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Prepared by EUMETSAT
Agenda Item: 2.1
Discussed in WG I

Report on Frequency Management related topics

This report will provide an overview on the outcome of the following meeting/conferences on issues of interest to CGMS:

- 42nd annual meeting of the Space Frequency Coordination Group (SFCG), 29 May – 2 June 2023;
- World Radiocommunication Conference 2023 (WRC-23), 20 November – 15 December 2023;
- 5th meeting of WMO Expert Team on Radio Frequency Coordination (ET-RFC), 20 – 22 February 2024.

Issues of relevance for CGMS that were discussed and progressed at SFCG-42 are:

- Efficient utilization of the bands 2200–2290 MHz and 2025-2110 MHz;
- Update of SFCG Remote Sensing information in OSCAR;
- RFI reporting section on SFCG website.

Regarding WRC-23, a summary of the outcome on items of relevance to CGMS is provided as well as an outlook to WRC-27 on agenda items of potential interest/concern to CGMS.

Finally, the first version of the WMO position for WRC-27 agenda items is provided in Attachment 1 to this document, which was developed at the 5th meeting of the WMO Expert Team on Radio Frequency Coordination (ET-RFC).

Action/Recommendation proposed: CGMS is invited to note this report and to provide feedback and information on its activities via the CGMS/SFCG Liaison Officer to SFCG-43 (June 2024) on any frequency related matter as appropriate.

REPORT ON FREQUENCY MANAGEMENT RELATED TOPICS

1 INTRODUCTION

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2 42ND ANNUAL MEETING OF THE SPACE FREQUENCY COORDINATION GROUP (SFCG), 29 MAY – 2 JUNE 2023

2.1 Efficient utilization of the frequency bands 2200–2290 MHz (SFCG AI 41/9) and 2025-2110 MHz (SFCG AI 42/9)

SFCG aligned its Resolution 24-1R1 (Interference mitigation techniques for future systems planning to operate in the 2200-2290 MHz band) with the newly established ITU-R Recommendation SA.2155-0 (see Attachment 1) on the optimisation of the use of the band 2200-2290 MHz by promoting several practices, in particular reducing the operational bandwidth to no more than 6.2MHz.

Resolution 24-1R1 resolves:

1. That systems developed for use in the 2200-2290 MHz band not transmit when beyond view of their cooperating earth stations or when beyond view of their cooperating data relay systems;

2. That systems, that are not using spread spectrum modulation, using this band be designed to minimize their operational bandwidths to reduce the potential interference to other systems in the band and that, whenever practical, bandwidths should not exceed 6.2 MHz, to reduce future congestion in the band;

3. That due consideration be given to interference mitigation techniques including earth station geographical diversity, frequency reuse, the use of CDMA spread-spectrum signals or suppressed carrier modulation schemes for non spread-spectrum signals, steerable beams with reduced space station antenna sidelobe levels for space-space links, increased earth station antenna gain enhancing the link margin, reduced earth station antenna side lobe levels, earth station isolation from mobile links and the use of data relay satellites, if available, to augment and replace earth stations;

4. That other bands, like the band 25.5-27.0 GHz, be considered for high data rate systems.

Furthermore, SFCG has set up action item 42/9 on the topic of an update of SFCG Resolution 27-1 regarding interference mitigation techniques in the companion uplink frequency band 2025-2110 MHz. The background for this action item is that in the ITU-R satellite notification process the trend is observed that satellite systems are filed with much broader frequency bands than necessary or used so that coordination is getting more and more complicated or even impossible.

Triggered by this negative trend, ITU-R recently developed Recommendation ITU-R SA.2156 (see Attachment 2) which has the purpose to limit interference within the frequency band 2025-2110 MHz through band limitation, in particular reducing the operational bandwidth.

SFCG action item 42/9 calls upon its members to consider updating SFCG Resolution 27-1 in order to include the guidelines from ITU-R Recommendation SA.2156 in terms of maximum operational bandwidth and interference mitigation techniques.

2.2 Update of SFCG Remote Sensing information in OSCAR (SFCG AI 41/14)

SFCG action item 41/14 called for SFCG member agencies to check the information about their passive and active sensors in the WMO OSCAR database and provide corrections and additions as needed.

It should be noted that CGMS has concluded to complement this existing process for the OSCAR/Space update through the OSCAR/Space Support Team (O/SST) with the process and templates for the update of active and passive microwave sensor information, as established between SFCG and WMO. Details can be found in input document SF42-65/D.

Based on two input contributions, SFCG revised its report on SFCG Remote Sensing Information (SFCG 40-1R2) and provided a response to WMO on three aspects:

1. Updates to the OSCAR database;
2. Inconsistent information at different levels of the database;
3. Frequency information other than for active and passive microwave sensors.

Regarding the third aspect, SFCG commented to WMO that OSCAR/Space contains information about "frequencies for satellite management" and "frequencies for scientific data acquisition and communication services at ground stations".

SFCG maintains its own internal database for inter-agency coordination of these frequencies and does not use the information in OSCAR/Space for this purpose.

SFCG started a discussion on what possible negative consequences the public availability of such information in OSCAR/Space could have and will continue to discuss this issue at its next meeting in June 2024. Although SFCG did not have any specific comments/proposals at this stage, SFCG would like to stay in dialog with WMO on this aspect.

Finally, in order to continue reviewing and updating the SFCG Remote Sensing Information in OSCAR, SFCG established action item 42/10.

2.3 RFI reporting section on SFCG website (SFCG AI 41/16)

SFCG agreed on the update of specific page on the SFCG website about RFI affecting EESS sensors. Here a list of scientific articles documenting cases of RFI to EESS (active and passive) sensors were added. This update also highlights the fact that the list does not include all cases of sensors or frequency bands affected by RFI.

This specific site can be found under
https://www.sfcgonline.org/RFI%20to%20EESS%20Sensors/default.aspx

In order to further update and extend this information with further cases of RFI to EESS sensors of the SFCG website, SFCG action item 42/12 was established.

2.4 SFCG Objective to WRC-23 (Resolution SFCG 40-1R4)

SFCG completed its objectives to WRC-23 agenda items of interest/concern to SFCG (Resolution SFCG 40-1R4). This information is now overtaken by events, but it can be concluded that the results of WRC-23 are largely aligned with the objectives of SFCG.

3 OUTCOME OF WRC-23

World Radiocommunication Conference 2023 (WRC-23) took place from 20 November to 15 December 2023 in Dubai.

The goal of a WRC is to modify the Radio Regulations (RR). This international treaty on radiocommunications dates back to 1906, when the International Radiotelegraph Convention was signed. In the 117 years since, the Radio Regulations have undergone 38 revisions and expanded to a four-volume agreement of more than 2000 pages.

Overall, about 5000 participants were registered for WRC-23 with around 4000 physically attending, including delegates from ITU Member States and ITU Radiocommunication Sector

Members representing international organizations, equipment manufacturers, network operators and industry forums attending as observers.

A total of 151 Member States signed the WRC-23 Final Acts. The Final Acts constitute a record of the decisions taken at the conference including both the new and revised provisions of the Radio Regulations.

3.1 WRC-23 Agenda Item 1.14

Agenda item 1.14 called for the review and consideration of 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).

The aim of this agenda item was to establish frequency allocations for EESS (passive) for passive sensors operating in the bands 239.2-242.2 and 244.2-247.2 GHz in order to cover specific channels for ice cloud measurements with the primary frequency allocations in the Radio Regulations to provide the best possible regulatory basis for protecting such use in the long-term future.

The challenge of this agenda item was to get these new frequency allocations for EESS (passive) without unduly constraining the operation of other primary services currently allocated in this frequency range. To achieve that, a shift of the existing fixed service (FS) and mobile service (MS) allocations in overlap with the new allocations to EESS (passive) to the frequency band 235-238 GHz was agreed accompanied with a new footnote according to which EESS (passive) shall not claim protection from stations in the FS and MS.

Conclusion on WRC-23, agenda item 1.14: This result constitutes a significant achievement as with these new allocations for EESS (passive) all channels considered for ice cloud measurements are covered by primary frequency allocations to EESS (passive) and thus are protected to the extent possible.

3.2 WRC-23 Agenda Item 4 (Revision of Resolution 731 – Sharing of active and passive services above 100 GHz)

Agenda item 4 is a standing agenda item which calls for a review of Resolutions and Recommendations of previous conferences with a view to their possible revision, replacement or abrogation, among which is Resolution 731.

Unfortunately, Resolution 731 was adopted at WRC-2000 with an contradiction/inconsistency with Radio Regulations (RR) footnote 5.340 which, despite clearly stipulating that all emissions are prohibited, would allow to study sharing with active services in certain EESS (passive) bands above 100 GHz.

This contradiction/inconsistancy in the regulations more-and-more became a threat to passive microwave sensing, particularly in the last years where active services started looking into using bands above 100 GHz.

This invitation to study sharing in bands in which all emissions are prohibited gave the false impression that active services could be deployed in such bands subject to RR FN 5.340, but rather than fostering development/deployment of either services (passive or active) in bands above 100 GHz, it created uncertainty.

Thus, this contradiction had to be removed, which was done by revising Resolution 731 in the following way:

RES 731 (REV. WRC-23) … invites the ITU Radiocommunication Sector

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,~~ 174.8-182 GHz, ~~182-185 GHz,~~ 185-190 GHz, ~~190-191.8 GHz, 226-231.5 GHz~~ and 235-238 GHz;*

2. *To study under what conditions passive services operating in allocated frequency bands 100-102 GHz, 148.5-151.5 GHz, 182-185 GHz, 190-191.8 GHz and 226-231.5 GHz are compatible with active services allocated to adjacent bands;*

Conclusion on WRC-23, agenda item 4 related to Resolution 731: This result constitutes a significant achievement as this eliminates the possibility of undermining the strongest provision for the protection of passive bands, i.e. RR FN 5.340 (all emissions are prohibited). It strengthens the status of these passive bands and helps securing their long-term availability for passive sensing.

