

Outcome of WRC-19 and outlook to WRC-23

HLPP reference: Section 2.2.1

The World Radiocommunication Conference 2019 (WRC-19) took place in Sharm el-Sheikh, Egypt, from 28 October to 22 November 2019 with the participation of more than 3400 delegates.

The conference discussed and concluded upon quite a large number of agenda items of interest to CGMS members. Almost all of them were positively concluded with regard to the current and future use of meteorological and Earth-exploration satellite systems.

In particular, WRC-19 outcomes ensure continued adequate protection of measurements by scatterometers and altimeters operating in the 5 GHz range (agenda item 1.16), and adequate operational conditions for Data Collection Systems (DCS) from polar and geostationary orbits (agendas item 1.2).

The outcomes of WRC-19 ensure continued or improved protection of passive microwave measurements from in bands from 31.3 to 92 GHz and even up to 450 GHz that are adjacent to or overlapping with bands used or considered for use by fixed, mobile and fixed satellite services (agenda items 1.6, 1.13, 1.14, 1.15 and 9.1.9).

The outcome of WRC-19 was less satisfactory as regards the limits set to unwanted emissions from IMT-2020/5G systems operating in the 25.5-27 GHz band into the adjacent 23.6-24 GHz band used by passive microwave measurements (agenda item 1.13). Here especially the interim limits, applicable until 1 September 2027 are considered too relaxed for adequate protection of passive sensors and the period is too long, as mass-market deployment of IMT-2020/5G is expected for 2024/2025. In the light of this outcome of WRC-19, the actual IMT-2020/5G deployment in the 26 GHz band and its impacts on passive microwave measurements needs to be monitored.

Furthermore, WRC-19 and did not agree on global regulations to protect Earth stations that receive meteorological and Earth-exploration data in the band 25.5-27 GHz (agenda item 1.13). Such measures were considered a national issue and decisions on how to deal with the protection of Earth stations was left to the individual countries.

The agenda for WRC-23 contains again a number of items of interest to CGMS but without similar severe threats as at WRC-19, at this point in time. However, the preparatory works at regional and ITU-R level needs to be carefully followed with the same level of involvement of CGMS member agencies as for WRC-19.

Recommendation proposed:

- 1) CGMS member agencies to monitor the actual IMT-2020/5G deployment in the 26 GHz band and its impacts on passive microwave measurements.
- 2) CGMS member agencies to follow and contribute to the WRC-23 preparatory activities at national/regional and ITU-R level.

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1 INTRODUCTION

The WRC-19 took place in Sharm el-Sheikh, Egypt, from 28 October to 22 November 2019 with the participation of more than 3400 delegates.

This document informs of the outcomes of the World Radiocommunication Conference 2019 (WRC-19) of relevance to CGMS member agencies and provides an outlook to WRC-23.

2 BACKGROUND ON WORLD RADIOCOMMUNICATION CONFERENCES

The Radiocommunication Sector of the International Telecommunications Union, namely the ITU-R, holds a World Radiocommunication Conference (WRC) usually every three to four years to revise the Radio Regulations (RR), which constitute the regulatory framework for the usage of the radiocommunication frequency spectrum on a global basis.

Radio Regulations are an international treaty signed by the 191 ITU member states to govern the use of the radio-frequency spectrum in conjunction with the satellite orbits, providing operational conditions as well as necessary protection measures to ensure equitable access to the spectrum for a large number of radiocommunication services.

The WRCs are attended by delegates representing ITU member states and so-called “sector members” (i.e. groups of interest, including industry and international organisations), including organisations like EUMETSAT. Also, WMO as a sister UN organisation to the ITU, attends the WRCs and presents its positions to agenda items of interest and concern to union in form of a dedicated position paper, which is very well received and respected by the ITU member countries attending a WRC. However, neither the so-called sector members nor WMO have voting rights at a WRC, this is the sole privilege of the ITU member countries.

