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Managing spectrum for evolving technologies

Special Edition
World Radiocommunication Conference 2019

ITU WRC
SHARM EL-SHEIKH 2019

28 October – 22 November
Sharm El-Sheikh, Egypt

Managing spectrum for evolving technologies

Houlin Zhao

ITU Secretary-General

This is a very important time for ITU as we make final preparations for the World Radiocommunication Conference 2019 (WRC-19), to be held in Sharm El-Sheikh, Egypt, from 28 October to 22 November.

We look forward to welcoming more than 3000 delegates from ITU's 193 Member States and our sector members to Sharm El-Sheikh, where they will take on the huge task of negotiating amendments to the Radio Regulations, the international treaty governing the use of the radio-frequency spectrum and the geostationary-satellite and non-geostationary-satellite orbits.

Many of the delegates will also have participated the week prior to WRC-19 in the Radiocommunication Assembly (RA-19), which provides the technical basis for the work of WRC-19.

The key to a successful outcome of WRC-19 lies in building consensus on how to balance the demands of the different services that require radio-frequency spectrum, such as aeronautical, maritime, satellite, broadcasting, Earth observation, mobile broadband, amateur radio and railways.

WRC-19 will provide for the rapid evolution of information and communication technologies (ICTs) and the introduction of innovative radio services.

I hope that you will find the articles in this comprehensive special edition of the ITU News Magazine useful to understanding the conference procedure, as well as the many critical issues that are at stake. You can also read previous editions of ITU News Magazine this year, which provide an in-depth look at important topics on the WRC-19 agenda, such as terrestrial wireless communications, satellite communications and space science services. ■

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Managing spectrum for evolving technologies

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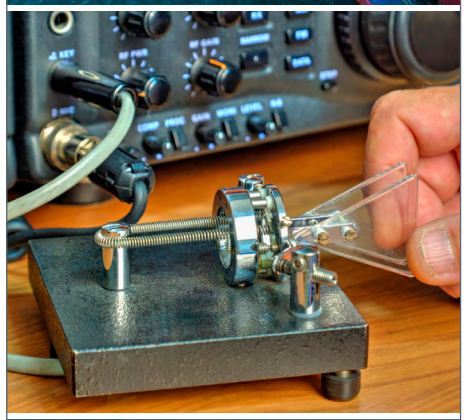
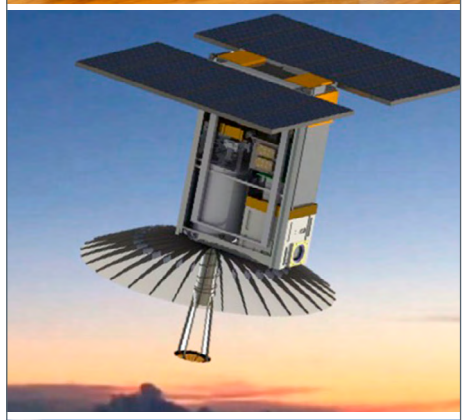
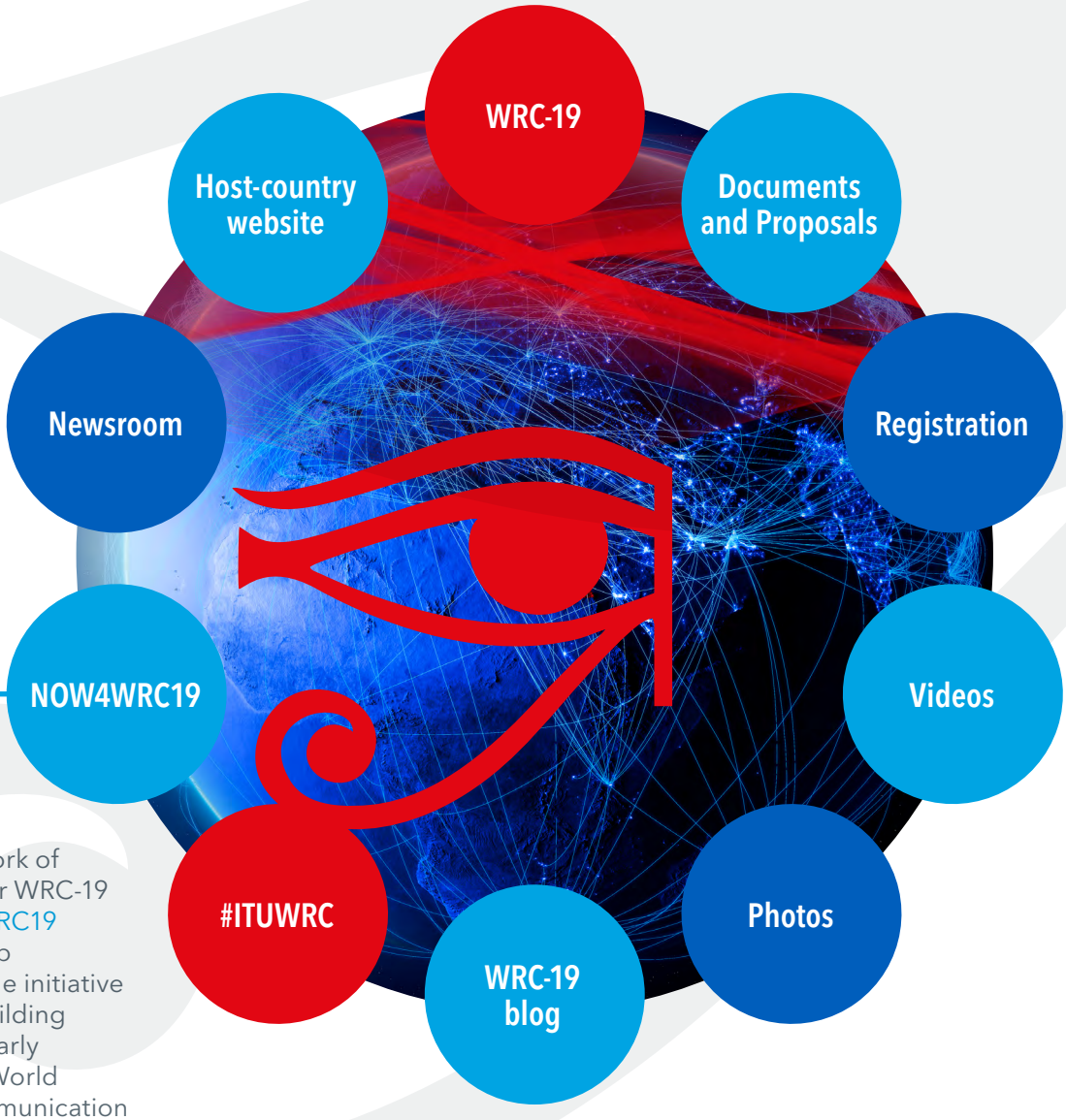
Industry perspectives





Follow WRC-19



The Network of Women for WRC-19 #NOW4WRC19 mentorship programme initiative started building capacity early on in the World Radiocommunication Conference (WRC) process in order to encourage a larger participation of women as delegates, chairs, vice-chairs, etc. at WRC-19.

ITU News Magazines dedicated to WRC-19:

WRC-19: Enabling global radiocommunications for a better tomorrow

Mario Maniewicz

Director of the ITU Radiocommunication Bureau

The ITU's upcoming World Radiocommunication Conference 2019 (WRC-19) will play a key role in shaping the technical and regulatory framework for the provision of radiocommunication services in all countries, in space, air, at sea and on land. It will help accelerate progress towards meeting the Sustainable Development Goals (SDGs). It will provide a solid foundation to support a variety of emerging technologies that are set to revolutionize the digital economy, including the use of artificial intelligence, big data, the Internet of Things (IoT) and cloud services.

WRC-19 and the RR

Every three to four years the conference revises the Radio Regulations (RR), the only international treaty governing the use of the radio-frequency spectrum and satellite orbit resources. The treaty's provisions regulate the use of telecommunication services and, where necessary, also regulate new applications of radiocommunication technologies.

> *"WRC-19 will play a key role in shaping the technical and regulatory framework for the provision of radiocommunication services in all countries."*
>
> Mario Maniewicz

The aim of the regulation is to facilitate equitable access and rational use of the limited natural resources of the radio-frequency spectrum and the satellite orbits, and to enable the efficient and effective operation of all radiocommunication services.

WRC-19 will be held in Sharm El-Sheikh, Egypt, from 28 October to 22 November 2019 and its agenda covers a wide range of radiocommunication services (see examples at the end of this article).

The preparations for the conference include studies and discussions that take place in the ITU-R Study Groups, the Conference Preparatory Meeting, the ITU inter-regional workshops, and also within the regional groups. The very nature of the process and study cycle helps build consensus and facilitates the work of the conference, where final decisions are made. See the infographic for more information on the preparatory process.

Each World Radiocommunication Conference affects the future development of information and communication technologies (ICTs) in many ways, including:

- Introducing and expanding access to the radio spectrum for new radiocommunication systems and applications;
- Protecting the operation of existing radiocommunication services and providing the stable and predictable regulatory environment needed for future investments;
- Avoiding the potential for harmful interference between radio services;

Preparation process

ITU-R Study Groups

As for the previous World Radiocommunication Conferences, the ITU Radiocommunication Sector (ITU-R) Study Groups and their subordinate groups played a key role in the preparatory process of WRC-19. They developed the technical basis for decisions to be taken at the conference in the form of global standards (Recommendations) and supporting studies (Reports) on all the radiocommunication issues on the WRC-19 agenda. The work was done on the basis of a collaborative participation of ITU Member States, Sector Members, Associates and Academia.

Conference Preparatory Meeting

The Conference Preparatory Meeting (CPM) held two sessions, one at the very beginning of the ITU R study cycle to organize the preparatory studies for WRC-19, and one at the end to finalize and approve the CPM Report to WRC-19.

The CPM Report provides a crucial reference for ITU Member States to prepare for the conference. It contains for each agenda item and issue, background information, the summary and analysis of the ITU-R studies results, as well as proposed solutions with examples of changes to the Radio Regulations for their implementation.

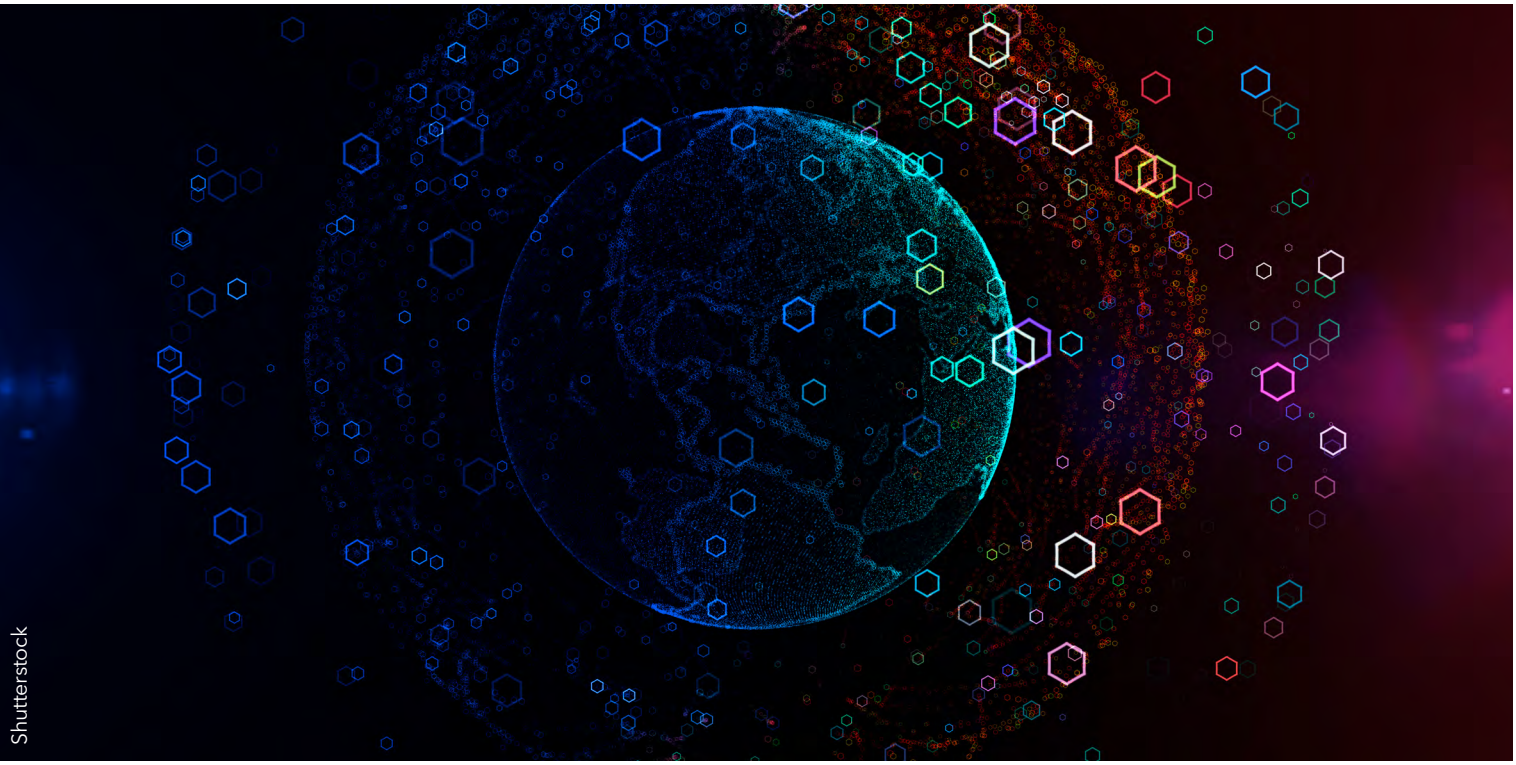
The discussions during the study cycle and the second session of the CPM anticipate the challenges that will be faced during WRC-19. However, in some cases, convergence of proposed solutions occur even prior to the conference, as for the agenda items or issues where a single solution is already indicated in the CPM Report.

Regional groups

In parallel with the work of ITU, the six main regional organizations (APT, ASMG, ATU, CEPT, CITEL and RCC) conduct studies and attempt to converge different national views into regional common proposals that are then brought to the conference. This will help significantly in the consensus-building process.

ITU inter-regional workshops

ITU inter-regional workshops are organized at specific moments during the study cycle to explain the different elements of the issues on the WRC agenda, and to foster greater cooperation between the regional groups and all stakeholders. Participants have the opportunity to exchange information and to understand the draft common views, positions and proposals of other regions.



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- Allowing the provision of high-quality radiocommunications while protecting vital uses of the radio spectrum, particularly for distress and safety communications; and
- Facilitating international roaming and increasing economies of scale, thereby making it possible for network and user devices to be more affordable.

Times of transformation

Currently, billions of people, businesses, and devices are connected to the Internet. ICTs are transforming each and every aspect of our lives, from the way people interact and communicate to the way companies do business.

People expect instantaneous high-quality connectivity, whether stationary or on-the-move, in their homes or outside in a crowd.

Companies search for new ways to increase their business and operational efficiency, whether by monitoring the condition of equipment and conducting predictive maintenance, or by monitoring customer data to offer personalized solutions. The increasing need for a new underlying ecosystem will be made possible by utilizing a variety of complementary terrestrial and satellite technologies/services.

The fifth generation of mobile technology, International Mobile Telecommunications (IMT)-2020 (5G) promises to enhance the connectivity infrastructure that delivers high-speed networks to end users, carries the flow of information from billions of users and IoT devices, and enables a whole array of services to different industry verticals. Spectrum for 5G services will be one of the main topics of WRC-19. More specifically, new allocations will be considered for the mobile service and identification for IMT of frequencies in the mm Wave bands (above 24 GHz).

In addition, satellite services aim at increasing connectivity, whether by providing access to broadband communications to unserved rural communities, or to passengers on aircrafts, on ships and on land, or by expanding backhaul of terrestrial networks.

WRC-19 will address fixed and mobile satellite services, earth stations in motion, and will revise the assignment procedures pertaining to satellite networks.

Leveraging the economic opportunities brought by technology should be possible not only for some, but for all. One target of SDG No. 9 is to increase access to ICTs and strive to provide universal and affordable access to the Internet in least-developed countries by 2020.

Fortunately, new technological innovations support this goal. They aim at expanding broadband connectivity and telecommunication services to least-developed countries, underserved communities, rural and remote areas, including mountainous, coastal and desert areas.

Towards this end, WRC-19 will consider spectrum for High-Altitude Platform Systems (HAPS) and will revise the regulatory framework for Non-Geostationary Satellite Systems (non-GSO). HAPS, operating in the stratosphere, can be used to provide fixed broadband connectivity for end users, and backhaul for mobile networks, thus increasing the coverage of these networks.

Constellations of non-GSO satellites aim at improving quality, increasing the capacity and reducing the costs of satellite services, which should enable satellite operators to bring market solutions that increase access to connectivity.

Times of uncertainty

These are times of transformation, but also of uncertainty. The number of natural disasters have increased considerably in the last decades: hurricanes, earthquakes, storms, floods, and fires. Climate change is a reality: we are experiencing heatwaves, and observing long-lasting glaciers melt.

Taking this into account, SDG No. 13 on climate action targets to strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries. To reach this target, several radiocommunication services offer the solution required to monitor, mitigate and adapt to these events.

Satellite communications, and in particular space sensing and Earth observation systems are used to monitor the state of the oceans and the conservation of forests. They can detect natural disturbances in the state of the atmosphere and provide accurate climate predictions.

Other radiocommunication systems are also used to collect and transmit data related to weather conditions (humidity, rainfall rates etc.), for example IoT systems and radars. These sources of information form the critical mass needed to detect climate-related hazards.

Broadcasting and broadband services provide early warning to the population which reduces the impact of natural and environmental disasters by strengthening the resilience and increasing adaptive capacity.

Amateur radiocommunication services, among others, assist relief operations especially when other services are still not operational. More recently, HAPS have also been deployed to rapidly deliver services with minimal ground network infrastructure in disaster-relief missions.

WRC-19's decisions will affect services of utmost importance in these times of transformation and uncertainty. They will allow us to harness the power of ICTs to overcome the challenges and seize the opportunities of today's digital economy.

Conclusion

Radiocommunication services are deeply transforming the health, education, and transportation sectors. They are improving financial inclusion, increasing transparency and supporting accountable institutions, promoting sustainable agriculture, helping to preserve life in the air, at sea and on land. They are a crucial accelerator towards the achievement of all the SDGs in both developed and developing countries.

The four year preparation cycle leading to the WRC, the high-level of commitment of participants from governments and industry, done through arduous work and extensive international negotiations, both in the preparatory process and during the WRC-19, will culminate in the signing of the WRC-19 Final Acts and revising the Radio Regulations – the invaluable international treaty that is the foundation for rational, efficient and economical use of the radio-frequency spectrum, enabling radiocommunication technology developments since the start of radiocommunications, 113 years ago.

WRC-19 agenda

WRC-19 will address a number of issues, including:

1.1	Amateur service: consider an additional frequency allocation to the amateur service in Region 1.
1.2	Earth stations operating in the mobile-satellite service, meteorological-satellite service and Earth exploration-satellite service: consider in-band power limits.
1.3	Meteorological-satellite service (space-to-Earth) and Earth exploration-satellite service (space-to-Earth): to consider possible regulatory changes that enable data collection systems essential for monitoring and predicting climate change, monitoring oceans, and water resources, weather forecasting and assisting in protecting biodiversity, improving maritime security.
1.4	Broadcasting-satellite service: consider possible revision to the limitations imposed on BSS.
1.5	Earth stations in motion (ESIMs): to consider communication of ESIMs with geostationary space stations in the fixed-satellite service to provide for the need for mobile communications, including global broadband satellite services.
1.6	Non-GSO FSS satellite constellations: to consider the development of a regulatory framework to encourage the development and implementation of new technologies in the fixed-satellite service (FSS).
1.7	Non-GSO satellites with short duration missions: to study the spectrum needs for telemetry, tracking and command in the space operation service and access the allocations to the space operation service.
1.8	Global Maritime Distress Safety Systems (GMDSS): consider regulatory provisions for modernizing GMDSS and supporting the introduction of additional satellite systems into the GMDSS.
1.9	Autonomous maritime radio devices: consider regulatory actions to protect the GMDSS and automatic identifications system (AIS); and maritime mobile-satellite service (Earth-to-space and space-to-Earth): to consider regulatory modifications to enable a new VHF data exchange system (VDES) satellite component.

WRC-19 agenda (continued…)

WRC-19 will address a number of issues, including:

1.10	Global Aeronautical Distress and Safety System (GADSS): consider spectrum needs and regulatory provisions for the timely identification and location of an aircraft during all phases of flight as well as distress and emergency situations.
1.11	Railway radiocommunication systems: harmonize spectrum to facilitate the deployment of railway train and trackside systems to meet the needs of the high-speed railway environment.
1.12	Intelligent Transport Systems (ITS): consider harmonization of spectrum to connect vehicles and improve traffic management and assisting safe driving.
1.13	International Mobile Telecommunications (IMT): consider additional allocations to the mobile service and identification of frequency bands for IMT for the future development of IMT-2020 or 5G applications.
1.14	High Altitude Platform Systems (HAPS): consider regulatory actions to facilitate access to broadband applications that can serve rural and remote areas using HAPS.
1.15	Land-mobile and fixed services applications: consider identification of frequency bands for these applications.
1.16	Wireless access systems, including radio local area networks (WAS/RLAN): review the regulatory provisions to accommodate the growth in the demand for WAS/RLAS systems and multimedia applications.
7	Satellite networks: regulatory changes to facilitate rational, efficient and economical use of radio frequencies and associated orbits, including the geostationary-satellite orbit.

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From Conference Preparatory Meeting to WRC-19

Khalid Al-Awadi

Chairman of the Conference Preparatory Meeting for WRC-19

Now that the second session of the Conference Preparatory Meeting (CPM19-2) for the World Radiocommunication Conference 2019 (WRC-19) is over, the world is ready to take the final mile in deciding on positions with regard to the agenda items of the conference.

The CPM Report to WRC-19, which is the output of the CPM19-2 meeting, would be the main reference for ITU Member States to learn about the background of every agenda item, as well as a summary and analysis of the results of studies conducted in ITU's Radiocommunication Bureau.

Members will also now be aware of the proposed methods to satisfy each of the agenda items, and the regulatory and procedural considerations associated with each of the methods. This, however, does not preclude any regional group or ITU Member State from introducing a new approach to satisfy the agenda items during the conference itself.

> *"We are used to seeing all regional groups, and ITU Member States, converge to single conclusions, by making compromises on the different topics."*
>
> Khalid Al-Awadi

Chairing the pre-conference discussions

Chairing CPM19-2 was quite an experience for me, with the knowledge that there were almost 1300 delegates from 106 ITU Member States and 83 Sector Members participating in the meeting. They came with a total of 198 contributions to be discussed over nine days. They aimed to reach convergence, or otherwise, include all concerns and points of view in the final CPM Report, which was crafted during the meeting.

At the beginning, you feel that it's a challenging task to conduct over nine days, given the variety of positions and views on each agenda item to be discussed. But when you focus on the real task and mandates of the meeting, you realize that there is no right or wrong.

All delegates are participating with the aim of understanding each other – and to reduce the burden during the conference. This is not the World Radiocommunication Conference itself, yet.

Brief outcomes of the Conference Preparatory Meeting

The results of the CPM were fascinating. We succeeded in coming to agreement on the eighth day. We succeeded in agreeing on a single conclusion for some candidate frequency bands under agenda item 1.13 for 5G (IMT-2020) identification, and also agenda item 1.16, for wireless access systems, including radio local area networks (WAS/RLAN). We succeeded in agreeing on a single conclusion for some regulatory issues related to space services that are being discussed under agenda item 7. Also, we agreed on a single conclusion for studies being conducted regarding sub-orbital vehicles, wireless power transmission for electric vehicles, and spectrum to support the implementation of narrowband and broadband machine-type communication infrastructure.

