3nd ITU INTER-REGIONAL WORKSHOP ON WRC-19 PREPARATION
Geneva, 4 – 6 September 2019

Document WRC-19-IRWSP-19/3-E
14 August 2019
English only

World Meteorological Organization

WMO POSITION ON WRC-19 AGENDA

World Meteorological Organization
COMMISSION FOR BASIC SYSTEMS
Steering Group on Radio-Frequency Coordination
SG-RFC 2019 meeting
Toulouse, 05-07th March 2019

SG-RFC-2019/Doc 06
Agenda item: 03.1
Submitted by:
Chair
30/03/2019

Restricted access: N

WMO Position on WRC-19 agenda

1 Introduction

In adopting the 2030 Agenda for Sustainable Development, world leaders agreed that a global indicator framework was necessary to progress towards the 17 transformational Sustainable Development Goals (SDGs) and 169 associated Targets. Meteorological services have an essential role to play in relation to the most of them, such as zero hunger, life on the land, sustainable cities and communities, etc. Numerical weather forecasting, based on meteorological services, is one of the most important cornerstones to achieve substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries as established by the UN Sendai Framework for Disaster Risk Reduction.

Timely warning of impending natural and environmental disasters, accurate climate prediction and detailed understanding of the status of global water resources: these are all critically important everyday issues for the global community. National Meteorological and Hydrological Services (NMHS) around the world are responsible for providing this information, which is required for the protection of the environment, economic development (transport, energy, agriculture,...) and the safety of life and property.

Radio-frequencies represent scarce and key resources used by National Meteorological and Hydrological Services to measure and collect the observation data upon which analyses and predictions, including warnings, are based or processed, and to disseminate this information to governments, policy makers, disaster management organizations, commercial interests and the general public.

Nowadays radio-based remote sensors (active and passive) are the main tools for environment and climate monitoring, disaster prediction, detection and mitigating negative effects of disasters. These sensors obtain environmental data by measuring level and parameters of natural and artificial radio waves that inherently contain information about the environment with which they have been in contact. Terrestrial and space-borne remote sensing applications form the backbone of the World Meteorological Organization (WMO) Integrated Global Observing System (WIGOS).

WMO information systems also make extensive use of radiocommunication systems and radio-frequency spectrum, and although they are also using commercially provided services such as communication satellites for the distribution of data, meteorological related radiocommunication systems are an essential and indispensable component of WMO's critical data collection and distribution systems (e.g. Earth-to-space and space-to-Earth transmissions). WMO Members in remote or isolated areas are most dependent on these special services and will benefit most from many of the new initiatives such as wireless broadband that are putting new stress on the demand for spectrum bandwidth.

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 in particular 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 development of new, mass-market and value-added radio applications is putting increasing pressure on the frequency bands used for meteorological purposes. This presents the potential risk of limiting meteorological and other related applications in the future.

On a more general basis, the utmost importance of radio-frequencies for all Earth Observation activities is also to be stressed. WMO in its role of coordinating observations, in particular with regard to global warming and climate change, is also an important Participating Organization of the intergovernmental Group on Earth Observations (GEO)[1].

This document reflects the preliminary WMO position on the agenda of the World Radiocommunication Conference 2019 (WRC-19) as given in Resolution 809 (WRC-15) "Agenda for the 2019 World Radiocommunication Conference", subsequently approved by the ITU Council 2016 in its Resolution 1380.

2 General comments

WIGOS comprises components which make use of a wide number of different radio applications and services, some of which may be affected by WRC-19 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 and climate-related disasters, and in the scientific understanding, monitoring and prediction of climate change and its impacts.

The impressive progress made in the recent years in weather 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.

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

[1] GEO has the objective to realize a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information. GEO focuses on nine Social Benefits Areas: Agriculture, Biodiversity, Climate, Disasters, Ecosystems, Energy, Health, Water and Weather. GEO strongly advocates full and open data sharing to ensure that all countries benefit from data and information mostly at no cost to users. The availability, reliability and protection of suitable frequency bands required for the operation of Earth observation systems is of critical importance to GEO, its 90 Member countries, its participating organizations and ultimately all citizens.

measurement of naturally-occurring radiations, usually of very low power levels, which contain 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 radiations.

For passive sensing bands shared with active services, the situation is tending to be more and more critical with the increased density of terrestrial active devices and serious cases of interference already being reported.

In the more critical passive sensing frequency bands, RR No. 5.340[2] 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. One example is the significant interference in the passive band 1 400-1 427 MHz being observed worldwide by the radiometers on SMOS and Aquarius satellites.

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.

As a consequence, 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.

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 in particular by altimeters, rain and cloud radars, scatterometers and Synthetic Aperture Radars[3] provides meteorological and climatology activities with important information on the state of the ocean, ice and land surfaces and atmospheric phenomena.

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 precipitation and wind measurements and play a crucial role in the immediate meteorological and hydrological alert processes. Meteorological radar networks represent the last line of defence 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.

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[2] Footnote 5.340 of the Table of Allocations in the international Radio Regulations.

[3] Synthetic Aperture Radars (SAR) provide complementary information useful for flood disaster management.

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.

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.

The Seventeenth World Meteorological Congress (Geneva, June 2015), attended by 167 Member countries, confirmed serious concern at the continuous threat to radio frequency bands allocated for meteorological and related environmental systems and adopted the Resolution 29 (Cg-XVII) – 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.