3.3 WRC-23 Agenda Items 1.16, 1.17, 9.1 Topic D (Protection of EESS (passive) from new non-geostationary satellite services and applications)

Under agenda items 1.16, 1.17, 9.1 Topic D regarding new non-geostationary satellite services and applications (e.g. Earth stations in motion and inter-satellite links around 18.6-18.8 GHz) around bands also allocated to EESS (passive), WRC-23 implemented appropriate

- power flux-density limits on the new satellite applications to protect passive microwave sensors observing in the band 18.6-18.8 GHz;
- e.i.r.p density limit on the new satellite applications to protect passive microwave sensors observing in the band 36-37 GHz.

Conclusion on WRC-23, agenda items 1.16, 1.17, 9.1 Topic D: The limits introduced into the Radio Regulations will provide the relevant level of protection for passive sensing in the frequency bands 18.6-18.8 GHz and 36-37 GHz from these new non-geostationary satellite services and applications.

3.4 WRC-23 Agenda Items 1.4 and 1.18 (Protection of the MetSat L-Band at 1675-1710 MHz)

Agenda item 1.4 dealt with the possibility to use 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. One band under consideration is 1710-1815 MHz, right above the MetSat L-Band at 1675-1710 MHz.

Thus, there would have been a risk of interference from unwanted emissions of HIBS in 1710-1885 MHz into an MetSat Earth stations below 1710 MHz, e.g. when the HIBS downlink transmission would be seen within the main beam of an HRPT station.

In order to avoid this potential interference scenario, WRC-23 introduced regulatory conditions which limit the operation of HIBS in the frequency bands 1710-1785 MHz in Regions 1 and 2, and 1710-1815 MHz in Region 3 to uplink transmissions towards HIBS only.

Agenda item 1.18 dealt with potential new frequency allocations to the mobile-satellite service (MSS) for future development of narrowband mobile-satellite systems in certain bands, including in parts of the MetSat L-Band, i.e. 1695-1710 MHz.

Fortunately, WRC-23 decided on a no-change (NOC) under this agenda item, thus the band 1675-1710 MHz will not be available for narrowband mobile-satellite systems. Furthermore, WRC-23 also decided that this band will not be reconsidered for narrowband MSS systems under a similar WRC-27 agenda item 1.12.

Conclusion on WRC-23, agenda items 1.4 and 1.18: Due to the limitiation of HIBS in the band 1710-1785 MHz to transmissions only in the uplink direction and no new frequency allocation to narrowband MSS systems in the band 1695-1710 MHz at WRC-23, nor for study at WRC-27, there is no negative impact on the MetSat L-Band downlink out of WRC-23.

3.5 WRC-23 Agenda Items 9.1 Topic A (Space Weather)

Agenda item 9.1 Topic A called for studies relating to the technical and operational characteristics, spectrum requirements and appropriate radio service designations for space weather (SW) sensors with a view to describing appropriate recognition and protection in the Radio Regulations without placing additional constraints on incumbent services.

The goal was to establish first level of recognition of Space Weather (SW) by

1. including a definition of space weather and its service designation under MetAids (space weather) in the ITU-R Radio Regulations (RR);
2. a new Resolution outlining the importance of space weather applications;
3. a follow-on WRC-27 agenda item for possible frequency allocations to MetAids (space weather) in specific frequency bands.

WRC-23 established, in a first step, the designation of Space Weather under a new sub-category of MetAids (space weather) in a new RR Article 29B and embedded the definition of space weather in a new Resolution 675, outlining the importance of space weather applications;

In a second step, WRC-23 agreed upon WRC-27 agenda item 1.17, to study the inclusion of new allocations to the MetAids (space weather) service for receive-only space weather observations in certain frequency bands.

Conclusion on WRC-23, agenda item 9.1 Topic A: The recognition of Space Weather in the Radio Regulations by means of the three elements described above is a significant achievement and paved the way for the next step, i.e. WRC-27 agenda item 1.17 to study possible frequency allocations to the MetAids (space weather) service for receive-only space weather observations in certain frequency bands.

3.6 WRC-23 Agenda Items 1.2 (Identification of bands for IMT in the range 3.3 to 10.5 GHz)

Agenda item 1.2 called for possible identification of the frequency bands 3300-3400 MHz, 3600-3800 MHz, 6425-7025 MHz, 7025-7125 MHz and 10.0-10.5 GHz for International Mobile Telecommunications (IMT).

Unfortunately, in the 6/7 GHz range Sea Surface Temperature (STT) measurements are performed, not having any status of protection in the Radio Regulations. Only a very weak footnote RR 5.458 exists that highlights the use of this range for SST, but with no commitment for protection included.

A future use of IMT in the band 6425-7125 MHz used for SST measurements will result in increased level of interference (RFI) to SST. Thus, the only possibility to compensate for this increased level of RFI was to identify complementary bands for SST.

As a consequential action to the increased level of RFI on SST at 6/7 GHz, WRC-23 established a future agenda item (WRC-27 agenda item 1.19) on possible new allocations to the EESS (passive) in the bands 4200-4400 MHz and 8400-8500 MHz.

Conclusion on WRC-23, agenda item 1.2: The establishment of WRC-27 agenda item 1.19 on possible new frequency allocations to the EESS (passive) in the bands 4200-4400 MHz and 8400-8500 MHz is a significant achievement as this issue was not even explicitly on the agenda due to the missing regulatory protection of SST at 6/7 GHz. Now, as one element of consideration, the merits of a multichannel instrument for future SST measurements has to be assessed.

4 OUTLOOK TO WRC-27

Under the standing agenda item 10 of a WRC, the agenda for the next WRC is discussed and established. The following provides a list of items of relevance to CGMS, of which the bold highlighted items are outlined in the following sub sections.

1.1: FSS aeronautical and maritime ESIMs in the 47.2-50.2 GHz and 50.4-51.4 GHz bands

1.2: FSS smaller antennas in the 13.75-14 GHz band

1.3: FSS gateways in the 51.4-52.4 GHz band transmitting to non-GSO systems

1.4: FSS and BSS downlinks in the 17.3 to 17.8 GHz range

1.6: Equitable access for FSS in the 37.5 to 51.4 GHz range

1.7: International Mobile Telecommunications (IMT) identifications in the 4.4-4.8 GHz, 7.125-8.4 GHz and 14.8-15.35 GHz bands

1.8: Radiolocation service in the 231.5-275 GHz and 275-700 GHz ranges

1.11: Space-to-space links in bands allocated to the MSS in the 1518 to 1675 MHz range and the 2483.5-2 500 MHz band

1.12: MSS in the 1427-1432 MHz, 1645.5-1646.5 MHz, 1880-1920 MHz and 2010-2025 MHz bands for low data rate non-GSO systems

1.13: MSS in the 694 to 2700 MHz range for direct connectivity to IMT user equipment

1.14: MSS in the bands 2 010-2 025 MHz, 2120-2160 MHz and 2 160-2 170 MHz

1.17: Regulatory provisions and protection of receive-only space weather sensors

1.18: Protection of EESS (passive) sensors from active services in adjacent bands above 86 GHz

1.19: New primary allocations to the EESS (passive) in the 4.2-4.4 GHz and 8.4-8.5 GHz bands for SST measurements

7: Satellite regulatory procedures

10: Preliminary agenda for WRC-31

4.1 WRC-27 Agenda Items 1.1 and 1.3 (New satellite agenda items with need to protect passive sensors)

Agenda items 1.1 and 1.3 regarding new satellite applications in existing allocations to the fixed-satellite service (FSS) requiring the establishment/update of limits to protect passive sensors in the bands 50.2-50.4 GHz and above 52.6 GHz, relevant for many operational and planned passive microwave sensors on non-geostationary MetSat.

Similarly to what was studied already in the past which led to the establishment of unwanted emission limits in Resolution 750 in the Radio Regulations to protect the bands 50.2-50.4 GHz and 52.6-54.25 GHz, studies will now have to be performed for these new satellite applications. Taking into account aggregation effects on potential RFI with already existing satellite applications, those existing limits will now have to be reviewed and potentially revised.

4.2 WRC-27 Agenda Item 1.7 (IMT in the 4.4-4.8 GHz, 7.125-8.4 GHz and 14.8-15.35 GHz bands)

Despite the fact that there are already a number of bands identified for IMT, including the newly identified bands, 6425-7125 MHz in Region 1 and 7025-7125 MHz in Region 3, there was still a large majority of countries at WRC-23 insisting to study even more bands for International Mobile Telecommunication (IMT). As a result of that WRC-27 agenda item 1.7 was established.

Under this new agenda item for IMT, sharing and compatibility studies will have to be performed, with a view to ensuring the protection of services to which the frequency band is

allocated on a primary basis, without imposing additional regulatory or technical constraints on those services, and also on services in adjacent bands.

Among the bands to be studied is also the range 7125-8400 MHz with the bands:

- 7450-7550 MHz for the data downlink from geostationary MetSats;
- 7750-7900 MHz for the data downlink from non-geostationary MetSats;
- 8025-8400 MHz for the downlink from Earth Observation (EO) satellites.