On the other hand, we realized that some other items of the conference were not so easy, and there were great differences in positions between regional groups. Nevertheless, we succeeded in taking all views and positions into consideration, and included all of them in the final CPM Report to WRC-19.

This effort will undoubtedly have facilitated the work of the world's regional groups in preparing for the conference. CPM19-2 left us all with a clear understanding on which issues are almost agreed on and concluded, and which issues require extra efforts and coordination between the regional groups prior to the start of WRC-19.

The period following the 2nd session of the CPM is a critical stage, where all regional groups conduct their final round of discussions to have their final positions on the agenda items of the conference.

Regional groups – final preparations for WRC-19

My regional group, the Arab Spectrum Management Group (ASMG) conducted its final meeting prior to WRC-19 (ASMG-25) between 27 July and 1 of August in Cairo, Egypt. ASMG extended the invitation to all other regional groups to participate in the ASMG meeting to discuss the final positions of the regional groups and to endeavour to reach a common understanding.

All other regional groups also held their meetings during the summer of 2019 (see all groups and meetings), and I understand that invitations were extended among the groups to attend each other's meetings. This enthusiasm to discuss WRC-19 matters before the conference itself is an indication of how everyone is eager to conclude the discussions on the WRC-19 agenda items as smoothly as possible.

Inter-regional workshops – a tremendous WRC-19 preparation tool

We felt the effect of regional group coordination during the 3rd session of the ITU's Inter-regional Workshop on WRC-19 Preparation, held from 4 to 6 September 2019, in Geneva. These workshops have been a tremendous tool in understanding each other's differences and concerns, and with less than two months away from the start of the conference, more commonalities between the regional groups were identified during the workshop.

WRC-19 hot topics

Many hot topics are expected to get thoroughly discussed at WRC-19, such as identification of IMT-2020 bands, which will be used for 5G applications, and the effect of this identification on Earth exploration satellite services (EESS), non-geostationary (NGSO) satellite systems, regulatory procedures, and their use of spectrum. The use of spectrum by high-altitude platform stations (HAPS), the introduction of additional satellite systems into the global maritime distress and safety system (GMDSS), the use of spectrum by earth stations in motion (ESIM) will also be discussed, and many more.

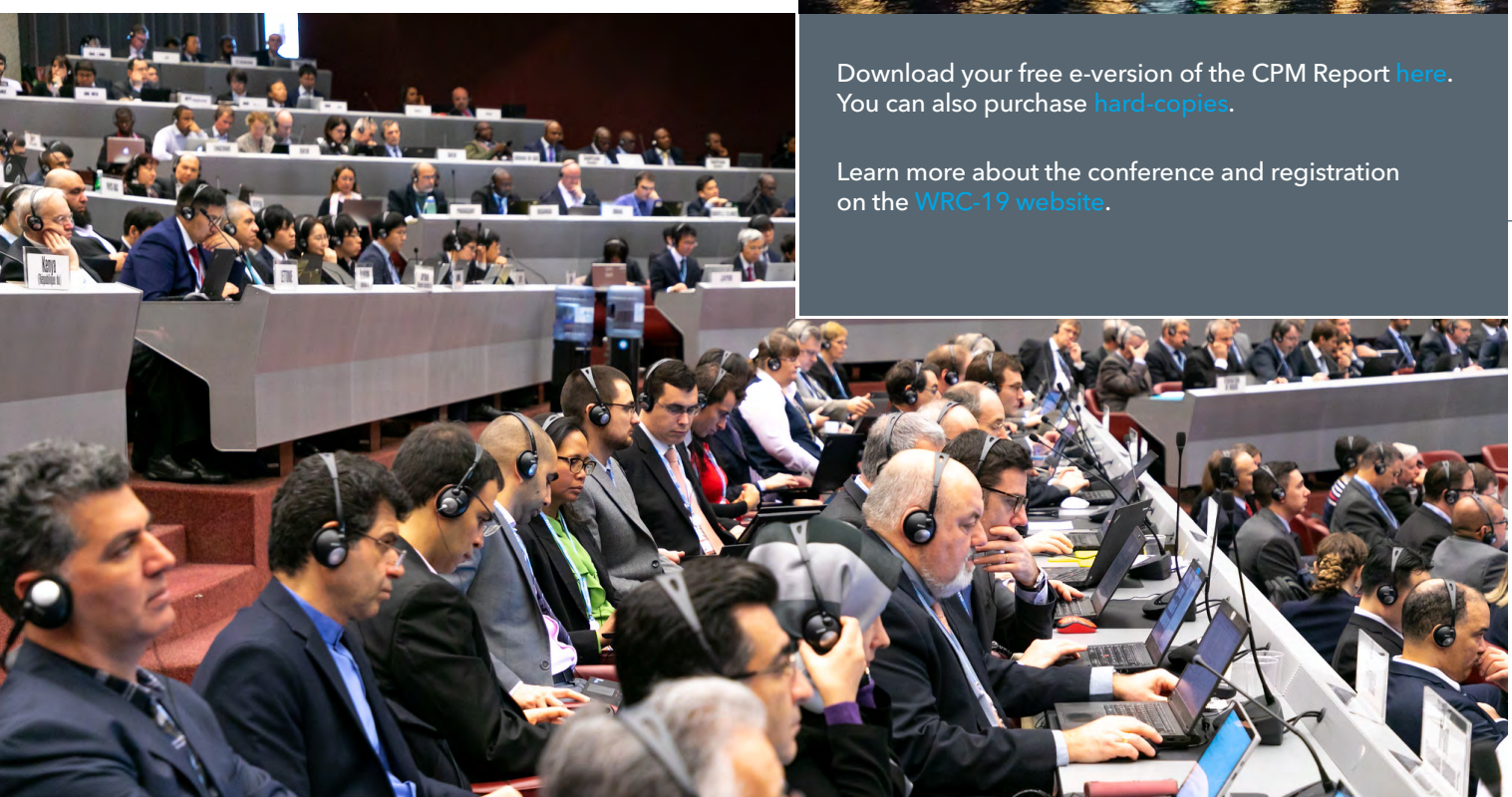
We can only hope that this conference will be as good as previous WRCs. We are indeed used to seeing all regional groups, and ITU Member States, converge to single conclusions, by making compromises on the different topics.

The CPM Report to WRC-19

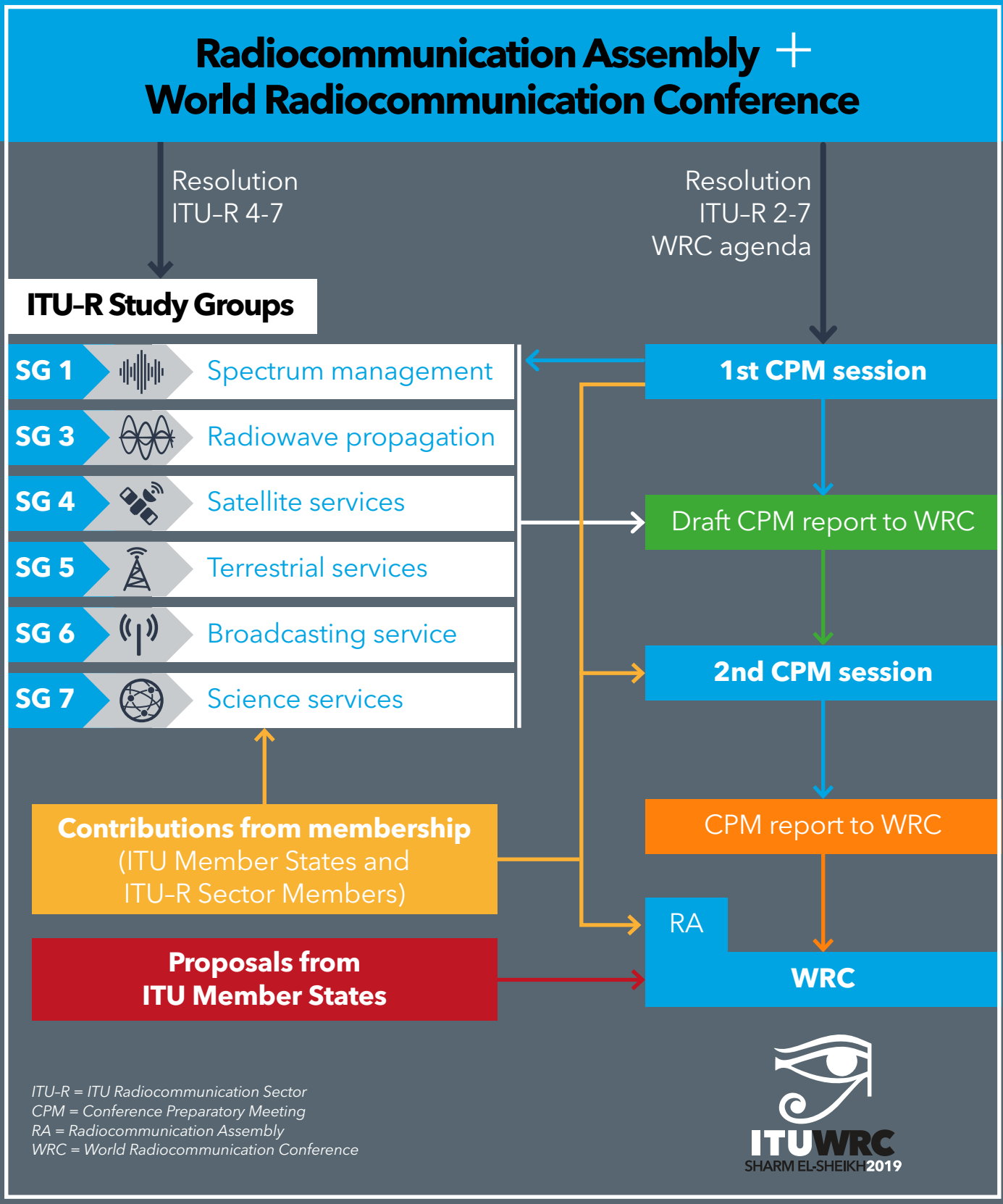
The second session of the Conference Preparatory Meeting (CPM) for the World Radiocommunication Conference 2019 (WRC-19) resulted in the publication of the CPM Report on technical, operational and regulatory/procedural matters to be considered by WRC-19.

Download your free e-version of the CPM Report here. You can also purchase hard-copies.

Learn more about the conference and registration on the WRC-19 website.



Organization of the ITU-R conference preparatory work



The Radio Regulations Board and WRC-19

Lilian Jeanty

Chairman of the Radio Regulations Board

In preparation for the World Radiocommunication Conference 2019 (WRC-19), the Radio Regulations Board (RRB, or the Board) has a number of tasks to perform. The Board presents to WRC-19 an overview of its activities carried out between WRC-15 and WRC-19, which is part of the Report of the Director of the ITU Radiocommunication Bureau under agenda item 9.1.

A separate report on the implementation of Resolution 80 (Rev. WRC-07) of the Radio Regulations (RR) regarding due diligence in applying the principles of the Constitution, is dealt with under WRC-19 agenda item 9.3.

Finally, the RRB shall, as mentioned in RR No. 13.0.1 and No. 13.0.2, submit to the WRC proposals for possible modifications to the RR. Such modifications are a result of Rules of Procedure that have been approved by the Board between WRC-15 and WRC-19, in order to alleviate difficulties or inconsistencies in the RR. This time, only a few possible modifications were identified, and are included in the Report of the Director of the ITU Radiocommunication Bureau.

> *"The RRB hopes to contribute to this work, and to play a role in finding a balance between all the different interests."*
>
> Lilian Jeanty

The Board's advisory role at WRCs

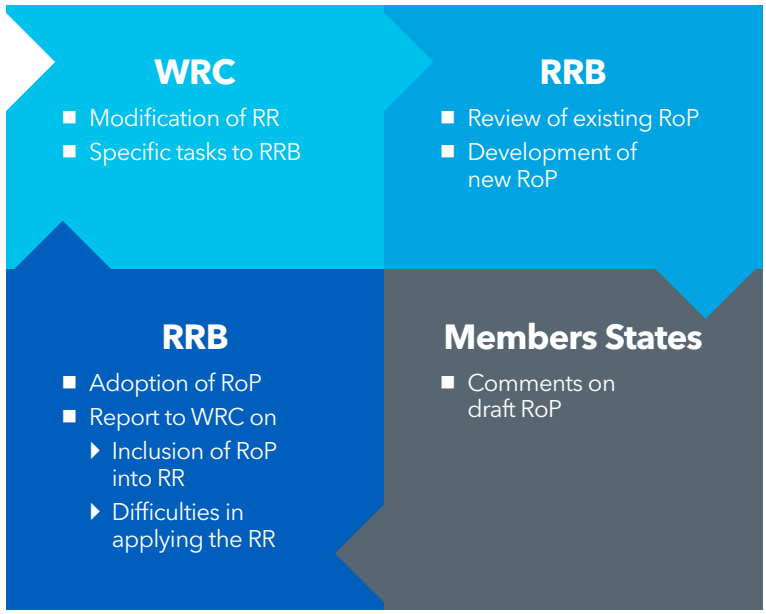
During WRC-19, the members of the Board participate in an advisory capacity to the conference. They give advice on difficulties in the application of regulatory provisions in force, as well as those under discussion at the conference. A WRC can also give instructions to the Board, based on No. 97 of the ITU Constitution (CS), to carry out certain activities after the conference.

For example, WRC-15 requested the Board to take a decision on the receivability of coordination requests for the new fixed-satellite service (FSS) allocation in the band 13.4–13.65 GHz before the date on which the allocation entered into force. In response to this request, the Board approved a revision of the Rule of Procedure on RR No. 9.11A.

Revising the Rules of Procedure

After WRC-19, the Board and the Bureau will perform a comprehensive review of the existing Rules of Procedure, considering the impact of the decisions of the conference, as it did following WRC-15. Existing Rules of Procedure may be modified or supressed and new rules developed. This is usually an extensive task and the resulting Rules of Procedure will complement the RR, and shall be used by administrations and the Radiocommunication Bureau in the application of the RR. It is the intention of the Bureau and the Board to finalize this review and adopt the new or modified Rules of Procedure before the new RR come into force.

The cycle of production of the Rules of Procedure



RR = Radio Regulations
RRB = Radio Regulations Board (the Board)
RoP = Rules of Procedure
WRC = World Radiocommunication Conference

Issues the Board has faced since WRC-15

The RRB has submitted reports on Resolution 80 (Rev. WRC-07) to most WRCs since WRC-2000. The report to WRC-19 focuses on particular issues the Board has encountered in its work, and therefore would like to bring to the attention of WRC-19. Some of the most important are the application of No. 13.6 of the RR, CS Article 48, and the treatment of requests for extensions of regulatory time limits to bring into use or bring back into use frequency assignments.

No. 13.6 of the Radio Regulations and validating recorded frequency assignments

The use of No. 13.6 (Article 13, Section II) of the RR is an important tool to enable the Bureau to validate that the frequency assignments recorded in the Master International Frequency Register (MIFR) reflect reality and have been recorded legitimately.

Whenever it appears from reliable information available that a recorded assignment has not been brought into use, or is no longer in use, or continues to be in use but not in accordance with the notified characteristics, the Bureau will request the notifying administration to clarify the situation. After the conclusion of an investigation under RR No. 13.6, the Bureau may submit to the Board a request for a decision on the cancellation of frequency assignments to a satellite network.

The application of RR No. 13.6 is not subject to any time limitation. As a result, the scope of an investigation can sometimes go back several years.

For example, an administration might have notified several years ago frequency assignments that were never brought into use, or may not have been in use for more than the suspension period. However, these assignments were subsequently brought into use and continued to be in use at the time of the inquiry under RR No. 13.6.

Following an investigation under RR No. 13.6 where there was non-compliance with the Radio Regulations, there would be no regulatory basis for the Board to maintain the assignments in the MIFR, even if there was an actual satellite in operation and no outstanding coordination issues. In such cases, the only recourse available to the administration would be to bring their case to a WRC, or to submit a new filing.

In dealing with requests for cancellation of frequency assignments, the Board is concerned with both maintaining the credibility of the MIFR, which contains the rights and obligations of administrations, and ensuring that operational satellites are duly coordinated. The Board also notes the possible difficulties around providing and verifying information for situations that go back several years.

It is clear how RR No. 13.6 is to be implemented, especially after the modifications made at WRC-15, and therefore would not require further modification. Nevertheless, WRC-19 could provide guidance to the Board in relation to the above-mentioned issues.

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Article 48 of the ITU Constitution

Previous conferences have made decisions with regard to the application of the ITU Constitution (CS) Article 48 (Installations for National Defence Services). WRC-15 decided that administrations must invoke CS Article 48 explicitly, and noted that Article 48 refers to military radio installations, and not to stations used for governmental purposes in general.

However, in the course of its work, the Board considered concerns raised by some administrations regarding the appropriateness of other administrations' application of CS Article 48. For example, administrations invoking CS Article 48 after the Bureau has launched an investigation under RR No. 13.6, or administrations invoking CS Article 48 for frequency assignments that seem not to be used for military purposes.

In addressing these cases, the Board considered that it was not within its mandate to make decisions on the application of CS Article 48, but that there is nevertheless cause for concern that the article has a potential for misuse which would compromise the integrity of the regulatory framework.

It would therefore be worthwhile for WRC-19 to discuss once more the application of CS Article 48, taking note of the issues encountered by the Board and the Bureau in its work.

Requests for extensions of regulatory time limits

WRC-15 reaffirmed the Board's authority to address requests for time limited and qualified extensions to the time for bringing into use, or bringing back into use, frequency assignments in cases of either *force majeure*, or co-passenger delay.

On quite a regular basis such requests have been received from administrations. These were considered on a case-by-case basis, based on the information provided. Judging whether a case qualified for *force majeure* has not always been easy, but since there is a clear list of criteria that have to be met, no particular difficulties have been encountered with the current process. The same goes for cases of co-passenger delay. The Board considered co-passenger cases based on the information provided.

There were also requests received from developing counties for an extension of the time limit, that were based on particular difficulties encountered, but not on *force majeure* or co-passenger delay. Because the authority of the Board is limited to these two elements, the requests could not be acceded to. In these cases, the Board instructed the Bureau to continue to take into account the frequency assignments of the satellite network until the last day of the upcoming WRC, noting that resolution of such situations is within the competence of a WRC.

This approach works when there is an upcoming WRC, but creates a long period of uncertainty when such a request is received just after a WRC. Therefore, WRC-19 might be willing to discuss the possibility of giving the Board a mandate to address requests, on a case-by-case basis, for time limited and qualified extensions from developing countries, in particular those that have a reliance on satellite services to ensure connectivity over its entire territory. These extensions should be based on conditions that would need to be specified by the WRC or the Board.

Challenges for WRC-19

The issues described in this article cover only a small part of the items included in the Resolution 80 (Rev. WRC-07) report, and the report covers a small part of all the issues to be discussed and solved during WRC-19. The challenge lies in bringing all these different issues to a satisfying conclusion, noting the diversity in views of the members.

The RRB hopes to contribute to this work, and to play a role in finding a balance between all the different interests.

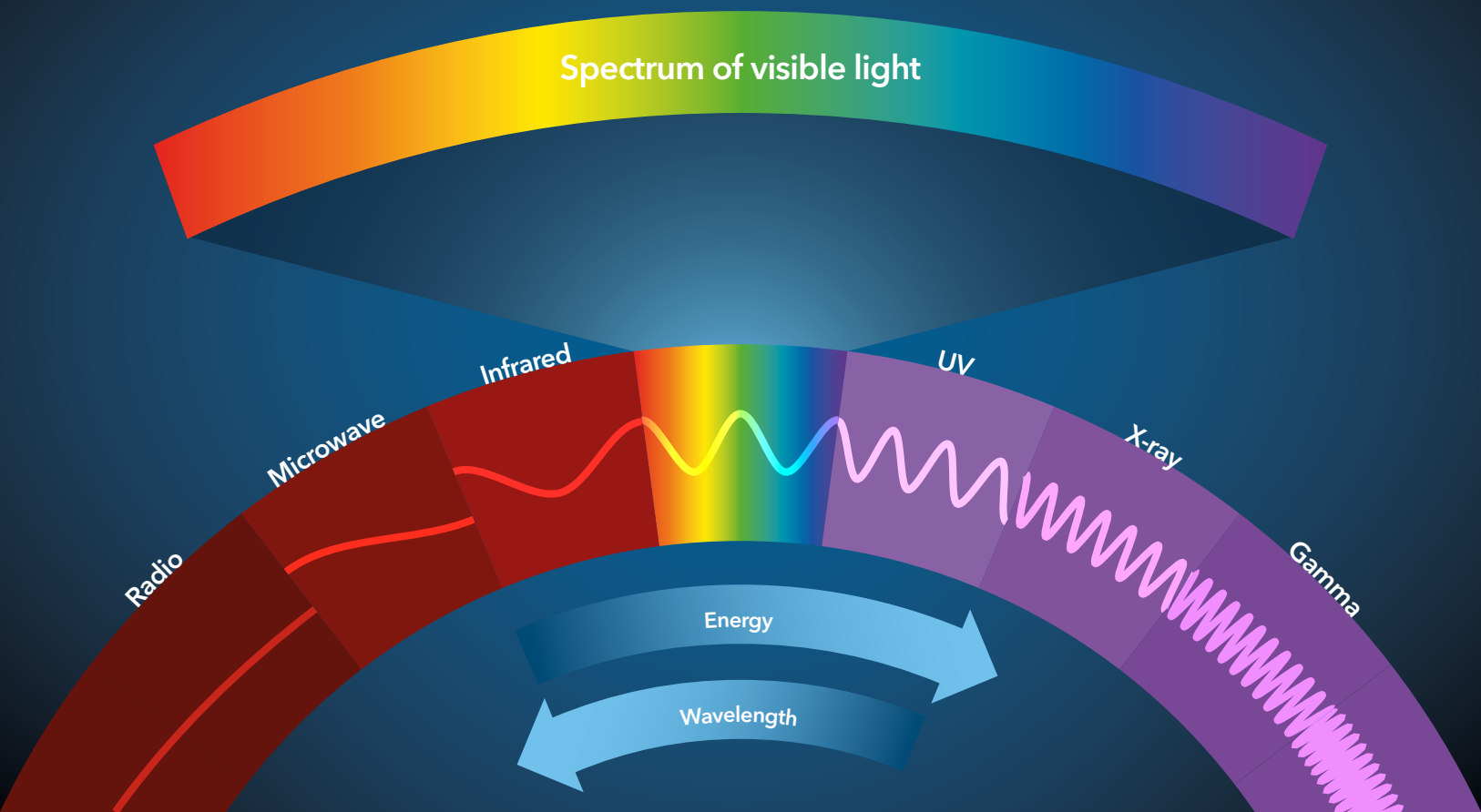
The radio spectrum

The radio spectrum is part of the electromagnetic spectrum

When we tune our radio, watch TV, send a text message, or cook in a microwave oven, we are using electromagnetic energy. We depend on this energy every hour of the day. Without it, the world we know could not exist. Electromagnetic energy travels in waves and spans a broad spectrum from very long radio waves to very short gamma rays. The human eye can only detect a small portion of this spectrum called visible light.
An x-ray machine detects a different portion of the spectrum, and a radio uses yet another portion.