The Seventeenth World Meteorological Congress (Geneva, June 2015) "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", and "urged the pursuance of, in an organized manner, to ensure the availability and protection of suitable radio-frequency bands required for meteorological and related environmental operations and research."

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 Seventeenth World Meteorological Congress (Geneva, June 2015).

3 WMO preliminary position on WRC-19 Agenda

Among WRC-19 agenda items, fourteen items are related to frequency bands or issues of prime interest or concern for meteorology and the related fields.

Agenda item 1.1 : Amateur service in the 50-54 MHz band

Agenda item 1.2 : Satellite hard limits at 400 MHz

Agenda item 1.3 : Meteorological Satellite (MetSat) and Earth Exploration Satellite Service (EESS) at 460-470 MHz

Agenda item 1.6 : Non Geostationary Satellite Orbit (GSO) of the Fixed Satellite Service (FSS) at 37.5-51.4 GHz

Agenda item 1.7 : Non GSO satellites with short duration missions

Agenda item 1.11 : Frequency bands harmonization to support railway radiocommunication systems

Agenda item 1.13 : International Mobile Telecommunication 2020 (IMT2020)

Agenda item 1.14 : High Altitude Platforms (HAPS)

Agenda item 1.15 : Fixed Service (FS) and Land Mobile Service (LMS) above 275 GHz

Agenda item 1.16 : Radio Local Area Network (RLAN) 5 GHz

Agenda item 7 : Satellite regulatory procedures

Agenda item 9.1.5 : RLAN 5 GHz and reference to radar ITU-R recommendations

Agenda item 9.1.9 : FSS at 51.4-52.4 GHz

Agenda item 10 : Agenda for next WRCs

3.1 Agenda item 1.1

"to consider an allocation of the frequency band 50-54 MHz to the amateur service in Region 1, in accordance with Resolution 658 (WRC-15)."

Footnote of the Radio Regulation (RR) No. 5.162A provides an additional allocation to the radiolocation service on a secondary basis in the frequency 46-68 MHz in a number of countries, limited to the operation of wind profiler radars (WPR) in accordance with Resolution 217 (WRC-97);

This secondary status provided to wind profiler radars could create difficulties if a new allocation for the amateur service were to be on a primary basis. ITU-R studies show that a large coordination distance (from 29 km to over 300 km) is needed to ensure the protection of WPR.

Furthermore, although a new allocation for the amateur-satellite service is not excluded under the agenda item, no studies have been conducted. As amateur-satellite service could lead to harmful interference produced in the WPR main beam, WMO opposes any new allocation to the amateur-satellite service in this frequency band.

WMO Position on WRC-19 agenda item 1.1:

WMO does not oppose an allocation to the amateur service in the 50-54 MHz provided that:

- appropriate protection of the radiolocation service allocated by RR No 5.162A is ensured based on a case by case approach; and
- the status of the new allocation to the amateur service provides the radiolocation service equality or precedence relative to the amateur service.

Should an allocation to the Amateur service be decided in the 50-54 MHz band, WMO favours a secondary allocation (i.e. Method B1 or Method B2). WMO is opposed to any primary allocation to the Amateur service in all or portion of the 50-54 MHz band (methods A or C) unless a specific provision is applied for the protection of the radiolocation service.

3.2 Agenda item 1.2

"to consider in-band power limits for earth stations operating in the mobile-satellite service, meteorological-satellite service and Earth exploration-satellite service in the frequency bands 401-403 MHz and 399.9-400.05 MHz, in accordance with Resolution 765 (WRC-15)."

WMO notes that some non-GSO DCS systems use the 399.9-400.05 MHz frequency band for meteorological applications. However, the WMO position focuses on the frequency band 401-403 MHz.

Globally, tens of thousands of data collection system (DCS) stations are operating in the 401-403 MHz frequency band communicating to sensitive receivers on GSO and non-GSO satellites for the purpose of collecting essential weather and climate data. These DCS stations operate with low power. Use of earth stations with higher equivalent isotropic radiated power (e.i.r.p.) than those related to these DCS systems,

in particular for telecommand links (Earth to space), would negatively impact on the operation of those systems.

A set of in-band e.i.r.p. limits (Earth-to-space) need to be tailored to ensure the operations of both non-GSO and GSO DCS systems. Current ITU-R studies show that in the frequency band 401-403 MHz an e.i.r.p. limit of 22 dBW should be applied to GSO/Highly elliptical orbit (HEO) systems and an e.i.r.p limit of 7 dBW should be applied to non-GSO (Medium Earth Orbit (MEO) and Low Earth Orbit (LEO)) systems. Proposals that waive the e.i.r.p. requirement for some satellite systems beyond any transition period (5 to 10 years proposed in CPM report), potentially even indefinitely, will create an imbalance and render the spectrum unusable for DCS systems constrained by limits.

Usage of the band 401-403 MHz with the proposed limits will have to take into account the framework set forth by the general frequency band partitioning contained in Recommendation ITU-R SA.2045.

WMO Position on WRC-19 agenda item 1.2:

WMO supports :

- the establishment of an appropriate set of in-band e.i.r.p. limits applied to all earth stations to ensure the protection of existing and future use of DCS meteorological operations in the 401-403 MHz frequency band (i.e. Method E),
- that these limits be applied to new satellite system filings effective on the last day of WRC-19,
- a maximum transition time of 5 years from the last day of WRC-19 applied to all existing satellite systems brought into use before 22 November 2019.