3 WRC-19 AGENDA ITEMS OF RELEVANCE TO CGMS

The WRC-19 agenda items of most relevance to CGMS were the following:

1.2 Introduction of power limits in the frequency band 401-403 MHz

(Issue: Protection of the Data Collection System (DCS) band from conflicting use by small satellites and small satellite constellations);

1.3 Upgrade of the secondary allocation to the MetSat and EESS service (space-to-Earth) to primary status in the frequency band 460-470 MHz

(Issue: Improvement of the status of the use in this band by DCS against other services allocated to this band without undue constraining those other services);

1.6 Development of a regulatory framework for non-geostationary Fixed Satellite Service (FSS) satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space)

(Issue: Protection of the bands used for passive microwave sensing that are adjacent to the targeted bands);

1.7 Identification of spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, including potential new allocations in specific bands below 1 GHz

(Issue: Safeguard the band 400.15-403 MHz used by DCS systems);

1.13 Identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis

(Issue: Provisions are needed in the authorization for IMT-2020/5G to use the band 25.5-27 GHz to i) ensure protection of existing and future Earth stations and, most importantly ii) protect adjacent bands used for passive microwave sensing through appropriate limits to unwanted emissions from 5G stations);

1.14 Appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations HAPS

(Issue: Protection of frequency bands used by passive sensors neighbouring to bands under consideration for HAPS);

1.15 Identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz

(Issue: Protection of the frequencies to be used by passive microwave sensors like the currently developed Ice Cloud Imager (ICI) instrument embarked on the second generation Metop satellites);

1.16 Consideration of issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5150-5925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service

(Issue: Protection of measurements from active sensing instruments using the 5 GHz range, i.e. SAR, scatterometers and altimeters);

9.1.9 Possible allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space)

(Issue: Protection of adjacent bands used for passive microwave sensing);

10 Draft Agenda for WRC-23.

(Issue: Minimise to the extent possible the number of agenda items with potential impact on spectrum used by CGMS member agencies).

4 RELEVANT OUTCOMES OF WRC-19

4.1 WRC-19 Agenda Item 1.16: Consideration of issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5150-5925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service

WRC-15 already discussed the possible extension of the current RLAN (WiFi) spectrum (5150-5350 MHz and 5470-5725 MHz) through the additional allocation of the 5350-5470 MHz gap under its agenda item 1.1, but could not reach a conclusion and therefore agreed to further study the issue under the new WRC-19 agenda item 1.16.

This agenda item 1.16 considered not only the band 5350-5470 MHz but also the entire 5 GHz area including the bands already available for RLAN, such as the band 5250-5350 MHz used by e.g. ASCAT.

Already in 2016, CGMS member agencies injected studies into ITU-R on the sharing and compatibility of the use of the band 5350 – 5470 MHz by RLAN and C-Band SAR, scatterometers and altimeters, with the same negative conclusion regarding compatibility with RLAN.

Since July 2018, there has been no more support to an identification for RLAN in the band 5350 - 5470 MHz on a global basis.

Outcome of WRC-19 on Agenda Item 1.16

Considering the lack of support on a global basis, WRC-19 agreed not to identify the band 5350-5470 MHz for RLAN due to interference with Earth observation instruments, such as SARs, altimeters and scatterometers.

Similarly, WRC-19 agreed not to relax the conditions of the use of the band 5250-5350 MHz for RLANs.

Thus, the conditions for nominal operations of SAR, scatterometers and altimeters at 5 GHz are safeguarded.

4.2 WRC-19 Agenda Items 1.2, 1.3 and 1.7 related to frequency bands used by Data Collection Systems (DCS)

4.2.1 WRC-19 Agenda Item 1.2: Introduction of power limits in the frequency band 401-403 MHz

The objective was to protect the operations of Data Collection Systems (DCS) from geostationary (GSO) and non-geostationary (NGSO) Earth exploration satellite service (EESS) and MetSat satellite systems in the bands 401-403 MHz and 399.9-400.05 MHz from the increasing use of these bands for telemetry, tracking and command (TT&C) purposes by a fast growing number of other satellite systems, mainly so-called “small satellites”.

To minimise the proliferation of such TT&C usage, which could threaten the large number of existing data collection system (DCS) stations communicating to sensitive receivers on GSO (for DCPs) and more significantly non-GSO satellites (ARGOS), the establishment of an in-band power (EIRP) limit was necessary. The power (EIRP) levels of these telecommand links (Earth-to-space) of satellite systems, more and more commercial entities, are usually much higher than the EIRP levels used for the operation of DCS systems in these bands.

Outcome of WRC-19 on Agenda Item 1.2

Appropriate EIRP limits, in-line with the proposed by all CGMS member agencies, were established in the bands 401-403 MHz and 399.9-400.05 MHz to avoid misuse of the bands by other geostationary and/or non-geostationary systems for other purposes than DCPs.

These agreed limits should allow the continued operations of current and future DCS systems on geostationary and non-geostationary meteorological satellites in a stable global regulatory framework.

