ITU World Radiocommunication Conference 2023 (WRC-23)

Shinya Otsuki, Nobuki Sakamoto, Saiko Kameda, and Junichi Iwatani

Abstract

Since radio waves used in radio communications travel across national borders, international rules are required. Therefore, the International Telecommunication Union (ITU), the United Nations' organization specialized in telecommunications, set forth the Radio Regulations (RR), which provides international rules for radio waves in each frequency and in each region of the world. The RR is reviewed and revised about every four years, and the international conference held for this purpose is the ITU World Radiocommunication Conference (WRC). Since the revised RR will be reflected in the regulations of Japan, the WRC is an extremely important meeting for the NTT Group, which provides mobile phones and other wireless services. This article reports on the ITU WRC 2023 (WRC-23) held in Dubai, United Arab Emirates, from November 20 to December 15, 2023.

Keywords: ITU-R, World Radiocommunication Conference, Radio Regulations

1. ITU World Radiocommunication Conference 2023 (WRC-23)

The World Radiocommunication Conference (WRC) is the largest conference in the International Telecommunication Union (ITU) to discuss updating the Radio Regulations (RR), which provides international rules and regulations for allocation of the spectrum to radio services, use of satellite orbits, and administrative and operational procedures for radio stations. The WRC is usually held every three to four years [1] and the last WRC, the ITU WRC 2023 (WRC-23), was held in Dubai, United Arab Emirates, from November 20 to December 15 (**Fig. 1**). Approximately 3900 participants from 163 Member States attended the WRC-23 and discussed agenda items for revision of the RR, as shown in **Table 1**. About 130 delegates from Japan, including the Ministry of Internal Affairs and Communications, other government agencies, and private companies attended the WRC-23, as well as NTT and NTT DOCOMO from the NTT Group.

In the RR, the world is divided into three regions, as shown in **Fig. 2**, and frequencies are allocated to services all over the world or in each region. In some cases, frequencies are allocated to services only for specific countries. As also shown in Fig. 2, there are four regional telecommunication organizations in Region 1, one in Region 2, and one in Region 3. Each

Fig. 1. WRC-23 meeting session.

Table 1. Agenda items of WRC-23.