WMO opposes :

- any use of the part of the band 401-403 MHz designated to GSO DCS operation (Recommendation ITU-R SA.2045) by non-GSO telecommand uplinks (i.e. Method F),
- any limits expressed in terms of e.i.r.p. densities per Hz (i.e. Method F) since it cannot provide adequate protection to DCS and would allow a combination of multiple telecommand carriers,
- any solution that would allow for an unlimited time the use of the band 401-403 MHz by systems operating above the required e.i.r.p limits (i.e. Method G).

3.3 Agenda item 1.3

"to consider possible upgrading of the secondary allocation to the meteorological satellite service (space-to-Earth) to primary status and a possible primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz, in accordance with Resolution 766 (WRC-15)"

Data collection systems (DCS) operate in the MetSat service and the EESS (Earth to-space) systems in the frequency band 401-403 MHz (Earth-to-space) and 460-470 MHz (space-to-Earth). DCS are essential for monitoring and predicting climate change, monitoring ocean, and water resources, weather forecasting and assisting in protecting biodiversity, as well as improving maritime security. The 460-470 MHz is used for an essential downlink component of DCS for commanding and interrogating DCS stations.

According to RR No. 5.289, Earth exploration-satellite service applications may also be used in the bands 460-470 MHz for space-to-Earth transmissions by providing the necessary protection to incumbent primary services and also constraining such operations to be secondary to the MetSat operations.

A primary allocation to the MetSat (space-to-Earth) service and EESS (space-to-Earth) in the frequency band 460-470 MHz would provide regulatory stability for space and meteorological agencies deeply involved in satellite data collection programs and the public sectors funding the development and operation of such systems.

ITU-R studies show that the following power flux density (pfd) mask applied to NGSO Metsat and EESS satellite systems will protect incumbent terrestrial radio services:

$$\mathrm{pfd}\left(\mathrm{dBW}/\left(\mathrm{m}^2 \cdot 4\ \mathrm{kHz}\right)\right) = \begin{cases} -157 & 0° \le \alpha < 5° \\ -157 + 0.5(\alpha - 5) & 5° \le \alpha < 15° \\ -152 & 15° \le \alpha \le 90° \end{cases}$$

Furthermore, ITU-R studies show that the following pfd mask applied to GSO Metsat and EESS satellite systems will protect incumbent terrestrial radio services:

$$\mathrm{pfd}\left(\mathrm{dBW}/\left(\mathrm{m}^2 \cdot 4\ \mathrm{kHz}\right)\right) = \begin{cases} -162 & 0° \le \alpha \le 15° \\ -162 + 0.5(\alpha - 15) & 15° < \alpha < 35° \\ -152 & 35° \le \alpha \le 90° \end{cases}$$

where α is the angle of arrival at the terrestrial station antenna.

WMO Position on WRC-19 agenda item 1.3:

WMO supports the upgrade of the MetSat (space-to-Earth) allocation to primary in the frequency band 460-470 MHz with the use of the appropriate pfd limits for GSO and non-GSO satellites to protect incumbent services agreed in ITU-R studies.

WMO also supports a new primary allocation to the EESS (space-to-Earth) in the frequency band 460-470 MHz with the same pfd limits as MetSat to protect incumbent services, while also retaining the priority of the MetSat service over EESS as currently expressed in footnote RR No. 5.289.

Therefore, WMO supports method C of the CPM report. However, WMO has some concerns regarding the *resolves 5* of the draft Resolution proposed under this method as this will restrict the future development of Metsat service and EESS in the frequency band. WMO proposes the deletion of *resolves 5*.

3.4 Agenda item 1.6

"to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-

50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), in accordance with Resolution 159 (WRC-15).”

Under this agenda item, studies indicate that Resolution 750 (Rev.WRC-15) needs to be revised for both GSO and non-GSO FSS systems to accommodate non-GSO FSS operations while ensuring protection of the EESS (passive) in the 50.2-50.4 GHz frequency band. These studies include the effect of the aggregation of interference from GSO and non-GSO FSS networks and systems operating or planned to operate in the frequency bands 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space).

Compatibility studies in ITU-R between non-GSO FSS systems and EESS (passive) have shown that the limits currently in Resolution 750 are not sufficient for the protection of EESS (passive). Since the GSO FSS limits in Resolution 750 consume more than the entire EESS (passive) interference budget, accommodation of the non-GSO FSS consequently requires tightening of the GSO FSS limits in Resolution 750 as well. These studies showed that unwanted emission limits in the range of −51.3 to −69.8 dBW/200 MHz for non-GSO FSS user equipment and in the range of −27 to −66 dBW/200 MHz for gateways would be required to meet the EESS (passive) protection criteria in Recommendation ITU-R RS.2017. For GSO FSS satellites, two studies show that GSO earth stations emissions can cause EESS (passive) protection criteria exceedance as much as 74.3 dB with elevation angles above 70 degrees when considering an input power of 0 dBW/200 MHz. One of these studies show that the necessary unwanted emission limits in the range −58.1 to −51.3 dBW/200 MHz for GSO user equipment and −48.7 to −44.1 dBW/200 MHz for gateways would be required to ensure protection of the EESS (passive).

Studies were conducted on compatibility between non-GSO FSS and the EESS (passive) in 36-37 GHz frequency band where the studies showed no compatibility problems.

In addition, regarding the 50.4-51.4 GHz frequency band, ground based radiometer operations are at risk of interference due to their unprotected status.

