WMO highlights that bands above 71 GHz used by passive sensors are unique resources for atmospheric measurements. These passive bands are indispensable for meteorological forecasting and climate monitoring.

WMO is concerned that in the process of establishing the sharing conditions in bands above 71 GHz under *invites 1* and *2* of ITU-R Resolution **731**, the protection of passive sensors in bands with co-primary allocations with active services and even more so in bands covered by footnote **RR No 5.340** could not be ensured. Thus, WMO urges that the protection requirements of passive sensors are appropriately taken into account when establishing the sharing conditions with active services. In addition, WMO is also of the view that any new studies related to active services in those bands can only be undertaken when duly justified spectrum requirements are assessed.