No.	Agemda item
1.1	Possible measures to address, in the frequency band 4800–4990 MHz, protection of stations of the AMS and MSS located in international airspace and waters from other stations located within national territories and to review the pfd criteria in No. 5.441B.
1.2	Study of IMT identification including primary distribution to mobile operations in the 3300–3400 MHz, 3600–3800 MHz, 6425–7025 MHz, 7025–7125 MHz and 10.0–10.5 GHz bands
1.3	Studies to consider possible allocation of the frequency band 3600–3800 MHz to the mobile, except aeronautical mobile, service on a primary basis within Region 1
1.4	Facilitating mobile connectivity in certain frequency bands below 2.7 GHz using high-altitude platform stations as International Mobile Telecommunications base stations
1.5	Review of the spectrum use of the frequency band 470–960 MHz in Region 1
1.6	Consideration of regulatory provisions to facilitate the introduction of sub-orbital vehicles
1.7	Studies on a possible new allocation to the aeronautical mobile-satellite (R) service within the frequency band 117.975–137 MHz in order to support aeronautical VHF communications in the Earth-to-space and space-to-Earth directions
1.8	Review and possible revision of Resolution 155 (Rev.WRC-19) and No. 5.484B in the frequency bands to which they apply
1.9	Consideration of regulatory provisions for updating Appendix 27 of the Radio Regulations in support of aeronautical HF modernization
1.10	Studies on frequency-related matters, including possible additional allocations, for the possible introduction of new non-safety aeronautical mobile applications
1.11	Consideration of possible regulatory actions to support modernization of the Global Maritime Distress and Safety System and the implementation of e-navigation
1.12	Possible secondary allocation to the Earth exploration-satellite service (active) for spaceborne radar sounders in the range of frequencies around 45 MHz
1.13	Examination of a possible upgrade to primary status of the secondary allocation to the space research service in the frequency band 14.8–15.35 GHz
1.14	Review of existing distributions and review of new distributions for earth exploration satellite services (passive) in the 231.5–252 GHz band in accordance with the requirements of modern remote sensing observations
1.15	Operation of earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service in the frequency band 12.75–13.25 GHz (Earth-to-space)
1.16	Use of the frequency bands 17.7–18.6 GHz, 18.8–19.3 GHz and 19.7–20.2 GHz (space-to-Earth) and 27.5–29.1 GHz and 29.5–30 GHz (Earth-to-space) by earth stations in motion communicating with non-geostationary space stations in the fixed-satellite service
1.17	Study of technical and operational issues and regulatory provisions for satellite-to-satellite links in the frequency bands 11.7–12.7 GHz, 18.1–18.6 GHz, 18.8–20.2 GHz and 27.5–30 GHz
1.18	Studies relating to spectrum needs and potential new allocations to the mobile satellite service in the frequency bands 1695–1710 MHz, 2010–2025 MHz, 3300–3315 MHz and 3385–3400 MHz for future development of narrowband mobile-satellite systems
1.19	Primary allocation to the fixed-satellite service in the space-to-Earth direction in the frequency band 17.3–17.7 GHz in Region 2
2	Use of incorporation by reference in the Radio Regulations
4	General review of the Resolutions and Recommendations of world administrative radio conferences and world radiocommunication conferences
7	Implementation of Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference
8	Footnotes to the Table of Frequency Allocations in Article 5 of the Radio Regulations
9	Report of the Director of the Radiocommunication Bureau
9.1	Activities of the ITU Radiocommunication Sector since WRC-19
Issue a)	Protection of radio spectrum-reliant space weather sensors used for global prediction and warnings
Issue b)	Studies on technical and operational measures to be applied in the frequency band 1240–1300 MHz to ensure the protection of the radionavigation-satellite service (space-to-Earth)
Issue c)	Use of International Mobile Telecommunications systems for fixed wireless broadband in the frequency bands allocated to the fixed service on a primary basis
Issue d)	Protection of EESS in the frequency band 36–37 G
9.2	Report of the Director on any difficulties or inconsistencies encountered in the application of the RR and comments from administrioons
9.3	Action in response to Resolution 80 (Rev. WRC-07)
10	Preliminary agenda for the 2027 World Radiocommunication Conference

AMS: aeronautical mobile service
EESS: Earth exploration-satellite service
HF: high frequency
MSS: mobile-satellite service
VHF: very high frequency

