Recent Activities of ITU-R Study Group 5 on Terrestrial Radiocommunication Systems

Shinya Otsuki, Junichi Iwatani, and Nobuki Sakamoto

Abstract

Radiocommunication systems, such as mobile communication systems, which are represented by smartphones, wireless local area network systems, which are commonly used at home and office, and fixed wireless systems, which provide flexible and resilient communication in times of disasters, play important roles in telecommunication networks. The International Telecommunication Union - Radiocommunication Sector (ITU-R), an international standardization organization, is responsible for standardization of radiocommunication systems and the frequencies they use. Recent activities of the ITU-R's Study Group 5 and its Working Parties, which deal with terrestrial radiocommunication systems, and the contributions of NTT laboratories and NTT DOCOMO to those activities, are outlined in this article.

Keywords: ITU-R, wireless LAN, IMT

1. Structure of ITU-R and jurisdiction of Study Group 5

The International Telecommunication Union - Radiocommunication Sector (ITU-R) is a sector of the ITU responsible for establishing regulations and standards for radiocommunication systems. The structure of ITU-R is illustrated in **Fig. 1**. The Study Groups (SGs) work on developing technical, operational, and procedural bases for efficient use of the radio spectrum and the geostationary-satellite orbit and develop ITU-R Recommendations and Reports. One of the missions of SGs is to conduct research necessary for discussions at the World Radiocommunication Conference (WRC), which revises the Radio Regulations (RR) providing international rules and regulations for spectrum allocation to radio services, use of satellite orbits, and administrative and operational procedures for radio stations, all of which are needed for the use of radio waves. Six SGs have been established at the ITU-R, and their compositions are shown in **Table 1** [1].

As shown in the table, SG 5 is in charge of systems and networks for fixed, mobile, radiodetermination, amateur, and amateur-satellite services, and Dr. Hiroyuki Atarashi (NTT DOCOMO) from Japan was appointed as the vice chair for the current study cycle (2019–2023) as well as the previous study cycle (2015–2019). Under SG 5, there are four Working Parties (WPs), as shown in **Table 2**, and these WPs conduct discussions on ITU-R Recommendations. As delegations of part of Japan led by an official of the Ministry of Internal Affairs and Communications, NTT laboratories have been participating in WP 5A, which is in charge of land mobile services excluding International Mobile Telecommunications (IMT)[*1], and WP 5C, which is in charge of fixed services. NTT DOCOMO has been participating in WP 5D, which is in charge of IMT.

*1 IMT: Includes 3rd-generation mobile communication systems and beyond, such as IMT-2000, IMT-Advanced, and IMT-2020 systems. IMT-2000 includes W-CDMA (Wideband Code Division Multiple Access), HSPA (High-Speed Packet Access), and LTE (Long Term Evolution) as radio interfaces. IMT-Advanced includes LTE-Advanced as a radio interface.

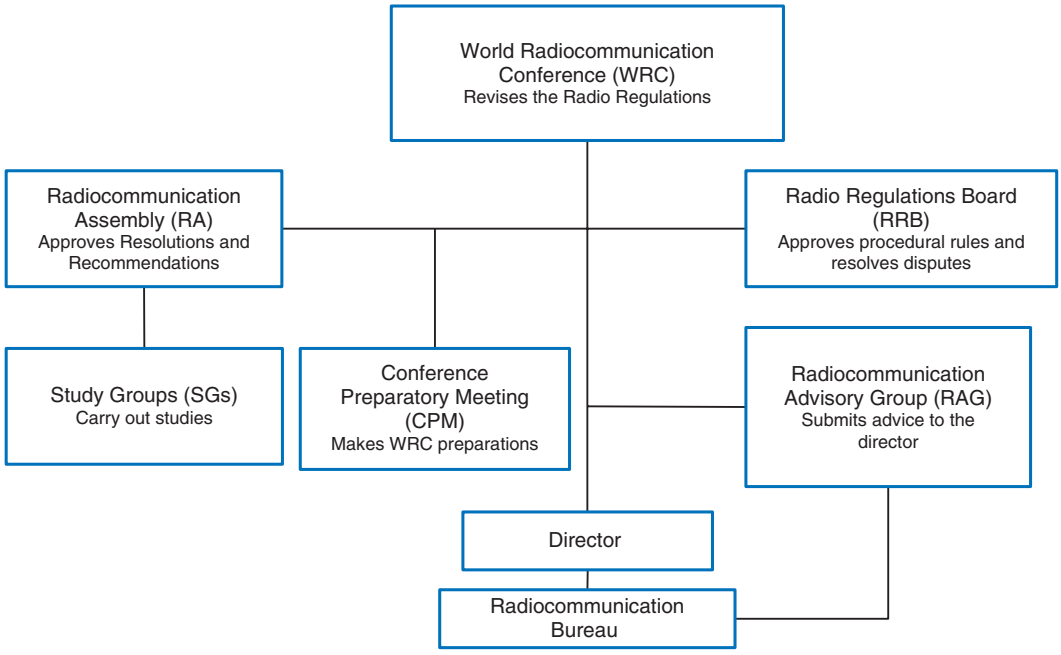


Fig. 1. Structure of ITU-R.