WMO Position on WRC-19 agenda item 1.6:

Should the regulatory framework for non-GSO satellite be adopted under this agenda item, WMO supports revision of Table 1-1 of Resolution 750 for FSS satellite systems (for both non-GSO and GSO satellites) in the 47.2-50.2 GHz and 50.4-51.4 GHz frequency ranges to ensure the protection of EESS (passive) in the band 50.2-50.4 GHz (i.e. Method A, issue 2, option B). Within this method, WMO further supports option 1 in Resolution 750 making the unwanted emission limits applied to FSS systems brought into use after the date of entry into force of the Final Acts of WRC-19.

To this respect, WMO supports the following maximum unwanted emissions limits to be included in Resolution 750:

- for Earth stations operating with non GSO systems, -51 dBW/200 MHz for UE and -49 dBW/200 MHz for Gateways.
- for Earth stations operating with GSO systems, -58 dBW/200 MHz for UE and -44 dBW/200 MHz for Gateways. Should WRC-19 decide not to change the GSO FSS limits in Resolution 750, at this Conference, an agenda item for WRC-23 will be required to review these GSO FSS unwanted emission limits.

WMO would also appreciate the development of a solution to ensure the continued operation of the ground-based radiometers in the 50.4-51.4 GHz frequency band.

3.5 Agenda item 1.7

"to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution 659 (WRC-15)."

WMO is concerned with consideration of a potential new allocation to the space operation service (SOS) within the frequency range 400.15-406 MHz which is extensively used on a worldwide basis by radiosondes (Meteorological Aids or Metaids) and meteorological satellite (Data Collection System or DCS) operations.

Studies show that co-channel operation with DCS systems will result in harmful interference to the DCS. It should be noted that the spectrum used by DCS operations (401-403 MHz) is heavily congested and very closely coordinated between operators, and there are no segments of spectrum where non-GSO short duration mission satellites can be accommodated to avoid co-channel operation with DCS. Based on studies, the existing SOS allocation in 401-402 MHz is not appropriate for use for satellites with characteristics and mission requirements matching those of non-GSO short duration mission satellites.

Furthermore, for the frequency range 400.15-406 MHz studies show that co-channel operation between the non-GSO short duration mission satellite systems (earth stations and space stations) and Metaids is not possible in the same geographic area. Metaids operating in the 400.15-406 MHz frequency band are deployed globally and based on the global usage and requirements in the framework of WIGOS, WMO concluded that the entire 400.15-406 MHz band is required for Metaids operation for the foreseeable future.

Moreover, studies show the need for a guard band of 1 MHz to ensure the protection of COSPAS-SARSAT system operating in the 406-406.1 MHz.

WMO recognizes that some of the non-GSO short duration satellites that would use spectrum allocated under this agenda item would perform meteorological and Earth science missions. However, based on the study results summarized above, a new SOS allocation is not feasible in the 400.15-406 MHz frequency band.

WMO notes the link with WRC-19 Agenda Item 1.2 on in-band e.i.r.p. limits for earth stations operating in the mobile-satellite service (399.9-400.05 MHz), meteorological-satellite service and Earth exploration-satellite service in the frequency band 401-403 MHz.

WMO Position on WRC-19 agenda item 1.7:

WMO emphasises that the frequency band 400.15 – 406 MHz is the key band for global radiosonde and DCS operations. Based on the results of ITU-R studies showing that a new SOS allocation is not feasible in the 400.15-406 MHz frequency band, WMO is strongly opposed to consideration of this frequency band under this agenda item (CPM Method B).

3.6 Agenda item 1.11

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

WMO is only concerned regarding the considerations of the secondary mobile allocation in the frequency band 400.15-406 MHz (Earth-to-space) and the mobile allocation in the 460-470 MHz (space-to-Earth)

frequency band. The 400.15- 406 MHz frequency band is heavily used for radiosonde operations and both frequency bands are heavily used for data collection systems (DCS) that operate in the MetSat service and the EESS (Earth to-space) (tens of thousands of DCS stations).

WMO Position on WRC-19 agenda item 1.11:

WMO emphasises that the frequency band 400.15 – 406 MHz is the key band for global radiosonde and DCS operations. WMO is strongly opposed to the consideration of this frequency band under this agenda item (i.e. Method B).

WMO will not oppose the consideration of the 460-470 MHz frequency band as long as no additional constraints are added to the use of MetSat service and EESS in this frequency band.

3.7 Agenda item 1.13

"to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 238 (WRC-15)."

This agenda item considers possible new spectrum allocations suitable for delivery of terrestrial wireless broadband (IMT 2020) in the frequency range between 24.25 GHz and 86 GHz.

- Sharing and compatibility studies were required for the following frequency bands, including compatibility with services in adjacent bands, as appropriate: 24.25-27.5 GHz, 31.8-33.4 GHz, 37-40.5 GHz, 40.5-42.5 GHz, 42.5-43.5 GHz, 45.5-47 GHz, 47-47.2 GHz, 47.2-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz, 81-86 GHz.

WMO is concerned with the following issues:

- Adjacent band compatibility between IMT2020 and EESS (passive) in the bands 23.6-24 GHz, 31.5-31.8 GHz, 36-37 GHz, 50.2-50.4 GHz, 52.6 - 54.25 GHz and 86-92 GHz.
- Sharing with EESS (space-to-Earth) in the band 25.5 – 27 GHz

Current ITU-R studies, in all frequency bands, show that only a significant reduction of IMT2020 unwanted emissions in the adjacent bands can ensure protection of EESS (passive) sensors. WMO is concerned that the current specifications for IMT-2020 are largely insufficient to comply with the required unwanted emission limits needed to protect EESS (passive) sensors. Therefore a solution to this agenda item must specify much more stringent, mandatory adjacent band emission limits.