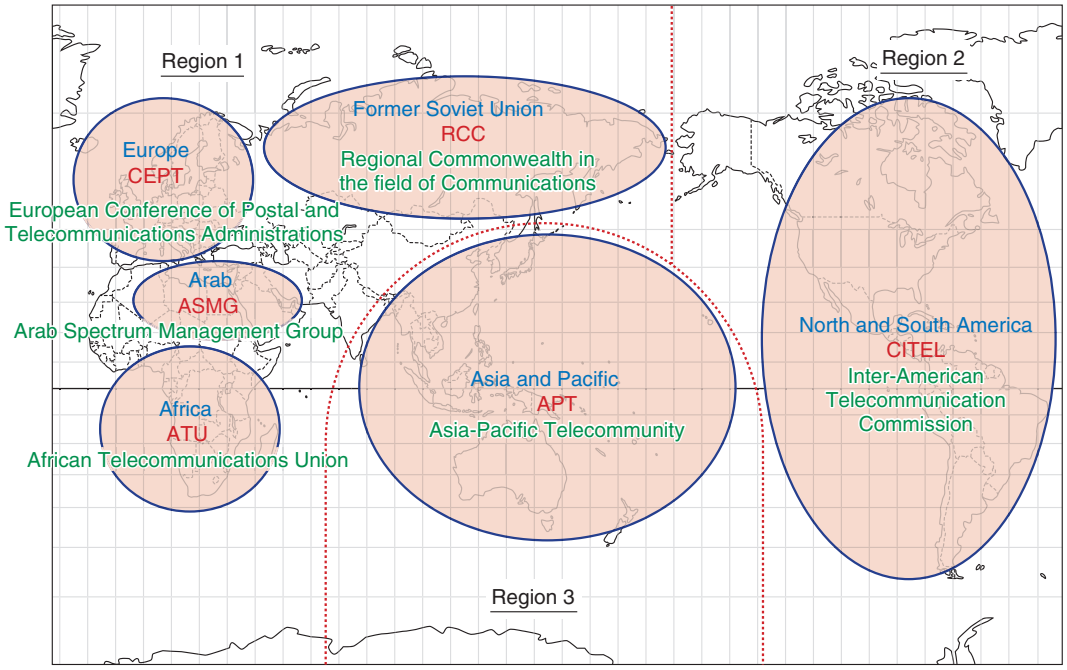

Fig. 2. Regions in the RR and regional telecommunication organizations.

regional telecommunication organization conducts activities for preparation work on WRC. Japan is a member of the Asia-Pacific Telecommunity (APT) in Region 3 and is also active in the APT Conference Preparatory Group for WRC (APG), which develops common proposals for WRC from APT.

Figure 3 shows the structure of WRC-23. There are seven committees (COMs 1–7) under the Plenary. Discussions to revise the RR were mainly made in COM 4 for terrestrial/maritime/aeronautical issues, COM 5 for satellite issues, and COM 6 for general issues and agenda items for future WRCs. Dr. Hiroyuki Atarashi (NTT DOCOMO) from Japan was appointed as the chair of COM 4, which addresses terrestrial issues, including identifications of frequencies for International Mobile Telecommunication (IMT)[*1] such as fifth-generation mobile communication systems (5G) and Beyond 5G (agenda item 1.2) and considerations on the use of high-altitude platform stations (HAPS)[*2] as IMT base stations (HIBS) for the implementation of non-terrestrial networks (NTN) (agenda item 1.4).

1.1 Identification of frequencies for IMT (agenda item 1.2)

Regarding the additional identification of frequencies for IMT such as 5G and Beyond 5G, discussions were held on the frequency range of 6425–7025 MHz (Although the scope of this agenda item is only for Region 1, this agenda item relates to Japan in Region 3 and the details are described later in this article) and the frequency range of 7025–7125 MHz (worldwide). Japan supported the identification of the frequency range of 7025–7125 MHz for IMT based on the studies conducted by the ITU Radiocommunication Sector (ITU-R) and supported the identification of the frequency range of 6425–7025 MHz for IMT in Region 1 because of the benefit of economies of scale. Although identification of the frequency range of 6425–7025 MHz for IMT in Region 3 is out of the scope of this agenda item, proposals were made for identification of this frequency range for IMT in 6 countries in Region 3, including China, and countries in Region 2. From the view of the harmful interference to existing radio systems, such as satellite systems, that are operated in the same frequency band, discussions were held with respect to the limit on

*1 IMT: Includes 3rd-generation mobile communication systems and beyond, such as IMT-2000, IMT-Advanced, IMT-2020, and IMT-2030.

*2 HAPS: Airborne platform expected to operate at high altitude such as stratospheric environment using solar plane type aircraft and airships. The frequencies used for communications between HAPS and the ground base station (gateway station) (feeder link) was added at WRC-19.