Most of today's MetSat and EO missions are using one of the above bands in the 7/8 GHz range for the downlink and/or broadcast of the measured data. Thus, studies for a possible identification for IMT concern nearly all these missions.

4.3 WRC-27 Agenda Item 1.8 (Radiolocation service in the 231.5-275 GHz and 275-700 GHz ranges)

For these new applications in the Radiolocation service (RLS) two components are considered, a receive-only use, which is similar to passive sensors, detecting the extremely weak power that is naturally radiated by objects, and an active use. For this active component compatibility with passive sensors has to be ensured.

Therefore, sharing and compatibility studies (in-band and adjacent bands) will have to be performed for active millimetric and sub-millimetric wave RLS systems in bands above 231.5 GHz with passive sensors. This is relevant for many planned passive microwave sensors, such as Ice Cloud Imagers on non-geostationary MetSat.

4.4 WRC-27 Agenda Item 1.17 (Space Weather follow-on)

WRC-27 Agenda item 1.17 calls for consideration of regulatory provisions for receive-only space weather sensors and their protection in the Radio Regulations in the following frequency bands:

- 27.5-28.0 MHz;
- 29.7-30.2 MHz;
- 32.2-32.6 MHz;
- 37.5-38.325 MHz;
- 73.0-74.6 MHz;
- 608-614 MHz.

Here it is to be noted that possible new primary MetAids (space weather) allocations to be made for the above bands are subject to not claiming protection from, nor constraining the future development of, incumbent services in these frequency bands or in adjacent bands.

4.5 WRC-27 Agenda Item 1.18 (Protection of EESS (passive) sensors from active services in adjacent bands above 86 GHz)

The work under this WRC-27 Agenda item 1.18 is split into two topics, protection of particular bands for EESS (passive) and particular bands for Radioastronomy. The interest of CGMS is related to the protection of EESS (passive) from unwanted emissions of active services operating in frequency bands adjacent to the EESS (passive) allocations as outlined in the table below, where No. 5.340 applies.

Resolution 750 (Rev. WRC-19) is to be updated should any regulatory measures be required to ensure the protections of the EESS (passive).

Establishment of unwanted emission limits in Resolution 750 in the Radio Regulations for the passive bands 86-92 GHz, 114.25-116 GHz, 164-167 GHz, 200-209 GHz, all covered by 5.340 (all emissions are prohibited), proactively before the active services are deployed, would be beneficial for many operational and planned passive microwave sensors on non-geostationary MetSat satellite systems.

The following EESS (passive) bands and adjacent active services are to be studied:

EESS (passive) frequency band	Active service frequency band	Active service
86-92 GHz	81-86 GHz	Fixed-satellite service (FSS) (Earth-to-space), mobile service (MS)
	92-94 GHz	MS, radiolocation service (RLS)
114.25-116 GHz	111.8-114.25 GHz	Fixed service (FS), MS
164-167 GHz	158.5-164 GHz	FS, FSS (space-to-Earth), MS, mobile-satellite service (MSS) (space-to-Earth)
	167-174.5 GHz	FS, FSS (space-to-Earth), inter-satellite service (ISS), MS
200-209 GHz	191.8-200 GHz	FS, ISS, MS, MSS, radionavigation service (RNS), radionavigation-satellite service (RNSS)
	209-217 GHz	FS, FSS (Earth-to-space), MS

Here it is to be highlighted that the modified Resolution 731 (Rev. WRC-23), see section 3.2, calls for compatibility studies between the EESS (passive) in the bands 100-102 GHz, 148.5-151.5 GHz, 182-185 GHz, 190-191.8 GHz and 226-231.5 GHz and active services in adjacent bands, which are not in scope of this agenda item.

4.6 WRC-27 Agenda Item 1.19 (Possible new primary allocations to the EESS (passive) in the 4.2-4.4 GHz and 8.4-8.5 GHz bands for SST)

As a consequential action to the outcome of WRC-23 Agenda item 1.2 for IMT identification in the 6/7 GHz range and its possible impact on SST measurements WRC-23 established

agenda item agenda item 1.19 on possible new frequency allocations to the EESS (passive) in the bands 4200-4400 MHz and 8400-8500 MHz.

The aim of the studies under WRC-27 agenda item 1.19 is to determine the conditions of usage of the frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz by the EESS (passive) which would then be used in conjunction with the 6/7 GHz frequency range. In this context also the merits of a multichannel instrument for future SST measurements has to be assessed, as already outlined in section 3.6 above.

4.7 WRC-27 Agenda Item 10 (Preliminary agenda for WRC-31)

Under the standing agenda item 10 of a WRC, also the preliminary agenda for the next but one WRC is discussed and established. The following provides a list of items of potential relevance to CGMS without going into any further detail on these items at this stage:

2.1: New allocations in 275-325 GHz for passive and active services

2.3: NGSO ESIMs in 12.75-13.25 GHz (EESS (active) in adjacent band)

2.6: IMT in bands [102-109.5 GHz, 151.5-164 GHz, 167-174.8 GHz, 209-226 GHz and 252-275 GHz]

2.10: EESS (Earth-to-space) in the frequency band 22.55-23.15 GHz

2.11: EESS (space-to-Earth) for EO payload data in bands within the range 37.5-52.4 GHz

2.12: Possible new allocations to the EESS (active) in the frequency bands [3000-3100 MHz] and [3300-3400 MHz]

2.13: Studies between EESS (active) SARs and radiolocation in 9.2-10.4 GHz

5 WMO ON FREQUENCY RELATED MATTERS

5.1 WRC-23 from the perspective of WMO

WMO was well represented through participation of WMO staff and several members of the ET-RFC.

WMO provided the following input contributions to WRC-23:

- WMO position on the World Radiocommunication Conference 2023 (WRC-23) Agenda (Document WRC-23 No 66);
- Sea Surface Temperature Measurements - Agenda item 1.2 (Document WRC-23 No 67),;
- Space Weather Issue - Agenda item 10 (Document WRC-23 No 68).

Conclusion on WRC-23: All WRC-23 agenda items of relevance for WMO were concluded in-line with the WMO positions as presented in WRC-23 document 66.

5.2 WMO Expert Team on Radio Frequency Coordination (ET-RFC)

The fifth meeting of the Expert Team on Radio Frequency Coordination (ET-RFC) was held at the Caribbean Telecommunications Union (CTU) Headquarters in Port of Spain, from 20 to 22 February 2024.

One essential task and outcome of this meeting was the development of the first version of the WMO positions for WRC-27, see Attachment 3.

During the process of development of this first version of the WMO positions to WRC-27 the following action item was identified, which was also send to CGMS members for feedback:

RFC2024.17: WMO SEC: to submit the first version of WMO Position on the WRC-27 agenda to WMO Members (incl. through the network of NFPs), adding in the cover letter the call for input to verify any current and planned use of: (1) the EESS (active) allocation in the frequency band 17.2-17.3 GHz and (2) the EESS (passive) allocation in the frequency band 15.35–15.4 GHz to ensure that additional technical and operational characteristics, if any, are submitted to the ITU-R WP 7C. Also, to ask if radiosondes in 1.7GHz are still in use.

So far only limited feedback was received regarding the use or plans for using the bands 15.35–15.4 GHz for EESS (passive) and 17.2-17.3 GHz for EESS (active). ROSHYDROMET, JAXA and EUMETSAT have no plans for using these to bands. Canada reported their plans to utilize the 17.2-17.3 EESS (active) allocation, along with the 13.25-13.75 GHz EESS (active) allocation, for the Terrestrial Snow Mass Mission (TSMM), a dual-frequency synthetic aperture radar.

Attachment 1

RECOMMENDATION ITU-R SA.2155-0

Guidelines on the use of the frequency band 2 200-2 290 MHz by Earth exploration-satellite service/space research service/space operation service satellite networks or systems that are not using spread-spectrum modulation

o (2022)

Scope

This Recommendation provides guidelines for the use of the frequency band 2 200-2 290 MHz by the Earth exploration-satellite service (EESS), space research service (SRS) and space operation service (SOS) networks or systems. The aim is to optimize the use of the band by promoting practices that allow the maximum number of satellite networks and systems sharing the band, including techniques that would reduce the bandwidth within the Advance Publication Information (API) filing. This Recommendation addresses EESS/SRS/SOS satellite networks or systems that are not using spread-spectrum modulation.