Studies also show that separation distances in the order of 3 to 10 km, depending on site conditions and IMT in-band e.i.r.p., are required to ensure protection of EESS Earth stations in 25.5-27 GHz frequency band. A methodology is under development in ITU-R for enabling administrations to define the separation distance needed. It should also be noted that while existing and planned EESS Earth stations may be protected, deployment of future, currently unplanned, EESS earth stations would be constrained. WMO points out the need to ensure the protection of existing earth stations but also the future deployment of receiving earth stations under the EESS (space-to-Earth) allocation in the frequency band 25.5-27 GHz.

Regarding the 24.25-27.5 GHz and 50.4-51.4 GHz frequency bands, an interference problem could occur with ground-based radiometers.

WMO notes the frequency overlaps with WRC-19 Agenda Items 1.6, 1.14 and 9.1.9 which need to be taken into account.

WMO Position on WRC-19 agenda item 1.13:

WMO accepts the fact that for certain bands there is wide support of new IMT-2020 identification/allocations. WMO does not oppose to identification/allocation in these bands provided that adequate protection of EESS (Earth-to-space and space-to-Earth) and EESS (passive) is ensured.

Protection of EESS (passive)

WMO requests that the necessary mandatory IMT 2020 unwanted emission limits be established in table 1-1 of Resolution 750 (rev. WRC-15) to ensure the protection of all current and future EESS (passive) sensors.

Specifically, WMO provides the following positions:

- **24.25-27.5 GHz:**
    - WMO supports Method A2-alternative 1-condition A2a- option 1 for the protection of EESS (passive) in the frequency band 23.6-24 GHz. Without new compelling elements (e.g. antenna pattern measurements), in particular on relevant IMT-2020 antenna model, WMO supports the following unwanted emission levels:
        - -55 dB(W/200 MHz) for base stations,
        - -51 dB(W/200 MHz) for user equipment.
    - WMO strongly opposes option 4 (deletion of table 1-2 of ITU-R Resolution 750 in *total contradiction with the intent WRC-19 agenda item 1.13*),
    - WMO also strongly opposes option 5 ("no condition is necessary"), since it is inconsistent with all ITU-R study results.
    - Regarding the second harmonic IMT 2020 emission from the 24.25-27.5 GHz frequency band, WMO supports Method A2-alternative 1-condition A2b-option 1 for the protection of EESS (passive) in the 50.2-50.4 GHz and 52.6-54.25 GHz frequency bands.

  WMO notes that the protection of EESS (passive) in 23.6-24 GHz frequency band is also addressed under agenda item 1.14.
- **31.8-33.4 GHz:** WMO supports the only Method B1 for this frequency band (protection of EESS (passive) in the frequency band 31.5-31.8 GHz).
- **37-40.5 GHz:**
    - WMO opposes the reference to ITU-R Resolution 752 as the in-band limits specified in that resolution are not appropriate and were not determined for adjacent band protection.
    - WMO supports Method C2-Alternative 1 Condition C2a -option 1 for the protection of EESS (passive) in the frequency band 36-37 GHz. WMO requests that the necessary mandatory IMT2020 unwanted emission limits be established and supports the following unwanted emission levels :
        - -47 dB(W/100 MHz) for base stations,
        - -46 dB(W/100 MHz) for user equipment.

- WMO opposes option 2 ("no condition is necessary"), since it is inconsistent with all ITU-R study results.

- **47.2-50.2 GHz:**
  - WMO supports a no change for this frequency band as this EESS (passive) frequency band is also addressed under agenda items 1.6 and 9.1.9 which will create additional constraints on the EESS (passive) operations.
  - However, if an IMT2020 identification is decided, WMO would support Method H2-Alternative 1- Condition H2a-option 1 for the 47.2-50.2 GHz (protection of EESS (passive) in the frequency band 50.2-50.4 GHz) with the following mandatory unwanted emission levels applied:
    - -49.3 dB(W/200 MHz) for base stations,
    - -48.6 dB(W/200 MHz) for user equipment.
  - WMO strongly opposes option 3 ("no condition is necessary"), since it is inconsistent with all ITU-R study results.

- **50.4-52.6 GHz:**
  - WMO supports a no change for this frequency band as this EESS (passive) frequency band is also addressed under agenda items 1.6 and 9.1.9 which will create additional constraints on the EESS (passive) operations.
  - However, if an IMT2020 identification is decided, WMO would support Method I2-Alternative 1- Condition I2a-option 1 for the protection of the EESS (passive) bands 50.2-50.4 GHz and 52.6 - 54.25 GHz with the following mandatory unwanted emission levels applied:
    - For the band 50.2-50.4 GHz:
      - -49.3 dB(W/200 MHz) for base stations,
      - -48.6 dB(W/200 MHz) for user equipment.
    - For the band 52.6-54.25 GHz:
      - -45.3 dB(W/100 MHz) for base stations,
      - -44.3 dB(W/100 MHz) for user equipment.
  - WMO strongly opposes option 3 ("no condition is necessary"), since it is inconsistent with all ITU-R study results.