4.2.2 WRC-19 Agenda Item 1.3: Upgrade of the secondary allocation to the MetSat and EESS service (Space-to-Earth) to primary status in the frequency band 460-470 MHz

DCS systems like ARGOS use the frequency band 460-470 MHz for transmitting commands and interrogations to the DCPs.

So far, this downlink component of DCS had been operated globally under a so-called secondary allocation, which does not allow to request any kind of protection vis-à-vis the other primary services allocated in this frequency band.

This regulatory situation is somewhat unsafe for operations of DCS in this band, as such operations can be challenged by individual administrations at any time claiming interference caused to other systems using this band in their country.

To improve the regulatory framework for this component of DCS systems, several regional groups proposed an upgrade of the status of MetSat and the EES services

to a primary status. For the protection of the other already primary allocated fixed and mobile services appropriate power flux density (pfd) masks were proposed. However, certain ITU regions (particularly Africa, the Arab States and India) with strong interests to protect their terrestrial fixed and mobile deployments with safety related applications requested pfd masks, which were considered too stringent for a reasonable operation of DCS systems.

Outcome of WRC-19 on Agenda Item 1.3

Because of divergent positions, WRC-19 was unable to come to a globally acceptable solution for modifying the regulations for this band and had to decide on a no change under this Agenda Item.

In particular, the pdf mask levels requested by some countries were unreasonable and therefore not acceptable.

Consequently, DCS will have to continue to operate under the current regulatory regime. To mitigate the interference potential from DCS to terrestrial systems, next generation DCS like ARGOS-4 on Metop-SG will operate with spread spectrum techniques.

4.2.3 WRC-19 Agenda Item 1.7: Identification of spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, including potential new allocations in specific bands below 1 GHz

This agenda item addressed the growing spectrum needs for telemetry, tracking and command for satellites with short duration missions, i.e. for which the associated filing has a period of validity of less than 3 years. These short duration missions, called “small satellites” are typically composed of small non-GSO satellites launched as single units or as part of constellations.

For satisfying the spectrum requirements of a significantly growing number of small satellite systems for telemetry, tracking and command in the space operation service for small satellites. For this, possible new allocations or an upgrade of the existing allocations to the space operation service within the frequency ranges 150.05-174 MHz and 400.15-420 MHz were to be assessed.

One of the preferred bands for the developers and operators of small satellites was the band 401-403 MHz, which made a strong linkage with Agenda Item 1.2 on the establishment of in-band EIRP limits in this band.

Outcome of WRC-19 on Agenda Item 1.7

WRC-19 decided to make available the bands 137-138 MHz and 148-149.9 MHz for such kind of small satellite and systems.

The use of these bands is subject to causing no harmful interference to or claim protection from the existing services to which the frequency bands are allocated on a primary basis, including MetSat in the band 137-138 MHz.

This decision does not negatively affect the current and future meteorological satellite systems. It hopefully provides a useful spectrum resource for small satellite systems thus releasing some pressure of such systems of having to the need to use the band 401-403 MHz due to a lack of alternatives.

4.3 WRC-19 Agenda Items with possible unwanted emission limits into frequency bands used for passive microwave sensing (1.6, 1.13, 1.14, 1.15, and 9.1.9)

The following Table provides an overview of the agenda items (1.6, 1.13, 1.14, 1.15, and 9.1.9) described in the following sub-sections (except agenda item 1.15) versus the corresponding frequency bands allocated in the ITU Radio Regulations to the Earth-Exploration Satellite Service (passive) and used by numerous sensors CGMS member agency satellites:

EESS (passive) band	AI 1.13 (IMT-2020/5G)	AI 1.14 (HAPS)	AI 1.6 (NGSO FSS) & (GSO FSS)	AI 9.1.9 (FSS)
23.6-24 GHz	24.25-27.5 GHz	24.25-27.5 GHz (Region 2 only)		
31.3-31.8 GHz	31.8-33.4 GHz	31-31.3 GHz		
36-37 GHz	37-43.5 GHz		37.5-39.5 GHz	
50.2-50.4 GHz	47.2-50.2 GHz 50.4-52.6 GHz		47.2-50.2 GHz 50.4-51.4 GHz	
52.6-54.25 GHz	50.4-52.6 GHz			51.4-52.4 GHz
86-92 GHz	81-86 GHz			

4.3.1 WRC-19 Agenda Item 1.6: Development of a regulatory framework for non-geostationary Fixed Satellite Service (FSS) satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space)

This agenda item dealt with the development of a regulatory framework for non-geostationary (NGSO) fixed-satellite service (FSS) satellite systems to coexist among NGSO FSS and with geostationary (GSO) FSS in bands below and above the bands allocated to the Earth-Exploration Satellite Service (passive) at 36-37 GHz and 50.2-50.4 GHz.