Keywords

Tracking, telemetry, command, Earth exploration-satellite, space research, space operation, TT&C, EESS, SRS, SOS

Related ITU-R Recommendations and Reports

Recommendation ITU-R SA.363 – Space operation systems

Recommendation ITU-R SA.1024 – Necessary bandwidths and preferred frequency bands for data transmission from Earth exploration satellites (not including meteorological satellites)

Recommendation ITU-R SA.1273 – Power flux-density levels from the space research, space operation and Earth exploration-satellite services at the surface of the Earth required to protect the fixed service in the bands 2 025-2 110 MHz and 2 200-2 290 MHz

Recommendation ITU-R S.1716 – Performance and availability objectives for fixed-satellite service telemetry, tracking and command systems

Recommendation ITU-R F.1777 – System characteristics of television outside broadcast, electronic news gathering and electronic field production in the fixed service for use in sharing studies

Report ITU-R SA.2325 – Sharing between space-to-space links in space research, space operation and Earth exploration-satellite services and IMT systems in the frequency bands 2 025-2 110 MHz and 2 200-2 290 MHz

The ITU Radiocommunication Assembly,

considering

a) that the frequency band 2 200-2 290 MHz is allocated, among other services, to the space research service (SRS), Earth exploration-satellite service (EESS) and space operation service (SOS) in the space-to-Earth and space-to-space directions;

b) that the frequency band 2 200-2 290 MHz is presently congested and interference among different satellite networks and systems may exceed the protection levels in relevant ITU-R Recommendations;

c) that the number of satellite links using the frequency band 2 200-2 290 MHz is expected to continue to increase in the future and, as a result, may potentially increase the interference levels;

d) that most space-to-Earth and space-to-space satellite links currently operating in the frequency band 2 200-2 290 MHz typically use an emission bandwidth of no more than 6.2 MHz;

e) that the use of larger emission bandwidths than referenced above may, for non-spread spectrum signals, under certain circumstances, make it more difficult to coordinate;

f) that the frequency band 2 200-2 290 MHz is traditionally used for tracking, telemetry and command (TT&C) for the operation of spacecraft and also for relatively low data-rate payload data transmission;

g) that for relatively high data-rate payload data transmission, higher frequency bands are available as alternatives to the frequency band 2 200-2 290 MHz as they can accommodate larger emission bandwidths;

h) that congestion in the band can be reduced by selection of the minimum bandwidth necessary to accomplish the intended mission;

i) that the use of large earth station antennas with high gains and low sidelobe levels reduces the impact of potential interference;

j) that interference in the band can also be reduced by ensuring that space stations transmit only when in visibility of their associated receive stations;

k) that precise information relating to the number of carriers and their associated bandwidths, number of specific earth stations, and service area could facilitate the coordination process;

l) that for the case of satellite systems containing multiple satellites, frequency reuse would allow a more efficient use of spectrum resources, therefore reducing the total necessary bandwidth of such systems,

recognizing

a) that some administrations already ensure that non-spread spectrum transmissions in frequency band 2 200-2 290 MHz be limited to 6.2 MHz;

b) that frequency assignments to non-GSO satellite networks or systems in the frequency band 2 200-2 290 MHz are not subject to the coordination procedure under Section II of the Radio Regulations (RR) Article **9**;

c) that ITU-R Circular Letter CR/420 states that these bands are in fact the most common bands for space operation of non-GSO satellite networks or systems and submitting

a more realistic frequency band as part of the Advance Publication Information (API) will facilitate the procedure under Section 1A of RR Article **9** and minimize correspondence exchange between various involved administrations,

noting

a) that, according to RR No. **1.111**, a *satellite system* is defined as a *space system* using one or more artificial *earth satellites*;

b) that, according to RR No. **1.112**, a *satellite network* is defined as *satellite system* or a part of a *satellite system*, consisting of only one satellite and the cooperating *earth stations*;

c) that according to RR No. **5.392**, Administrations are urged to take all practicable measures to ensure that space-to-space transmissions between two or more non-geostationary satellites, in the space research, space operations, and Earth exploration-satellite services in the frequency bands 2 025-2 110 MHz and 2 200-2 290 MHz, shall not impose any constraints on Earth-to-space space-to-Earth and other space-to-space transmissions of those services and in those bands between geostationary and non-geostationary satellites,

recommends

1 that EESS/SRS/SOS satellite networks or systems that are not using spread spectrum modulation and are planning to operate in the frequency band 2 200-2 290 MHz should consider reducing their bandwidth to the operational minimum required by their satellite network or system in order to minimize congestion and the potential for interference to other systems and services operating in this frequency band;

2 that, for space-to-Earth operations in the frequency band 2 200-2 290 MHz, administrations operating EESS/SRS/SOS satellite networks or systems that are not using spread spectrum modulation, should consider using an operational bandwidth, of no more than 6.2 MHz;

3 that, for space-to-space operations in the frequency band 2 200-2 290 MHz, administrations operating EESS/SRS/SOS satellite networks or systems that are not using spread spectrum modulation, should consider using an operational bandwidth of no more than 6.2 MHz;

4 that space-to-Earth and space-to-space operations in the frequency band 2 200-2 290 MHz should only transmit when in view of their associated receiving stations;

5 that for space-to-Earth operations in the frequency band 2 200-2 290 MHz, due consideration should be given to interference mitigation techniques which may include:

i) earth station geographical diversity;

ii) increased earth station antenna gain enhancing the link margin;

iii) reduced earth station antenna sidelobe levels;

iv) use of data relay satellites, if available, to augment and/or replace earth stations;

v) the use of CDMA spread-spectrum signals or suppressed carrier modulation schemes for non-spread-spectrum signals;

vi) steerable beams with reduced space station antenna sidelobe levels for space-space links; and

vii) earth station isolation from mobile links;

6 that for relatively high data-rate payload transmissions by EESS or SRS networks or systems, frequency bands allocated to EESS or SRS that are higher in frequency than the frequency band 2 200-2 290 MHz should be considered as alternatives as they provide adequate bandwidths for such transmissions;

7 that when submitting RR Appendix **4** information to the Radiocommunication Bureau (BR) for EESS/SRS/SOS satellite networks or systems intended to operate in the space-to-Earth direction in the frequency band 2 200-2 290 MHz, administrations should:

– refrain, whenever possible, from using generic parameters, such as typical earth stations with the service area over the whole Earth surface, and large ranges of power/e.i.r.p. and signal bandwidths;

– consider specifying the carrier frequency and the bandwidth, and as far as possible, the number of specific earth stations, and their associated geographic coordinates, consistent with the required actual operations.

NOTE – *recommends* 2 and 3 may not be applied during launch operations.

Attachment 2

RECOMMENDATION ITU-R SA.2156-0

Guidelines on the use of the frequency band 2 025-2 110 MHz by Earth exploration-satellite service/space research service/space operation service satellite networks or systems that are not using spread-spectrum modulation

o (2022)

Scope

This Recommendation provides guidelines for the use of the frequency band 2 025-2 110 MHz by the space research service (SRS), Earth exploration-satellite service (EESS), and space operation service (SOS) networks or systems. The aim is to optimize the use of the band by promoting practices that allow the maximum number of satellite networks and systems sharing the band, including techniques that would reduce the bandwidth within the Advance Publication Information (API) filing. This Recommendation addresses EESS/SRS/SOS satellite networks or systems that are not using spread-spectrum modulation.

Keywords

Tracking, telemetry, command, Earth exploration-satellite, space research, space operation, TT&C, EESS, SRS, SOS

Related ITU-R Recommendations and Reports

Recommendation ITU-R SA.363 – Space operation systems

Recommendation ITU-R SA.1024 – Necessary bandwidths and preferred frequency bands for data transmission from Earth exploration satellites (not including meteorological satellites)

Recommendation ITU-R SA.1273 – Power flux-density levels from the space research, space operation and Earth exploration-satellite services at the surface of the Earth required to protect the fixed service in the bands 2 025-2 110 MHz and 2 200-2 290 MHz

Recommendation ITU-R S.1716 – Performance and availability objectives for fixed-satellite service telemetry, tracking and command systems

Recommendation ITU-R F.1777 – System characteristics of television outside broadcast, electronic news gathering and electronic field production in the fixed service for use in sharing studies

Recommendation ITU-R SA.1863 – Radiocommunications used for emergency in manned space flight

Report ITU-R SA.2325 – Sharing between space-to-space links in space research, space operation and Earth exploration-satellite services and IMT systems in the frequency bands 2 025-2 110 MHz and 2 200-2 290 MHz

The ITU Radiocommunication Assembly,

considering

a) that the frequency band 2 025-2 110 MHz is allocated, among other services, to the space research service (SRS), Earth exploration-satellite service (EESS) and space operation service (SOS) in the Earth-to-space and space-to-space directions;

b) that the frequency band 2 025-2 110 MHz is presently congested and interference among satellite networks and systems may exceed the protection levels in relevant ITU-R Recommendations;

c) that the number of satellite links using the frequency band 2 025-2 110 MHz is expected to continue to increase in the future and, as a result, may potentially increase the interference levels;

d) that most space-to-space satellite links currently operating in the frequency band 2 025-2 110 MHz typically use an emission bandwidth of no more than 6.2 MHz;

e) that most Earth-to-space satellite links currently operating in the frequency band 2 025-2 110 MHz typically use an emission bandwidth no more than 2 MHz;

f) that the use of larger emission bandwidths than referenced above may for non-spread spectrum signals under certain circumstances, make it more difficult to coordinate;

g) that the frequency band 2 025-2 110 MHz is traditionally used for tracking, telemetry, and command (TT&C) for the operation of spacecraft;

h) that higher frequency bands are available as alternatives to the frequency band 2 025-2 110 MHz as they provide adequate bandwidths for relatively high data-rate payload data transmission;

i) that congestion in the band can be reduced by selection of the minimum bandwidth necessary to accomplish the intended mission;

j) that the use of large earth station antennas with high gains and low sidelobe levels reduces the impact of potential interference;

k) that interference in the band resulting from earth-to-space transmissions can also be reduced by ensuring that earth stations transmit only when in visibility of their associated space station;

l) that interference in the band resulting from space-to-space transmissions can also be reduced by ensuring that space stations transmit only when in visibility of their associated space station;

m) that precise information relating to the number of carriers and their associated bandwidths, number of specific earth stations, and service area could facilitate the coordination process;

n) that for the case of satellite systems containing multiple satellites, frequency reuse would improve spectrum efficiency, therefore reducing the total necessary bandwidth of such systems,

recognizing

a) that frequency assignments to non-GSO satellite networks and systems in the 2 025-2 110 MHz frequency band are not subject to the coordination procedure under Section II of the Radio Regulations (RR) Article **9**;

b) that ITU-R Circular Letter CR/420 states that these bands are in fact the most common bands for space operation of non-GSO satellites networks and systems and submitting a more realistic frequency bands as part of the Advance Publication Information (API) will facilitate the procedure under Section 1A of RR Article **9** and minimize correspondence exchange between various involved administrations,

noting

a) that, according to RR No. **1.111**, a *satellite system* is defined as a *space system* using one or more artificial *earth satellites*;

b) that, according to RR No. **1.112**, a *satellite network* is defined as *satellite system* or a part of a *satellite system*, consisting of only one satellite and the cooperating *earth stations*;

c) that according to RR No. **5.392**, administrations are urged to take all practicable measures to ensure that space-to-space transmissions between two or more non-geostationary satellites, in the space research, space operations, and Earth exploration-satellite services in the frequency bands 2 025-2 110 MHz and 2 200-2 290 MHz, shall not impose any constraints on Earth-to-space space-to-Earth and other space-to-space transmissions of those services and in those bands between geostationary and non-geostationary satellites,

recommends

1 that EESS/SRS/SOS satellite networks or systems that are not using spread spectrum modulation and are planning to use the frequency band 2 025-2 110 MHz should consider reducing their bandwidth to the operational minimum required by their satellite network or system in order to minimize congestion and the potential for interference to other systems and services operating in this frequency band;