Table 1. Structure of ITU-R SGs.

	Scope of work
SG 1: Spectrum management	Spectrum management principles and techniques, general principles of sharing, and spectrum monitoring
SG 3: Radiowave propagation	Propagation of radio waves in ionized and non-ionized media, and the characteristics of radio noise
SG 4: Satellite services	Systems and networks for fixed-satellite, mobile-satellite, broadcasting-satellite, and radiodetermination-satellite services
SG 5: Terrestrial services	Systems and networks for fixed, mobile, radiodetermination, amateur, and amateur-satellite services
SG 6: Broadcasting service	Radiocommunication broadcasting, including vision, sound, multimedia, and data services principally intended for delivery to the general public
SG 7: Science services	Systems for space operation, space research, earth exploration and meteorology; systems for remote sensing, including passive and active sensing systems; radio astronomy; and standard frequency and time signals

2. Recent status of SG 5-related meetings

2.1 WP 5A

WP 5A is mainly responsible for land mobile services (excluding IMT). Wireless access systems including wireless local area networks (LANs), public protection and disaster relief wireless systems, railway wireless systems, intelligent transport systems (ITS), amateur radio, and new technologies for land mobile services in general are being discussed as the main target systems, and Recommendations and Reports are being developed. In this section, the status of discussions at WP 5A, focusing on the topic of

Table 2. Structure of WPs in SG 5.

	Scope of work
WP 5A	Land mobile service above 30 MHz (excluding IMT); wireless access in fixed services; amateur and amateur-satellite services
WP 5B	Maritime mobile service including Global Maritime Distress and Safety System (GMDSS); aeronautical mobile service; and radiodetermination service
WP 5C	Fixed wireless systems; HF and other systems below 30 MHz in fixed and land mobile services
WP 5D	IMT Systems

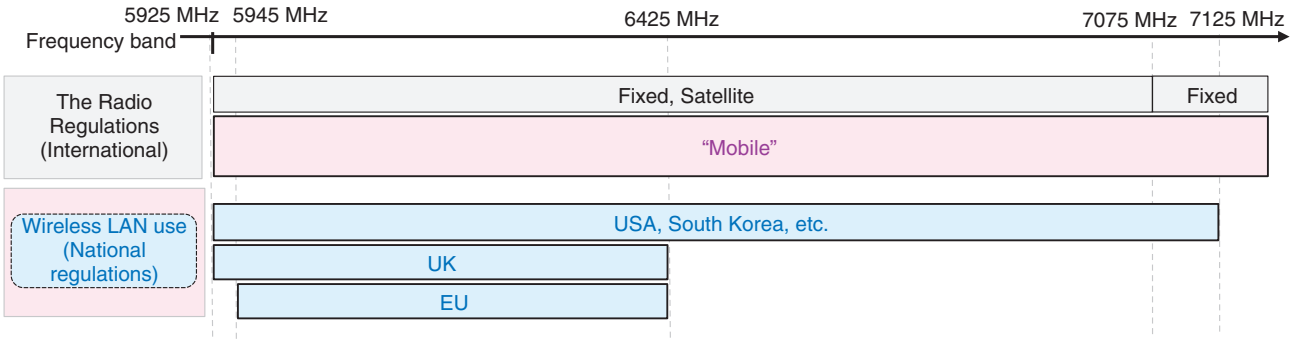


Fig. 2. International regulations regarding the use of the 6-GHz band of wireless LANs and domestic services of several countries.

wireless LANs, which is strongly related to the NTT Group's business, is explained.

2.1.1 Discussions on wireless LANs

At the 2019 World Radiocommunication Conference (WRC-19), the revision of the RR [2] was agreed to ease the restrictions on 5-GHz-band wireless LANs that allows outdoor use and higher transmission power in the 5.2-GHz band. Since WRC-19, discussions on wireless LANs have continued, and the revision of ITU-R Recommendations M.1450 and M.1801, which contain technical guidelines for wireless LANs, are being discussed. Two points for the revision are under discussion. The first is that Recommendation M.1450 includes the conditions of wireless LANs described in the RR and the national regulations of major countries; however, it does not reflect the latest modification of them, and its current version is being discussed for revision. Japan proposed to revise the texts on the basis of the recent revisions of the RR that include relaxed conditions for the 5.2-GHz band decided at WRC-19 and relevant national regulations in Japan, which were reflected in the working document for the revision of the Recommendation. It is expected that the Recommendation will be discussed further for revision. The second point of discussion is revision of the Recommendations on the basis of the recent status of wireless LANs including updates to the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standard. IEEE is proposing to update the summary section of the wireless LAN standards in Recommendations M.1450 and M.1801 to reflect the extension of the frequency band specified in IEEE 802.11ax that uses the 6-GHz band. Although this proposal is supported by the US, the UK, and other countries, China and Russia do not support it because they are concerned about interference with fixed satellites that may be caused by increased use of wireless LANs in the 6-GHz band. With regard to the frequency allocation in the RR, as shown in **Fig. 2**, the 6-GHz band is allocated to multiple services (such as fixed satellite services and other fixed services) in addition to mobile services such as wireless LANs and IMT. In several countries, wireless LANs are used in the 6-GHz band. The use of the 6-GHz band for wireless LANs is also being discussed in Japan.