For the protection of these EESS (passive) bands 36-37 GHz and 50.2-50.4 GHz, this agenda included the establishment of appropriate unwanted emission limits for non-GSO FSS satellite systems (Earth-to-space).

Not part of this agenda item was the revision of the existing unwanted emission limits for GSO FSS satellite systems (Earth-to-Space) to protect EESS (passive) at 50.2-50.4 GHz, however, finally WRC-19 agreed to consider their revision as well.

Outcome of WRC-19 on Agenda Item 1.6

The limits of unwanted emissions from NGSO FSS Earth stations into the 200 MHz used by the EESS (passive) in the 50.2-50.4 GHz band were set to:

- - 42 dBW for GSO FSS Earth stations not employing uplink power control at zenith;
- - 35 dBW at a minimum elevation angle of 15° for Earth stations employing uplink power control (implemented on OneWeb, SpaceX and probably O3B gateways).

The limits of unwanted emissions from GSO FSS Earth stations into the 200 MHz used by the EESS (passive) in the 50.2-50.4 GHz band were set to:

- - 25 dBW for GSO FSS Earth stations with antennas with an elevation angle below 80° antenna and gains greater than or equal to 57 dBi;
- - 30 dBW for GSO FSS Earth stations with antennas with an elevation angle below 80° antenna and gains less than 57 dBi;
- - 45 dBW for GSO FSS Earth stations with an elevation angle equal or above 80°, irrespective of the antenna gain.

These limits for GSO FSS are 10 to 35 dB more stringent than the existing limits in the ITU Radio Regulations, and ensure protection of passive sensors in the 50.2-50.4 GHz passive band.

WRC-19 could not conclude on the potential impact of the downlink from large non-GSO satellite constellations on EESS (passive) in the 36-37 GHz band, which needs further study within ITU-R for consideration at WRC-23, if necessary.

4.3.2 WRC-19 Agenda Item 9.1.9: Possible allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space) (limited to GSO gateways)

This agenda item dealt with a possible new allocation to the GSO FSS (Earth-to-Space), limited to gateways in the frequency band 51.4-52.4 GHz, including the establishment of appropriate unwanted emission limits to protect the EESS (passive) in the frequency band 52.6-54.25 GHz.

Outcome of WRC-19 on Agenda Item 9.1.9

The following limits for unwanted emissions from GSO FSS Earth Stations (limited to gateways) into any 100 MHz of the EESS (passive) band 52.6-54.25 GHz were set to:

- - 37 dBW for Earth stations with elevation angles lower than 75°;
- - 52 dBW for Earth stations with elevation angles equal to or higher than 75°.

These limits ensure the protection of passive sensors in the 52.6-54.25 GHz band.

4.3.3 WRC-19 Agenda Item 1.14: Appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations

HAPS are aerostatic platforms operating in the 20-50 km altitude range as base station for communication to multiple terrestrial users in visibility of the platform.

Because of growing interests in HAPS, mainly from the aerospace industry and Internet-related companies, this agenda item sought to:

- Identify new spectrum for HAPS in certain frequency bands in Region 2, among which the band 24.25-27.5 GHz, close to the EESS (passive) band at 23.6-24 GHz, and/or;
- Extend spectrum identifications agreed at previous WRCs, possibly in the band 31-31.3 GHz adjacent to the EESS (passive) 31.3-31.5 GHz band.

Outcome of WRC-19 on Agenda Item 1.14

For the frequency band 31-31.3 GHz, the HAPS identification was extended to a world-wide identification (both ground-to-HAPS and HAPS-to-ground directions).

For all cases of relevance, the HAPS identifications approved at WRC-19 are associated with appropriate unwanted emission limits to protect passive sensors operated in the bands 23.6-24 GHz and 31.3-31.5 GHz.

4.3.4 WR WRC-19 Agenda Item 1.15: Identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz

Universities and industry are investigating the possibilities of using frequencies in the range 275-450 GHz for applications like "close proximity radio-communication", "wireless links for data centres" and "intra-device communications".

To foster such developments, Agenda Item 1.15 called for the identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz.

Frequency bands above 275 GHz are not yet allocated to any radiocommunication service. However, Radio Regulations footnote 5.565 identifies frequencies above 275 GHz used or planned to be used by passive service applications, i.e. in the Earth Exploration Satellite Service (passive) and Radioastronomy service.