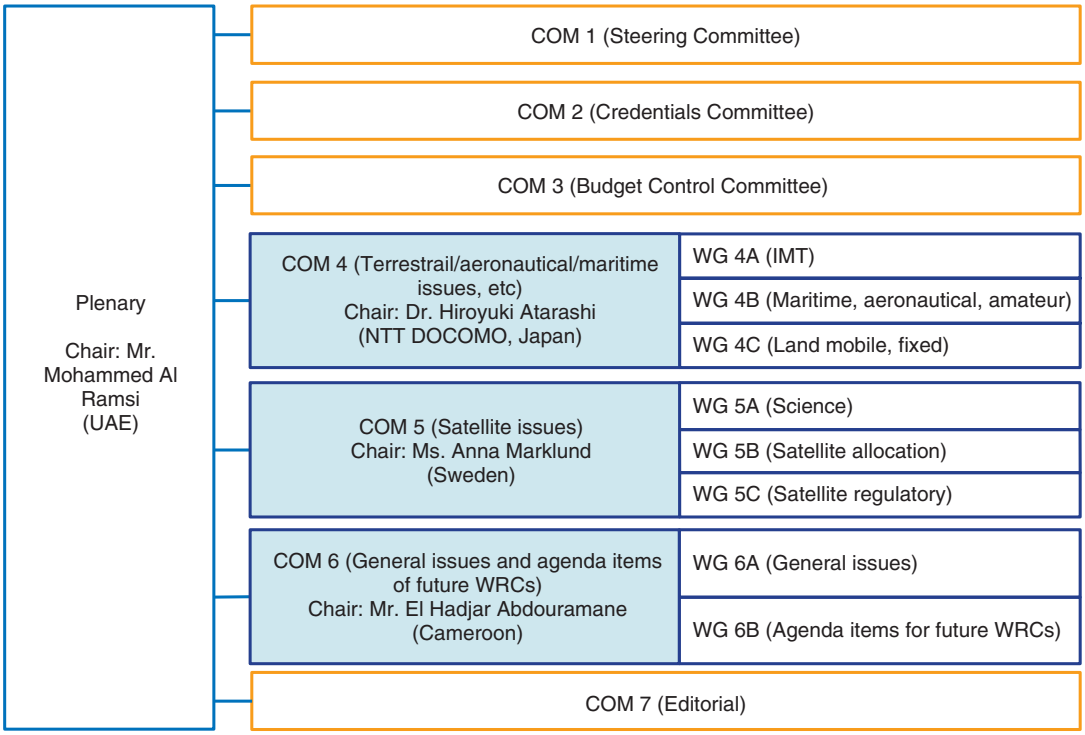

Fig. 3. Structure of WRC-23.

equivalent isotropic radiated power applied to IMT base stations. After discussion, consensus was finally reached, and the identification of the frequency range of 7025–7125 MHz for IMT was agreed to in all of Region 1, some countries in Region 2 (Brazil and Mexico), and all of Region 3. Regarding the proposal of identifying the frequency range of 6425–7025 MHz for IMT in some counties of Region 3, considering the interference to neighbouring countries, identification of this frequency range to only a few countries (Cambodia, Laos, and Maldives), excluding China, was agreed. Identification of the frequency range of 6425–7025 MHz for IMT was also agreed in all of Region 1 and in some countries in Region 2 (Brazil and Mexico).

1.2 Consideration of the use of HIBS (agenda item 1.4)

In Beyond 5G, a space radio access network (RAN) and NTN are expected to be implemented, which will enable the expansion of coverage in mountainous areas and at sea and the quick restoration of communication networks in the event of a large-scale disaster. HIBS is one candidate to implement a space RAN and NTN [2]. At the previous WRC (WRC-19), Japan proposed and led discussions to include the consideration of HIBS in the WRC-23 agenda item, and at WRC-23, discussions were held on the addition of new frequency bands (694–960, 1710–1885, 2500–2690 MHz) and a review to relax conditions for the use of existing available frequency bands (1885–1980, 2010–2025, 2110–2170 MHz) for use of communications between HIBS and terminals. As a result of the discussions, the addition of new frequency bands other than 694–960 MHz and the relaxation of conditions in the existing available frequency bands were agreed. Regarding the 694–960-MHz band, there were many discussions with China, Russia, Vietnam, and Iran, who were concerned about interference to existing systems. Finally, it was agreed to use this frequency band for HIBS in Regions 1 and 2. In Region 3, it was also agreed to use the entire frequency band or portions of this frequency band for HIBS in 14 countries, including Japan and countries where HIBS is expected to be deployed[*3].