2 that, for Earth-to-space operations in the frequency band 2 025-2 110 MHz, administrations operating EESS/SRS/SOS satellite networks or systems that are not using spread spectrum modulation, should consider using an operational bandwidth of no more than 2.0 MHz;

3 that, for space-to-space operations in the frequency band 2 025-2 110 MHz, administrations operating EESS/SRS/SOS satellite networks or systems that are not using spread spectrum modulation, should consider using an operational bandwidth of no more than 6.2 MHz;

4 that Earth-to-space and space-to-space operations in the frequency band 2 025-2 110 MHz should only transmit when in view of their receiving space stations;

5 that for Earth-to-space operations in the frequency band 2 025-2 110 MHz, due consideration should be given to interference mitigation techniques which may include:

i) earth station geographical diversity;

ii) increased earth station antenna gain enhancing the link margin;

iii) reduced earth station antenna sidelobe levels;

iv) use of data relay satellites, if available, to augment and/or replace earth stations;

v) the use of CDMA spread-spectrum signals or suppressed carrier modulation schemes for non-spread-spectrum signals;

vi) steerable beams with reduced space station antenna sidelobe levels for space-space links; and

vii) earth station isolation from mobile links;

6 that when submitting RR Appendix **4** information to the Radiocommunication Bureau for EESS/SRS/SOS satellite networks or systems intended to operate in the Earth-to-space direction in the frequency band 2025-2110 MHz, administrations should:

– refrain, whenever possible, from using generic parameters, such as typical earth stations with the service area over the whole Earth surface, and large ranges of power/e.i.r.p. and signal bandwidths;

– consider specifying the carrier frequency and the bandwidth, and as far as possible, the number of specific earth stations, and their associated geographic coordinates, consistent with the required actual operations.

NOTE – *recommends* 2 and 3 may not be applied during launch operations.

Attachment 3

Preliminary WMO Position on the World Radiocommunication Conference 2027 (WRC-27) agenda*

1 Introduction

World Meteorological Organization (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[1], the Paris Climate Agreement, the Sendai Framework for Disaster Risk Reduction and the Early Warnings for All initiative[2].

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 Radiocommunication Conference (Geneva, 2012)[3] observes that:

– Earth observation data are essential for monitoring and predicting climate change, for disaster prediction, monitoring and mitigation, for increasing the understanding, modelling and verification of all aspects of climate change, and for related policymaking.

– 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.

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* Expert Team Radio Frequency Coordination, 20-22 February 2024, hybrid session (Doc. ET-RFC-5, 05/03/2024).

1 See: Sustainable Development Goals (wmo.int).

2 See: Executive Action Plan 2023-2027 (The UN Global Early Warning Initiative for the Implementation of Climate Adaptation): EARLY WARNINGS FOR ALL: Executive Action Plan 2023... | E-Library (wmo.int).

3 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: Radio Regulations 2020 – ITU Hub.

– 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 environmental applications, but also opportunities for enhancing observations.

WMO remains committed to working with ITU towards optimizing the use of the radio-frequency spectrum for the benefit of the global community.

This document reflects the WMO position on the agenda of the World Radiocommunication Conference 2027 (WRC-27)[4].

2 General comments

WIGOS comprises components that make use of a wide number of different radio applications and services, some of which may be affected by WRC-27 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, etc) and solar activity that affect all populations and economies, is to a great extent attributable to space-borne observations and their assimilation in numerical weather and environmental prediction 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 be changed, ignored or 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, Radio Regulation (RR) No **5.340**[5] stating that "all emissions are prohibited" enables in principle passive services to deploy and

4 Resolution **813 (WRC-23)**, "Agenda for the 2027 World Radiocommunication Conference".

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 adjacent bands not adequately regulated to ensure the protection of Earth exploration-satellite service (passive) (EESS (passive)) systems from interference. Several geophysical parameters contribute, at varying levels, to natural emissions, which can be observed at a given frequency and present unique properties. Therefore, measurements at several frequencies in the microwave spectrum must be made simultaneously in order to isolate and retrieve each individual contribution and to extract the parameters of interest from the given set of measurements.

Consequently, interference affecting a given "passive" frequency band can cause disturbances in the overall measurement of a given environmental variable.

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 by altimeters, rain and cloud radars, scatterometers and Synthetic Aperture Radars[6], 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 radio-frequency spectrum allocations to the Earth exploration and meteorological-satellite services for telemetry, telecommand and control (2 200-2 290 MHz and 2 025-2 110 MHz) as well as for satellite downlink of the collected data (1 675-1 710 MHz, 7 450-7 550 MHz, 7 750-7 900 MHz, 8 025-8 400 MHz and 25.5-27 GHz).

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 process. Radar data are input to nowcasting and to numerical weather and environmental 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 defence in a disaster warning strategy against loss of life and property in flash floods 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 (temperature, relative humidity and wind speed) with the high vertical

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5 Radio Regulations footnotes are found in Volume 1 of the Radio Regulations. The Radio Regulations can be obtained at: https://www.itu.int/hub/publication/r-reg-rr-2020/.

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

resolution 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.

In addition to meteorological observations, the WMO's mandate also covers related environmental observations, including observations of space weather. The collection and exchange of space weather data are important for detecting solar activity events, including solar flares and high energetic particles, and their relevant consequences for the Earth's geomagnetic and ionospheric conditions, and other space weather phenomena that impact services critical to the economy, safety and security of administrations and the populations of their countries.

2.3 WMO Actions

The Nineteenth World Meteorological Congress (Geneva, 2023), attended by 193 Member countries, adopted WMO Resolution 31 (Cg-19)[7] – WMO Position of the World Radiocommunication Conference 2023 (WRC-23) Agenda, 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.

Additionally, WMO Resolution 31 (Cg-19) "… stresses that some radio-frequency bands are a unique natural resource due to their special characteristics and natural radiation enabling space-borne 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 weather, water, climate and other related environmental observations that contribute to the Observations and Monitoring pillar of the Global Framework for Climate Services (GFCS).

3 WMO PRELIMINARY POSITION ON WRC-27 AGENDA ITEMS

Among WRC-27 agenda items, 16 items or topics are related to frequency bands or issues of prime interest or concern for meteorology and related environmental fields:

Agenda item 1.1: Fixed-satellite service (FSS) aeronautical and maritime earth stations in motion (ESIMs) in the 47.2-50.2 GHz and 50.4-51.4 GHz bands

Agenda item 1.2: FSS smaller antennas in the 13.75-14 GHz band

Agenda item 1.3: FSS gateways in the 51.4-52.4 GHz band transmitting to non-geostationary satellite orbit (non-GSO) systems

[7] WMO Resolution 31 (Cg-19): Cg-19: World Meteorological Congress (WMO-No. 1326) [Abridged final report].

Agenda item 1.4: FSS and broadcasting-satellite service (BSS) downlinks in the 17.3 to 17.8 GHz range

Agenda item 1.6: Equitable access for FSS in the 37.5 to 51.4 GHz range

Agenda item 1.7: International Mobile Telecommunications (IMT) identifications in the 4.4-4.8 GHz, 7.125-8.4 GHz and 14.8-15.35 GHz bands

Agenda item 1.8: Radiolocation service in the 231.5-275 GHz and 275-700 GHz ranges

Agenda item 1.11: Space-to-space links in bands allocated to the mobile-satellite service (MSS) in the 1 518 to 1 675 MHz range and the 2 483.5-2 500 MHz band

Agenda item 1.12: MSS in the 1 427-1 432 MHz, 1 645.5-1 646.5 MHz, 1 880-1 920 MHz and 2 010-2 025 MHz bands for low data rate non-GSO systems

Agenda item 1.13: MSS in the 694 to 2 700 MHz range for direct connectivity to IMT user equipment

Agenda item 1.14: MSS in the bands 2 010-2 025 MHz, 2 120-2 160 MHz and 2 160-2 170 MHz

Agenda item 1.17: Regulatory provisions and protection of receive-only space weather sensors

Agenda item 1.18: Protection of EESS (passive) sensors from active services in adjacent bands above 76 GHz

Agenda item 1.19: New primary allocations to the EESS (passive) in the 4.2-4.4 GHz and 8.4-8.5 GHz bands for SST measurements

Agenda item 7: Satellite regulatory procedures

Agenda item 10: Preliminary agenda for WRC-31

3.1 Agenda item 1.1

"to consider the technical and operational conditions for the use of the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz (Earth-to-space), or parts thereof, by aeronautical and maritime earth stations in motion communicating with space stations in the fixed-satellite service and develop regulatory measures, as appropriate, to facilitate the use of the frequency bands 47.2-50.2 GHz and 50.4-51.4 GHz (Earth-to-space), or parts thereof, by aeronautical and maritime earth stations in motion communicating with geostationary space stations and non-geostationary space stations in the fixed-satellite service, in accordance with Resolution **176 (Rev.WRC-23)**"

This agenda item considers regulatory provisions to facilitate the deployment of earth stations in motion (ESIMs) operating in the fixed-satellite service (FSS). This agenda item introduces a potential for increased interference to the EESS (passive) in the frequency band 50.2-50.4 GHz. It is worth noting that the frequency band 50.2-50.4 GHz corresponds to a reference window for atmospheric temperature profiling (surface temperature).