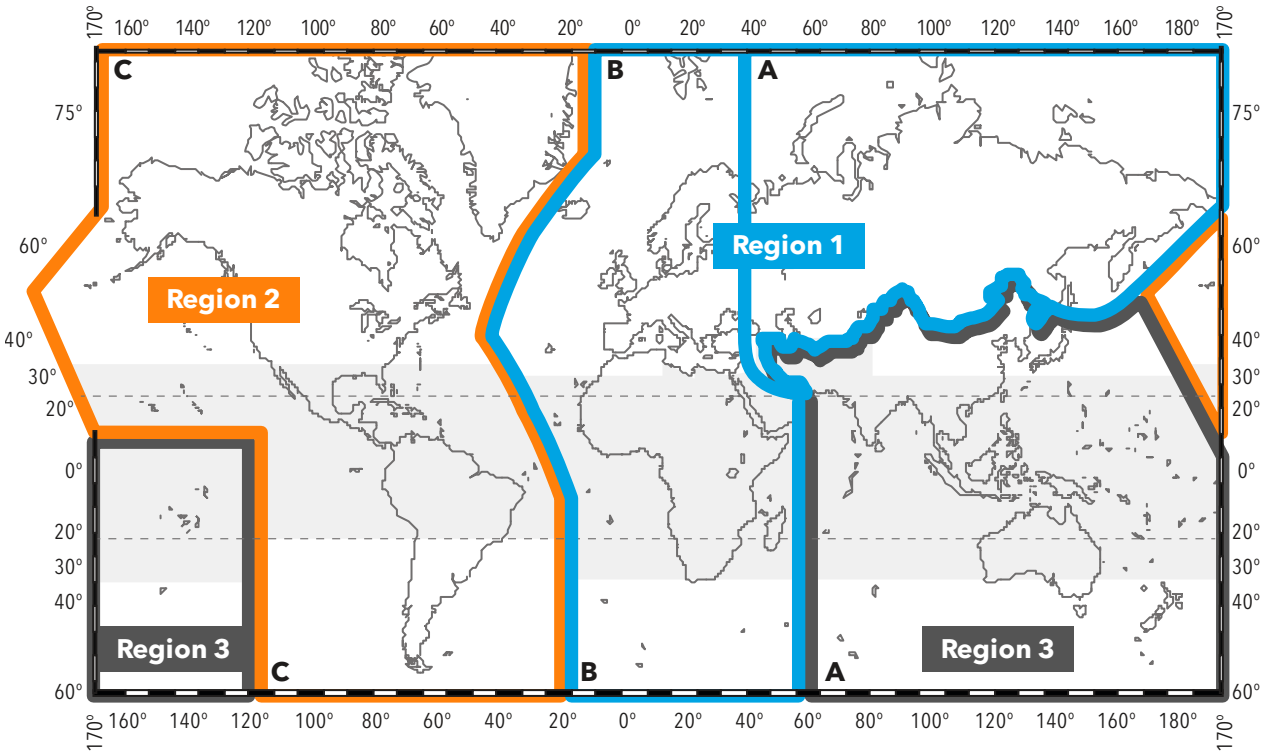
Source: Introduction to the electromagnetic spectrum (NASA)

The electromagnetic spectrum



For the allocation of radio spectrum frequencies the world is divided into three regions

Region 1	Region 2	Region 3
Arab States	Americas	Asia-Pacific
Africa		
Europe		
Commonwealth of Independent States		



Representing the Arab States

Tariq Al Awadhi

Executive Director, Spectrum Affairs
Chairman, Arab Spectrum Management Group (ASMG)

The International Telecommunication Union (ITU) holds a World Radiocommunication Conference (WRC) every three to four years. The WRC is the highest-level international forum to discuss and decide on the radio spectrum and issues related to radiocommunication services around the world. The WRC also reviews and revises the Radio Regulations, an international treaty regulating the use of frequency spectrum for all purposes including mobile, broadcasting and satellite.

There are a number of agenda items set for the upcoming World Radiocommunication Conference (WRC-19) covering various radio-communication services. Technical and regulatory studies are carried out within the study groups of the ITU Radiocommunication Sector (ITU-R), with active participation and contributions from ITU Member States and Regional Groups including the Arab Spectrum Management Group (ASMG).

The decisions of the WRC have a huge impact on the use of the limited resource of radio spectrum in the region, and play a crucial role in identifying the future trends of technology and infrastructure development in Arab States.

"The decisions of the WRC have a huge impact on the use of the limited resource of radio spectrum in the region."

Tariq Al Awadhi

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Arab States' preparation for WRC-19

ASMG has held its five preparatory meetings for the study cycle (2016–2019). The 21st meeting was held in 2016 and the 25th and last meeting was held in July-August 2019. These meetings were a platform for shaping the region's views about the different WRC-19 agenda items and crystalizing the Arab common proposals for all agenda items of the conference.

The meetings have provided the opportunity for other regional organizations and industry members and technology vendors to participate, to assure information exchange, and continuous coordination to facilitate the work and decisions ahead of the conference.

Arab States prepared views for the conference

As results of the preparatory meetings, ASMG's views on different agenda items have been prepared, especially for agenda items related to International Mobile Telecommunications (IMT-2020 or 5G).

In particular, for WRC-19 agenda item 1.13, the ASMG administrations have interest in and are supporting IMT in certain frequency bands, particularly the 26 GHz band, as well as the range 40.5–43.5 GHz.

Furthermore, ASMG has prepared proposals for other key agenda items under satellite technical and regulatory issues such as agenda items 1.5, 1.6, 7 and other mobile services and applications such as intelligent transport systems (ITS), high-altitude platforms (HAPS), and proposals for future conferences' agenda items under agenda item 10 relating to IMT and earth stations in motion.

The importance of ITU–R's role in the WRC preparation study cycle

ITU–R has had a major role during the preparation process in this study cycle. In facilitating the meetings of different study groups and working parties, ITU–R has significantly contributed in converging different views between regional organizations in different events.

In particular, ITU–R organized three successful inter-regional workshops where participants could express and discuss their positions for each agenda item.

ASMG is looking forward to continuing this collaborative participation at the upcoming WRC-19, with other countries, international, regional and intergovernmental organizations, scientific and industrial institutions and manufacturers, and specialized agencies of the United Nations.

We will all come together to discuss and find consensus-based solutions and decisions for the various agenda items of the WRC-19, which this time, is being hosted by Egypt, one of the ASMG member administrations.

Leading Working Groups 4A and 5A

The ASMG is aspiring to lead the works of Working Groups 4A and 5A of the conference successfully, and will participate actively in the different levels of the conference, in cooperation with other regional organizations.

Representing Africa

John Omo

Secretary General, African Telecommunication Union (ATU)

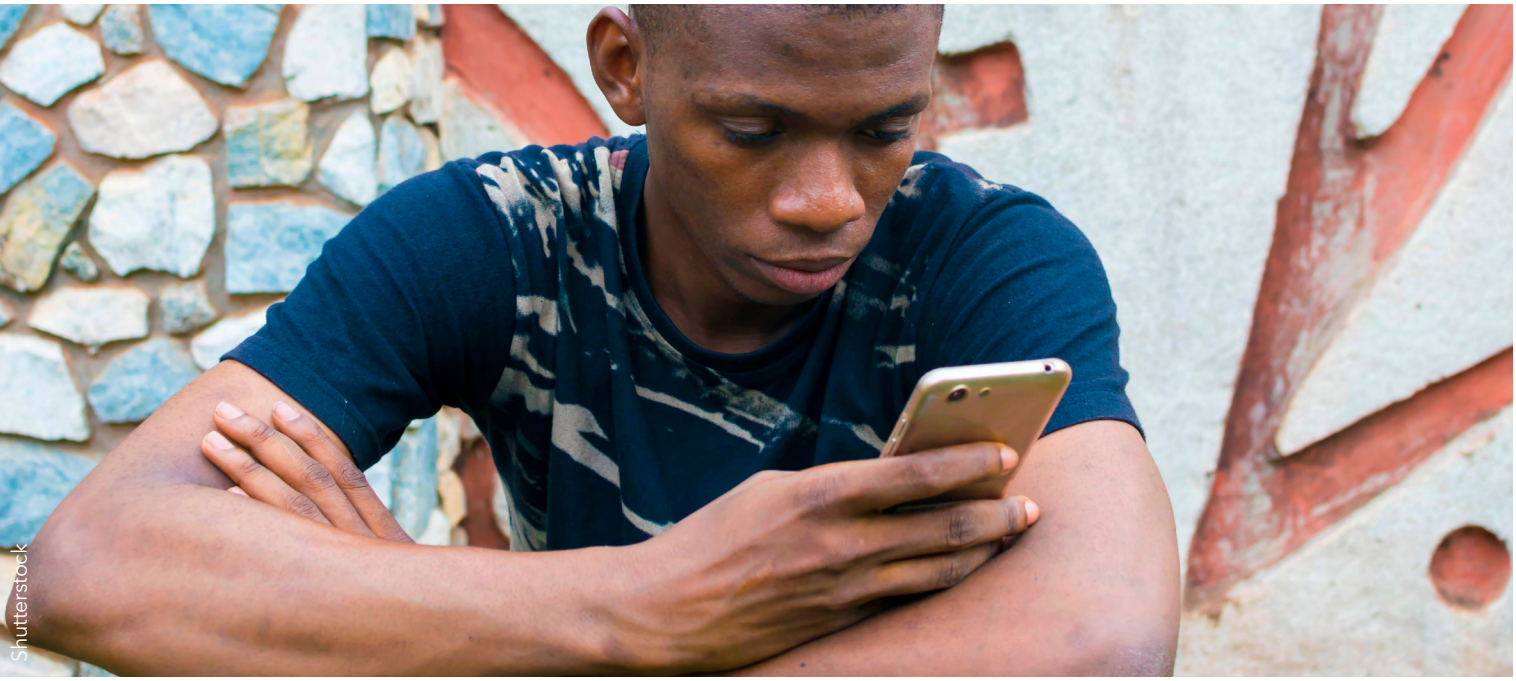
World Radiocommunication Conferences (WRCs), are of profound significance to Africa and the world, by way of providing an unparalleled, authoritative platform to improve the world's principal framework for the management of the radio spectrum and satellite orbital resources, i.e. the Radio Regulations (RR).

The role of ATU

The African Telecommunication Union (ATU) is the responsible institution for African preparations, participation and coordination at both WRCs and Radiocommunication Assemblies (RAs).

Preparations are mainly done via technical working group meetings which provide recommendations to the African Preparatory Meetings for WRCs. The latter's mandate is to develop the African common positions and proposals to the WRCs and RAs, as well as, plan Africa's participation.

> *"World Radiocommunication Conferences are of profound significance to Africa and the world."*
>
> John Omo



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The aspirations for Africa at WRC-19

Every agenda item of the upcoming World Radiocommunication Conference 2019 (WRC-19) is important. However, some agenda items are seen to be of greater significance to Africa. This is because they encapsulate the aspirations of Africa for the use of spectrum in the key areas of information and communication technologies (ICTs) for enhanced socio-economic growth and sustainability. The following lists some of these agenda items and their respective importance to Africa (note: the list is not in order of significance):

- **Agenda item 1.14:** Facilitation of the new High-Altitude Platform Stations (HAPS) in terms of additional spectrum identification or otherwise. The new HAPS systems appear to be a good solution for the rural connectivity challenge in Africa and globally. HAPS systems are "mobile base stations in the air" aimed at providing mobile/broadband connectivity to areas where terrestrial infrastructure is hard to reach such as rural/remote areas.
- **Agenda item 1.13:** Additional spectrum identification for IMT between 24.25 and 86 GHz to support 5G and the further growth of broadband and mobile communications in general. This is a crucial agenda item because it seeks the identification of 5G spectrum at a global scale to support the much needed economies-of-scale and system interoperability, thereby supporting global roaming of 5G devices.
- **Agenda item 1.4:** Review of Annex 7 to Appendix 30 aims at streamlining the satellite orbital resource plan for satellite broadcasting to identify additional resources (in terms of both the orbital locations and frequencies) that could be available for countries whose orbital resources in the said plan can no longer be used, due to degradation of the operating environment, since the plan was established in 1977.

As most African countries are affected (i.e. their planned resources in the original plan can no longer be used), the agenda item promises the much-needed relief for African countries to acquire new and usable satellite orbital resources for satellite broadcasting.

- **Agenda item 1.5:** Facilitation of earth stations in motion (ESIM) in 17.7–19.7 GHz and 27.5–29.5 GHz with a view to supporting the increasing need for mobile-satellite broadband communications on moving platforms (e.g. trains and aircraft). This agenda item is a welcome booster to the continued growth of the civil aviation sector in Africa and the need for on-board connectivity.

- **Agenda item 7:** Improvements to satellite regulations so as to reflect and cater for the special needs of African and other developing countries in terms of both the allocation principals of these resources, as well as attendant regulatory and administrative procedures. The scale of utilization of the satellite resources is skewed against the developing countries. Therefore, the issues which this agenda item seeks to improve – such as a special light-weight regime for satellite systems with short-duration missions – is key to Africa.

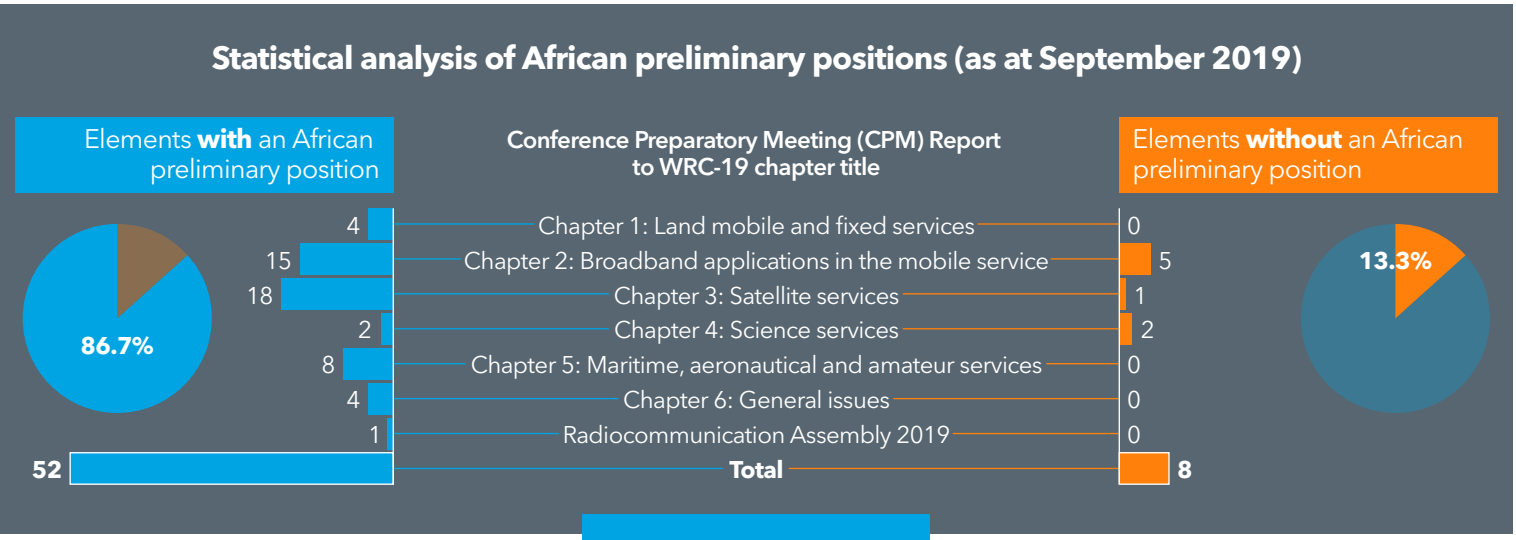
- **Agenda items 1.8 and 1.10:** The Global Maritime Distress Safety Systems (GMDSS) and the Global Aeronautical Distress and Safety System (GADSS), respectively. The proposed changes to GMDSS and GADSS regulations would result in enhancements of both safety and value-for-money through competition (by removal of monopoly).

As both the civil aviation and maritime sectors register unprecedented growth, it becomes extremely crucial that safety arrangements are also enhanced. The two agenda items seek to achieve this noble goal.

- **Agenda item 9.1 issue 7:** Unauthorized (illegal) operation of satellite communication terminals. Regrettably, despite provision 18.1 of the Radio Regulations which prohibits the unauthorized operation of satellite communication terminals, such terminals continue to exist in Africa. To cub this vice, Africa is advocating for the establishment of additional mandatory measures to address the unauthorized operation of earth station terminals besides non-mandatory measures such as capacity building.

- **Agenda item 1.1:** Facilitate global harmonization by way of allocating the amateur service in 50–54 MHz in Africa and Europe (known as Region 1 in ITU for the allocation of spectrum). Africa stands to benefit from the "weak signal communications" capability of the amateur service offered by the said frequency range. As is common knowledge, amateur service radiocommunications, though a hobby for the most part, can be very crucial in providing and supporting emergency communications in times of disaster.

- **Agenda item 8:** Deletion of country footnotes or country names from footnotes in order to promote the harmonization of spectrum policy and use. This agenda item is key in fostering the much-desired harmonization in terms of spectrum policy and use.



Download the CPM Report.

Harmonized spectrum use among countries is crucial in fostering optimized use of the spectrum resource by preventing harmful interference among systems, and so promoting economies of scale (hence cheaper prices), and interoperability of communication devices, hence roaming from one country or region to another.

- **Agenda item 10:** WRC-19 agenda item 10 is a vehicle through which, based on the country/regional proposals, WRC-19 shall propose to the ITU Council agenda items for WRC-23 (and beyond if need be). Clearly, this agenda item is critical to Africa as it is the channel through which future African aspirations for the use of the spectrum could be included in WRC-23, and be addressed as such. For example, studies for possible authorization of High Altitude IMT Base Stations (HIBS) to use existing International Mobile Telecommunications (IMT) identifications in bands below 3 GHz, could be done within ITU if the issue is accepted as an agenda item for WRC-23.

State of preparations for WRC-19 and RA-19

So far, ATU has held three African preparatory meetings (APMs): in Nairobi (2016), Senegal (2017) and Cairo (2018), respectively. ATU has also convened three ATU WRC-19 Working Group (WG) meetings; in July 2017 (Kenya), June 2018 (Zimbabwe), and June 2019 (Botswana).

As a result of the above and other undertakings, the African region has preliminary common positions on about 87% of the issues for WRC-19 (see figure). It is expected that the last and final preparatory meeting scheduled for 26–30 August 2019 in South Africa, will confirm the preliminary positions, and develop common proposals on open issues – many of which now have a recommendation from the working groups.

Representing Europe

Alexander Kühn

Chairman, Conference Preparatory Group
The European Conference of Postal and Telecommunications Administrations (CEPT)

The long and exciting process of preparations for the World Radiocommunication Conference will culminate in four weeks of intense international negotiations in Sharm El-Sheikh, Egypt, in November 2019.

As in the past, Europe's views and positions on the different agenda items and issues are being prepared by the European Conference of Postal and Telecommunications Administrations (CEPT) through the work of the Electronics Communications Committee (ECC) Conference Preparatory Group (CPG).

Cooperating with other regions on spectrum regulation

CEPT has set the wheels in motion to initiate essential exchange and cooperation with all other five regional groups representing the global key CEPT partners on international spectrum regulation. It has been, and still is, the strength of consensual decisions at the ITU level which facilitates the efficient and effective use of spectrum beyond territorial borders.

> *"It has been, and still is, the strength of consensual decisions at the ITU level which facilitates the efficient and effective use of spectrum beyond territorial borders."*
>
> Alexander Kühn

As there is a certain dependency between many of the different agenda items, a good balance, which provides room for newcomers and incumbents, is key to the success of the World Radiocommunication Conference 2019 (WRC-19).

The exchange of views between the different regional groups has intensified over recent years and has proven successful, resulting in common views on a number of agenda items prior to the start of WRC-19. This is a clear response to the highly dynamic developments in radiocommunications and the growth of a global understanding that worldwide allocations and harmonization of spectrum use are essential elements of a forward-looking spectrum policy in support of the United Nations' Sustainable Development Goals.

CEPT proposals – addressing the needs of existing and future radio

CEPT proposals on WRC-19 issues are forward looking and well balanced to address the needs of the existing and future radio services. "Connectivity everywhere" could be one of the main headlines of WRC-19. Wireless broadband is crucial for the "gigabit society" and WRC-19 will consider the identification of frequency bands for the future development of International Mobile Telecommunications (IMT-2020 – aka 5G) including possible additional allocations to the mobile service.

CEPT is looking for the worldwide harmonization of bands and usage conditions, by proposing at least 11.25 GHz total bandwidth for IMT, while ensuring a balance with existing other services through appropriate measures. Such measures are chosen to ensure in particular the full operability of meteorological systems.

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Furthermore, CEPT is seeking the harmonized international regulation of satellite broadband connectivity on-board aircrafts, ships and trains. In addition, wireless access systems are used in cars worldwide, which makes it necessary to harmonize such usage of low power wireless access systems/radio local area networks (WAS/RLAN) in the 5 GHz range.

Setting the scene for next generation RLAN

It is also time for us to set the scene for the possible next generation of RLAN using Terahertz-spectrum above 275 GHz. And finally, no access system may work without backhaul. Thus, CEPT supports harmonized spectrum for high altitude platform stations in the fixed service, which will have the capability of providing connectivity to unconnected or remote areas.

Safety and security in the air and at sea

Safety and security in the air and at sea are necessary for global mobility and trade. Therefore, CEPT supports regulatory actions on the Global Aeronautical Distress and Safety System (GADSS) and Global Maritime Distress Safety Systems (GMDSS). This includes acknowledgement of the International Civil Aviation Organization's intensive activities, and the International Maritime Organization's strategic decision on a new satellite provider of GMDSS, as well as spectrum for autonomous maritime devices.

Looking into space

Looking into space, CEPT is supportive of solutions for short satellite missions addressing the spectrum needs for telemetry, tracking and command of small and medium enterprises as well as academia. This leads to future space radiocommunications, and a new balance between geostationary systems and non-geostationary satellite networks in the millimetre wave spectrum needs to be found. In this context, a question on the formal limits of an agenda item has been raised again. In the past, administrations have always shown their pragmatism if the necessary technical information were available. Hence, I am optimistic that WRC-19 will find the best solution for this balance and will provide certainty and clarity.

Regulatory questions on new developments

WRC-19 is also at a crossroads and needs to find common ways into the future for regulatory questions on several new developments, such as mega-constellations with thousands of satellites on the one hand, and appropriate requirements for short duration missions on the other, or an effective protection of distress satellite systems (COSPAS-SARSAT) and passive services, i.e. radioastronomy or the Earth Exploration-Satellite Service (EESS).

More specific international provisions

Some terrestrial applications, such as Intelligent Transport Systems (ITS), radiocommunications between train and tracksides, or the impact of wireless charging electric vehicles, indicate a trend towards more specific international provisions. This raises a particular concern about what World Radiocommunication Conferences should deal with. Although it seems favourable to satisfy the needs of those specific applications, it will attract others, which may mean that future WRCs will be unable to handle all kinds of radio applications within their time limits. Therefore, CEPT favours to keep such issues of harmonization measures and studies for specific applications within the remit of the ITU Radiocommunication Sector (ITU-R), and the Radiocommunication Assembly (RA), where they get a similar level of global attention as from a WRC.

Finally, what keeps me optimistic is knowing that the WRC process is still a huge success for ITU. Numerous proposals for WRC-23 have already been received by CEPT on all types of services, to amend the international framework further. We will now start to circulate these ideas among the other regional partner groups in order to find those agenda items of global and regional interest at WRC-19, that can be successfully studied.

In summary, this WRC will once again address something important for everyone!

Representing the Commonwealth of Independent States

Albert Nalbandian

Chairman, Working Group on preparation for WRC-19/RA-19
Regional Commonwealth in the Field of Communications (RCC)

The limited nature of the radio frequency (RF) spectrum and satellite orbits ("spectrum/orbit") resource and its economic value is a recognized fact today. This has resulted in increased competition for it.

Strict compliance with the provisions of the ITU Radio Regulations (RR) ensures equitable access to this resource by all countries of the world. Such compliance also ensures that all radiocommunication systems operate in either an interference-free environment, or with acceptable levels of interference.

Radio applications – depending on frequency availability

The success of any radio application heavily depends on the availability of frequencies and the relevant harmonized standards. The growing spectrum users' requirements and advances in wireless digital technology dictate the need to update the RR.