*3 HIBS (694–960 MHz): The entire band or portions of this band is now available in Australia, Maldives, Micronesia, Papua New Guinea, Tonga, Vanuatu, China, India, Indonesia, Japan, Korea, Malaysia, Philippines, and Thailand.

1.3 Other agenda items (agenda items relating to science and satellite issues)

Other topics relating to science and satellites issues were also discussed. In agenda item 1.13, consideration was made to upgrade the status of space research (satellite-to-satellite, satellite-to-Earth station) in the frequency range of 14.8–15.35 GHz from secondary service to primary service[*4], and it was agreed to upgrade the status to primary service in principle. However, it was also agreed to apply a power flux density (pfd) limit at the surface of the Earth to radio waves transmitted from a satellite for satellite-to-satellite link and to keep a secondary basis between a satellite and an Earth station with respect to the protection of terrestrial services in several countries including Japan.

Agenda item 1.16 relates to non-geostationary orbit satellites, which have been increasingly used. In this agenda item, it was discussed to enable communications with the Earth stations on ships and aircraft in the frequency ranges of 17.7–18.6, 18.8–19.3, 19.7–20.2, 27.5–29.1, and 29.5–30 GHz. Finally, it was agreed to make the communications available in those frequency bands and to establish conditions so that such communications would not adversely affect terrestrial radio systems, including 5G and private 5G systems in the 28-GHz-frequency band.

1.4 Agenda items for WRC-27

During the WRC-23, the agenda items for future WRCs were also discussed, and the agenda items shown in **Table 2** were decided as the agenda items for the WRC-27.

Regarding additional identification of frequencies for IMT, discussions were held mainly on the frequency range so-called Frequency Range 3 (FR3) or mid-band, particularly the frequency range of 7–15 GHz. After discussion, the frequency ranges of 7125–8400-MHz and 14.8–15.35-GHz bands were agreed as candidates. The frequency range of 4400–4800 MHz was also decided as a candidate, a certain range of which is already used for IMT in Japan.

To implement NTN, direct-to-handset satellite communications are very attractive, which provide direct communications between mobile terminals such as smartphones and low-Earth orbit satellites. For the agenda item for WRC-27, frequency bands for this type of communications were discussed on the basis of proposals from Japan and other countries, and it was decided that the frequency range of 694 MHz–2.7 GHz would be a candidate for discussion at WRC-27.

2. ITU Radiocommunication Assembly 2023 (RA-23)

Preceding WRC-23, the ITU Radiocommunication Assembly 2023 (RA-23) was held from November 13 to 17, 2023 at the same venue as the WRC-23. The RA is the general meeting of the ITU-R and approves ITU-R Recommendations, ITU-R Questions, and ITU-R Resolutions, which provide the working method of ITU-R and appoints the chairs and vice-chairs of ITU-R Study Groups (SGs).

The RA-23 approved Resolution ITU-R 56-3, which defines the name of the so-called "6G" as IMT-2030 [3]. The RA-23 also approved Recommendation ITU-R M.2160, which provides a framework and overall objectives of the future development of IMT for 2030 and beyond [4]. With these documents, it is expected to accelerate studies relating to 6G in ITU-R.

As shown in **Fig. 4**, the chairs and vice-chairs of each SG were appointed, and all three candidates nominated by Japan were approved as candidates for vice-chairs of SG 4, SG 5, and SG 6. Regarding the structure and scope of the SGs, inter-satellite service is explicitly included in the scope of SG 4 [5].