This agenda item asked for guidance in the Radio Regulations on which bands can be used or not for fixed and land-mobile service applications to ensure protection of microwave passive sensors operating above 275 GHz.

The corresponding compatibility studies in the ITU-R indicated an interference potential in some parts of the bands used by nadir or conical scanning instruments where the atmospheric attenuation is the lowest. According to these studies, the use of the bands 296-306 GHz, 313-318 GHz and 333-356 GHz would be incompatible with the existing EESS (passive) systems and thus were excluded from consideration for identification for use by fixed and mobile systems.

Outcome of WRC-19 on Agenda Item 1.15

The new regulatory framework provides clear guidance and discourages the use of the bands 296-306 GHz, 313-318 GHz and 333-356 GHz for which ITU-R studies have concluded that protection of passive sensors cannot be ensured without specific measures that have to be imposed on fixed and land-mobile service applications. These measures will have to be determined by a future WRC.

4.3.5 WRC-19 Agenda Item 1.13: Protection of passive sensors from unwanted emissions in the neighbouring bands under study for IMT2020/5G

The protection of passive sensors from unwanted emissions was part of a broader agenda Item 1.13 addressing the possibility of a global identification of frequency

bands for the future development of IMT-2020/5G, including possible additional allocations to the mobile service on a primary basis.

The bands considered were the bands 24.25-27.5 GHz, 31.8-33.4 GHz, 37-43.5 GHz, 45.5-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz and 81-86 GHz.

The most sensitive discussions related to the conditions associated to the identification of the bands 24.25-27.5 GHz and 37-43.5 GHz for use by IMT-2020/5G systems in order to enable their future development whilst ensuring the protection of other services.

IMT-2020/5G industry and relevant administrations assigned the highest priority to the band 24.25-27.5 GHz, and exerted unprecedented political pressure accordingly.

The setting of limits to unwanted emissions from IMT-2020/5G base stations (BS) and User Equipment (UE) operating in the 24.25-27.5 GHz band into the adjacent 23.6-24 GHz band used for passive microwave measurements was the most controversial issue of WRC-19.

Throughout the preparation process and during the conference, a large spread was observed among the six ITU regional groups on the proposed limits. The Arab States were in favour of setting no limit at all, and other proposed limits were -28 dBW/200 MHz (CITEL=Americas), -32 dBW/200 MHz (Africa and parts of Asia), -42 dBW/200 MHz (CEPT=Europe supported by China) and -49 dB dBW/200 MHz (Russian and Regional Commonwealth).

Europe, the Russian Federation and its neighbouring countries, China, India and Japan supported stringent limits to adequately protect Earth observation microwave passive measurements. On the contrary, the Americas, the African and Arab countries and most of the Asia-Pacific countries were advocating for less protective limits minimising constraints on the development of IMT-2020/5G systems.

Outcome of WRC-19 on Agenda Item 1.13 (passive sensor protection)

In view of the economic priority assigned to the worldwide development of IMT-2020/5G services WRC-19 had to find a global compromise, and it did not come as a surprise that the compromise achieved in the final days of WRC-19 could not provide the desirable protection of microwave passive measurements.

The “compromise” was negotiated in a reduced and restricted group (2 persons per region) where political considerations and economic stakes prevailed over the technical elements.

The limits to unwanted emissions of IMT-2020/5G BS and UE into the 23.6-24 GHz band were set in a two-phase approach, aimed at stimulating the early deployment of IMT-2020/5G systems with loose limits and evolving towards more protective limits for passive microwave measurements:

- Limits of -33 dBW/200 MHz for IMT Base Stations (BS) and -29 dBW/200 MHz for IMT User Equipment (UE) were set for IMT-2020/5G deployments until 1 September 2027, which is for example 9 dB higher than the limits proposed by Europe (-42 / -38 dBW/200 MHz for BS / UE);
- Final limits applicable to deployments after 1 September 2027 are -39 dBW/200 MHz for BS and -35 dBW/200 MHz for UE, which is for example 3 dB higher than the limits proposed by Europe.

Here especially the interim limits, applicable until 1 September 2027 are considered too relaxed for adequate protection of passive sensors and the period is too long, as mass-market deployment of IMT-2020/5G is expected for 2024/2025.

Annex 1 contains a statement of WMO read out at the WRC-19 Plenary regarding the decisions on IMT-2020/5G unwanted emission limits to protect the 23.6-24 GHz band used by passive microwave sensors.