> *"The key to WRC success is good preparation through regional cooperation, coordination among the regions, and compromise at the conference."*
>
> Albert Nalbandian

According to the ITU Constitution and Convention, any changes to the RR are the prerogative of the ITU World Radiocommunication Conferences (WRCs), held every four years (see figure below).

Two peculiarities of WRCs, including of course the upcoming WRC-19, are that:

- WRC agendas contain a large number of issues related to both spectrum and regulations for radio services/technologies;
- WRC decisions directly concern a wide range of users of radio devices.

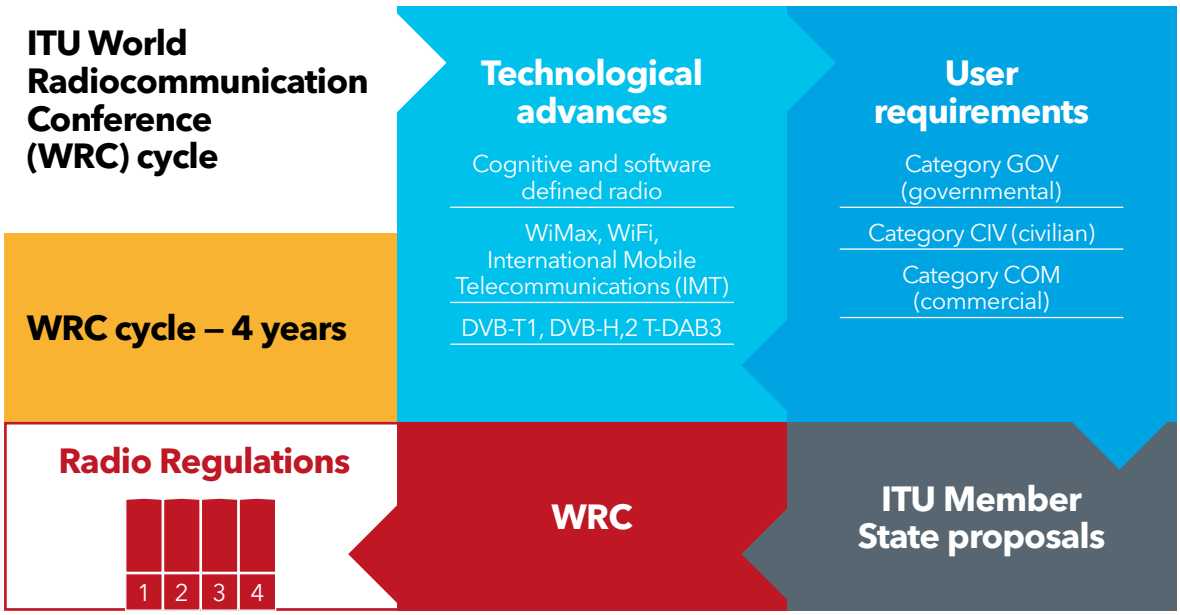
It was ITU Council Resolution 1380 (revised in 2017) that determined that the next WRC and the accompanying Radiocommunication Assembly would be held in 2019.

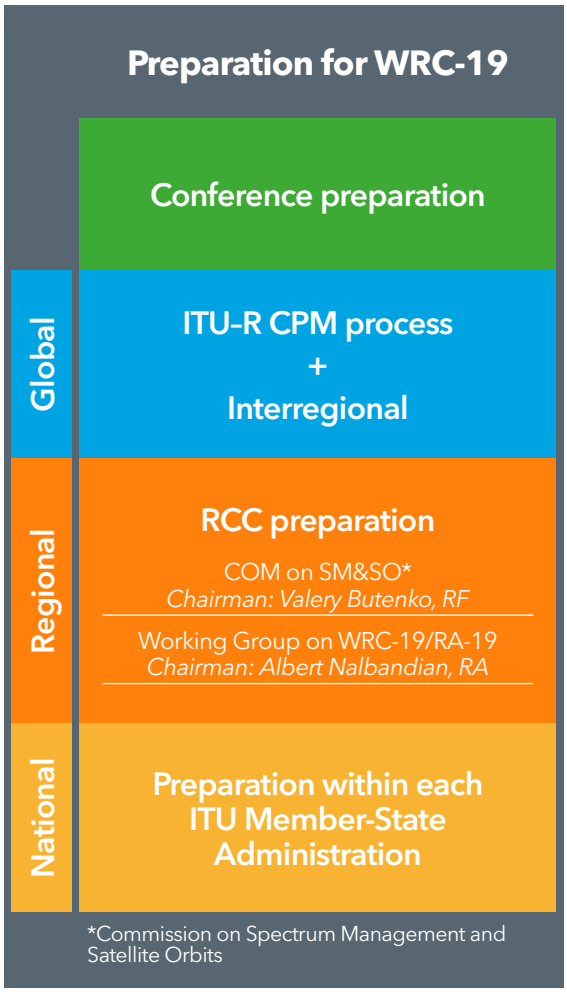
RCC preparation for a WRC

Participation of the RCC delegations in the ITU conferences since 1995 has shown that systematic preparation on a regional level has contributed significantly to the protection of national interests (see figure on next page).

In the RCC, preparation for a WRC and RA is entrusted to the RCC Commission on regulation of the use of the radio frequency spectrum and satellite orbits.

The RCC Working Group on the WRC-19/RA-19 develop the draft RCC common proposals (CPs) for WRC-19. After consideration and approval by the RCC Commission, they are sent to ITU within the prescribed deadline.





About the WRC-19 agenda

For many decades, ITU has been actively dealing with unique global radiocommunication issues. Usually, such issues are included in a WRC agenda. Today, WRC-19 has a full agenda, with many challenges ahead.

Among them are issues including the future development of IMT (5G) networks and satellite systems with a large number (up to thousands) of low-orbit satellites in non-geostationary orbit.

Some challenging issues

Consideration of the development of future IMT (5G technology) networks is extremely important in terms of understanding the complexity of the challenges faced by the organizers of the various sectors of the digital economy. IMT-2020/5G technology is characterized by high speed and low delay in signal transmission. In addition, a large number of devices can connect to such networks. In particular, new technologies will be especially in demand in the areas of the Internet of Things (IoT), unmanned transport and the digitalization of industry and agriculture.

In recent years, there has been a sharp increase in interest in the use of radiocommunications: both terrestrial (mobile, maritime, aeronautical radio systems) and space (based on geostationary (GSO) and non-geostationary (NGSO) satellite networks). A giant leap in radiocommunications has been the transition to digital technologies. This has made it possible to significantly increase the sensitivity and selectivity of systems, as well as reduce the size of the equipment with improved performance.

Implementation of the satellite communication systems in non-geostationary orbits requires modification of the regulatory regime for the use of the spectrum-orbit resource.

Regardless of WRC-19 decisions on these issues, development of such systems will continue. However, it is necessary to pay special attention to the possible negative impact of sharply increasing electromagnetic radiation on the environment.

In my opinion, the lack of competent personnel, rather than the availability of capital, will be a deterrent to the innovation and growth of the digital economy.

The importance of regional cooperation

Coordination and cooperation with other regional organizations is a way to improve the effectiveness of the preparation of the Member States for ITU conferences. Regional preparatory work between conferences can help in building consensus on the many agenda items at a WRC.

Since 2009, the ITU Radiocommunication Bureau has organized a series of workshops on the most important issues and stages of WRC preparation, to help the ITU membership prepare adequately for the conference, and in particular, to respond to the requests of the ITU Radiocommunication Sector (ITU-R) Sector Members so that they are informed on the progress in the preparations.

The six recognized regional organizations (APT, ASMG, ATU, CEPT, CITEL and RCC) were well represented in these meetings for WRC-19.

Participants were not only informed on the progress made in implementing the decisions of the first session of the Conference Preparatory Meetings (CPM-1 and CPM-2), but also exchanged views on:

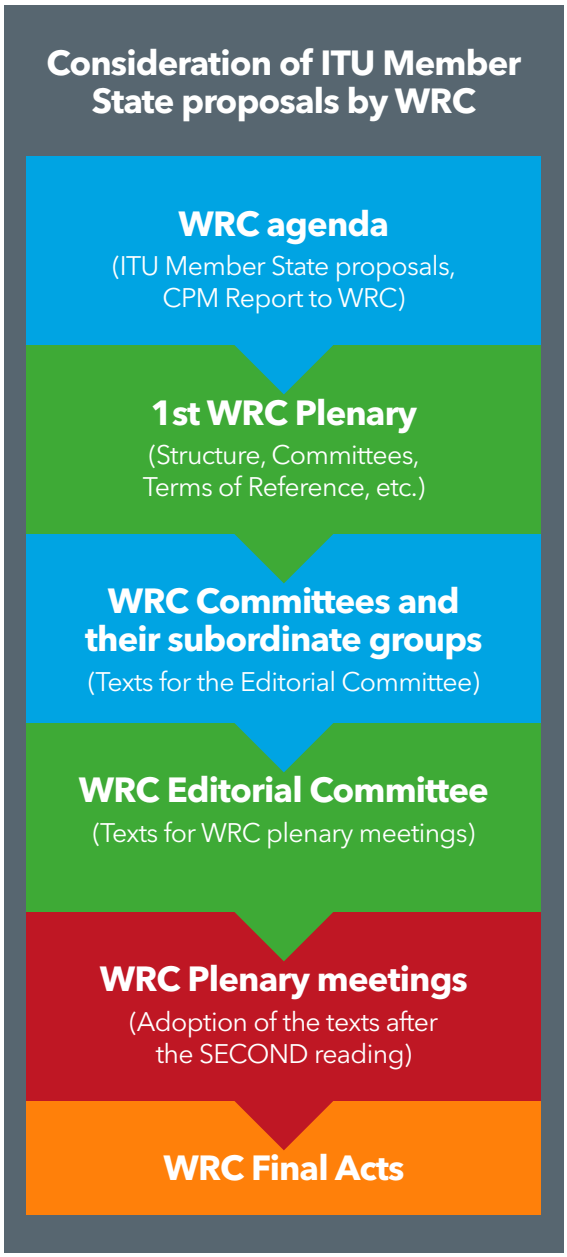
- the possible methods to satisfy the WRC agenda items on the basis of results of the studies carried out by the competent ITU-R groups included in the CPM Report to WRC;
- the report of the Director of the Radiocommunication Bureau;
- the Radio Regulations Board report on Resolution 80 (Rev. WRC-07).

These workshops provide another opportunity for ITU-R members to discuss conference issues before its opening.

Representatives of the AC RCC are also involved in the interregional preparatory work, in particular in the Informal Group on the preparation of coordinated proposals on the draft structure of the conference, including the Steering Committee.

Common proposals developed by each of the six regional groups are being submitted to the conference, and will greatly facilitate consensus building on the various issues to be discussed to satisfy agenda items.

If ITU Member States agree on one method to satisfy an agenda item or issue, it may be proposed that such item or issue be considered at the first plenary meeting of WRC-19 and be referred directly to the Editorial Committee for further processing. The order of consideration of proposals by the conference is shown in the figure on the next page.



The key to the success of WRC-19

Experience with WRCs has shown that regional preparatory work between conferences can help in building consensus on some agenda items.

The key to WRC success is good preparation through regional cooperation, coordination among the regions, and compromise at the conference.

The ultimate aim is to reach consensus on all the agenda items at WRC-19, and to provide broadband access to information for everyone, anywhere, at any time.

Representing the Americas

Carmelo Rivera

Chairman, Working Group for Regional and World Radiocommunication Conferences
Inter-American Telecommunication Commission (CITEL)

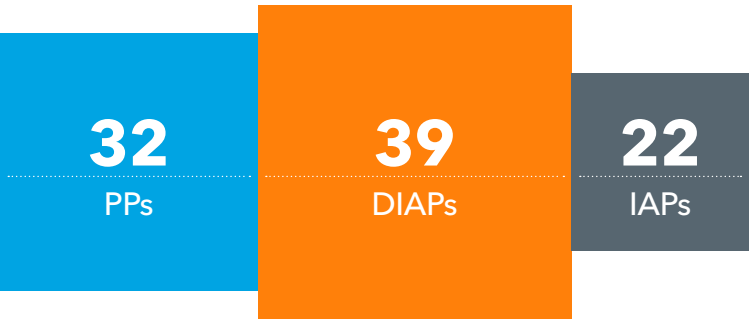
Over 60 personnel in leadership roles are currently dealing with 24 World Radiocommunication 2019 (WRC-19) agenda items and 30 sub-issues (see the Report of the CPM to WRC-19). These numbers do not reflect the hundreds that have been involved in the drafting, discussing, re-writing, modifying proposals, footnotes, resolutions and tables of allocation.

The Inter-American Telecommunication Commission (CITEL) Permanent Consultative Committee – II (Radicommunication and Broadcasting) (PCC-II) has met a total of seven times since the last World Radicommunication Conference held in 2015 (WRC-15), in various locations.

> *"I mention the numbers of people, meetings, and agenda items, just to give an idea of the scope of work that has been undertaken in preparation for the upcoming world conference in just one of six regions around the world."*
>
> Carmelo Rivera

The Americas region conference preparatory outcomes

As of the latest meeting, held in April 2019, the conference preparatory outcomes of the Americas region include:



- 32 Preliminary Proposals (PPs) (Proposals from a Member State not supported by another);
- 39 Draft Inter-American Proposals (DIAPs) (Proposals supported by two or more Member States);
- 22 Inter-American Proposals (IAPs) (Proposals supported by at least six Member States) (not considered final until membership agrees that discussion has ended on the issue).

Inter-American Proposals to WRC-19

Of the 22 IAPs, only eight are (at the time of me writing this article) ready to be sent forward to the ITU for discussion during WRC-19. These can be found as Document 11 on the Documents and Proposals page of the WRC-19 website, and include: WRC-19 agenda items 1.1, 1.11, 1.12, 1.16 (5250–5350 MHz, 5350–5470 MHz and 5850–5925 MHz), 9.1 (9.1.2) and 9.1 (9.1.8).

Other IAPs, where there is general agreement are: parts of 1.4, 1.8, 1.10, 1.13, 1.14, 1.16, 7, 9.1 (9.1.3, 9.1.4, 9.1.5, 9.1.6) but, as already mentioned, discussion on these agenda items are still continuing, and were not yet deemed ready to submit them to the WRC.

At the time of me writing this article, we have one meeting left to finalize our deliberation of these and other agenda items that have not yet reached the level of support to enable them to be considered Inter-American Proposals.

The scope of WRC-19 preparation – and a month to negotiate

I mention the numbers of people, meetings, and agenda items, just to give an idea of the scope of work that has been undertaken in preparation for the upcoming world conference in just one of six regions around the world.

I have to assume that similar work is ongoing in the other five regions to some degree. Before we know it, the time for preparation will be over and, as we have done in the past, thousands of us will meet for a month (more for some of us). Or rather, as I like to put it, I get to spend a month with thousands of people from around the world where I don't have to explain what I do for a living. During that month we will not only come to final decisions on the hundreds of inputs, but we will also decide on issues that we will be discussing and working on for the next three to four years.

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Recognizing dedication and hard work

The amount of work that goes into each and every WRC never ceases to impress me. For that reason, I am extremely grateful to all that have shown their dedication and poured their hard work into the many hours required before we can even start our discussions. The army of subject matter experts that have worked and will continue to work to make this conference a success will probably never receive more than a pat on the back for a job well done.

I would like to express my heartfelt appreciation to all, from those that have attended and participated in the development of CITEL's inputs, the rapporteurs and group chairs, the CITEL secretariat staff, the ITU staff, and the members of other regional organizations that have helped us along the way. I sincerely hope I haven't left anyone out.

See you in Sharm El-Sheikh. Best of luck to all!

Representing Asia and the Pacific

Kyu-Jin Wee

Chairman, APG-19 Asia-Pacific Telecommunity (APT)

For the preparation of the World Radiocommunication Conference 2019 (WRC-19), the Asia-Pacific Telecommunity (APT) Preparatory Group for WRC (APG) last met in August 2019 in Tokyo, Japan, with around 600 participants from 26 APT members, representatives of other regional groups, and international organizations. In that meeting, Preliminary APT Common Proposals (PACPs) on most of the WRC-19 agenda items were developed by consensus.

Diversity is one of the characteristics of the Asia Pacific region. More than 50 years of historical different usage of radio spectrum, and different geographical and economic development situations have led to different demands for spectrum usage. However, a consensus approach has worked well to develop PACPs, with the spirit of utmost goodwill, as addressed in the Radio Regulations.

> *"A consensus approach has worked well to develop Preliminary APT Common Proposals, with the spirit of utmost goodwill."*
>
> Kyu-Jin Wee

WRC-19 agenda items in brief

The following is APT's view on some selected WRC-19 agenda items. It is very well recognized that those complex issues will be further discussed at WRC-19, both within the APT region, and also with other regions.

International Mobile Telecommunications

Preliminary APT Common Proposals on agenda item 1.13 support identifying the frequency band 24.25–27.5 GHz and the frequency band 37–43.5 GHz, or portions thereof, for International Mobile Telecommunications (IMT) globally.

APT members have agreed to further investigate whether the frequency bands 47.2–50.2 GHz or portions thereof, 50.4–52.6 GHz, 71–76 GHz and 81–86 GHz could be considered for IMT identification at WRC-19.

APT members, in principle, support the frequency band 66–71 GHz for identification of IMT. However, APT members are still investigating the method and condition(s) to be adopted when identifying this band for IMT.

The four ranges of the active service band are proposed: 24.25–24.75 GHz, 24.25–25.25 GHz, 24.25–26.5 GHz or 24.25–27.5 GHz. Both the unwanted emission limits and the active service band should be carefully investigated together to find an appropriate solution to achieve the protection of Earth exploration-satellite service (EESS) (passive), and to avoid unnecessary constraints to IMT stations.

Radio local area networks

APT members are of the view that the protection of incumbent services including their current and planned use in the frequency bands 5150–5350 MHz, 5350–5470 MHz, 5725–5850 MHz and 5850–5925 MHz should be ensured, without adversely affecting these services.

APT members support the allocation of the 5725–5850 MHz frequency band to the mobile service on a primary basis in Region 3.

In the frequency band 5150–5250 MHz, APT members do not support Method A2, A4, A5 and A6. Moreover, no consensus was reached on either Method A1 or A3. However, APT members support further consideration and investigation on the possibility of outdoor wireless access/radio local area networks (WAS/RLANs) operation, under the condition that incumbent services, including the future development of these services, are fully protected.

Railway and intelligent transport systems

While there is a common understanding that the harmonized frequency use of railway and Intelligent Transport Systems (ITS) application, globally or regionally, would benefit all members, there are still different views among regional groups on whether the RR would need to include such idea of harmonization.

One view is that the ITU Radiocommunication Sector (ITU-R) Report or Recommendation would suffice for such harmonization. However, it is worth noting that one of the objectives of the RR is "to facilitate the efficient and effective operation of all radiocommunication services", as addressed in the preamble.

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APT proposes new WRC Resolutions on railway communications and ITS, respectively, without specifying the frequency bands, but encouraging members to consider the relevant ITU-R Report or Recommendation for harmonized use of spectrum.

Earth stations in motion

Since WRC-03 introduced Resolution 902 (WRC-03), which provides a provision for the operation of earth stations on board vessels in the fixed-satellite service, WRC-15 introduced regulations for earth stations in motion (ESIM) operating in the frequency bands 19.7–20.2 GHz and 29.5–30 GHz, contained in Resolution 156 (WRC-15).

Now WRC-19 agenda item 1.5 (Resolution 158 (WRC-15)) is seeking for a provision for the operation of all kinds of ESIM, on ships, aircraft and on land. Furthermore, there are already several proposed new agenda items regarding ESIM for WRC-23 in different frequency bands.

While ESIM are recognized as useful applications and envisaged being facilitated more in future, agenda item 1.5 would need to consider two aspects: The first is how ESIM protect existing services and their future development. The second is how the provision for ESIM under WRC-19 agenda item 1.5 would impact the RR in future.

Asia Pacific countries are very much keen to protect their existing and future development, because many countries in the region have deployed mobile systems as allocated in the mobile service, while some ESIM applications may be allowed in their territory. In this regard, pfd limits and altitude limits for ESIM are still under discussion.

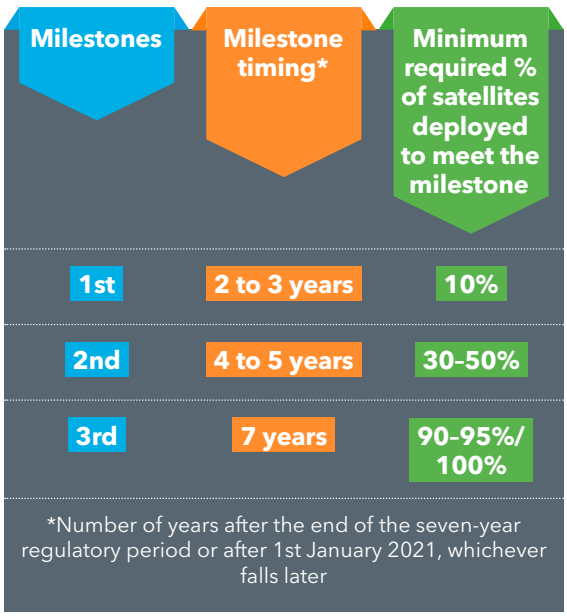
PACPs propose to include the following text in the Resolution; "the successful compliance of this Resolution does not oblige any administration to authorize/licence any ESIM to operate within the territory under its jurisdiction unless such an operation fully complies with its national jurisdiction".

Satellite services (agenda item 7, issue A) – Bringing into use definition

Regarding Agenda item 7, issue A, APT members are of the view that the definition of the bringing into use (BIU) of frequency assignments to non-geostationary (NGSO) systems should be in accordance with the current practice as contained in the Rules of Procedure – that is to keep a continuous period of 90 days for frequency assignments of the fixed-satellite service (FSS)/mobile-satellite service (MSS)/broadcasting-satellite service (BSS), and no fixed period for frequency assignments other than the FSS/MSS/BSS.

With respect to the regulatory provision No. 11.44C of the BIU, notified orbital planes, APT members could support Option 2, as outlined in the CPM19-2 report.

Milestone-based approach



When considering the ranges of milestones and associated deployment factors in the table, WRC-19 may consider allowing a degree of flexibility to NGSO satellite operators. If they miss the percentage criterion in the 1st or 2nd milestone in the table, they would need to achieve those criteria at the subsequent milestone.

Transitional measures

APT members could support Option 1; the commencement date of the milestone process to be 1 January 2021, at this stage.

Addition of country names to existing footnotes

Both WRC-12 and WRC-15 permitted country names to be added to existing footnotes, while it is not the purpose of Resolution 26 (Rev. WRC-07). Considering this practice, APT is proposing to modify Resolution 26 in order to provide an alternative procedure.

Issues under WRC-19 agenda item 9.1

WRC-2000 had ambitiously set 39 agenda items under agenda item 1 for WRC-2003. The preparatory work for these agenda items proved very challenging. A new approach was then adopted at WRC-03 to move some topics as issues under agenda item 9.1 (formerly known as 7.1). This new approach seems to have successfully reduced the numbers of topics under agenda item 1.

WRC	Number of agenda items under 1	Numbers of issues identified under 9.1 (besides Resolution 80)	Number of items (workload for study groups)
WRC-03	1.1-1.39 (1.7, 1.8 and 1.10 were divided into 3, 2, 2 sub-items respectively)	0 issues	39 + 4 = 43 (There were 7 sub-items, but 3 parent items were not allocated to specify study groups)
WRC-07	1.1-1.21	4 issues	21 + 4 = 25
WRC-12	1.1-1.25	3 issues	25 + 3 = 28
WRC-15	1.1-1.18	8 issues	18 + 8 = 26
WRC-19	1.1-1.16	9 issues	16 + 9 = 25

Agenda item 9 is a standing agenda item, which reads "to consider and approve the Report of the Director of the Radiocommunication Bureau, in accordance with Article 7 of the Convention:" and 9.1 is "on the activities of the Radiocommunication Sector since WRC-15".