It should be noted that in this frequency band, both footnote RR No. **5.340** and Resolution **750 (Rev.WRC-19)** apply. Resolution **750 (Rev.WRC-19)** emphasizes the critical importance of long-term protection of the EESS (passive) in the frequency bands 23.6-24 GHz, 31.3-31.5 GHz, 50.2-50.4 GHz, 52.6-54.25 GHz and 86-92 GHz to weather prediction, the Early Warnings for All initiative, and climate monitoring.

Resolution **750 (Rev.WRC-19)** already contains unwanted emissions limits applicable to FSS (Earth-to-space) in the bands 49.7-50.2 GHz and 50.4-50.9 GHz for the protection of EESS (passive) in the band 50.2-50.4 GHz. These limits were determined for traditional FSS fixed earth stations, and these limits may not be appropriate for ESIMs.

In order to ensure that the EESS (passive) in the band 50.2-50.4 GHz is adequately protected, the activities under WRC-27 agenda item 1.1 should determine whether the current limits have to be modified or whether specific new limits have to be added.

Working Party 4A is the responsible group for studies.

Preliminary WMO Position on WRC-27 agenda item 1.1

The WMO does not oppose the operation of ESIMs in the bands 47.2-50.2 GHz and 50.4-51.4 GHz (Earth-to-space) provided that the protection of the EESS (passive) in the adjacent frequency band 50.2-50.4 GHz continues to be ensured through mandatory unwanted emission limits in Resolution **750 (Rev.WRC-19)**.

3.2 Agenda item 1.2

"to consider possible revisions of sharing conditions in the frequency band 13.75-14 GHz to allow the use of uplink fixed-satellite service earth stations with smaller antenna sizes, in accordance with Resolution **129 (WRC-23)**"

The adjacent frequency band 13.25-13.75 GHz is allocated to the Earth exploration-satellite service (active) (EESS (active)). Remote sensing instruments such as scatterometer, altimeter and precipitation radar are operating in that frequency band.

Working Party 4A is the responsible group for studies.

WMO Position on WRC-23 agenda item 1.2

WMO is not opposed to the use of uplink FSS earth stations with smaller antenna sizes in the frequency band 13.75-14 GHz provided that the remote sensing instruments operating under the EESS (active) in the adjacent frequency band 13.25-13.75 GHz are not impacted by the potential changes in FSS operations.

3.3 Agenda item 1.3

"to consider studies relating to the use of the frequency band 51.4-52.4 GHz to enable use by gateway earth stations transmitting to non-geostationary-satellite orbit systems in the fixed-satellite service (Earth-to-space), in accordance with Resolution **130 (WRC-23)**"

This agenda item considers extending the use of the FSS by gateway earth stations transmitting to non-geostationary-satellite orbit (non-GSO) systems. This agenda item introduces a potential for increased interference to the EESS (passive) in the 52.6-54.25 GHz frequency band.

It should be noted that in the 52.6-54.25 GHz frequency band both footnote RR No. **5.340** and Resolution **750 (Rev.WRC-19)** apply.

Resolution **750 (Rev.WRC-19)** already contains unwanted emissions limits applicable to GSO FSS (Earth-to-space) networks in the band 51.4-52.4 GHz for the protection of EESS

(passive) in the band 52.6–54.25 GHz. However, non-GSO FSS unwanted emission limits are not specified.

The activities under WRC-27 agenda item 1.3 should develop the relevant corresponding limits for non-GSO FSS (Earth-to-space) networks in the band 51.4-52.4 GHz taking into account possible aggregation effects with the use of this band by gateway earth stations transmitting to GSO FSS networks, including the possible need for adjustments to those existing limits in Resolution **750 (Rev.WRC-19)**, as stipulated in *recognizing j)* and *resolves* 2 of Resolution **130 (WRC-23)**.

Working Party 4A is the responsible group for studies.

WMO Position on WRC-27 agenda item 1.3

WMO is not opposed to the use of the frequency band 51.4-52.4 GHz to enable use by gateway earth stations transmitting to non-GSO systems in the FSS (Earth-to-space) provided that the protection of the EESS (passive) in the frequency band 52.6–54.25 GHz is still adequately ensured through the inclusion of relevant mandatory unwanted emission limits and/or necessary adjustments to the existing limits in Resolution **750 (Rev.WRC-19)**. These mandatory limits must account for aggregate interference from GSO and non-GSO FSS systems into the EESS (passive).

3.4 Agenda item 1.4

"to consider a possible new primary allocation to the fixed-satellite service (space-to-Earth) in the frequency band 17.3-17.7 GHz and a possible new primary allocation to the broadcasting-satellite service (space-to-Earth) in the frequency band 17.3-17.8 GHz in Region 3, while ensuring the protection of existing primary allocations in the same and adjacent frequency bands, and to consider equivalent power flux-density limits to be applied in Regions 1 and 3 to non-geostationary-satellite systems in the fixed-satellite service (space-to-Earth) in the frequency band 17.3-17.7 GHz, in accordance with Resolution **726 (WRC-23)**"

The adjacent frequency band 17.2-17.3 GHz is allocated to the EESS (active) for the possible operation of remote sensing instruments such as scatterometers and precipitation radars. However, there is currently very limited documented use of that frequency band by the EESS (active) within ITU-R documents. WMO is seeking input from its members to verify any current and planned use of this EESS (active) allocation to ensure that additional technical and operational characteristics, if any, are submitted to the ITU-R WP 7C.

Working Party 4A is the responsible group for studies.

WMO Position on WRC-27 agenda item 1.4

WMO is not opposed to new allocations to the FSS (space-to-Earth) and broadcasting-satellite service (BSS) (space-to-Earth) provided that the EESS (active) in the frequency band 17.2-17.3 GHz is protected.

3.5 Agenda item 1.6

"to consider technical and regulatory measures for fixed-satellite service satellite networks/systems in the frequency bands 37.5-42.5 GHz (space-to-Earth), 42.5-43.5 GHz (Earth-to-space), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz

(Earth-to-space) for equitable access to these frequency bands, in accordance with Resolution **131 (WRC-23)**"

This agenda item considers technical and regulatory measures for equitable access in some FSS frequency bands. This agenda item may potentially increase the use of the corresponding bands by the FSS and, as a consequence, might introduce a potential for increased interference to the EESS (passive) in the frequency bands 36-37 GHz and 50.2-50.4 GHz.

It should be noted that in the 50.2-50.4 GHz frequency band, both footnote RR No. **5.340** and Resolution **750 (Rev.WRC-19)** apply.

Working Party 4A is the responsible group for studies.

Preliminary WMO Position on WRC-27 agenda item 1.6

WMO will monitor this agenda item to assess if any technical and regulatory measures considered for the FSS could adversely impact the protection of the EESS (passive) in the frequency bands 36-37 GHz and 50.2-50.4 GHz.

3.6 Agenda item 1.7

"to consider studies on sharing and compatibility and develop technical conditions for the use of International Mobile Telecommunications (IMT) in the frequency bands 4 400-4 800 MHz, 7 125-8 400 MHz (or parts thereof), and 14.8-15.35 GHz taking into account existing primary services operating in these, and adjacent, frequency bands, in accordance with Resolution **256 (WRC-23)**"

WMO has major concerns regarding an International Mobile Telecommunications (IMT) identification in the 7 125-8 400 MHz frequency band (or parts thereof). Multiple frequency bands within this frequency range proposed for IMT operations are used extensively in support of EESS and meteorological-satellite service (MetSat) operations that are of critical interest to WMO.

Frequency band	Operations	Notes
7 190-7 250 MHz	EESS (Earth-to-space)	Used for tracking, telemetry and control (TT&C) only
7 450-7 550 MHz	MetSat (space-to-Earth)	GSO MetSats only Used to enable wide bandwidths to meet high data rates for the downlink of raw instrument data from geostationary (GSO) MetSat systems
7 750-7 900 MHz	MetSat (space-to-Earth)	Non-GSO MetSats only For transmitting the raw meteorological data from non-geostationary (non-GSO) meteorological satellites and the global dissemination of the meteorological data directly to the users of direct broadcast earth stations
8 025-8 400 MHz	EESS (space-to-Earth)	Earth stations in this band constitute a critical part of the EESS communications infrastructure.

		Used to enable wide bandwidths to meet high data rates for the downlink of raw instrument data from EESS systems. Used for real-time data transmission directly from the satellite to direct broadcast earth stations with a direct line-of-sight to the satellite. These stations provide immediate observations of the local environment and are used for tasks ranging from forecasting weather to monitoring plant health to directing fire fighters battling wildland fires.

There is currently a very high number of MetSat and EESS earth stations worldwide, including, a large number of receive-only stations that do not need to be licensed, some of which are portable stations, meaning that their locations may not be known.