On a more positive note:

- The outcomes of similar discussions on unwanted emissions of IMT-2020/5G systems operating above 37 GHz in the 36-37 GHz band used by passive microwave sensors led to the following limits:
 - ✓ -43 dBW/MHz and -23 dBW/GHz, and
 - ✓ recommending -30 dBW/GHz for countries wishing an even higher level of protection of passive microwave sensors.
- Following the results of the studies performed during the 4-year preparatory cycle, WRC-19 decided that other frequency bands considered under this agenda item were not suitable for IMT-2020/5G, in particular the following bands:
 - ✓ 31.8-33.4 GHz (no impact on the passive band 31.3-31.8 GHz);
 - ✓ 47.2-50.2 GHz (no impact on the passive band 50.2-50.4 GHz);
 - ✓ 50.4-52.6 GHz (no impact on the passive bands 50.2-50.4 GHz and 52.6-54.25 GHz);
 - ✓ 81-86 GHz (no impact on the passive band 86-92 GHz).

Latest developments in Europe on unwanted emissions in the 23.6-24 GHz

When reviewing the outcome of WRC-19, the European administrations agreed that the initial period, until 1 September 2027, during which the too relaxed limits for unwanted emissions prevail was too long to protect passive microwave

measurements from the mass market deployment of IMT-2020/5G systems in Europe, which is expected to be effective already by 2024/25.

Therefore, CEPT member countries and the European Commission agreed to advance the end of the initial phase in Europe, from 1 September 2027 to 1 January 2024. The corresponding modifications to the EC Decision on IMT-2020/5G at 26 GHz were adopted in March 2020.

The revised decision also requests to European countries not to allow high-density broadband access systems (e.g. IMT 2020/5G, FWA, etc.) in bands below 23.6 GHz, to avoid cumulative interference effects, which compensates for the 3 dB relaxation of WRC-19 limits to the -42 / -38 dBW/200 MHz (for BS / UE) adopted in the initial EC Decision.

This represents major improvements over the WRC-19 compromise and mitigates the risk of interference with microwave passive sensors over Europe.

4.4 WRC-19 Agenda Item 1.13: Protection of Earth Stations at 26 GHz

The protection of 26 GHz Earth stations was part of agenda Item 1.13 addressing the possibility of a global identification of frequency bands for the future development of IMT-2020/5G, including possible additional allocations to the mobile service on a primary basis.

The objective for CGMS member agencies was to obtain adequate protection for Earth stations operating in the 25.5-27 GHz band and to retain the possibility to deploy future Earth stations.

This is because the 25.5-27 GHz band is the only frequency band allocated to EESS (space-to-Earth) enabling the downlink of large data volumes from MetSat missions.

In practice, protection requires the establishment of adequate separation distances to protect the operation of current and future Earth stations from interference from IMT-2020/5G deployment.

Corresponding studies in the ITU-R showed that the required separation distances are fairly small, i.e. 4 km (line of sight) for Earth stations in the framework of non-geostationary MetSat and Earth observation satellite systems and 3 km for Earth stations of geostationary MetSat systems. When considering the likelihood of further attenuation of the interference signals due to clutter, the separation distances would further reduce to less than 1 km.

Administrations in Europe have recognised the need to maintain the possibility for using existing and future Earth stations in the 25.5-27 GHz band when licensing IMT-2020/5G at 26 GHz. However, appropriate provisions/regulations are needed for this purpose. For the determination of the required protection zone a methodology is already provided in ECC Recommendation (19)01.

However, at ITU level the corresponding Draft New Recommendation ITU-R SA.[IMT-EESS/SRS coordination] was not adopted by the Radiocommunication Assembly prior to WRC-19 for tactical reasons and was sent back to the corresponding ITU-R Study Group.

Outcome of WRC-19 on Agenda Item 1.13 (Earth station protection)

Many administrations around the world considered the protection of EESS Earth stations in the 25.5-27 GHz band as a national issue, in view of the short separation/coordination distances involved.

This prevented WRC-19 to decide on any binding international regulation on the topic, and WRC-19 instead provided guidance for the protection of EESS Earth stations in the 25.5-27 GHz band, in the following terms:

- Protection of Earth stations “should be facilitated through bilateral agreements for cross-border coordination as necessary”;
- Encouragement to administrations to ensure that IMT implementation allows for the continued use of Earth stations and their future development;

This means in practice that the operator of such Earth stations will need to cooperate with each country selected or considered for the deployment of its Earth stations to ensure that relevant protection measures are in force.