With the principles contained in WRC Resolution 804 (Rev. WRC-12) and the WRC-03 experience, those topics which are unlikely to require changes to the RR have been put as issues under agenda item 9.1.

However, those issues might require changes to the RR. Careful examination is, therefore, required before allocating topics under agenda item 9.1.

Most importantly, the number of agenda items should be within the manageable range, and then the next WRC should decide whether they really need changes to the RR.

It is expected that WRC-19 will develop better and wiser decisions for future agenda items.

Note: This article was prepared just after the last APG meeting, and the Preliminary APT Common Proposals and views are currently under the consideration of APT members to become an APT WRC-19 Common Proposal.

ITU World Radiocommunication Conferences (WRCs)

WRCs update the Radio Regulations, the international treaty governing the use of the radio-frequency spectrum and satellite orbits

and

ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services

Mobile | Satellite | Maritime | Emergency | Aviation | Broadcasting | Science

Past ITU World Radiocommunication Conferences

1995 — **WRC-95**: 23 October–17 November, Geneva, Switzerland

1997 — **WRC-97**: 27 October–21 November, Geneva, Switzerland

2000 — **WRC-2000**: 8 May–2 June, Istanbul, Turkey

2003 — **WRC-03**: 9 June–4 July, Geneva, Switzerland

2007 — **WRC-07**: 22 October–16 November, Geneva, Switzerland

2012 — **WRC-12**: 23 January–17 February, Geneva, Switzerland

2015 — **WRC-15**: 2-27 November – Geneva, Switzerland

Over 3250 participants attended WRC-15 from 163 ITU Member States and 131 Observer organizations

ITU World Radiocommunication Conference 2019 (WRC-19)

ITUWRC SHARM EL-SHEIKH2019

Source: ITU Radiocommunication Sector

GLOBAL SATELLITE COALITION

Maintaining and expanding spectrum for satellite communications

Global Satellite Coalition (GSC)

Article by a coalition of the world's satellite industry associations: ABRASAT, APSCC, AVIA, CA, ESOA, GVF and SIA

At the upcoming World Radiocommunication Conference 2019 (WRC-19), ITU and its Member States will take decisions that will have an impact on many challenges and opportunities facing today's telecommunication regulators. These include enabling next-generation connectivity, connecting the unconnected 49% of the world, and ensuring increasingly resilient telecommunication networks for emergency situations. The satellite communication industry is directly relevant to each one.

Satellite communications and 5G

The 5G network is envisioned as an access network-agnostic architecture that includes new cellular wireless technologies, fixed wireless networks, Wi-Fi and satellite networks. Each technology is critical to serve many different use cases.

> *"WRC-19 decisions must ensure that satellite communications can meet the demands of the communities and customers they serve, by maintaining and expanding access to harmonized spectrum resources."*
>
> GSC

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Harnessing the capabilities of satellite technology maximizes the reach and capabilities of this network of networks. Doing so also maximizes the ability of the 5G ecosystem to solve bigger problems, like extending high-speed access to the next billion people, improving network resiliency, and enabling ubiquitous connectivity in the air, across the seas, and around the globe.

By providing consumers broadband access of up to 100 Mbps and contributing to the 5G standards process through 3GPP, communication satellites are key to a world that promises inclusive, economic growth based on next-generation connectivity and 5G.

Business plans for important verticals may not be feasible without the wide area coverage, reliability and resilience offered by satellite. Their role is already recognized by the European Commission and governments including the United States as well as the European Conference of Postal and Telecommunications Administrations (CEPT), 3GPP and most recently, ITU itself.

Satellite communications and connecting the unconnected

Satellite communications already provide affordable connectivity to countless otherwise underserved or unconnected customers around the world. Their continued deployment will help prevent the digital divide from becoming a chasm: a real risk as terrestrial-only 5G networks are planned mainly for parts of densely-populated areas.

Satellites also enable broadband connectivity to critical industries such as oil and gas, mining as well as to hundreds of millions of devices connected each year on-board mobile platforms such as automobiles, planes, trains and ships. Connections to Unmanned Aerial Vehicles (UAVs), for the Internet-of-Things (IoT), driverless cars and buses are also soon to come.

Satellite communications and disasters

The ubiquity and resilience of satellite networks make them critical to the increasing number of disasters (man-made or natural) happening in today's world. These strengths underpin the Crisis Connectivity Charter signed by the satellite industry in 2015 with the United Nations' (UN's) Emergency Telecommunications Cluster (ETC). Most recently, when Cyclone Idai struck Mozambique and surrounding countries in Africa, the satellite communication industry quickly provided affordable capacity and equipment to disaster responders.

ITU plays a critical role here too by rapidly deploying satellite solutions and ensuring regulatory barriers do not prevent deployment. This is why ITU has also decided to sign the Crisis Connectivity Charter with the satellite industry and the UN, etc.

World Radiocommunication Conference 2019 – the IMT challenge

Spectrum allocations are the critical issue for both the satellite industry and the International Mobile Telecommunications (IMT) industry at WRC-19. Without adequate spectrum, the satellite communication industry will neither be able to maintain and grow its 5G services, connect the unconnected, nor will it be able to provide the degree of support needed in an increasingly vulnerable world.

ITU has long recognized IMT as warranting identifed spectrum for its use (ITU's Study Group 5 Working Party 5D). The challenge lies in identifying spectrum for IMT, without IMT's use of the frequency bands impairing the growth and development of other radio services.

Cyclone Idai heading towards Mozambique and Zimbabwe in 2019

Shutterstock/NASA

To enrich one industry at the expense of the other, would be to the detriment of the industry lacking sufficient spectrum, along with the governments, businesses and consumers that depend on that industry's services.

At WRC-19, the challenge will be to identify spectrum for IMT while also ensuring continued access to spectrum to enable the continuity and growth of vital services provided by other technologies, including satellite.

WRC-19 agenda item 1.13 – calling for spectrum for IMT

WRC-19 agenda item 1.13 will be crucial. It calls on the conference to identify more spectrum for IMT. This consideration must assess:

- the spectrum already available for IMT;
- the spectrum actually utilized by IMT;
- the need to protect existing services and to allow them to continue to develop and evolve in the spectrum they already use;
- whether identifying spectrum for IMT would impose any additional regulatory or technical constraints on services to which a given band is currently allocated on a primary basis. (Resolution 238 (WRC-15) suggests that IMT should not displace other services);
- the ability of satellite communications to provide the valuable services that only they can provide; and
- the investments of the satellite industry and its customers in developing and deploying powerful new technologies which utilize spectrum already allocated to satellite communications but now being sought by IMT.

The following facts are directly relevant:

- Agenda item 1.13 is considering a staggering 33 GHz of spectrum for IMT between 24.25 GHz and 86 GHz;
- A recent study conducted by LS Telcom provides valuable data on whether the IMT industry needs more spectrum than already allocated.
  - Typically, only half of the spectrum harmonized for use in a particular region has been licensed to mobile operators.
  - There is upwards of 300 MHz (and in some countries as much as 700 MHz) spectrum that is yet to be licensed for mobile services, from within bands that are already identified and harmonized.
  - Progress towards licensing the 700 MHz, 2300 MHz and 2600 MHz bands is relatively slow, and licensing of the 1400 MHz and 3300 MHz bands which were identified at WRC-15 has hardly begun. Together, these bands comprise up to 570 MHz of mobile spectrum.
  - Compared to the ITU's estimations of IMT spectrum demand in 2020, the amount of spectrum licensed is roughly a third of that forecast.
  - Proposed IMT spectrum uses are not compatible with many existing satellite services.

- Spectrum below 24.25 GHz is available for IMT.

- Administrations can re-farm existing wireless spectrum to maximize next-generation wireless spectrum availability.

Additional spectrum can be identified for IMT by taking decisions at WRC-19 that:

- promote sector competition between IMT and other sectors;
- advance inclusive connectivity to reach the 49% unconnected, including directly via satellite;
- encourage the development of 5G as a "network of networks" with all sectors of the communication industry – including the satellite industry;
- prioritize resilient telecommunication networks in response to disasters, especially via satellite;
- avoid allocating spectrum to IMT beyond what is demonstrated as truly being needed;
- avoid disrupting or constraining the evolution of existing satellite services with the introduction of IMT.

Important guarantees at WRC-19

WRC-19 decisions must ensure that satellite communications can meet the demands of the communities and customers they serve, by maintaining and expanding access to harmonized spectrum resources. This includes the Ku-band, Ka-band, Q/V-band, E-band, and the C-band in which IMT is seeking identifications at WRC-19, and in national consultations.

Harmonized spectrum in these bands is critical for the provision of communication services via satellite – including the expanding mobile and broadband connectivity needs that are uniquely met by satellites.

The satellite industry will propose that the World Radiocommunication Conference in 2023 (WRC-23) consider further changes to help achieve these objectives by taking advantage of the unique and increasing advantages of satellite communications.

Note: AT&T, a member of SIA, does not concur with the views in the article.
Any views expressed in this article do not necessarily reflect those of ITU.

5G's future hangs in the balance at WRC-19

John Giusti

Chief Regulatory Officer, GSMA

From cleaner oceans and more efficient transport systems to safer factories, smarter cities and more preventative health care, billions of citizens are counting on 5G innovation to improve their lives. The outcome of the World Radiocommunication Conference 2019 (WRC-19) will determine if these innovations can happen.

5G is the next step in our journey to connect all societies to a better future. Building upon and working with 4G, 5G will deliver more than just faster downloads with lower lag – it will be an evolutionary step with a revolutionary impact. It promises to have a deeper impact on our lives than any previous mobile generation. Without the necessary support at WRC-19, that impact could be delayed or even lost.

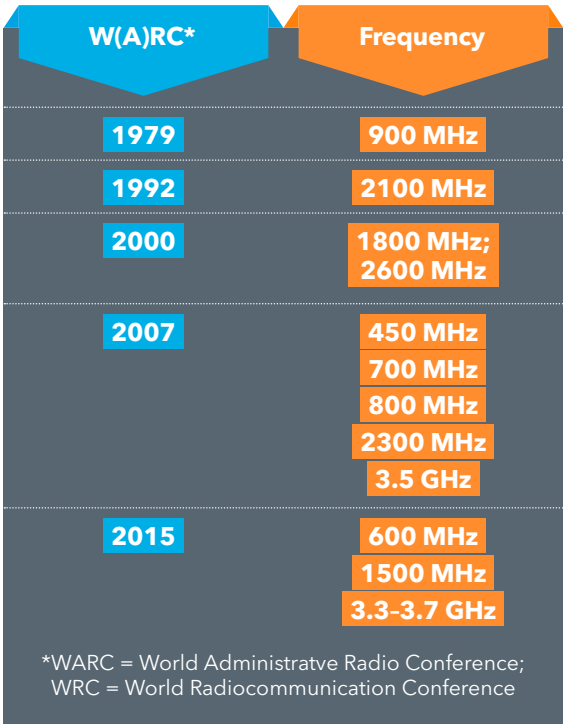
ITU support matters

More than two-thirds of the people on the planet – over 5 billion – now have a mobile subscription, connecting people to each other and to the digital economy. The Internet is the most important enabler of social development and economic growth of our time. Already 3.6 billion people are online through mobile, and this figure is set to grow by an additional 1.4 billion by 2025.

> *"The future of connectivity is on the table at WRC-19, and the work we do in Sharm El-Sheikh will have a huge impact on how we connect everyone and everything to 5G, realizing a better future for all."*
>
> John Giusti

ITU plays a critical role in connecting the world's citizens to the enabling power of mobile services through the identification of harmonized spectrum, fostering scale and affordability. Progress from 2G to 3G to 4G has seen each generation offer new capabilities and bring new benefits to more people. 4G networks already cover 81% of the global population.

Starting with the 900 MHz band in 1979 (the World Administrative Radio Conference (Geneva, 1979), the ITU's Radio Regulations laid the foundation for today's mobile broadband networks. These allocations and identifications have paved the way for mobile broadband to thrive.



The facts are clear: 5G and other services can co-exist

In Sharm El-Sheikh this year, the 3000 delegates representing nearly all of the world's nations have the unique opportunity to deliver new levels of connectivity across the globe. With access to the right spectrum, 5G networks are expected to cover nearly 40% of the global population by 2025.

Tremendous study and discussion have already been put into WRC-19 agenda item 1.13. The specially created Task Group 5/1 met extensively between May 2016 and August 2018, taking an an exhaustive look at mmWave frequencies (bands including 26 GHz, 40 GHz, 50 GHz and 66 GHz).

The sharing and compatibility studies showed that, while some services need protection measures, scenarios with many services show positive margins that don't require additional measures.

The development of the Radio Regulations at WRC follows a simple rule: where existing services need protecting, measures will be put in place; where sharing is feasible, no action is required at WRC.

The Conference Preparatory Meeting (CPM) Report for agenda item 1.13 is huge, and full of potential conditions. In many cases these conditions are simply not necessary, and in places, they jeopardize future connectivity. At risk is the development of 5G networks, which, under some of these conditions, could be severely compromised for the next decade. In the case of unwanted emission limits on the 26 GHz band, some of the more conservative conditions will block its use for 5G entirely, which is a strange contradiction to the global support for the band for 5G.

Writing unnecessary or needlessly onerous conditions will create delays and negatively impact the socio-economic benefits that flow from International Mobile Telecommunications (IMT). Conversely, the certainty that comes with fair fact-based decisions will set off a positive chain reaction, including the development of the next wave of innovative services and devices and the support of large-scale investments.

IMT will continue to be a good neighbour to other important radiocommunication services. As we approach WRC-19, it is clear that misinformation about the technical impact of 5G systems on other services is putting the potential of 5G at risk. Work done in preparation for the conference has demonstrated that 5G can be used safely alongside other services, including weather sensing services, commercial satellite services, radar and others.

Working together, we can help 5G reach its potential at WRC-19

The performance benefits of mmWave 5G, including ultra-high speeds and low lag, will drive revolutionary new applications across many sectors around the globe. This holds the potential to create an intelligently connected world and enable a new, unprecedented era of industrial connectivity. It can facilitate enhanced services and help nations address our most pressing global concerns: climate change, enhanced economic growth, and fairer societies.

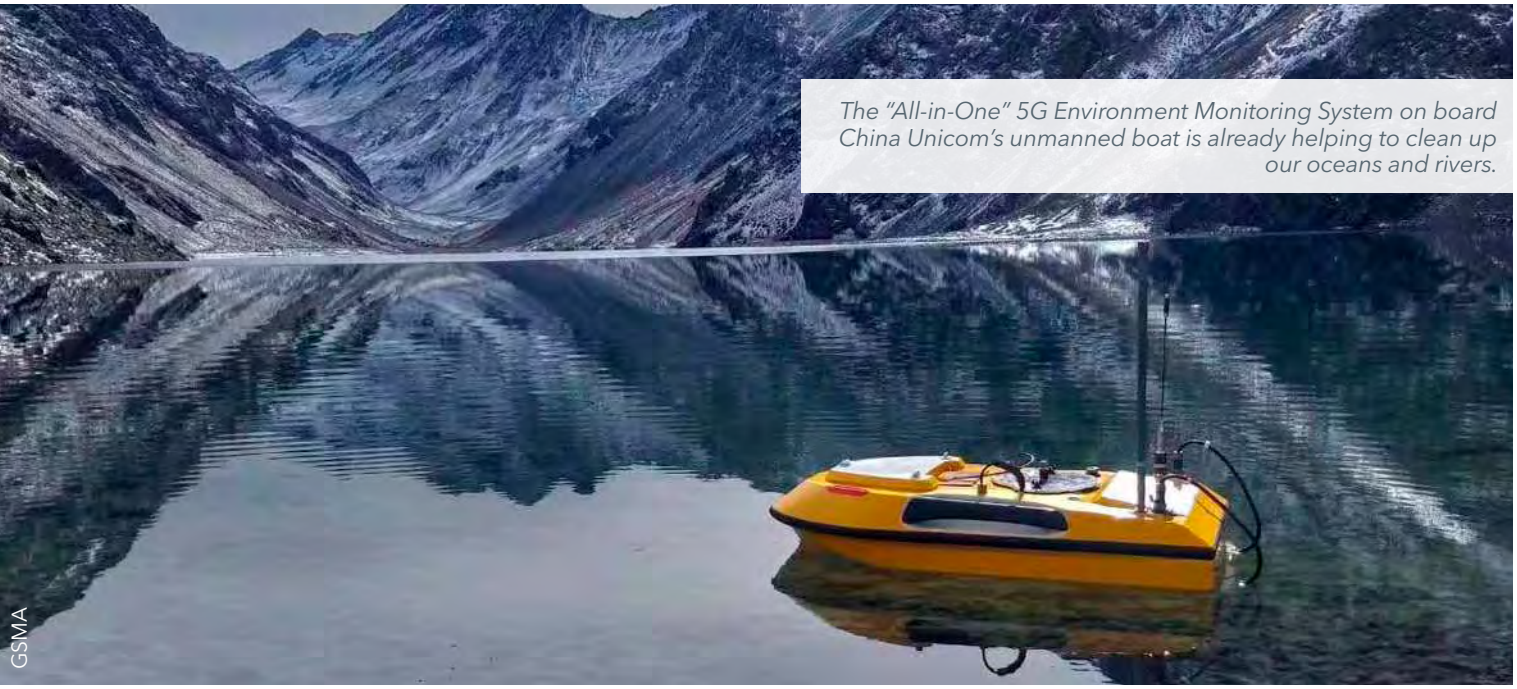
Whether it is a school that wants to educate more students; a city that wants to improve air quality or a company that wants to improve worker safety, 5G can build on the success of mobile networks in ways that matter to everyone.

5G stands to provide amazing improvement to health care, especially in poorer, rural areas. 5G will enable doctors to diagnose and treat patients that may be thousands of miles away. High-speed, low-latency 5G connectivity will make remote surgery feasible, bringing the skills of talented doctors to remote locations. Additionally, 5G will pave the way for more patient monitoring technologies to aid chronically ill patients, and help shift focus to prevention and wellness, rather than treatment.

In smart cities, intelligent transport systems (ITS) can help reduce congestion and pollution. Connected sensors in infrastructure and vehicles can send high-quality, detailed information on traffic flow, accidents, and congestion to traffic management centres. 5G also provides a cost-effective way of wirelessly connecting millions of people in growing cities.

The benefits extend beyond technology industries and high-GDP nations. In Sub-Saharan Africa, for example, there is strong leadership around smart transportation hubs. Here, mmWave 5G connections will enable the coordinated movement of goods and the remote control of essential machinery, leading to more efficient port operations, lower costs, and increased trade.

WRC-19 is key to enabling these advances through the global harmonization of mmWave spectrum.



The "All-in-One" 5G Environment Monitoring System on board China Unicom's unmanned boat is already helping to clean up our oceans and rivers.

GSMA

Making the most of spectrum for all

Based on the unprecedented number of people connected in its relatively short history, the mobile industry has shown its commitment to being an efficient and effective custodian of spectrum resources. The use of mmWaves will be no different. Over a 15-year period, from 2020 to 2034, access to this resource is expected to power a USD 565 billion boost in global GDP, with USD 152 billion in tax revenue coming from mmWave 5G services.

5G's success is not measured only in the prosperity it will bring to society, but also its ability to connect the underserved to health care, education and employment opportunities and to protect the environment we live in. In fact, the mobile industry was the first industry sector to commit to do its part to meet the targets of the 17 United Nations (UN) Sustainable Development Goals, and it annually measures its contribution to those shared goals. Twenty seven mobile operators with 2/3 of the world's connections have also committed to support an industry-wide approach to net-zero emissions, in line with the UN Paris Agreement to combat climate change.

The WRC process has always depended on collaboration between countries and industries within the ITU family. This time, together, we have the opportunity to set the stage for the next wave of digital services, bringing revolutionary new services to citizens, industries and governments. The future of connectivity is on the table at WRC-19, and the work we do in Sharm El-Sheikh will have a huge impact on how we connect everyone and everything to 5G, realizing a better future for all.

Note: Any views expressed in this article do not necessarily reflect those of ITU.

Broadband connectivity with high-altitude platforms

Edgar Souza

Specialist in Telecommunications Regulation, Anatel

Agostinho Linhares

Manager of Spectrum, Orbit and Broadcasting Division, and Coordinator of the Brazilian Preparation for WRC-19, Anatel

Recent estimates from the ITU Telecommunication Development Sector (ITU-D) indicate that in 2018, more than 48% of individuals all around the world were still not using the Internet (see the Measuring the Information Society Report 2018). Focusing the analysis on the least-developed countries, it was found that four out of five individuals globally are still offline. Providing Internet access to those individuals is an enormous challenge that has not yet been tackled.

> *"Large-scale deployment of HAPS will be enabled by such a remarkable evolution of the technology, but it still struggles with the lack of spectrum bands identified for this purpose."*
>
> Edgar Souza/Agostinho Linhares

Although terrestrial and satellital technologies have been successfully playing their roles in providing connectivity, the numbers clearly show that there is a lot of room for improvement of those indicators. Connecting the unconnected is a very important step for the development of an information society with more inclusion and reliability.

WRC-19's role in helping to connect the unconnected

The World Radiocommunication Conference 2019 (WRC-19) will have the opportunity to contribute to reducing this gap by promoting a more efficient usage of spectrum. Access to spectrum is fundamental to foster the development of a myriad of business models that will enable the connection of the unconnected.

In this regard, new spectrum identifications for high-altitude platform systems (HAPS) will be discussed at WRC-19, and the existing ones will be reviewed.

ITU studies on HAPS

During this study cycle, the ITU Radiocommunication Sector (ITU-R) has conducted studies to assess the spectrum needs for HAPS to address Resolution 160 (WRC-15) – WRC-19 agenda item 1.14 (to consider, on the basis of ITU-R studies in accordance with Resolution 160 (WRC-15), appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations).

The studies considered several aspects such as the evolution of the concept, the state-of-the-art of the technology, and the requirements of new broadband applications.

The studies (see Report ITU-R F.2438-0 (11/2018)) indicate that there is a need for almost 3 GHz of additional spectrum for HAPS to meet the requirements of certain applications (see system 6 in Report ITU-R F.2438-0 (11/2018)).

This is much more than the 600 MHz that are currently identified worldwide for HAPS operating in the fixed service (additionally, to the fixed service identifications, some bands were identified for HAPS operating in the mobile service as IMT base stations. See Radio Regulations (RR) Footnote 5.388A).

See the ITU backgrounder on high-altitude platform systems

ITU–R began to study spectrum identifications for HAPS in the 1990's. The telecommunications ecosystem and technology enablers for HAPS have evolved a lot since then.