During the RA-23, the maximum number of terms for Working Party (WP) chairs was discussed. It was agreed that the maximum number of terms is 2 (1 term corresponds to approximately 4 years), extendable to 3 if circumstances necessitate.

Other ITU-R Resolutions, Recommendations, and Questions were also approved and will serve as guidelines for future ITU-R activities.

3. Future plans

Towards WRC-27, the NTT Group will continue to actively participate in and contribute to ITU-R meetings, preparatory meetings in the Asia-Pacific region such as APG, and relevant meetings in Japan.

*4 Primary and secondary services: Radiocommunication services are classified into primary basis or secondary basis. Radiocommunication stations for services on secondary basis shall not cause harmful interference to stations for services on primary basis and shall not claim protection against interference from radio stations for services on primary basis.

Table 2. Agenda items of WRC-27.

No.	Agenda item
1.1	Studies on the use of the frequency bands 47.2–50.2 GHz (Earth-to-space) and 50.4–51.4 GHz (Earth-to-space), or parts thereof, by aeronautical and maritime earth stations in motion in the fixed-satellite service
1.2	Studies on possible revisions of sharing conditions in the frequency band 13.75–14 GHz to allow the use of uplink fixed-satellite service earth stations with smaller antenna size
1.3	Studies relating to the use of the frequency band 51.4–52.4 GHz to enable its use by gateway earth stations transmitting to non-geostationary-satellite orbit systems in the fixed-satellite service (Earth-to-space)
1.4	Possible new primary allocation to the fixed-satellite service (space-to-Earth) in the frequency band 17.3–17.7 GHz and possible new primary allocation to the broadcasting-satellite service (space-to-Earth) in the frequency band 17.3–17.8 GHz in Region 3, and consideration of equivalent power flux-density limits to be applied in Regions 1 and 3 to non-geostationary-satellite systems in the fixed-satellite service (space-to-Earth) in the frequency band 17.3–17.7 GHz
1.5	Studies on development of regulatory measures, and implementability thereof, to limit the unauthorized operations of non-geostationary-satellite orbit (non-GSO) earth stations in the fixed-satellite service (FSS) and mobile-satellite service (MSS) and associated issues related to the service area of non-GSO FSS and MSS satellite systems
1.6	Consideration of technical and regulatory measures for fixed-satellite service satellite networks/systems in the frequency bands 37.5–42.5 GHz (space-to-Earth), 42.5–43.5 GHz (Earth-to-space), 47.2–50.2 GHz (Earth-to-space) and 50.4–51.4 GHz (Earth-to-space) for equitable access to these frequency bands
1.7	Sharing and compatibility studies and development of technical conditions for the use of International Mobile Telecommunications (IMT) in the frequency bands 4400–4800 MHz, 7125–8400 MHz (or parts thereof), and 14.8–15.35 GHz for the terrestrial component of IMT
1.8	Studies on possible new additional allocations to the radiolocation service on a primary basis in the frequency range 231.5–275 GHz, and possible new identifications for radiolocation service applications in frequency bands within the frequency range 275–700 GHz