WRC-19 also invited ITU-R to develop an ITU-R Recommendation on methodologies for calculating coordination zones around EESS/SRS Earth stations in order to avoid harmful interference from IMT systems. This will lead to reconsidering the Draft Recommendation ITU-R SA.[IMT-EESS/SRS coordination].

5 PROSPECTS: DRAFT AGENDA FOR WRC-23

The development of the Agenda for the WRC-23 was addressed under Agenda Item 10 of WRC-19, and was one of the most sensitive topics.

More than 80 proposals for agenda items covering 35 different topics were submitted by administrations and the 6 regional groups. In addition, less urgent topics were gathered for the preliminary agenda of WRC-2027.

Generally, a number of proposed agenda items with high potential impacts on the existing or future use of frequency bands for communicating with meteorological and Earth observation satellite or for passive microwave measurements were not retained.

In particular, the range 7.125 GHz to 8.5 GHz containing the bands 7.75-7.9 GHz and 8.025-8.4 GHz used by meteorological and Earth observation satellite systems

was fortunately not retained and is now out of the focus of political discussions on IMT, which is very positive.

However, an agenda item seeking for additional spectrum for IMT systems in a substantial number of bands in the range 3.3 GHz to 10.5 GHz was retained (Agenda Item 1.2) including the band 6.425-7.025 GHz (in ITU Region 1). This band is in overlap with the band used for sea surface temperature (SST) measurements, which unfortunately has no status of protection in the Radio Regulations.

Two more agenda items related to IMT systems need to be carefully followed:

- Item 1.4 Use of high-altitude platform stations as IMT base stations (HIBS) in the mobile service in certain frequency bands below 2.7 GHz already identified for IMT, on a global or regional level;

Under this agenda item 1.4 there could be issues associated with the protection of adjacent bands.

- Item 9.1c Study the use of IMT systems for fixed wireless broadband in the frequency bands allocated to the fixed services on primary basis.

Although agenda item 9.1c is not supposed to lead to changes in the Radio Regulations in 2023, the study cycle 2019-2023 needs to be carefully monitored, as many of the bands allocated to the Fixed service are either also allocated to or adjacent to science services. Although no particular band is targeted at this point, the identification of specific bands for consideration could turn into a threat.

On the positive side, the following items were included in the draft WRC-23 agenda:

- 1.14 Review and consider possible adjustments of the existing or possible new primary frequency allocations to EESS (passive) in the frequency range 231.5-252 GHz, to ensure alignment with more up-to-date remote-sensing observation requirements.

The objective of agenda item 1.14 is to ensure that passive microwave measurements in the frequency range 231.5-252 GHz are protected and the required spectrum is allocated to future passive microwave sensors, for example the Ice Cloud Imager (ICI) instrument on Metop-SG satellites.

- 9.1a) Review the results of studies relating to the technical and operational characteristics, spectrum requirements and appropriate radio service designations for space weather sensors with a view to describing appropriate recognition and protection in the Radio Regulations without placing additional constraints on incumbent services.

The objective of agenda item 9.1a is to gather information on space weather sensors/instruments/missions, identify their spectrum requirements and protection needs, and ways to reflect space weather in the ITU Radio Regulations.

A comprehensive overview of all WRC-23 of potential interest to CGMS is provided in document CGMS-48-WMO-WP-02 which provides the preliminary position of WMO on relevant WRC-23 agenda items.

6 RECOMMENDATIONS FOR CONSIDERATION BY CGMS WORKING GROUP I

1) The interim limits for unwanted emissions from IMT-2020/5G systems operating in the 25.5-27 GHz band, applicable until 1 September 2027, are considered too relaxed for adequate protection of passive sensors in the band 23.6-24 GHz and the period is too long, as mass-market deployment of IMT-2020/5G is expected for 2024/2025.

It is recommended that CGMS member agencies monitor the actual IMT-2020/5G deployment in the 26 GHz band and its impacts on passive microwave measurements.

2) The latest experience at WRC-19 with a large number of items of interest to CGMS has proven the importance of involvement in a WRC preparatory process and the participation at a WRC itself in order to be able to influence the decisions of relevance for Meteorological and Earth-Exploration satellite systems.

Therefore, it is recommended that CGMS member agencies follow and contribute to the WRC-23 preparatory activities at national/regional and ITU-R at the same level of involvement as for WRC-19.