It should also be noted that 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. Preliminary results of studies ongoing in ITU-R WP 7C show that interference will occur on current and planned sea surface temperature (SST) measurements especially in coastal areas if IMT is deployed in any portion of the 6 425-7 125 MHz band. A similar conclusion can be drawn for the 7 125-7 250 MHz band if an IMT identification is made in that frequency band.

In addition, there would be a need to study the impact from possible new IMT identifications in 4 400-4 800 MHz and 7 125-8 400 MHz on the potential new EESS (passive) allocations for SST measurements in the bands 4 200-4 400 MHz and 8 400-8 500 MHz being considered under WRC-27 agenda item 1.19.

This agenda item also calls for consideration of an IMT identification in the 14.8-15.35 GHz frequency band. A primary allocation to the EESS (passive) exists in the adjacent band 15.35-15.4 GHz, where RR No **5.340** applies. However, no use of the frequency band for passive operations has been identified. WMO is seeking input from its members to verify any current and planned use of this EESS (passive) allocation to ensure that technical and operational characteristics, if any, are submitted to the ITU-R WP 7C.

Working Party 5D is the responsible group for studies.

WMO Position on WRC-27 agenda item 1.7

WMO opposes any IMT identification:

– in the 7 125-7 250 MHz frequency band since SST measurements, performed in the overlapping 7 075-7 250 MHz frequency range, are of prime importance for weather forecasting, the Early Warnings for All initiative, and climate monitoring. The 7 075-7 250 MHz frequency range used for SST measurements will always be needed to ensure continuity with past and current SST measurements. Combining this frequency range with nearby channels considered under agenda item 1.19 is required to improve science retrievals and to mitigate RFI to the greatest extent.

– in the 7 450-7 550 MHz and 7 750-7 900 MHz frequency bands to ensure the protection of MetSat (space-to-Earth) allocations used for the transmission of collected data from GSO and non-GSO MetSat systems.

– in the 8 025-8 400 MHz frequency band to ensure the protection of EESS (space-to-Earth) allocations used for the transmission of data collected from Earth exploration satellites.

Introduction of widely deployed IMT networks will also limit future deployment of MetSat and EESS earth stations that are essential for the distribution of meteorological, related environmental (including space weather) and Earth observation data to the WMO user community.

– WMO requests that the impact of IMT operations in the frequency ranges 4 400-4 800 MHz and 8 215-8 400 MHz on the potential new EESS (passive) allocations under agenda item 1.19 be taken into consideration.

3.7 Agenda item 1.8

"to consider possible additional spectrum allocations to the radiolocation service on a primary basis in the frequency range 231.5-275 GHz and possible new identifications for radiolocation service applications in the frequency bands within the frequency range 275-700 GHz for millimetric and sub-millimetric wave imaging systems, in accordance with Resolution **663 (Rev.WRC-23)**"

Agenda item 1.8 considers regulatory changes to support the operation of radiolocation systems within the 231.5-700 GHz frequency range. The specific frequency bands to be studied for radiolocation operations have not yet been specified. There is significant potential that frequency bands to be studied will overlap or be adjacent to frequency bands used for current or future EESS (passive) operations.

The relevant allocated EESS (passive) bands in this range are: 226-231.5 GHz, 250-252 GHz (both of which are exclusively passive bands, as per RR No. **5.340**), and 235-238 GHz, 239.2-242.2 GHz and 244.2-247.2 GHz (which are shared with active services).

Above 275 GHz there are currently no allocations in the RR, but RR No. **5.565** identifies a number of bands that are relevant and already used for EESS (passive) measurements, a number of which have been shown as not being able to share with FS and MS applications.

WMO has no concerns with potential receive-only applications of the radiolocation service as they would not pose any compatibility concerns with the EESS (passive).

In addition, the band 237.9-238 GHz is also allocated to EESS (active) (see RR No. **5.563B**).

Working Party 5B is the responsible group for studies.

WMO Position on WRC-27 agenda item 1.8

WMO opposes any new allocations to the radiolocation service in the frequency band 250-252 GHz where footnote RR No. **5.340** applies.

WMO is not opposed to new allocations to the radiolocation service on a primary basis in the frequency range 231.5-275 GHz, except for 250-252 GHz as noted above, or to new identifications in the frequency range 275-700 GHz provided that the protection of the existing allocations/identifications to the EESS (passive) and the EESS (active) is ensured, from both in-band and/or out-of-band emissions of these possible new radiolocation service applications.

WMO is also of the view that consideration should be given to the protection of ground-based passive atmospheric sensing in the bands 235-238 GHz, 250-252 GHz and 265-275 GHz.

3.8 Agenda item 1.11

"to consider the technical and operational issues, and regulatory provisions, for space-to-space links among non-geostationary and geostationary satellites in the frequency bands 1 518-1 544 MHz, 1 545-1 559 MHz, 1 610-1 645.5 MHz, 1 646.5-1 660 MHz, 1 670-1 675 MHz and 2 483.5-2 500 MHz allocated to the mobile-satellite service, in accordance with Resolution **249 (Rev.WRC-23)**"

This agenda item calls for studies on provisions to allow space-to-space links to be operated in several frequency bands allocated to the mobile-satellite service (MSS).

WMO concerns are specifically related to the consideration of the frequency band 1 670-1 675 MHz and its potential impact on the MetSat service operating in the adjacent band of 1 675-1 710 MHz.

With respect to MetSat usage, the 1 675-1 710 MHz frequency band is globally used by GSO and non-GSO MetSat systems for the downlink of the measured data as well as the global dissemination of the data directly to users. For a number of different applications, the use of the MetSat 1 675-1 710 MHz is an indispensable component in existing and currently developed GSO and non-GSO MetSat satellite systems/networks as well as in future constellations of small MetSat satellites. Therefore, it is important to preserve the long-term availability and protection of the band 1 675-1 710 MHz for MetSat use.

It should be noted that the frequency band 1 668.4-1 700 MHz is allocated to the meteorological aids (MetAids) service. WMO is seeking input from its members to confirm the use of this frequency band by radiosondes.

Working Party 4C is the responsible group for studies.

WMO Position on WRC-27 agenda item 1.11

WMO is not opposed to study regulatory provisions for space-to-space links among GSO and non-GSO satellites in bands allocated to the MSS provided that there is no negative impact on the interference environment for MetSat systems in the 1 675-1 710 MHz frequency band.

3.9 Agenda item 1.12

"to consider, based on the results of studies, possible allocations to the mobile-satellite service and possible regulatory actions in the frequency bands 1 427-

1 432 MHz (space-to-Earth), 1 645.5-1 646.5 MHz (space-to-Earth) (Earth-to-space), 1 880-1 920 MHz (space-to-Earth) (Earth-to-space) and 2 010-2 025 MHz (space-to-Earth) (Earth-to-space) required for the future development of low-data-rate non-geostationary mobile-satellite systems, in accordance with Resolution **252 (WRC-23)**"

WMO has concerns regarding the protection of the EESS (passive) allocation in the frequency band 1 400-1 427 MHz and the EESS (Earth-to-space and space-to-space) and space operation service (SOS) in the frequency band 2 025-2 110 MHz.

The EESS (passive) allocation in the frequency band 1 400-1 427 MHz is used for measurements of soil moisture, salinity, ocean surface temperature and vegetation index. WMO recognizes that the proposed MSS operations in 1 427-1 432 MHz are in the space-to Earth direction, however recent studies have shown that, depending on interference path geometry, space-to-Earth transmissions can result in interference to EESS (passive) operations.

EESS/MetSat satellite systems are using the frequency band 2 025-2 110 MHz for TT&C. Since this band is very commonly used, radiofrequency interference in this band would affect a large number of MetSat and EESS satellites.

Working Party 4C is the responsible group for studies.

WMO Position on WRC-27 agenda item 1.12

WMO does not oppose consideration of MSS allocations for low data rate applications provided that:

- studies are conducted which consider the need for MSS unwanted emissions limits for the protection of the EESS (passive) in the frequency band 1 400-1 427 MHz, and those studies form the basis for mandatory unwanted emission limits, if required, in Resolution **750 (Rev.WRC-19)**.
- there is no negative impact on the interference environment for the EESS/SOS in the 2 025-2 110 MHz frequency band.

3.10 Agenda item 1.13

"to consider studies on possible new allocations to the mobile-satellite service for direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage, in accordance with Resolution **253 (WRC-23)**"

This agenda item considers new frequency allocations to the MSS to supplement terrestrial IMT network coverage where IMT user equipment would obtain service via MSS space stations. The agenda item does not indicate specific frequency bands to be considered within the broad frequency range of 694-2 700 MHz.

This agenda item appears to only deal with possible new allocations to the MSS for direct connectivity in frequency bands already allocated to the mobile service and identified for IMT.

If this is the case, WMO concerns will be focused on the protection of systems in bands adjacent to bands identified for use by IMT as follows:

– meteorological radars operating in the 2 700-2 900 MHz band, for which MSS providing service to IMT user equipment in the frequency band 2 500-2 690 MHz could result in similar compatibility issues that were studied between high altitude IMT base stations (HIBS) operating below 2 690 MHz and meteorological radars operating above 2 700 MHz under WRC-23 agenda item 1.4;

– MetSat in the 1 675-1 710 MHz band, which is used globally by GSO and non-GSO MetSat systems/networks for the downlink of measured data as well as the global dissemination of data directly to users;

– EESS and SOS in the 2 025-2 110 MHz frequency band, which are used for TT&C of EESS/MetSat satellite systems.