- **81-86 GHz:**
  - WMO supports a no change for this frequency band.
  - However, if an IMT2020 identification is decided, WMO would support Method L2-Alternative 1- Condition L2a-option 1 for the protection of the EESS (passive) in the frequency band 86-92 GHzwith the following mandatory unwanted emission limits applied:
    - -49.9 dB(W/100 MHz) for base stations,
    - -49.8 dB(W/100 MHz) for user equipment.

Protection of receiving EESS Earth stations

WMO requests that the long-term usage and future deployment of receiving EESS Earth stations (in particular in the 25.5-27 GHz frequency band) should not be constrained by the IMT2020 usage. WMO supports establishment of a methodology for administrations to use for the definition of the required separation distance between IMT2020 and EESS stations and that administrations be invited to adopt specific measures to ensure protection of EESS/SRS stations (i.e. Method A2 alternative 1 condition A2c option 1).

WMO also supports the deletion of RR N° 5.536A and 5.536B, under the condition A2c option 2.

WMO strongly opposes condition A2c-option 5 ("no condition is necessary").

Ground-based radiometers

WMO would appreciate the development of a solution to ensure the continued operation of the ground-based radiometers in the 24.25-27.5 GHz and 50.4-51.4 GHz frequency bands.

3.8 Agenda item 1.14

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

Resolution 160 (WRC-15) calls for studies to identify additional spectrum needs for gateway and fixed terminal links for HAPS in order to facilitate access to broadband applications delivered by HAPS. This resolution includes studying possible changes to current Fixed service allocations in 6 440-6 520 MHz, 6 560-6 640 MHz, 27.9-28.2 GHz and 31-31.3 GHz. If the existing allocations for HAPS are not suitable, then studies could be conducted to assess the spectrum needs of HAPS in the frequency bands of 38-39.5 GHz on a global level and 21.4-22 and 24.25-27.5 GHz in Region 2.

WMO is concerned with potential compatibility issues between HAPS and:

- the EESS (passive) in the frequency bands 6.425-7.25 GHz, 21.2-21.4 GHz, 22.21-22.5 GHz, 23.6-24 GHz, 31.3-31.8 GHz; and
- EESS (s-E) in the frequency band 25.5 – 27 GHz.

WMO notes that HAPS downlinks will have a more severe impact in EESS and Space Research Service (SRS) receiving earth stations than HAPS uplinks. In addition, HAPS uplinks may have a more severe impact on EESS (passive).

Regarding the 24.25-27.5 GHz frequency band, an interference problem could occur with ground-based radiometers.

Furthermore, WMO notes the frequency overlaps with WRC-19 Agenda Items 1.6 and 1.13 which need to be taken into account.

WMO Position on WRC-19 agenda item 1.14:

WMO does not oppose new HAPS band identifications provided that the long-term usage and future deployment of receiving EESS Earth stations (in particular in the 25.5-27 GHz band) is not constrained by the HAPS usage and the protection of EESS (passive) is ensured.

WMO supports Method B2 options 2 and 3 for the frequency band 25.25-27.5 GHz.

WMO also requests that the necessary HAPS unwanted emission limits be established to ensure the protection of all current and future EESS (passive) sensors as follows:

- Method B1 option 1 for the frequency band 6440-6520 MHz (protection of the EESS (passive) in-band),
- Method B2 option 1a or 1b for the frequency band 21.4-22 GHz (protection of the EESS (passive) in the 21.2-21.4 GHz frequency band),
- Method B3 either option 1 or 2 (depending of the direction of the HAPS usage) for the frequency band 24.25-25.25 GHz (protection of the EESS (passive) in the 23.6-24 GHz frequency band),
- Method B1 either option 1a or 1b for the frequency band 31-31.3 GHz (protection of the EESS (passive) in the 31.3-31.8 GHz frequency band).

Furthermore, WMO would appreciate the development of a solution to ensure the continued operation of the ground-based radiometers in the 24.25-27.5 GHz frequency band.

3.9 Agenda item 1.15

"to consider identification of frequency bands for use by administrations for the land mobile and fixed services applications operating in the frequency range 275-450 GHz, in accordance with Resolution 767 (WRC-15)."

Resolution 767 (WRC-15) invites the ITU-R to conduct sharing and compatibility studies regarding the introduction of land-mobile and fixed services into the frequency range 275-450 GHz. Before any new allocations, technical characteristics and spectrum requirements of these future systems need to be documented. RR No. 5.565 lists several frequency bands in the range 275-1 000 GHz identified for EESS (passive), SRS (passive) and Radioastronomy.

A number of sharing and compatibility studies between FS and EESS (passive), considering aggregate impact of FS deployments have concluded that sharing would not be possible in the EESS (passive) frequency bands 296-306 GHz, 313-320 GHz and 331-356 GHz. These bands hence cannot be made available to the FS/LMS whereas in the remaining parts of the 275-450 GHz range, FS/LMS identification do not cause concern for WMO.

In this case, the amount of spectrum (in total 134 GHz) that would be identified for use by FS/LMS applications exceeds the current spectrum needs of 50 GHz for each service (with possibility of overlap).

WMO Position on WRC-19 agenda item 1.15:

In general, WMO does not oppose the identification of land-mobile and fixed services in part of the 275-450 GHz band provided that protection of EESS (passive) is ensured and the identification is done in a manner consistent with footnote RR No. 5.565.