7 CONCLUSIONS

The conference discussed and concluded upon quite a large number of agenda items of interest to CGMS members. Almost all of them were positively concluded with regard to the current and future use of meteorological and Earth-exploration satellite systems.

In particular, WRC-19 outcomes ensure continued adequate protection of measurements by scatterometers and altimeters operating in the 5 GHz range (agenda item 1.16), and adequate operational conditions for Data Collection Systems (DCS) from polar and geostationary orbits (agendas item 1.2).

The outcomes of WRC-19 ensure continued or improved protection of passive microwave measurements from in bands from 31.3 to 92 GHz and even up to 450 GHz that are adjacent to or overlapping with bands used or considered for use by fixed, mobile and fixed satellite services (agenda items 1.6, 1.13, 1.14, 1.15 and 9.1.9).

The outcome of WRC-19 was less satisfactory as regards the limits set to unwanted emissions from IMT-2020/5G systems operating in the 25.5-27 GHz band into the adjacent 23.6-24 GHz band used by passive microwave measurements (agenda item 1.13). Here especially the interim limits, applicable until 1 September 2027 are considered too relaxed for adequate protection of passive sensors and the period is too long, as mass-market deployment of IMT-2020/5G is expected for 2024/2025. In the light of this outcome of WRC-19, the actual IMT-2020/5G deployment in the 26 GHz band and its impacts on passive microwave measurements needs to be monitored.

Furthermore, WRC-19 and did not agree on global regulations to protect Earth stations that receive meteorological and Earth-exploration data in the band 25.5-27 GHz. Such measures were considered a national issue and decisions on how to deal with the protection of Earth stations was left to the individual countries.

The agenda for WRC-23 contains again a number of items of interest to CGMS but without similar severe threats as at WRC-19, at this point in time. However, the preparatory works at regional and ITU-R level needs to be carefully followed with the same level of involvement of CGMS member agencies as for WRC-19.

A comprehensive overview of all WRC-23 of potential interest to CGMS is provided in document CGMS-48-WMO-WP-02 which provides the preliminary position of WMO on relevant WRC-23 agenda items.

Annex I

Statement of WMO at the WRC-19 Plenary regarding the decisions on IMT-2020/5G unwanted emission limits to protect the 23.6-24 GHz band used by passive microwave sensors

Dear Mr Houlin Zhao

First of all, congratulations on the success to date in conducting the 2019 World Radiocommunication Conference. I understand that it is one of the largest WRCs held, with over 3300 participants debating and collaborating to maintain and update the Radio Regulations.

Radio spectrum is a limited resource and, as technology advances, the demands on this spectrum are increasing. As such, I was very pleased to hear of the strong recognition expressed by many delegations at WRC-19 during the constructive discussions on the risk of modern communication technologies to our passive bands that are so critical to the work of WMO Members' national meteorological and hydrological services.

I have been informed that WRC-19 is near to approving levels of out of band emission from 5G systems, planned to operate in the band adjacent to the Earth observation passive frequency band (23.6-24 GHz), that are much higher than the levels proposed by WMO to this conference. I understand that these very relaxed constraints to 5G systems will be applicable until end of 2027 and then even if these levels will become more stringent, they will remain higher than the proposed limits in the WMO proposal. These levels are also higher than the majority of ITU-R studies conducted during the last four years and such high levels during the eight-year transition period are of grave concern for WMO and the global meteorological community.

We recall that this frequency band, specifically and appropriately identified in the Radio Regulation, cannot be replaced by other part of microwave spectrum due to its physical and radiation characteristics and that it represents 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.

Furthermore, the weather forecasts generated by the national weather services are primarily based on the results of numerical weather prediction. In this context the observations of weather satellites are a critical input and it should be noted that across all the main numerical weather prediction centres, microwave observations have the greatest impact on accuracy, providing 30-40% of all forecast skill from observations. It should be further noted that numerical weather prediction is critical to predicting severe meteorological disasters such as tropical cyclones, flooding and heatwaves.

This WRC-19 decision has the potential to significantly degrade the accuracy of data collected in this frequency band which would jeopardize the operation of existing Earth observation satellite systems essential for all weather forecasting and warning activities

of the national weather services. Potential effects of this could be felt across multiple impact areas including aviation, shipping, agricultural meteorology and warning of extreme events as well as our common ability to monitor climate change in the future.

In this light of cooperation and collaboration, I request that you invite the Chairman of WRC-19 to present this statement to the plenary when the issue 1.13 is being considered.

Yours sincerely,
P Taalas
Secretary General