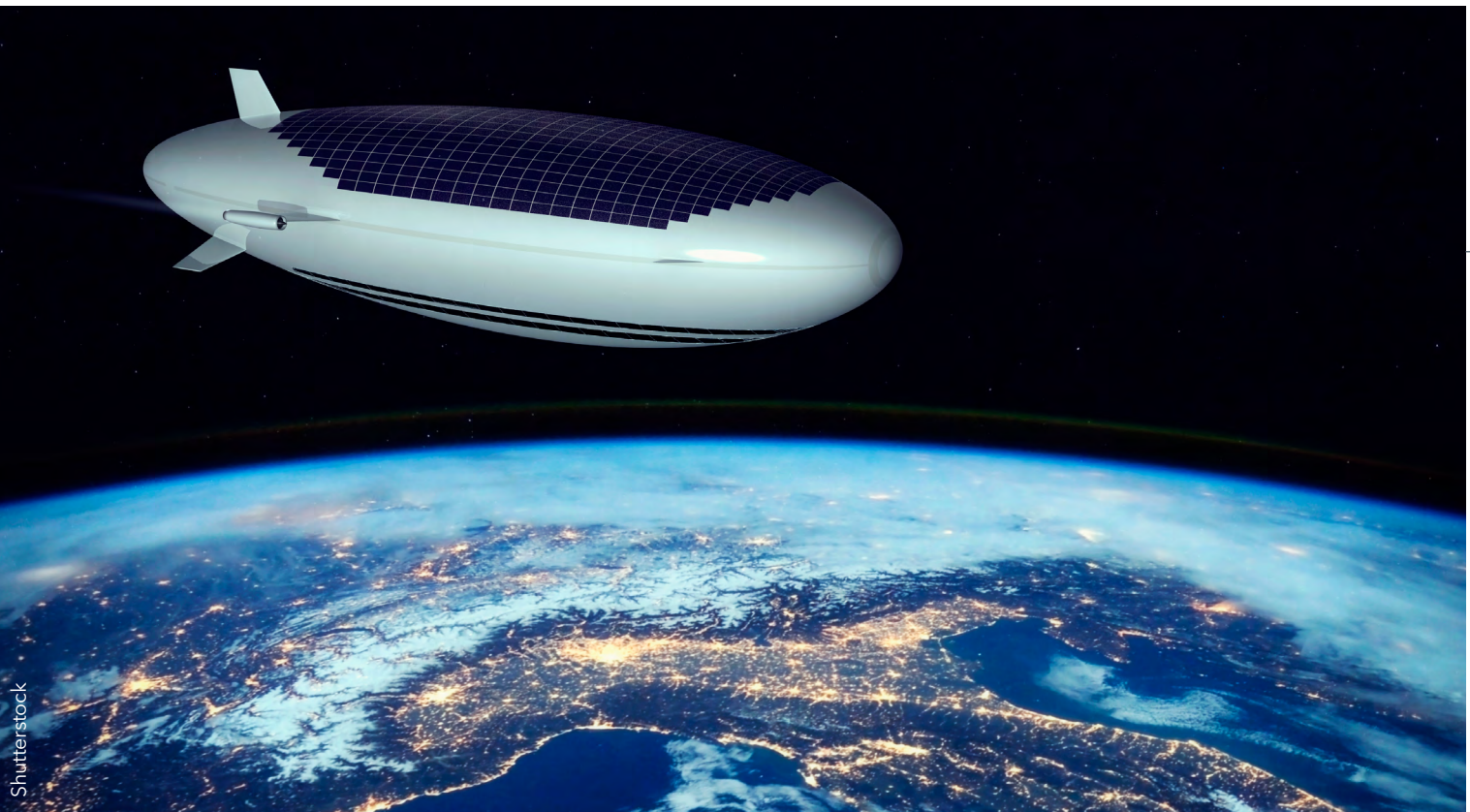
Solar-powered lightweight platforms are examples of the current state-of-the-art of a technology that can be used to provide affordable broadband connectivity in unserved areas.

Large-scale deployment of HAPS will be enabled by such a remarkable evolution of the technology, but it still struggles with the lack of spectrum bands identified for this purpose.

The WRC-19 agenda dealing with HAPS

The WRC-19 agenda item 1.14 will discuss the possible use of several frequency bands for HAPS broadband systems, some of them for worldwide usage, some for regional usage, some already identified for HAPS (Resolves to invite ITU–R 2 and 3 in Resolution 160 (WRC-15)), some already allocated to the fixed service (Resolves to invite ITU–R 4 in Resolution 160 (WRC-15)).

In these discussions, it will be very important to consider that the harmonized use of spectrum will bring to the ecosystem many benefits and it will facilitate achieving economies of scale. This is especially desired for a system like HAPS, which aims to connect individuals who are offline and live mostly in the least-developed countries. Economies of scale will be crucial for successful low-cost deployments of HAPS technology.



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Additional means of connecting the unserved

It is noteworthy to mention that a global large-scale deployment of HAPS is not foreseen to occur at the expense of other connectivity solutions. On the contrary – it presents itself as an innovative proposal – an additional way to connect unserved and underserved areas.

The operational characteristics of the platform, which is defined in No. 1.66A of the Radio Regulations as "a station located on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth", enables the possibility of moving it to areas with higher-connectivity demands, and makes it a suitable communication solution to support, for example, natural disaster relief missions in areas that become disconnected all of a sudden. Solar-powered platforms also have a fast and environmentally-friendly deployment.

Feasibiliy of the candidate bands for HAPS

Several technical studies have been conducted by ITU-R to evaluate the feasibility of the candidate bands for HAPS. Such studies can be found in recently published reports, such as F.2471, F.2472 and F.2475).

Now it is up to the WRC-19 to decide whether these bands will be identified and what possible changes would be required to the Radio Regulations. The regulatory provisions should not impose undue constraints or unnecessary limitations for countries wishing to deploy this technology to give a chance for this application to succeed.

Instead, they should establish reasonable conditions for implementation of the systems, facilitate access to spectrum considering the most recent advances of the technology, ensure protection of incumbent services, and enable the shared use of the bands for more efficient usage of the spectrum.

Note: Any views expressed in this article do not necessarily reflect those of ITU.

Spectrum for air transport and safety

Loftur Jonasson

Technical Officer, Communications, Navigation, Surveillance and Frequency Spectrum, International Civil Aviation Organization (ICAO)

Air transport drives sustainable socio-economic development in hundreds of nations, and for the last 45 years air traffic growth has consistently defied economic recessionary cycles, expanding two-fold once every fifteen years.

These trends still hold true today and in 2018, air transport directly and indirectly supported the employment of 65.5 million people while contributing over USD 2.7 trillion to global GDP, and carrying over 4.3 billion passengers and over 60 million tonnes of cargo.

As a specialized agency of the United nations, the International Civil Aviation Organization (ICAO) was established by a number of States in 1944 to manage the administration and governance of the Convention on International Civil Aviation, also known as the Chicago Convention.

> *"Current and future air navigation, and air traffic management systems are highly dependent upon the availability of sufficient, suitably protected radio spectrum."*
>
> Loftur Jonasson

The ICAO Convention provides the required multilateral framework enabling commercial and civilian flights over the territories of its 193 member States. ICAO standards and recommended practices (SARPs), as contained in 19 annexes to the Convention, provide a complete regulatory framework for aviation, including personnel licensing, technical requirements for aircraft operations, airworthiness requirements, aerodromes and communication, navigation and surveillance systems.

The safety of air operation is highly dependent on the availability of reliable communication and navigation services. Current and future air navigation, and air traffic management systems are highly dependent upon the availability of sufficient, suitably protected radio spectrum that can support the high integrity and availability requirements associated with aeronautical safety systems supporting truly global operations.

Fixed-satellite service (FSS) spectrum for remotely-piloted aircraft systems

The ITU World Radiocommunication Conference in 2015 (WRC-15) took on the difficult task of developing provisions to enable the use of satellites operating under the fixed-satellite service (FSS) for the command and control (C2-Link, known in ITU as control and non-payload communications) of remotely-piloted aircraft systems (RPAS; also known as Unmanned Aircraft Systems; or UAS). This became Resolution 155 (WRC-15).

Developing SARPs – ICAO's biggest task in recent decades

Since 2014, ICAO has been developing SARPs that will guide States in setting their own national regulations regarding RPAS.

ICAO

This is one of the largest tasks ICAO has undertaken in recent decades. The current focus of the work is on SARPs related to airworthiness, operations, operator certification, licensing of remote pilots, air traffic management, C2-Link, detect and avoid, and security.

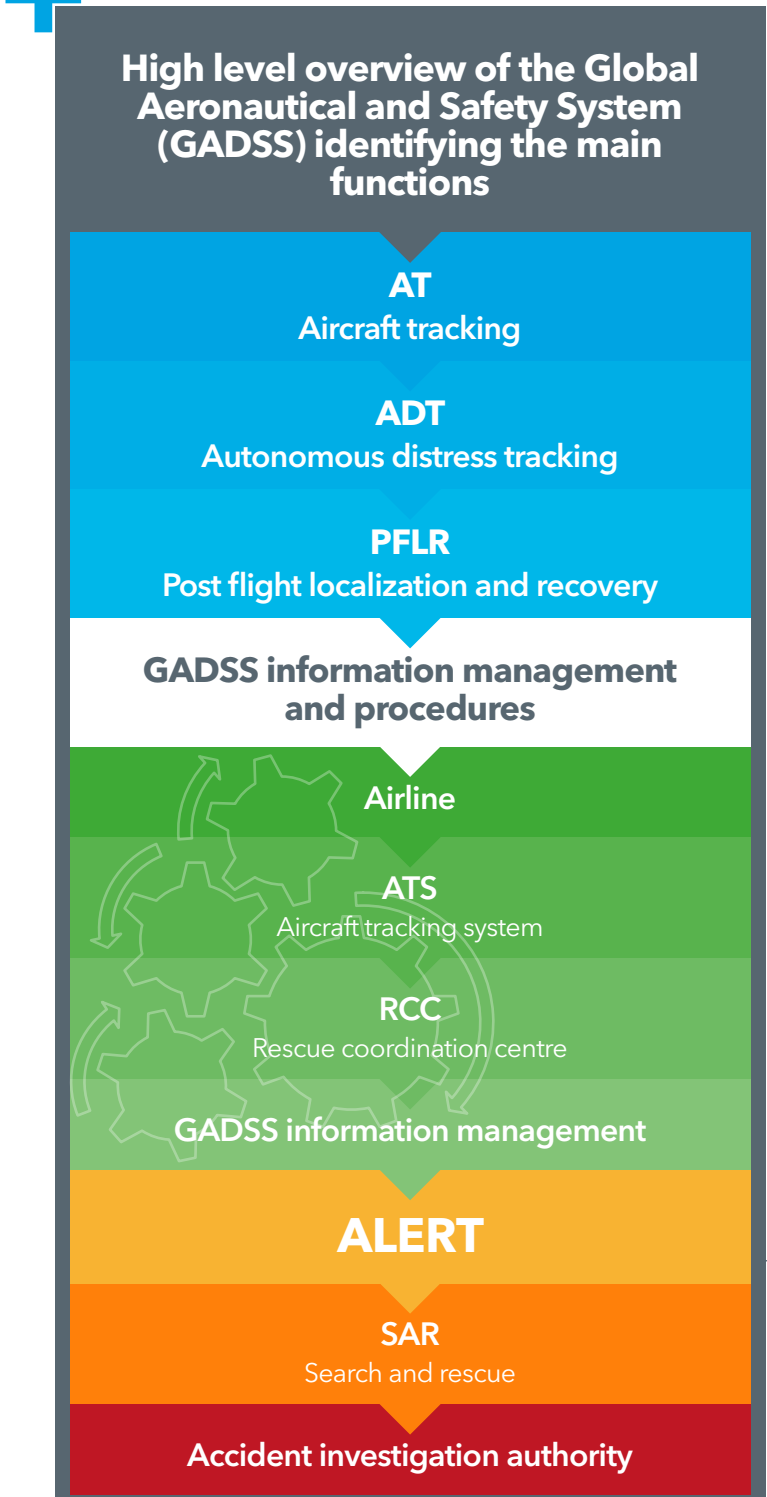
Resolution 155 (WRC-15) puts the responsibility into the hands of ICAO and aviation regulators to ensure that the C2-Link is free from harmful interference. As this is an unusual and untested approach, ICAO has been requested to report on the progress of developing SARPs for WRC-19 and WRC-23.

Progress is good thus far, and the initial drafting of the first of two packages of C2-Link SARPs was finalized in June this year, and circulated for review by States. Development of the second and more detailed technology-specific package has just begun.

Global Aeronautical Distress and Safety System (GADSS) (WRC-19 agenda item 1.10)

One of the many reasons aviation maintains such a high level of safety is the willingness to learn important lessons – even from very rare events – such as the tragedies of Malaysia Airlines flight 370 and Air France flight 447. These two tragedies highlighted the value of improved flight tracking and the alerting of search and rescue services, ultimately culminating in the Concept of Operations for the GADSS (see figure).

High level overview of the Global Aeronautical and Safety System (GADSS) identifying the main functions



Source: Global Aeronautical Distress and Safety System (GADSS) Concept of Operations (Version 6.0)

Based on the GADSS concept, the first set of new SARPs for flight tracking and autonomous distress tracking were recently introduced. It has already been concluded that the GADSS requirements can be satisfied using existing systems operating within current frequency allocations.

Hence, no action is required by WRC-19 to modify Article 5 of the Radio Regulations. However, some minimal amendments to Chapter VII may be useful, making reference to the GADSS and its related provisions, as contained in the ICAO regulatory framework.

Sub-orbital vehicles (WRC-19 agenda item 9.1.4)

Sub-orbital vehicles, including space planes, are being developed to reach altitudes and velocities that are much higher than those of conventional aircraft. Reusable sub-orbital vehicles that launch like traditional rockets have become routine, and re-useable space vehicles that routinely take off and land on traditional runways are close to becoming a reality. In the not so distant future, we may see hypersonic travel which could cut the travelling time between the most distant points on the Earth down to 90 minutes.

The introduction of sub-orbital vehicles will pose unique challenges for spectrum and frequency management communities. While transitioning between ground and space, these vehicles must safely share airspace used by conventional aircraft. Once they reach space, however, they no longer perform in a manner consistent with an aircraft. For that matter, even the definitions in the Radio Regulations don't seem to apply. Hence, further studies are required within ITU-R and, based on their outcome, attention by a future WRC may be needed.

Telemetry, tracking and command in the space operation service (WRC-19 agenda item 1.7)

While this WRC-19 agenda item is unrelated to aviation, it is highly relevant. Some of the potential solutions to it may have a significant impact on aeronautical operations.

One of the key aeronautical concerns arises from the possible use of an existing allocation in the frequency band 137–138 MHz for the space operation service (SOS) for the satellite downlink (space-to-Earth). This would potentially have a significant impact on aviation, by changing the existing environment.

Currently, very few satellites are operating in this band, especially near the band edge of 137 MHz. Immediately below the band edge, at 136.975 MHz, there is a common signaling channel for an ICAO standardized aeronautical VHF datalink system used for air traffic control purposes. Any spillover into this common signaling channel could disrupt the operation of that system on a global basis.

Global Maritime Distress and Safety System (GMDSS) modernization; the introduction of additional satellite systems into the GMDSS (WRC-19 agenda item 1.8)

Civil aviation has many things in common with the marine industry. We share certain systems and frequencies for safety and distress; and in the case of a marine distress, in all likelihood there will be aircraft involved in its search and rescue.

The marine industry is currently looking at improving the GMDSS by adding a satellite service to it. The same satellite service provider also operates an aeronautical mobile satellite safety service in portions of the affected frequency band (1616–1626.5 MHz). This operation takes place under the aeronautical mobile satellite (route) service (AMS(R)S), a safety service – afforded priority in accordance with Article 40 of the ITU Constitution.

This satellite system is used for aircraft position reporting and communications between air traffic controllers and aircraft pilots, particularly in remote, oceanic, and polar areas. Both of these services are required to ensure the safe separation of aircraft.

The radio regulatory conditions of this particular frequency band are quite complex. One current proposal to accommodate priority access to the GMDSS in this band may cause an adverse impact on the existing operation under the AMS(R)S in the band. This needs to be avoided.

Potential items for WRC-23

Two exciting items have been identified by aviation to be potentially addressed by the World Radiocommunication Conference in 2023 (WRC-23).

First, technology improvements have put the focus back on bands in the high frequency range (3–30 MHz) for the provision of high availability services to aviation, including digital voice and data, in remote and oceanic areas.

Second, the enabling of low Earth orbit satellite relay of certain VHF frequencies in the aeronautical mobile (route) service in some remote and oceanic areas may be a very cost effective means of improving air/ground pilot to controller communications, considering that this may not require any modification to existing equipage on-board aircraft.

Note: Any views expressed in this article do not necessarily reflect those of ITU.

Maritime communications – safeguarding the spectrum for maritime services

Kitack Lim

Secretary-General, International Maritime Organization (IMO)

The global economy relies on some 1.5 million seafarers who collectively ensure the delivery of 10.7 billion tons (and rising) of goods traded by sea on an annual basis. This includes vital commodities, the goods that people need as well as those they want. From containerized finished goods and raw materials, to bulk dry cargos (including grains and minerals), to oil and gas, and refrigerated cargoes – more than 80% of world trade is carried by sea.

The maritime sector – a key player in achieving the SDGs

We must also consider the millions of passengers taking cruises and ferry crossings on passenger ships each year, whose safety must be guaranteed. In addition, the world relies on shipping for the sustainable future of the planet, and the maritime sector is a key player in supporting the achievement of the United Nations' Sustainable Development Goals (SDGs).

> *"The use of spectrum allocated to existing (and future) maritime services must, therefore, be safeguarded."*
>
> Kitack Lim

Shutterstock

For the shipping industry to function effectively, safely, sustainably and to protect the marine environment, communication systems are fundamental. Shipping relies on radio spectrum allocation for navigation, for distress and safety communication, for on board communication – and for social communication between crews and family and friends ashore.

Therefore, as the United Nations specialized agency with the responsibility for developing and adopting the universal standards and guidance for safe, secure and efficient shipping, with a strong focus on protecting the environment, the International Maritime Organization (IMO) has a keen interest in the World Radiocommunication Conference 2019 (WRC-19).

Ensuring safety of life at sea

IMO's International Convention for the Safety of Life at Sea (SOLAS) requires ships to carry specialized equipment for navigation and communication. The origins of these regulations can be traced back to the very first iteration of the SOLAS Convention adopted in 1914, in the wake of the Titanic disaster, which laid bare the need for distinct 24/7 maritime distress radiocommunications.

The links between IMO and ITU have now been cemented over many decades. The development of maritime radiocommunications needs to take into account the operational needs – as defined by IMO – and the regulatory needs – as defined by ITU.

IMO's SOLAS chapter IV on Radiocommunications is fundamental to ensuring the safety of life at sea. It incorporates the Global Maritime Distress and Safety System (GMDSS), which was fully implemented in 1999. The GMDSS today is an integrated communication system, mandating requirements for terrestrial and satellite technologies and shipboard radiocommunication systems. The aim is to ensure that no matter where an emergency at sea occurs, a distress call can be sent out and shore-based rescue authorities alerted.

The development of the GMDSS followed on from the work initiated by IMO Member States in the 1960s to study operational requirements for a satellite system devoted to maritime purposes, and then in the 1970s the adoption of a convention establishing the International Maritime Satellite Organization (then called Inmarsat), under the auspices of IMO, to provide those satellite services.

Until now, Inmarsat has been the only operational GMDSS mobile satellite service provider, alongside Cospas-Sarsat, which is part of the GMDSS with respect to emergency position-indicating radio beacons (EPIRBs).

Over the past few years, IMO has put arrangements in place to facilitate the introduction of additional GMDSS mobile satellite service providers, including the adoption of pertinent amendments to the SOLAS Convention.

These amendments will enter into force on 1 January 2020. IMO's Maritime Safety Committee (MSC), the custodian of the SOLAS Convention, has also adopted a resolution to recognize the first additional maritime mobile satellite services provider, Iridium Satellite LLC.

In parallel with those developments and as instructed by the last WRC conference (WRC-15), the ITU Radiocommunication Sector (ITU-R) has conducted studies to support the introduction of additional satellite systems into the GMDSS.

In this context, IMO invites WRC-19 to support the introduction of additional satellite systems into the GMDSS, by taking regulatory measures, by 1 January 2020, to ensure full protection and availability of the frequency bands to be used by recognized GMDSS satellite service providers for the provision of GMDSS services.

Increasing autonomous maritime radio devices

Another issue of interest to the maritime community will be considered at WRC-19, under the agenda item related to the frequency band 156–162.05 MHz for autonomous maritime radio devices to protect the GMDSS and automatic identifications system (AIS). Increasing numbers of autonomous maritime radio devices that use AIS technology or digital selective calling (DSC) technology (or both) or transmit synthetic voice messages are being developed. Some are developed to enhance the safety of navigation – but others are not designed specifically for safety purposes.

IMO invites WRC-19 to regulate the use of frequencies and identities available for the maritime mobile service, for autonomous maritime radio devices which enhance the safety of navigation. Other arrangements should be considered for autonomous maritime radio devices which do not enhance the safety of navigation.

A left-over from WRC-15 is the need for modification of the Radio Regulations to include new spectrum allocations to the maritime mobile-satellite service to enable a new very high frequency (VHF) data exchange system (VDES) satellite component. VDES will include data transmitted by automatic identification system (AIS), application specific messages (ASM) and VHF data exchange. Under certain conditions, IMO supports the availability of VDES, including both terrestrial and satellite components.

Protecting the integrity of GMDSS at WRC-19

IMO strongly believes that the integrity of the GMDSS must be protected. The use of spectrum allocated to existing (and future) maritime services must, therefore, be safeguarded.

This plays a role in several of the agenda items to be considered by WRC-19. For example, in considering the frequency band 460–470 MHz, where this band is used by maritime mobile services for on-board communication stations.

When considering the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites, IMO urgently requests WRC-19 to avoid allocating spectrum, in particular in the frequency bands already in use by maritime services for safety of life services.

Maritime radiocommunication developments and WRC-23

In anticipation of future developments in maritime radiocommunications, IMO would like WRC-19 to ensure that the preliminary agenda for the next World Radiocommunication Conference (WRC-23) includes the consideration of maritime users. Specifically, WRC-23 should include possible spectrum needs and regulatory actions to support GMDSS modernization and the implementation of e-navigation.

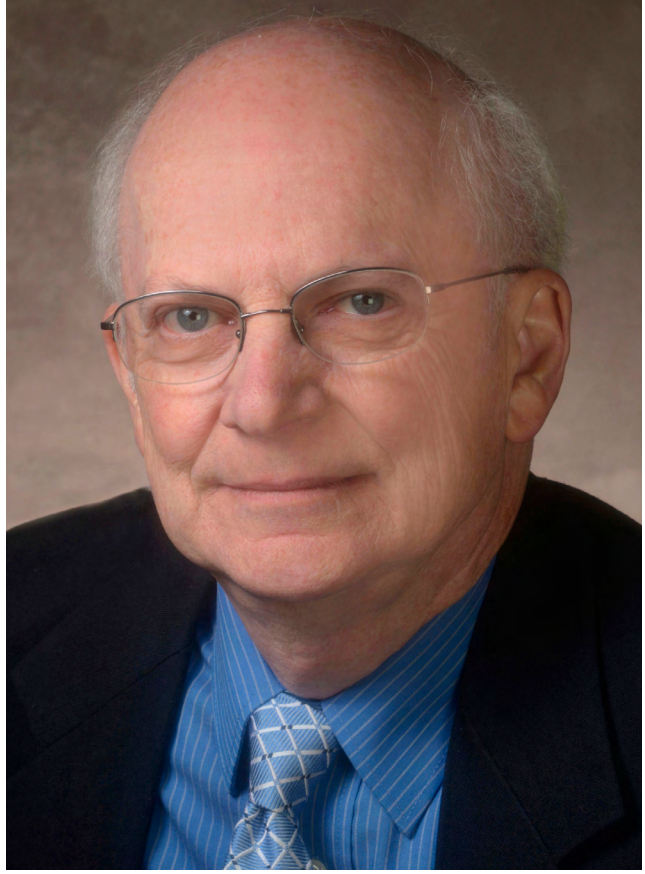
IMO looks forward to WRC-19 and to continue building on the long-established good collaboration with ITU.

Note: Any views expressed in this article do not necessarily reflect those of ITU.

Views of the International Amateur Radio Union on WRC-19 agenda items

David Sumner

Secretary, International Amateur Radio Union (IARU)



The International Amateur Radio Union (IARU) has participated in ITU conferences since 1927 and has been a Sector Member of ITU since 1932, playing an active role in the work of the ITU Radiocommunication Sector (ITU-R) and the ITU Telecommunication Development Sector (ITU-D) on behalf of more than three million licensees in the amateur and amateur-satellite services.