ITU-R studies have shown that fixed and land mobile services would not be compatible with the EESS (passive) in the bands 296-306 GHz, 313-320/318 GHz and 331/333-356 GHz. WMO is opposed to any solution that would maintain a possibility of using these bands for FS and LMS.

Consequently, WMO opposes Method C and Method F. WMO also opposes any regulatory solutions which would not be specified and proven to be effective to protect EESS (passive).

3.10 Agenda item 1.16

"to consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution 239 (WRC-15)."

This agenda item will consider the results of studies concerning Wireless Access Systems including radio local area networks in the frequency bands between 5 150 MHz and 5 925 MHz and take appropriate actions according to Resolution 239 (WRC-15). WMO interests are related to the following frequency bands:

- **5250 – 5350 MHz**

  This frequency band is already allocated to mobile service for RLAN use, the aim of this agenda item is to relax the access conditions (outdoor use) applicable to WAS/RLANs. ITU-R studies show that this compatibility would not be achieved and lead to a globally accepted conclusion that outdoor RLAN 5 GHz should not be authorized in this band.

  This frequency band is also used by ground-based meteorological radars. Any outdoor RLAN would require the protection of all the existing and future radars deployed in this frequency band

- **5 350-5 470 MHz**

  This frequency band is used by a number of EESS (active) instruments of different types, i.e. altimeters, scatterometers and Synthetic Aperture Radars (SAR). SARs, in particular, were specifically designed to operate solely within these 120 MHz as this frequency band is the only one left in the 5 GHz frequency range where the EESS (active) allocation is not shared with an allocation to the mobile service. Introduction of RLANs to this band would result in severe interference into SARs such as circular synthetic aperture radars (CSAR) on Sentinel 1 and RadarSat, scatterometers such as Metop-SG satellites and altimeters such as Poseidon on Jason satellites.

  This frequency band was already studied during the last study period under WRC-15 Agenda Item 1.1. Based on the ITU-R study results related to the protection of EESS (active) systems/applications, it is concluded that sharing would only be feasible if further additional mitigation techniques could be applied even if the RLAN systems are limited to indoor use only.

  This frequency band is also used by ground-based meteorological radars. Any proposed new allocations would require the protection of all the existing and future radars deployed in this

frequency band (development of any appropriate mitigation techniques to be applied to RLAN and not to meteorological radars).

ITU-R studies have concluded that the frequency band 5350-5470 MHz is not suitable for deployment of RLAN devices operating in the mobile service.

WMO also stresses the fact that the number of cases of interference to meteorological radars in the 5600-5650 MHz is continuing to increase worldwide and that is mainly due to non-compliant and illegal use of RLAN systems by-passing the required mitigation technique.

WMO Position on WRC-19 agenda item 1.16:

Due to potential for increasing interference to the EESS (active), WMO does not support relaxation of restrictions that would allow the outdoor use of RLAN devices in the 5250-5350 MHz frequency band. WMO is hence satisfied with the single method NOC proposed for this band (i.e. Method B).

WMO supports the conclusion that the frequency band 5350-5470 MHz is not suitable for operation of RLAN devices and supports the single method NOC with respect to the frequency band (i.e. Method C).

3.11 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 to the WRCs deals with any possible changes to the Radio Regulations affecting the advance publication, coordination, notification and recording of satellite networks.

WMO would not support changes to the advance publication, coordination, notification and recording procedures for satellite networks in the Radio Regulation, if they imposed unnecessary constraints on MetSat and ESS systems.

WMO Position on WRC-19 agenda item 7:

WMO has concerns regarding issues A and I of this agenda item.

Regarding issue A, the frequency bands used by EESS, Metsat and SOS should not be subject to any milestone-based approach, as this would not be a justified regulatory mechanism for MetSat and EESS satellite systems, which usually consist of a very limited number of satellites. Such a milestone-based approach, however, is intended to monitor the deployment of non-GSO systems composed of multiple, multi-satellite constellations, in particular frequency bands.

The regulations regarding the bringing into use shall not put undue constraints on satellite networks filed for using frequency bands allocated to EESS, Metsat and SOS.

Regarding issue I, regulation for short duration satellite should not adversely affect filings for other satellite networks.

3.12 Agenda item 9.1.5

"consideration of the technical and regulatory impacts of referencing Recommendations ITU-R M.1638-1 and ITU-R M.1849-1 in Nos. 5.447F and 5.450A of the Radio Regulations (Resolution 764 (WRC-15))."

Agenda Item 9.1.5 addresses changing the existing references to Recommendation ITU R M.1638-0 in both footnotes RR Nos. 5.447F and 5.450A, to Recommendation ITU R M.1638-1 and Recommendation ITU R M.1849-1. It should be noted that these references give protection to radiolocation service, including meteorological radars, from RLANs.

Recommendation ITU-R M.1638-0 is incorporated in Radio Regulations by reference in footnote Nos. 5.447F and 5.450A. These footnotes mention that "*stations in the mobile service shall not claim protection from radiodetermination services. Radiodetermination services shall not impose on the mobile service more stringent protection criteria, based on system characteristics and interference criteria, than those stated in Recommendation ITU R M.1638 0*".

Since the allocation for WAS/RLAN was made at WRC-03, Recommendation ITU R M.1638-0 has been revised by Recommendation ITU R M.1638-1 which gives the characteristics of and protection criteria for sharing studies for radiolocation (except ground based meteorological radars) and aeronautical radionavigation radars operating in the frequency bands between 5 250 and 5 850 MHz. This revision includes the addition of new radiolocation systems in the 5 GHz frequency bands.