However, Resolution **253 (WRC-23)** does not explicitly limit studies to bands already identified for IMT. Consideration of other frequency bands not currently identified for IMT could result in further WMO concerns. In particular, should any of the frequency bands listed in the table below be considered, WMO would have concerns with the protection of the associated incumbent radiocommunications services.

Radio service	Frequency band
Radiolocation (for Wind Profiler Radar(WPR))	904-928 MHz
EESS (active)	1 215-1 300 MHz
Radiolocation (for WPR)	1 270-1 295 MHz
Radiolocation (for WPR)	1 300-1 375 MHz
EESS (passive)	1 400-1 427 MHz
MetAids	1 668.4-1 700 MHz
MetSat (space-to-Earth)	1 675-1 710 MHz
SOS & EESS (Earth-to-space) (space-to-space)	2 025-2 110 MHz
SOS & EESS (space-to-Earth) (space-to-space)	2 200-2 290 MHz

Working Party 4C is the responsible group for studies.

WMO Position on WRC-27 agenda item 1.13

Under the understanding that activities under agenda item 1.13 are limited to frequency bands with mobile allocations already identified for IMT in the frequency range between 694 MHz and 2.7 GHz, WMO is not opposed to possible new allocations to the MSS for direct connectivity between space stations and IMT user equipment provided that there is no adjacent band negative impact on the interference environment of the following:

– MetSat systems in the 1 675-1 710 MHz band,

– EESS and SOS systems in the 2 025-2 110 MHz band, and

– meteorological radar systems in the 2 700-2 900 MHz band.

WMO opposes the study of other frequency bands not currently identified for IMT. However, if considered, the protection of meteorological systems in the 694-2 700 MHz range must be ensured.

3.11 Agenda item 1.14

"to consider possible additional allocations to the mobile-satellite service, in accordance with Resolution **254 (WRC-23)**"

This agenda item calls for studies on possible new frequency allocations to the MSS in the frequency bands 2 010-2 025 MHz (Earth-to-space) and 2 160-2 170 MHz (space-to-Earth) in Regions 1 and 3 and 2 120-2 160 MHz (space-to-Earth) in all Regions.

WMO has concerns regarding the frequency band 2 010-2 025 MHz (Earth-to-space) to ensure that the adjacent frequency band (2 025-2 110 MHz), used for TT&C of EESS/MetSat satellite systems (Earth-to-space), is not impacted.

Working Party 4C is the responsible group for studies.

WMO Position on WRC-27 agenda item 1.14

WMO does not oppose possible additional allocations to the MSS in the 2 010-2 025 MHz (Earth-to-space) band, provided that there is no impact on the operation of EESS/MetSat satellite systems in the adjacent 2 025-2 110 MHz frequency band.

3.12 Agenda item 1.17

"to consider regulatory provisions for receive-only space weather sensors and their protection in the Radio Regulations, taking into account the results of ITU Radiocommunication Sector studies, in accordance with Resolution **682 (WRC-23)**"

This agenda item is the follow-up to WRC-23 agenda item 9.1 topic a). WRC-23 approved Resolution **675 (WRC-23)** and added Article **29B**, which define space weather and designate space weather sensors to the MetAids service as the subset MetAids (*space weather*). The elaboration of these regulatory provisions in the Radio Regulations allowed WRC-23 to approve Resolution **682 (WRC-23)**, which resolves to conduct:

1) studies on spectrum needs, appropriate protection criteria for receive-only space weather sensors, and system characteristics;

2) sharing and compatibility studies pertaining to potential new primary allocations to MetAids (*space weather*) for receive-only sensors in the following frequency bands:
   - 27.5-28.0 MHz,
   - 29.7-30.2 MHz,
   - 32.2-32.6 MHz,
   - 37.5-38.325 MHz,
   - 73.0-74.6 MHz,
   - 608-614 MHz;

3) studies on possible regulatory provisions of the Radio Regulations to accommodate the possibility for an administration that wishes to notify a receive-only space weather sensor station for inclusion in the Master International Frequency Register.

Agenda item 1.17 is of primary interest to WMO since the focus is to establish regulatory provisions for the protection of receive-only space weather sensors within select frequency bands. In accordance with Resolution **682 (WRC-23)**, this must be accomplished without placing constraints on existing allocated radio services in the frequency bands under consideration nor constraining their future development.

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

WMO Position on WRC-27 agenda item 1.17

WMO supports new primary allocations to MetAids (*space weather*) for receive-only sensors in all the frequency bands listed in, and in accordance with, Resolution **682 (WRC-23)**.

3.13 Agenda item 1.18

"to consider, based on the results of ITU Radiocommunication Sector studies, possible regulatory measures regarding the protection of the Earth exploration-satellite service (passive) and the radio astronomy service in certain frequency bands above 76 GHz from unwanted emissions of active services, in accordance with Resolution **712 (WRC-23)**"

Frequency bands allocated to the EESS (passive) and the protection of corresponding EESS (passive) sensors are of prime interest to the WMO.

The work on this agenda item is split into two topics in Resolution **712 (WRC-23)**. The interest of WMO falls under *resolves* 1, where regulatory measures are to be considered for protection of the EESS (passive) from unwanted emissions of active services operating in frequency bands adjacent to certain EESS (passive) allocations where RR No. **5.340** applies. Resolution **750 (Rev.WRC-19)** is to be updated should any regulatory measures be required to ensure the protections of the EESS (passive). The following EESS (passive) bands and adjacent active services are to be studied:

EESS (passive) frequency band	Active service frequency band	Active service
86-92 GHz	81-86 GHz	Fixed-satellite service (FSS) (Earth-to-space), mobile service (MS)
	92-94 GHz	MS, radiolocation service (RLS)
114.25-116 GHz	111.8-114.25 GHz	Fixed service (FS), MS
164-167 GHz	158.5-164 GHz	FS, FSS (space-to-Earth), MS, mobile-satellite service (MSS) (space-to-Earth)
	167-174.5 GHz	FS, FSS (space-to-Earth), inter-satellite service (ISS), MS
200-209 GHz	191.8-200 GHz	FS, ISS, MS, MSS, radionavigation service (RNS), radionavigation-satellite service (RNSS)
	209-217 GHz	FS, FSS (Earth-to-space), MS

WMO also highlights that Resolution **731 (Rev.WRC-23)** calls for compatibility studies between the EESS (passive) in the bands 100-102 GHz, 148.5-151.5 GHz, 182-185 GHz, 190-191.8 GHz and 226-231.5 GHz and active services in adjacent bands, that are not in scope of this agenda item.

Working Party 7C is the responsible group for studies requested in *resolves* 1 of Resolution **712 (WRC-23)**.

WMO Position on WRC-27 agenda item 1.18

WMO fully supports the elaboration of mandatory regulatory provisions applicable to active services in order to ensure the protection and long-term usability of the EESS (passive) frequency bands 86-92 GHz, 114.25-116 GHz, 164-167 GHz and 200-209 GHz. WMO supports the update of Resolution **750 (Rev.WRC-19)** accordingly.

WMO stresses the need to address this issue by WRC-27 before there is widespread deployment of active services in the bands to be studied.

3.14 Agenda item 1.19

"to consider possible primary allocations in all Regions to the Earth exploration-satellite service (passive) in the frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz, in accordance with Resolution **674 (WRC-23)**"

The objective of this agenda item is to consider possible primary allocations in all Regions to the EESS (passive) in the frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz in order to allow for the continuity of SST measurements that are of prime importance for weather forecasting and climate monitoring.

The frequency range 6 425-7 250 MHz is currently used for conducting SST measurements from satellites on an unprotected basis in accordance with footnote RR No. **5.458**. Preliminary studies performed in the ITU-R show that SST measurements would be severely constrained by high density deployment of communication systems (e.g. RLAN or IMT) in this frequency range.

Based on these studies, radiofrequency interference (RFI) to SST measurements in the 6/7 GHz frequency range is expected to increase significantly in the near future, due to the WRC-23 decision, under agenda item 1.2, to identify the 6 425-7 125 MHz frequency band for use by IMT. Therefore, WRC-27 agenda item 1.19 was elaborated to propose a long-term solution for EESS (passive) sensors for SST measurements.

Preliminary studies performed in ITU-R WP 7C during the previous study cycle showed some opportunities for SST measurements in the frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz.

The aim of the studies under WRC-27 agenda item 1.19 is to determine the conditions of usage of the frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz by the EESS (passive). Such potential new allocations to the EESS (passive) would be used in conjunction with the 6/7 GHz frequency range. Combining multiple nearby channels in such a way is required to improve science retrievals and to mitigate RFI to the greatest extent.

Working Party 7C is the responsible group for studies.

WMO Position on WRC-27 agenda item 1.19

WMO supports new primary EESS (passive) allocations in the frequency bands 4 200-4 400 MHz and 8 400-8 500 MHz in order to ensure the long-term continuity of SST measurements, in conjunction with the existing 6/7 GHz frequency range.

3.15 Agenda item 7

"to consider possible changes, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, on 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 the 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.

WMO Position on WRC-27 agenda item 7

WMO will monitor the development of agenda item 7 issues to ensure that no unnecessary constraints are imposed on MetSat and EESS systems, and that the regulatory procedures for the corresponding ITU filings in the frequency bands used by these systems are not overly complicated.

3.16 Agenda item 10

"to recommend to the ITU Council items for inclusion in the agenda for the next world radiocommunication conference, and items for the preliminary agenda of future conferences, in accordance with Article 7 of the ITU Convention and Resolution **804 (Rev.WRC-23)**"

The WMO position on agenda item 10 will be developed later during the study period.