Overall IARU objectives for WRC-19 are:

- Global harmonization of the amateur 50–54 MHz allocation.
- Maintenance of existing spectrum access for amateurs.
- Strengthening protections for radiocommunication services against interference from other generators of radio-frequency (RF) energy.

> *"When new technology is developed that generates radio-frequency energy, it is essential that adequate protection of radiocommunication services be included in the system design."*
>
> David Sumner

Alfonso Tamez

The following agenda items are of particular interest.

Agenda item 1.1 – 50–54 MHz

The only WRC-19 agenda item on which the IARU seeks an improvement in an allocation to the amateur service is agenda item 1.1, regarding the frequency band 50–54 MHz in Region 1. The band is now allocated on a primary basis to the amateur service in Regions 2 and 3 and to some countries in Africa by country footnote.

The IARU supports modification of the Table of Frequency Allocations to allocate the band to the amateur service on a primary basis in Region 1, to provide a harmonized allocation across all three Regions.

Agenda item 1.7 – spectrum for non-GSO satellites

The IARU supports satisfying the spectrum requirements for non-GSO satellites with short duration missions within the existing allocations for the space operation service or the frequency ranges identified in invites ITU-R 3 of Resolution 659 (WRC-15), unless the satellites are amateur satellites as defined in Radio Regulations (RR) Nos. 1.56 and 1.57.

The band 144–146 MHz is especially important to amateurs as it is currently the only worldwide primary amateur and amateur-satellite allocation between 29.7 MHz and 24 GHz. It is heavily used in all three Regions for all forms of amateur communications including disaster response.

Agenda items 1.12 – intelligent transport systems; and 1.16 – wireless access systems

The frequency band 5650 to 5850 MHz (5650 to 5925 MHz in Region 2) is allocated to the amateur service on a secondary basis. The frequency band 5830 to 5850 MHz is allocated to the amateur satellite service (space-to-Earth) on a secondary basis, and in the frequency band 5650 to 5670 MHz, the amateur-satellite service (Earth-to-space) may operate subject to not causing harmful interference to other services operating in accordance with the Table of Frequency Allocations.

The frequency band 5760 to 5765 MHz is used for amateur weak-signal communication activity including terrestrial and Earth-Moon-Earth communications and propagation beacons.

There is growing interest among radio amateurs in experimentation, investigation of propagation phenomena, point-to-point communication and space communication in this band.

IARU requests that existing and future amateur use in this band be protected with special attention to the bands 5760 to 5765 MHz and 5830 to 5850 MHz.

Agenda item 1.13 – International Mobile Telecommunications

IARU supports no change (NOC) at 47–47.2 GHz. This narrow primary allocation to the amateur and amateur-satellite services, made at WARC-79 when the first terrestrial allocations above 40 GHz were agreed, is the only spectrum in which amateur experimentation with millimeter wavelengths can be conducted without practical constraints imposed by sharing with other services. Any identification for IMT in the frequency range 24.25–27.5 GHz should be accompanied by protection for the primary amateur and amateur-satellite allocation at 24–24.05 GHz, similar to what must be provided for the passive services below 24 GHz.

Agenda item 1.15 – 275–450 GHz

Resolution 767 (WRC-15) recognizes that the amateur service is developing and demonstrating applications above 275 GHz. As studies proceed to identify candidate frequency bands for other services in the frequency range 275–450 GHz the IARU supports maintaining access for non-commercial experimentation by stations in the amateur service to as much of the frequency range as possible, consistent with the protection of the passive and other active services.

Agenda item 4 – review of resolutions and recommendations of previous conferences

IARU supports the revision of Resolution 641 (REV.HFBC-87) proposed by the High Frequency Co-ordination Conference in ITU-R Study Group 6. Resolution 641 prohibits the broadcasting service from operating in the band 7000 to 7100 kHz. WRC-03 reallocated 7100 to 7200 kHz from the broadcasting service to the amateur service as part of a realignment of allocations between 7100 kHz and 7450 kHz. The conditions that led to the adoption of Resolution 641 still exist and now apply to the 7000 to 7200 kHz band.

Agenda item 9, issue 9.1.6 – wireless power transmission for electric vehicles (WPT-EV)

When new technology is developed that generates radio-frequency (RF) energy, it is essential that adequate protection of radiocommunication services be included in the system design. WPT-EV involves very large amounts of RF power and involves components connected in a system with associated power supplies and control equipment. The spurious emissions from all these system parts must be carefully controlled to avoid degrading the radio spectrum and causing interference to radiocommunication services in accordance with RR 15.12 and RR 15.13.

Sources of emissions on frequencies other than the fundamental frequency of WPT-EV could include:

- High order harmonics of the fundamental WPT frequency.
- Phase noise from the frequency control circuits ("jitter") causing wideband noise.
- Spurious signals from the switch-mode power supply on all control and power ports – conducted and common mode.
- Common mode signals on control cables and power lines from data communication networks associated with the control of the unit.

To ensure adequate protection to authorized radio services, proper compatibility studies must be conducted. IARU regards cooperation between ITU and standards organizations to be essential in the evolution of standards and frequencies for WPT-EV operation.

Agenda item 10 – items for inclusion in future WRC agendas

No future agenda items for new or harmonized spectrum allocations for the amateur services are being sought at WRC-19. This position does not preclude seeking specific allocations in the unallocated spectrum above 275 GHz if allocations to other services are considered.

IARU is carefully monitoring proposals for future agenda items that may impact existing amateur and amateur-satellite allocations.

Note: Any views expressed in this article do not necessarily reflect those of ITU.

WRC-19 agenda items related to space science and Earth observation

John E. Zuzek

Chairman, ITU Radiocommunication Sector (ITU-R) Study Group 7

Among the space science services are the Earth exploration-satellite and meteorological-satellite services, including systems for passive and active remote sensing of the Earth and its atmosphere. These radio services enable us to obtain important data about the Earth and its atmosphere. Also, the space research and space operation services are used by the world's civil space agencies to explore and work in space. These include robotic missions to other planets and objects in space along with the human exploration of space, the Moon, and beyond.

At a recent meeting of the Space Frequency Coordination Group (SFCG), various plans for lunar exploration were discussed including lunar missions from the United States, the European Space Agency (ESA), India, the Republic of Korea, China, Japan and Russia, among others. Access to and protection of the radio spectrum for these uses is critical to understanding the future of our planet and to all aspects of space exploration.

> *"Access to and protection of the radio spectrum for these uses is critical to understanding the future of our planet and to all aspects of space exploration."*
>
> John E. Zuzek

NASA

WRC-19 agenda items directly related to space science/meteorology

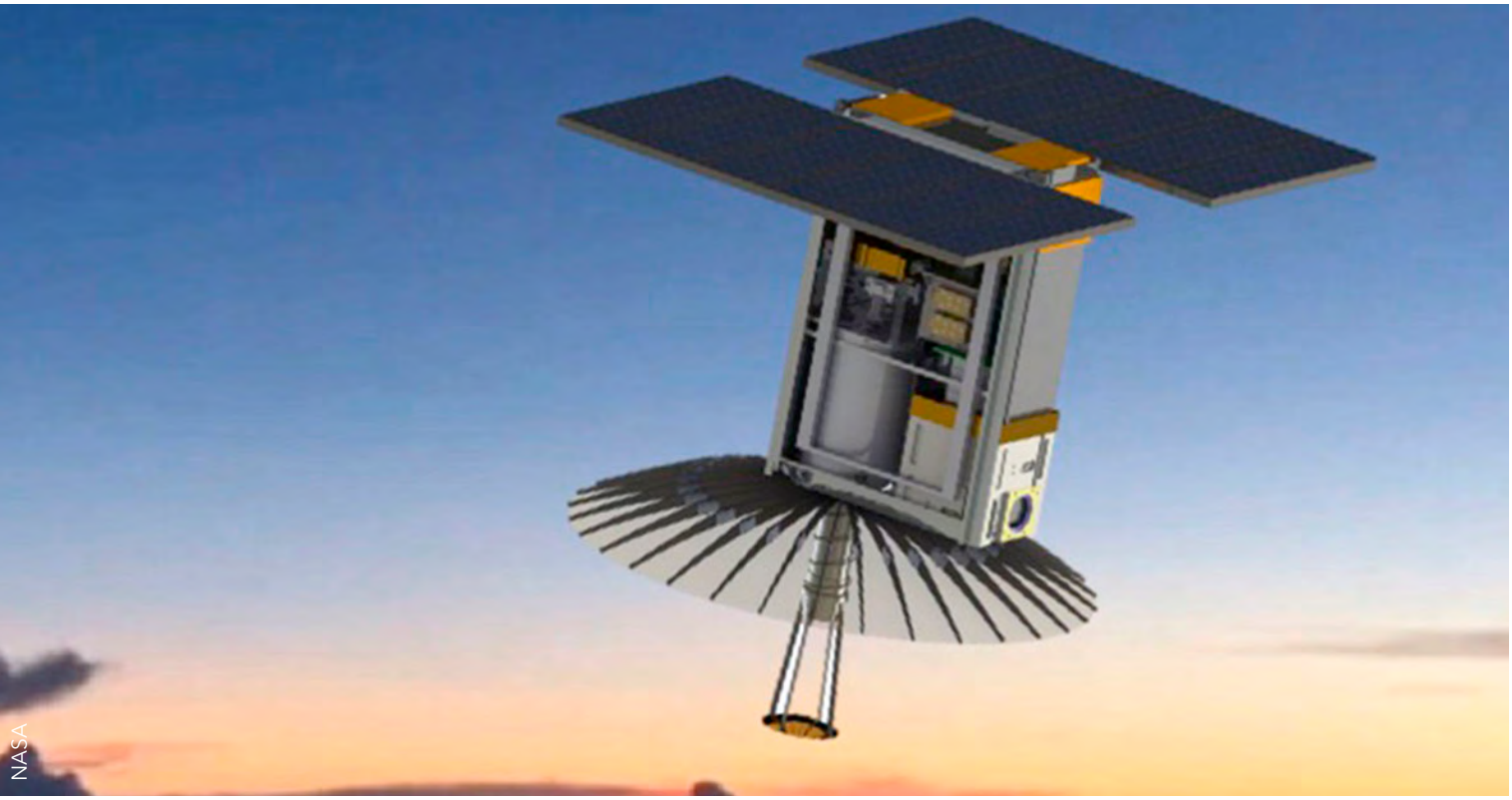
There are three WRC-19 agenda items directly related to space science and meteorology.

Agenda item 1.2 – frequency bands 401–403 MHz and 399.9–400.05 MHz

Agenda item 1.2 deals with in-band power limits for earth stations operating in the mobile-satellite service, meteorological-satellite service and Earth exploration-satellite service in the frequency bands 401–403 MHz and 399.9–400.05 MHz. This agenda item is a result of the recent significant increase in the use of these frequency bands for telemetry, tracking and command (TT&C) purposes.

The proliferation of such TT&C usage poses a potentially significant impact on the large number of existing lower power data collection system (DCS) stations communicating to sensitive receivers on GSO and non-GSO (NGSO) satellites.

Tens of thousands of DCS stations are deployed worldwide for collecting essential weather and climate data on small platforms such as ocean buoys. If the use of these bands for TT&C is not limited in some manner, the bands will become unusable by these low power DCS systems. Therefore, in-band power limits are needed to protect these DCS stations while allowing these small satellites to operate as well.


NASA

Agenda item 1.3 – frequency band 460–470 MHz

Agenda item 1.3 considers the possible upgrade of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a possible primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460–470 MHz. In order to provide for primary allocations in this band for space services, an appropriate power flux density (PFD) mask is needed for the space-to-Earth transmissions to protect the existing terrestrial users. These meteorological satellites are currently used for DCS downlink transmissions but on a non-interference, unprotected basis. Similarly, a number of small Earth-observation satellites have been using this band to downlink scientific data. The PFD mask derived by the ITU Radiocommunication Sector (ITU-R) studies will enable these systems to operate while protecting the terrestrial users in the band.

Agenda item 1.7 – TT&C

Agenda item 1.7 was developed to study the spectrum needs for TT&C in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations in certain portions of the radio spectrum. These NGSO short duration satellites are often small research satellites developed and operated by educational and scientific entities. There is currently limited spectrum available for their TT&C operations. Possible methods to satisfy this agenda item would provide possible solutions to this problem.

WRC-19 agenda items that may negatively impact space science/ Earth observation

There are several WRC-19 agenda items that are of concern to the space science and Earth-observation operators due to the possibility of negative impacts to these missions.

Agenda item 1.6 – NGSO fixed-satellite service

Agenda item 1.6 considers the development of a regulatory framework for NGSO fixed-satellite service (FSS) systems in certain bands between 37.5 and 51.4 GHz. Two of those frequency bands, 47.2–50.2 GHz and 50.4–51.4 GHz, for uplink transmissions are immediately adjacent to either side of the 50.2–50.4 GHz passive Earth observation band which is critical as a calibration window to measurements of atmospheric temperature.

The current limits in Resolution 750 (Rev. WRC-15) need to be properly revised to protect these important Earth observation functions from the aggregate interference from out-of-band emissions of both GSO and NGSO FSS systems.

Agenda item 1.13 – International Mobile Telecommunications

Agenda item 1.13 considers the 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 for this purpose in various bands from 24.25 to 86 GHz.

For space science operators, the main concern is protecting existing earth stations operating in 25.5–27 GHz for both Earth observation and space research downlinks and ensuring the operation of future receiving earth stations in this band.

The second issue involves the protection of certain critical Earth observation passive sensing bands, such as 23.6–24 GHz, 31.3–31.8 GHz, 50.2–50.4 GHz, 52.6–54.25 GHz, and 86–92 GHz. The protection of these bands from aggregate interference from out-of-band emissions from future IMT deployments is critical as many of these bands are used to obtain measurements on a global basis that cannot be made in any other way.

Agenda item 1.14 – high-altitude platform stations

Agenda item 1.14 considers appropriate regulatory actions for high-altitude platform stations (HAPS) within existing fixed service allocations. It should be noted that HAPS downlinks will have a more severe impact to space science receiving earth stations than HAPS uplinks. However, HAPS uplinks may have potential impact on adjacent band passive Earth observation sensor operations. Care must be taken to ensure the protection of these earth stations and Earth-observation sensors.

Agenda item 1.15 – land-mobile and fixed services

Finally, agenda item 1.15 considers identification of frequency bands for use by administrations for the land-mobile and fixed service applications operating in the frequency range 275–450 GHz. Currently, there are several bands that are being used by Earth observation systems in this frequency range.

Studies have indicated that except for the bands 296–306 GHz, 313–318 GHz and 333–356 GHz, the rest of this frequency range could be identified for use by fixed and land mobile operations while still protecting these Earth observation passive sensors.

Possible WRC-23 agenda items for space science and Earth observation

Currently, there are two items on the preliminary agenda for the World Radiocommunication Conference 2023 (WRC-23) that are directly related to the space science and Earth observation areas.

The first is agenda item 2.2, concerning a possible new allocation to the Earth exploration-satellite (active) service for spaceborne radar sounders within the range of frequencies around 45 MHz. This new application of Earth observation could enable the location of subsurface water from Earth orbit as well as measurements of ice thickness in the Polar Regions.

The second, agenda item 2.3, concerns space weather sensors, and the possibility of providing appropriate recognition and protection in the Radio Regulations for this important area of study. Space weather observations and study of the solar-terrestrial relationships have evolved from exploratory to operational as countries monitor solar flares and geomagnetic storms and their possible impact on life on Earth. The time has come to consider some sort of regulatory recognition of this important aspect of space and terrestrial science.

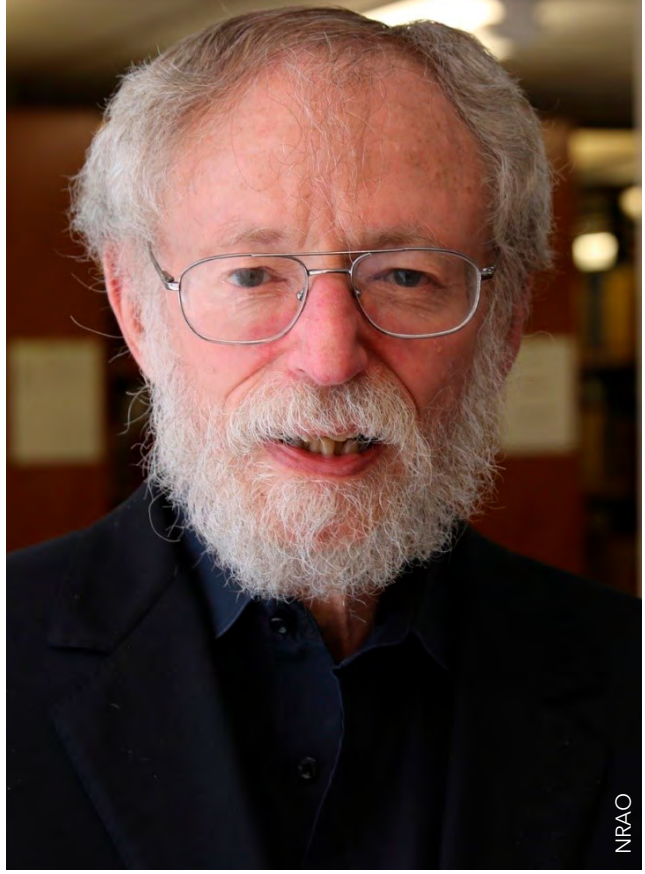
Other possible agenda items for WRC-23 being discussed in various regional groups that are related to space science and Earth observation are such things as a possible new allocation for the Earth exploration-satellite service in 22.55–23.15 GHz; radiocommunications for sub-orbital vehicles; a possible upgrade of the allocation of the band 14.8–15.35 GHz to the space research service; and, the consideration of possible adjustments to passive remote sensing allocations between 231.5 and 252 GHz.

Note: Any views expressed in this article do not necessarily reflect those of ITU.

Radio astronomy, spectrum management and WRC-19

Harvey Liszt

Spectrum Manager, National Radio Astronomy Observatory, (NRAO) and Chair, IUCAF

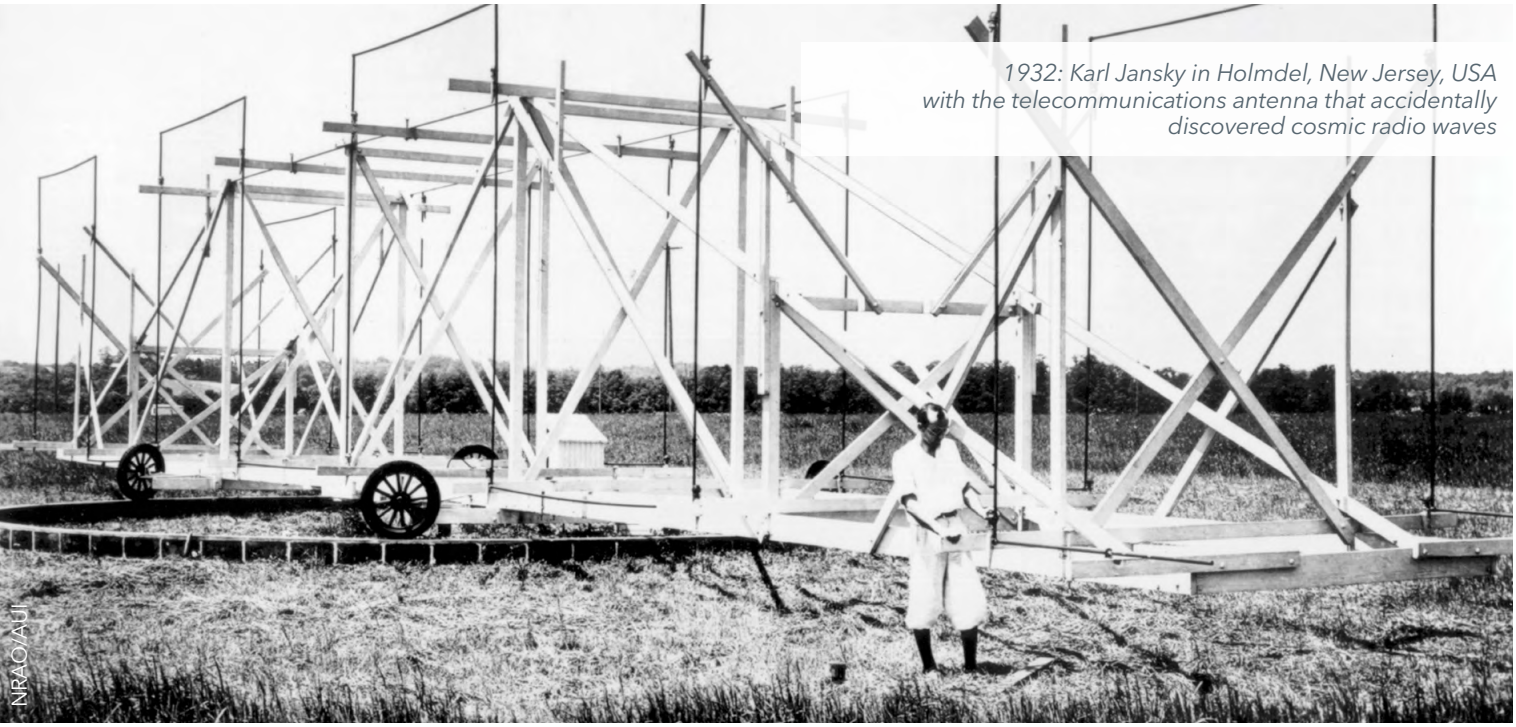

NRAO

Astronomy is the study of our place in the universe, and the radio astronomy service is responsible for many exciting discoveries in this grand endeavour. Whether imaging massive black holes in the centres of distant galaxies or watching new planetary systems form around nearby stars, radio astronomy's success depends on the careful management of radio spectrum. Radio astronomy will be strongly affected by the outcomes of the World Radiocommunication Conference 2019 (WRC-19), so it is a great privilege to contribute to this special edition of the ITU News Magazine.

Radio telescopes driven to "remote" sites

The discovery of cosmic radio waves by Karl Jansky in 1932 and the discovery of radio emission from the primordial Big Bang by Penzias and Wilson in 1964 were by-products of measurements to determine the noise contributions to telecommunication systems.

> *"Whether imaging massive black holes in the centres of distant galaxies or watching new planetary systems form around nearby stars, radio astronomy's success depends on the careful management of radio spectrum."*
>
> Harvey Liszt



NRAO/AUI

1932: Karl Jansky in Holmdel, New Jersey, USA with the telecommunications antenna that accidentally discovered cosmic radio waves

But the meadow where Jansky worked isn't used for radio astronomy now, as the need to avoid terrestrial interference has driven radio telescopes to remote sites that may also offer better high-frequency observing conditions. But the meaning of "remote" has changed: places that once seemed isolated are now merely suburban.

Truly remote areas range from the merely less-inhabited to the barely habitable, and the costs of operating there are considerable. In any case, new and old facilities alike require spectrum protection, and nowadays no site is hidden from high-altitude platforms, aircraft and satellites.

WRC-19 agenda items that impact on radio astronomy

Some WRC-19 agenda items stand out for their potential impact.

WRC-19 agenda item 1.13 – compatibility with 5G

Studies done under agenda item 1.13 have showed that strict limits on unwanted emissions and the use of appropriate coordination distances are critical elements of compatibility between radio astronomy and terrestrial 5G wireless.

Agenda item 1.14 – the challenge of HAPS

The high-altitude platform systems (HAPS) studied under agenda item 1.14 present unique challenges for radio astronomy. Circulating horizontally and moving vertically at nominal altitudes 20–26 km, HAPS platforms have service radii 50–70 km, but are visible above the horizon for 500 km or more.

Potential HAPS operators made substantial concessions in the levels of unwanted emissions at which they committed to illuminate radio telescopes, but the need for radio astronomy operators to avoid HAPS platforms' strong downlink signals will nonetheless require modification of RAS operations.