In addition, Recommendation ITU-R M.1849-1 was developed focusing on ground based meteorological radars, providing technical and operational characteristics, some of which were not present in Recommendation ITU R M.1638-0 such as radar equation, emission schemes, operational scenarios.

Currently, Recommendation ITU R M.1849-1 is not incorporated into the Radio Regulations but such reference would allow inclusion of the most up to date information on meteorological radars operating in the frequency band. It should be noted that current ITU-R studies show that referencing M.1849-1 in footnote 5.450A would have no technical and regulatory impact on existing services.

WMO Position on WRC-19 agenda item 9.1.5:

WMO supports any solution that ensures the continued protection of meteorological radars from WAS/RLAN systems operating under the mobile service allocation in the 5470-5725 MHz frequency band.

CPM Report Approaches A or B would meet the WMO needs for protection of meteorological radar operations by eliminating the difficulty with future updates to the ITU-R Recommendations referenced in the Radio Regulations while still maintaining the current sharing requirements.

3.13 Agenda item 9.1.9

"studies relating to spectrum needs and possible allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space) (Resolution 162 (WRC-15))."

WMO is concerned with the appropriate protection of EESS (passive) in the bands 50.2-50.4 GHz and 52.6-54.25 GHz from GSO FSS (E-s) in the band 51.4-52.4 GHz.

Studies show that unwanted emission limits will be required to protect the EESS (passive), however the studies have not concluded on agreed values for the limits.

Regarding the 50.4-51.4 GHz frequency band, an interference problem could occur with ground-based radiometers.

WMO Position on WRC-19 agenda item 9.1.9:

WMO is not opposed to the possible allocation of the frequency band 51.4-52.4 GHz to the FSS (E-s) provided that protection of EESS (passive) in the bands 50.2-50.4 GHz and 52.6-54.25 GHz is ensured.

WMO requests that the necessary FSS unwanted emission limits be established in Resolution 750 (rev. WRC-15) to ensure the protection of all current and future EESS (passive) sensors including GSO passive sensors (i.e. option 2 of the CPM report).

Furthermore, WMO would appreciate the development of a solution to ensure the continued operation of the ground-based radiometers in the 50.4-51.4 GHz frequency band.

3.14 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 **808 (WRC-12)**)."*

WMO will provide possible additional agenda items, as appropriate, and its position on other proposals in time for WRC-19. There are currently two items on the WRC-23 Preliminary Agenda that are of prime interest to WMO:

- WRC-23 Preliminary Agenda Item 2.2- "to conduct, and complete in time for WRC-23, studies for a possible new allocation to the Earth exploration-satellite (active) service for spaceborne radar

sounders within the range of frequencies around 45 MHz taking into account the protection of incumbent services, in accordance with Resolution 656 (WRC-15);"

- WRC-23 Preliminary Agenda Item 2.3- "in accordance with Resolution 657 (WRC-15), to review the results of studies relating to the technical and operational characteristics, spectrum requirements and appropriate radio service designations for space weather sensors, with a view to providing appropriate recognition and protection in the Radio Regulations without placing additional constraints on incumbent services;"

WRC-19 will make a final determination on retention of these agenda items on the WRC-23 Agenda when the agenda is finalized under WRC-19 Agenda Item 10.

CPM Report list a number of documents presented at last CPM meeting presenting some new possible WRC-23 agenda items. Among those proposals, the following items would be of concern for the meteorological community:

1) Proposal for NGSO ESIM in the frequency bands 17.7-20.2 GHz (space-to-Earth), 27.5 30.0 GHz (Earth-to-space), 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) (in document CPM19-2/7)

2) Proposal to revise footnote RR No. 5.522B relating to the use of 18.6-18.8 GHz for FSS non-GSO systems (in document CPM19-2/7)

3) Proposal for the allocation of the frequency bands 1 518-1 559 MHz, 1 626.6-1 660.5 MHz and 1 668-1 675 MHz to the mobile-satellite service (space-to-space) (in document CPM19-2/154)

Proposals 1) and 2) above could lead to threatening either in-band or adjacent band EESS (passive) allocations. WMO noted that document CPM19-2/178 provided comments toward these 2 proposals, providing relevant background and possible corrections to these proposed agenda items to ensure that the necessary protection of EESS (passive) be duly considered, in particular to account for aggregation of interference from all different types of FSS systems and stations (GSO and NGSO, fixed and ESIMs, ...).

Proposal 3) could lead to increased interference to the meteorological aids service and the meteorological satellite service in the 1668-1710 MHz range. Should this proposal be confirmed at WRC-19, the due protection of the MetAids and Metsat services should be specifically addressed.

WMO Position on WRC-19 agenda item 10:

WMO supports retention of both of the preliminary agenda items on the WRC-23 Agenda, related to EESS (active) around 45 MHz (AI 2.2) and to space weather sensors (AI 2.3).

In addition, WMO has concerns about two proposals made in document CPM19-2/7 related to the FSS in the 17.7-51.4 GHz frequency range. WMO does not support these two proposed agenda items, unless corrections presented in document CPM19-2/178 are captured to ensure that the necessary protection of EESS (passive) is duly considered.

Finally, WMO has also concerns about the proposal for possible MSS (s-to-s) allocations in the 1518-1675 MHz range made in document CPM19-2/154 and that could only be supported if the due protection of the MetAids and Metsat services in the 1668-1710 MHz range is specifically addressed.