1.9	Consideration of appropriate regulatory actions to update Appendix 26 in support of modernization of high-frequency spectrum use in the aeronautical mobile (OR) service
1.10	Power flux-density and equivalent isotropically radiated power limits for inclusion in Article 21 for the fixed-satellite, mobile-satellite and broadcasting-satellite services to protect the fixed and mobile services in the frequency bands 71–76 GHz and 81–86 GHz
1.11	Study of technical and operational issues and regulatory provisions for space-to-space transmissions in the frequency bands 1518–1544 MHz, 1545–1559 MHz, 1610–1645.5 MHz, 1646.5–1660 MHz, 1670–1675 MHz and 2483.5–2500 MHz
1.12	Studies on potential new allocations to, and regulatory actions for, the mobile-satellite service in the frequency bands 1427–1432 MHz (space-to-Earth), 1645.5–1646.5 MHz (space-to-Earth) (Earth-to-space), 1880–1920 MHz (space-to-Earth) (Earth-to-space) and 2010–2025 MHz (space-to-Earth) (Earth-to-space) required for the future development of low-data-rate non-geostationary mobile-satellite systems
1.13	Studies on possible new allocations to the mobile-satellite service for direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage
1.14	Studies on possible new frequency allocations to the mobile-satellite service in the frequency bands 2010–2025 MHz (Earth-to-space) and 2160–2170 MHz (space-to-Earth) in Regions 1 and 3 and 2 120–2160 MHz (space-to-Earth) in all Regions
1.15	Studies on frequency-related matters, including possible new or modified space research service (space-to-space) allocations, for future development of communications on the lunar surface and between lunar orbit and the lunar surface
1.16	Studies of technical and regulatory provisions necessary to protect radio astronomy operating in specific Radio Quiet Zones and, in radio astronomy service primary allocated frequency bands globally, from aggregate radio-frequency interference caused by systems in the non-geostationary-satellite orbit
1.17	Consideration of regulatory provisions and potential primary allocations to the meteorological aids service (space weather) to accommodate receive-only space weather sensor applications in the Radio Regulations
1.18	Studies on compatibility between the Earth exploration-satellite service (passive), the radio astronomy service in certain bands above 76 GHz, and active services in adjacent and nearby frequency bands
1.19	Studies on possible allocations to the Earth exploration-satellite service (passive) in the bands 4200–4400 MHz and 8400–8500 MHz
2	Use of incorporation by reference in the Radio Regulations
4	General review of the Resolutions and Recommendations of world administrative radio conferences and world radiocommunication conferences
7	Implementation of Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference
8	Footnotes to the Table of Frequency Allocations in Article 5 of the Radio Regulations
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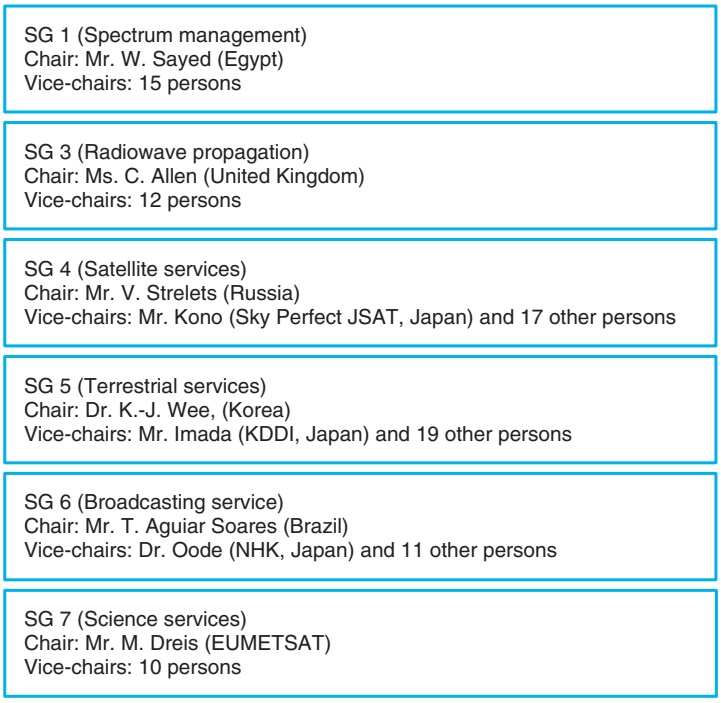

Fig. 4. ITU-R Study Group structure, and chairs and vice-chairs for 2024–2027.

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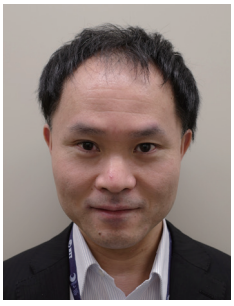

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