Agenda item 1.6 – concerns for optical astronomy

Agenda item 1.6 touches on a subject of great concern – spectrum for use by large fixed-satellite service (FSS) constellations in low Earth orbit (LEO) at 37–42.5 and 47–51.4 GHz. Comparable FSS LEO systems operating at 10.7–12.75 GHz are already being launched and have been of recent concern for their impact on the visual appearance of the night sky and optical astronomy more generally. Radio astronomy use of its primary allocation at 42.5–43.5 GHz is protected by Footnotes No. 5.551H and 5.551I in the Radio Regulations (RR), but the FSS systems studied under agenda item 1.6 were never defined with sufficient precision to identify the specific measures that FSS operators would have to take to meet the protection thresholds.

Agenda item 1.15 – a step towards allocating spectrum above 275 GHz?

Agenda item 1.15 addresses fixed service and land mobile service use of spectrum at 275–450 GHz, beyond the uppermost frequency allocations in Article 5.

Until now, this frequency range has been the near-exclusive province of radio astronomy and the Earth exploration satellite service (passive), with spectrum bands identified for use by their applications in RR Footnote No. 5.565. At WRC-19, a comparable footnote may be crafted identifying spectrum that can be used by the fixed and land mobile services, with consideration of compatibility but without regulatory constraints. Is this a step toward allocating spectrum above 275 GHz? Stay tuned.

Radio astronomy – a radio service or radiocommunication service?

Because it receives only cosmic radiation (or so we hope), radio astronomy has a somewhat unusual status in the ITU Radiocommunication Sector (ITU-R): it is a radio service but not a radiocommunication service. This could change if the radio search for extraterrestrial intelligence (SETI) succeeds and we begin to communicate with alien life forms in their protected frequency bands. In the meantime, RR No. 4.6 states "For the purpose of resolving cases of harmful interference, the radio astronomy service shall be treated as a radiocommunication service." This is unambiguous and rendered comparably in French. But a second sentence addressing unwanted emissions differs in the French and English, and reconciling the difference will be discussed at WRC-19 under agenda item 9. This arcane subject is of great interest to radio astronomy because it concerns some of the most basic aspects of its operation as a radio service.

2019: The 100 m Robert C. Byrd Green Bank Telescope in West Virginia, United States; a modern radio telescope that observes under the protection of our Radio Regulations while also searching for evidence of extraterrestrial civilizations at frequencies that might be protected by theirs

A new generation of radio telescopes

Astronomy might seem to be way "out there," but it is actually done "right here", and a new generation of radio telescopes is being constructed on scales that were scarcely imaginable a few decades ago. The mm/sub-mm ALMA array operating at 5000 m elevation was recently inaugurated in Northern Chile, the Square Kilometre Array is under development in Australia and South Africa, and planning for the next-generation VLA (ngVLA) is underway in the United States.

Towards success for radio astronomy at WRC-19

IUCAF's world map of radio telescopes and quiet zones is available here. Operating such instruments in the terrestrial environment of an increasingly crowded sky and busy radio spectrum presents a variety of challenges, but underlying everything is access to the radio spectrum. Radio astronomy looks forward to working with other services to bring WRC-19 to a successful and mutually satisfactory conclusion.

Note: Any views expressed in this article do not necessarily reflect those of ITU.

Studies on the use of frequency bands above 275 GHz by land-mobile and fixed service applications

José Costa

Director, Wireless Access Standards, Ericsson

In the Radio Regulations (RR) there are no frequency allocations above 275 GHz. RR No. 5.565 identifies certain frequency bands in the range 275–1000 GHz for use by administrations for passive service applications, without precluding the use of this range by active services and urging administrations to take all practicable steps to protect the passive services from harmful interference. Thus, in the RR there is already an implicit identification for land-mobile and fixed service applications above 275 GHz. RR No. 5.565 also indicates that all frequencies in the range 1000–3000 GHz may be used by both active and passive services.

WRC-19 agenda item 1.15 is to consider the identification of frequency bands for use by administrations for the land-mobile and fixed service applications operating in the frequency range 275–450 GHz, in accordance with Resolution 767 (WRC-15). This range of spectrum is expected to play an important role in providing connectivity for the increasing population in countries.

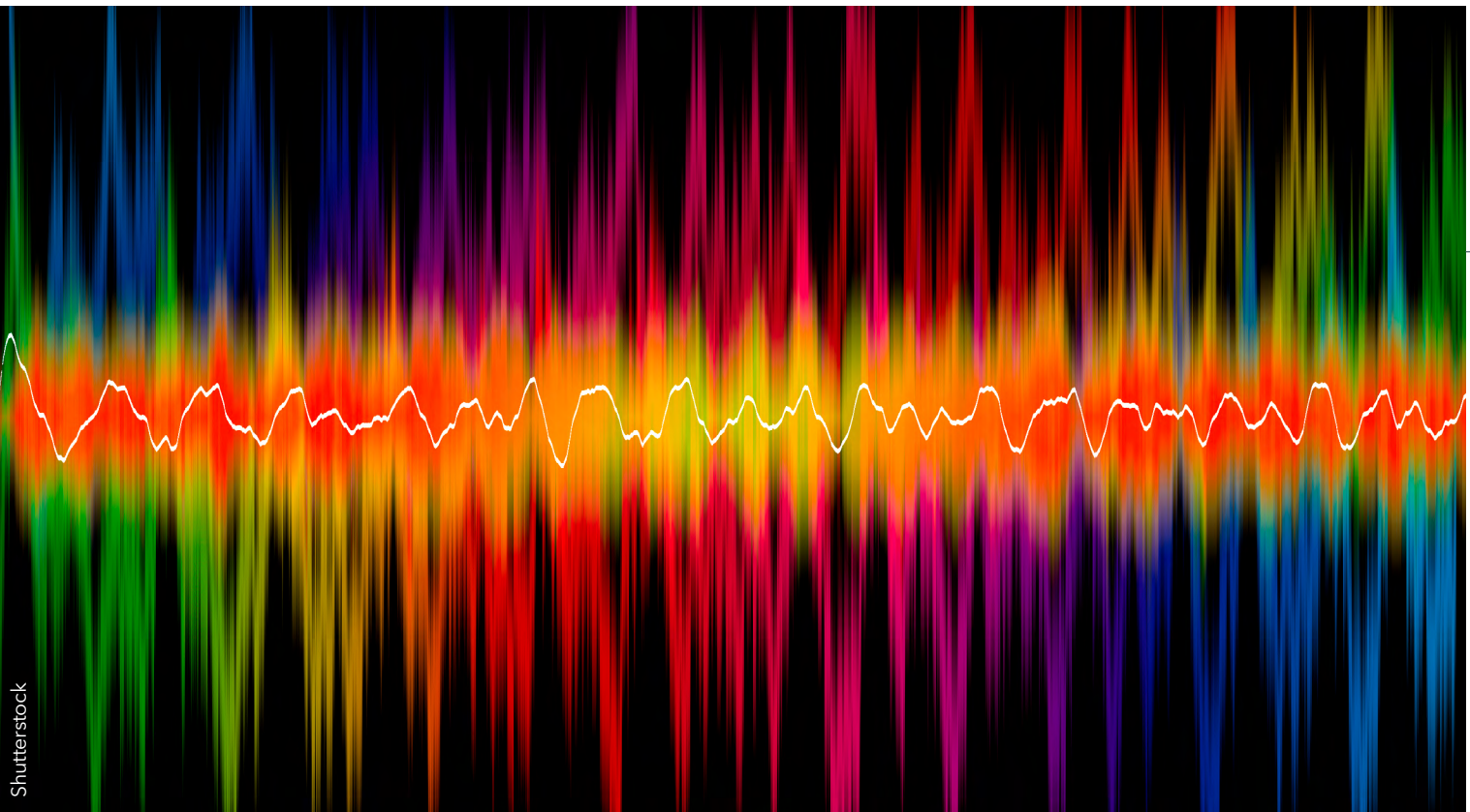
> *"The technological development of active services above 275 GHz is in its infancy and is expected to evolve over a long period of time."*
>
> José Costa

ITU-R studies to date

Recent advances in microwave technology make possible the use of frequencies above 275 GHz by active services for communications and other uses (cf. Reports ITU-R F.2416, M.2417, RA.2189, RS.2194, RS.2431, SM.2352 and SM.2450).

The studies conducted in the ITU Radiocommunication Sector (ITU-R) in support of WRC-19 agenda item 1.15 include the characterization of the land-mobile and fixed service applications that use and/or aim to use this frequency range, due to increasing interest. They were developed in a relatively short time to provide timely input for the sharing and compatibility studies:

- Report ITU-R F.2416 (11/2017) "Technical and operational characteristics and applications of the point-to-point fixed service applications operating in the frequency band 275–450 GHz", provides fixed service applications and their technical and operational characteristics operating in the frequency range 275–450 GHz for sharing and compatibility studies between fixed service applications and passive services, as well as among active services in the frequency range 275–450 GHz.



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- Report ITU-R M.2417 (11/2017) "Technical and operational characteristics of land-mobile service applications in the frequency range 275–450 GHz", covers close proximity mobile systems operating in the frequency range 275–450 GHz, including a description of the applications and characteristics of kiosk downloading mobile systems, ticket gate downloading mobile systems, inter-chip communication systems, intra-device communications, and wireless links for data centers. These are all high-capacity mobile applications over short distances, generally operating indoors.

The sharing and compatibility studies between land-mobile, fixed and passive services in the frequency range 275–450 GHz are documented in Report ITU-R SM.2450 (06/2019) "Sharing and compatibility studies between land-mobile, fixed and passive services in the frequency range 275–450 GHz". The report contains several studies to assess frequency sharing between passive service applications (radio astronomy and Earth exploration satellite) and the fixed and land-mobile service applications in the 275–450 GHz range.

The compatibility studies, based on the technical information available in Reports ITU-R M.2417-0 and ITU-R F.2416-0, seek spectrum that can be used by these applications without the need for specific constraints to protect passive service applications. The passive service studies are based on Reports ITU-R RA.2189-1 and ITU-R RS.2431-0:

- Report ITU-R RA.2189-1 (09/2018) "Sharing between the radio astronomy service and active services in the frequency range 275–3000 GHz" concluded that, at the emission powers considered there, sharing between radio astronomy and active services in the band 275–3000 GHz is possible if atmospheric characteristics as a function of height above sea level, as well as transmitter antenna directivity, are taken into account.

Harmful interference to radio astronomy facilities can be avoided using geographic exclusion zones surrounding radio astronomy facilities. Direct illumination of radio astronomy observatories, primarily at altitudes comparable to or above those of the observatories, could cause interference to radio astronomy systems.

Apart from exclusion zones, two basic strategies are possible for protecting the radio astronomy in these bands from fixed service emissions. The first involves lower powers and narrow beam antennas, and the second involves avoiding pointing towards radio astronomy facilities.

While this should be straightforward for most fixed service point-to-point uses, it is not applicable to some other terrestrial applications such as mobile use.

This report highlights the importance of sharing studies at specific geographic locations on a case-by-case basis.

- Report ITU-R RS.2431-0 (09/2018) "Technical and operational characteristics of EESS (passive) systems in the frequency range 275–450 GHz" provides the technical and operational characteristics of Earth observation (passive) sensors in the frequency range 275–450 GHz, to be used for sharing and compatibility studies between Earth exploration satellite (passive) remote sensing, and land-mobile and fixed service applications.

Most of the studies in Report ITU-R SM.2450 concluded that in the bands 275–296 GHz, 306–313 GHz, 320–330 GHz, and 356–450 GHz, no specific conditions to protect the Earth exploration satellite service (EESS) applications are necessary, for systems operating within the parameters given in the referenced ITU-R Reports.

These studies did not seek to develop conditions (such as power limits, shielding requirements and/or elevation angle restrictions, etc.) that could facilitate sharing with EESS in other frequency bands. Therefore, it is possible that active terrestrial service applications may very well share spectrum with EESS applications in other bands with conditions yet to be determined.

Thus, in the remaining frequency bands, 296–306 GHz, 313–320 GHz, 330–356 GHz, specific conditions are necessary, such as shielding, to ensure the protection of EESS (passive) applications from fixed and land mobile service applications, by using the latest relevant ITU-R Recommendations.

What's at stake?

The availability of enough spectrum for mobile backhaul applications will be critical for advanced and innovative mobile access operations as 5G, 6G, and beyond systems develop and traffic grows, while the traditional fixed service bands for backhaul run out of capacity. Indeed, there are other articles in this special issue covering the importance of WRC-19 agenda item 1.13 on the identification of spectrum for IMT. Furthermore, it is still to be determined the use of the frequencies above 275 GHz for fixed and mobile wireless access for 6G and beyond. Thus, it is necessary to keep all options open, and avoid adding anything in the RR that would curtail the use of this band for mobile backhaul and access in the future; particularly since the studies for this agenda item were unavoidably rather hurried.

It is necessary to enable the use of very large contiguous bandwidths to support high capacity and extreme peak data rates for mobile backhaul and access links. For example, as explained in Report ITU-R F.2416, the overall propagation conditions in the range 275–320 GHz band are similar to the frequency range 252–275 GHz that already has an allocation to the fixed service, thus the range 252–320 GHz would enable 68 GHz for backhaul systems capable of fulfilling the demands for very high capacity transmissions. Therefore, this frequency range may very well be used for outdoor point-to-point fixed service applications over several hundred metres, making it suitable for short distance and very high capacity fixed backhaul services, as an alternative to wireline applications in villages, suburban and dense metro areas.

The ITU–R studies on the compatibility of passive and active services have shown that, depending on the specific sub-band of the 275–450 GHz frequency range and the combined use of active and passive service applications, coexistence can be achieved either without needing specific conditions, or with the implementation of mitigation techniques such as minimum separation distances and avoidance angles. Adequate shielding has not been ruled out as an effective mitigation technique to protect EESS. ITU–R Recommendations and Reports on coexistence between active and passive service applications are expected to evolve over time to reflect technological developments.

Thus, it should be plausible and vital to have access to the 275–450 GHz frequency range for use by terrestrial fixed and land mobile service applications, while protecting EESS (passive) and the required terrestrial-based radio astronomy applications using the evolving guidance of ITU–R Recommendations and Reports. This would enable the use of the whole range, some parts without conditions and other parts with conditions, to be specified in the future. Further studies are needed in ITU–R to analyse the feasibility of using all the frequencies above 275 GHz, including the associated required conditions.

Summary

Since the use of the frequencies above 275 GHz offers many opportunities in the medium to long term for land-mobile and fixed service applications, it is important to continue studying the use of these frequencies in a coordinated and sincere manner.

The technological development of active services above 275 GHz is in its infancy and is expected to evolve over a long period of time. Further studies are therefore required to facilitate the use of frequencies above 275 GHz by all service applications. Such studies should address the evolving technical and operational characteristics, requirements, performance, and benefits associated with the use of the frequencies above 275 GHz by all service applications, and include the need to protect the EESS (passive) and radio astronomy applications.

Note: Any views expressed in this article do not necessarily reflect those of ITU.

WRC-19: Driving the growth of satellite broadband

Kathryn Martin

Director, Asia and the United States, Access Partnership

Wireless communications technologies are advancing at an unparalleled rate. New innovations have enabled impressive broadband speeds and extended reach, yet one technology stands out in its ability to bring connectivity to all: broadband satellite networks.

Satellite Internet services have come a long way over the last 20 years. Operators used to repurpose satellites that were not originally designed for Internet broadband, resulting in slow and expensive services compared to traditional wired Internet. Spurred-on by customer demand, satellite operators have invested in cutting-edge high-throughput satellites which increase Internet capacities by hundreds of orders of magnitude while greatly lowering the cost per megabyte. Internet speeds and prices are now comparable to terrestrial services, but with ubiquitous satellite coverage. Previously unserved and underserved communities, which land-based networks had deemed "not viable", can now be fully connected.

> *"A handful of critical agenda items will determine the level and reach of next-generation innovation and the success of future satellite networks."*
>
> Kathryn Martin

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Satellite companies are also leading innovation in the communication technology field, developing next-generation powerful, high-throughput Ka-band satellites that increase coverage areas and employ state-of-the-art technologies to provide secure connections to consumers, businesses and governments. These impressive constellations always keep people connected, whether at home, in the office, or on the move.

WRC-19 – Enabling satellite Internet to bridge the digital divide

The World Radiocommunication Conference (WRC-19) will play an important role in realizing the vision of satellite Internet companies to bridge the digital divide. The Conference is also central for regulators and policy-makers who seek to ensure that essential communication services are made available to their citizens.

This year's WRC is no exception, as administrations will make decisions that will have an impact on closing the digital connectivity gap. A handful of critical agenda items (AIs) will determine the level and reach of next-generation innovation and the success of future satellite networks and their goal of universal and affordable Internet coverage.

Agenda item 1.5 – a framework for earth stations in motion

WRC-19 agenda item 1.5, which considers a framework for earth stations in motion (ESIM), will be paramount in determining the future of satellite-broadband's reach and scale. At the last WRC, in 2015, the conference adopted a framework to allow ESIM to communicate with geostationary (GSO) fixed-satellite service (FSS) networks in the 19.7–20.2 GHz and 29.5–30 GHz bands.

WRC-15 adopted this agenda item to consider expansion of the frequency range in which ESIM can communicate to include the 18 GHz (17.7–19.7 GHz) and 28 GHz (27.5–29.5 GHz) bands at WRC-19.

The proposals being made seek to streamline the process to deploy aeronautical, maritime and land ESIM enabling connectivity for first responders, law enforcement and passengers on various modems of travel, including transport and shipping vessels, trains, airplanes and automobiles.

Ka-band satellite applications are already operating successfully on planes today, but regulations are fractured and restrictive. Expanding the use of these technologies is a natural next step in the evolution of mobile connectivity that will further enable communications and business in transit.

Agenda item 1.6 – regulatory guidance for little-developed bands

As satellite network design evolves to deliver true broadband connectivity, there is a corresponding need for additional spectrum to satisfy this demand. Under agenda item 1.6, the Conference will seek to develop regulatory procedures defining how non-GSO and GSO satellite networks share Q- and V-band fixed-satellite service spectrum between 37.5 GHz and 51.4 GHz. These bands are presently little-developed, but the availability of clear regulatory guidance will ensure that all advantages of satellite communication networks are realized.

Setting the agenda items for consideration at WRC-23

WRC-19 must also set the future agenda items for consideration at WRC-23, and initiate the studies needed. One such proposal is to examine the compatibility of fixed-satellite systems with terrestrial services allocated in the so-called "E-band" between 71–76 GHz and 81–86 GHz. Access to the E-band spectrum by fixed-satellite services would further bolster the broadband capacity delivered by satellite networks, improve connectivity speeds to end users, and position satellite services as an alternative or complementary platform to terrestrial networks for big-data applications.

In the context of setting future agenda items it is worth noting that the current satellite spectrum at the Ka-band has been targeted by the International Mobile Telecommunications (IMT) community. For the continued development of satellite broadband, Ka-band satellite spectrum must be protected from incursions by the IMT community.

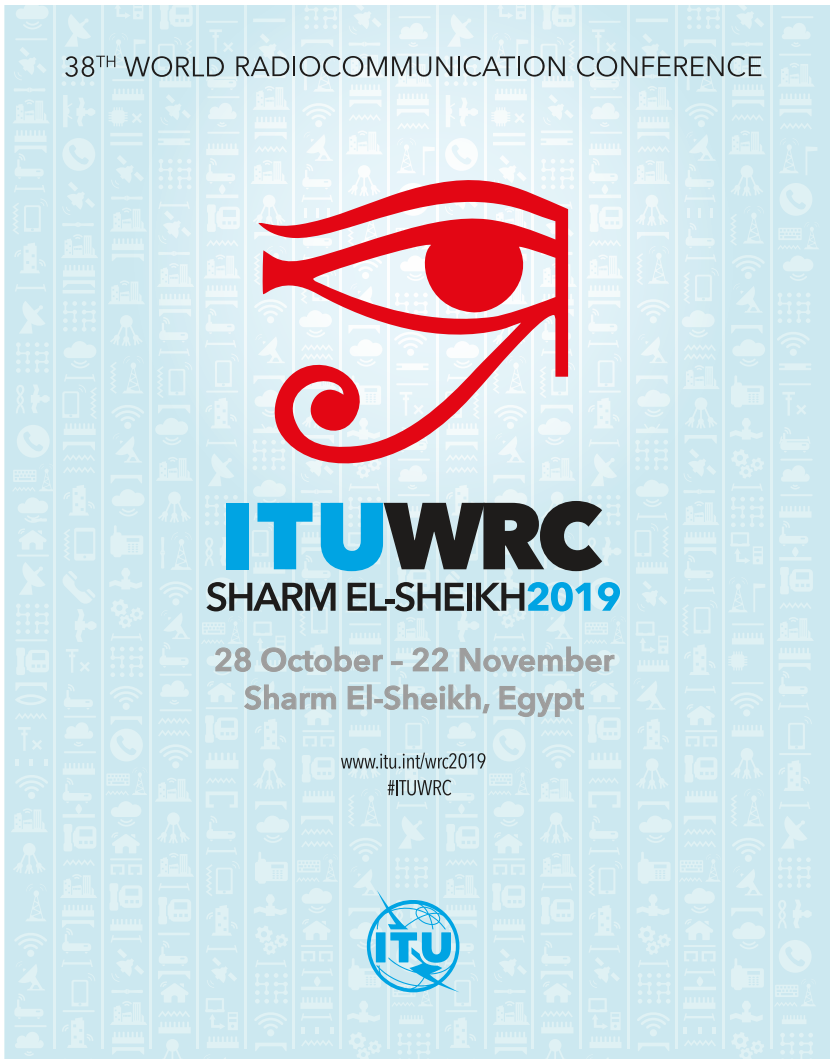
Agenda item 7 – improvements to regulatory procedures for satellite services

Finally, WRC-19 will consider improvements to the regulatory procedures for deploying satellite services, under agenda item 7. Decisions made under this agenda item result in reduced regulatory burdens on satellite operators and increased regulatory certainty, underpinning the continued investment in this fast-growing sector.

Innovation is being empowered by digital solutions supported by a critical backbone – the Internet. Connecting the unconnected to the global marketplace is essential to drive inclusive and sustainable economic growth where ideas, goods and services are shared with ease and efficiency.

Satellite Internet is at the forefront of this innovation lifecycle, aiming to provide Internet to anyone, anywhere. The upcoming WRC-19 plays a critical role in realizing this vision, and must protect satellite broadband spectrum for satellite innovations and services.

Note: Any views expressed in this article do not necessarily reflect those of ITU.



Roadmap to WRC-23

WRC-19

Defines the agenda for WRC-23

CPM-1

Allocates the work of the agenda items to the relevant study groups, rapporteurs, and defines the chapters and the structure of the CPM Report

ITU-R Study Groups (SGs)

Conduct studies for 4 years and prepare draft CPM text

SG 1	SG 3	SG 4
Spectrum management	Radiowave propagation	Satellite services
SG 5	**SG 6**	**SG 7**
Terrestrial services	Broadcasting service	Broadcasting service

CPM-2

Consolidates the CPM text that includes the methods to solve each agenda item

RA

Appoints study group chairmen and vice-chairmen, revises the structure of the study groups, and approves or revises ITU-R Resolutions

WRC-23

Modifies the Radio Regulations (e.g. allocation/ identification of frequency bands)

ITURA SHARM EL-SHEIKH 2019

21 – 25 October
Sharm El-Sheikh, Egypt

Regional groups/ multicountries

Consolidates Regional and Multicountry proposals

- Asia-Pacific Telecommunity (APT)
- Arab Spectrum Management Group (ASMG)
- African Telecommunications Union (ATU)
- European Conference of Postal and Telecommunications Administrations (CEPT)
- Inter-American Telecommunication Commission (CITEL)
- Regional Commonwealth in the Field of Communications (RCC)

WRC = World Radiocommunication Conference
CPM = Conference Preparatory Meeting
ITU-R = ITU Radiocommunication Sector
RA = Radiocommunication Assembly

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