2.1.2 Discussions on other systems

With regard to railway wireless systems, developing a new ITU-R Recommendation for global or regional harmonization of radio frequency between trains and trackside is being discussed. In regard to ITS, the preparation of an ITU-R Report that clarifies the requirements for wireless communications for connected automated vehicles, which are expected to be put into practical use in the future, is being discussed. Regarding the terahertz band (275 to 450 GHz), which is expected to be used for future sixth-generation mobile communication systems (6G), technologies for the coexistence of multiple different systems are being discussed.

2.2 WP 5B

The scope of WP 5B is the maritime mobile service, aeronautical mobile service, and radiodetermination service (e.g., radar), and this WP deals with many topics discussed at WRCs such as unmanned aircraft systems and sub-orbital vehicle communication systems. Although telecom operators have made few contributions to this WP, the NTT Group addresses these topics via liaison statements from other WPs that reflect the Group's opinions.

Table 3. WRC-23 Agenda Item 1.2: Candidate frequency bands for additional identification for IMT.

Frequency band	Region 1 (Europe, Russia, Arab countries, Africa)	Region 2 (North and South America)	Region 3 (Asia-Pacific region)
3300–3400 MHz	Subject of study	Subject of study	–
3600–3800 MHz	–	Subject of study	–
6425–7025 MHz	Subject of study	–	–
7025–7125 MHz	Subject of study	Subject of study	Subject of study
10,000–10,500 MHz	–	Subject of study	–

2.3 WP 5C

The scope of WP 5C is mainly fixed wireless systems (FWSs). This WP is developing ITU-R Recommendations and Reports on transport/trunking wireless network systems, fixed wireless access systems, mobile backhaul for land mobile radiocommunication, electronic news-gathering systems in the fixed service, and systems for temporary use in disaster relief.

One of the discussions in WP 5C is on the use of the high-frequency band above 92 GHz, which is expected to be used for communication systems in accordance with recent technical developments. Radio-frequency channel arrangements for FWSs (between 92 and 174.8 GHz) and the technical conditions to protect the Earth-exploration satellite service (EESS) are being studied. As a result of WRC-19, the 275-to-450-GHz band discussed at WRC-19 is now available for FWSs, and technologies for protecting EESS that are required for some of these frequency bands are being evaluated and studied. The completion of these studies is expected to facilitate high-capacity FWSs for the mobile backhaul and fronthaul in mobile networks. In addition, WP 5C has completed a revision work on Recommendations relating to parameters for FWSs for ultra-high-definition-television signal transmission used for broadcast auxiliary services.

2.4 WP 5D

At the ITU, cell-phone systems are collectively referred to as IMT, and WP 5D is responsible for this. WP 5D is responsible for developing Recommendations and Reports on the IMT radio interface, future technologies and concepts (vision) of IMT, usage of frequency bands identified for IMT (radio frequency arrangement), and frequency-sharing studies between IMT and other services. The standards for fifth-generation mobile communication systems (5G) are called IMT-2020[*2] in ITU-R, and the first version of Recommendation ITU-R M.2150, "Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2020 (IMT-2020)" was published in February 2021. After publication of this Recommendation, development of an ITU-R Report on the trends regarding future technologies of IMT has started and aiming for completion in 2022. This ITU-R Report contains a compilation of technologies that can be applied to IMT in the future. Development of an ITU-R Recommendation on the future IMT vision for 2030 and beyond has also started and is scheduled for completion in 2023. This Recommendation is aimed to serve as a guide for the further development of IMT and will include use-case scenarios, required capabilities, and a specific development schedule for IMT in the 2030s.

In preparation for WRC-23, studies on utilization of frequencies for IMT are proceeding at full speed. In WRC-23 Agenda Item 1.2, which covers identification of additional frequencies for IMT, the frequencies listed in **Table 3** are considered for each region. In Region 3 (Asia-Pacific region), including Japan, 100-MHz bandwidth from 7025 to 7125 MHz is under consideration. At WRC-19, it was decided to identify additional frequencies above the millimeter-wave band for IMT [3], and at WRC-23, the frequencies to be considered are being selected in the expectation that the demand for IMT frequencies below the millimeter-wave band will increase in the future.

WRC-23 Agenda Item 1.4 discusses issues concerning the use of frequencies for high-altitude platform stations (HAPS) as IMT base stations (HIBS). As of 2021, as shown in **Fig. 3(a)**, 1885 to 1980 MHz, 2010 to 2025 MHz, and 2110 to 2170 MHz are available as HIBS frequencies in Region 3, including Japan. In addition to considering those frequencies, WRC-23 Agenda Item 1.4 considers further identifications of the frequencies used by HIBS in terms of several

*2 IMT-2020: The 3rd Generation Partnership Project (3GPP) 5G-SRIT and 3GPP 5G-RIT are included as radio interfaces.

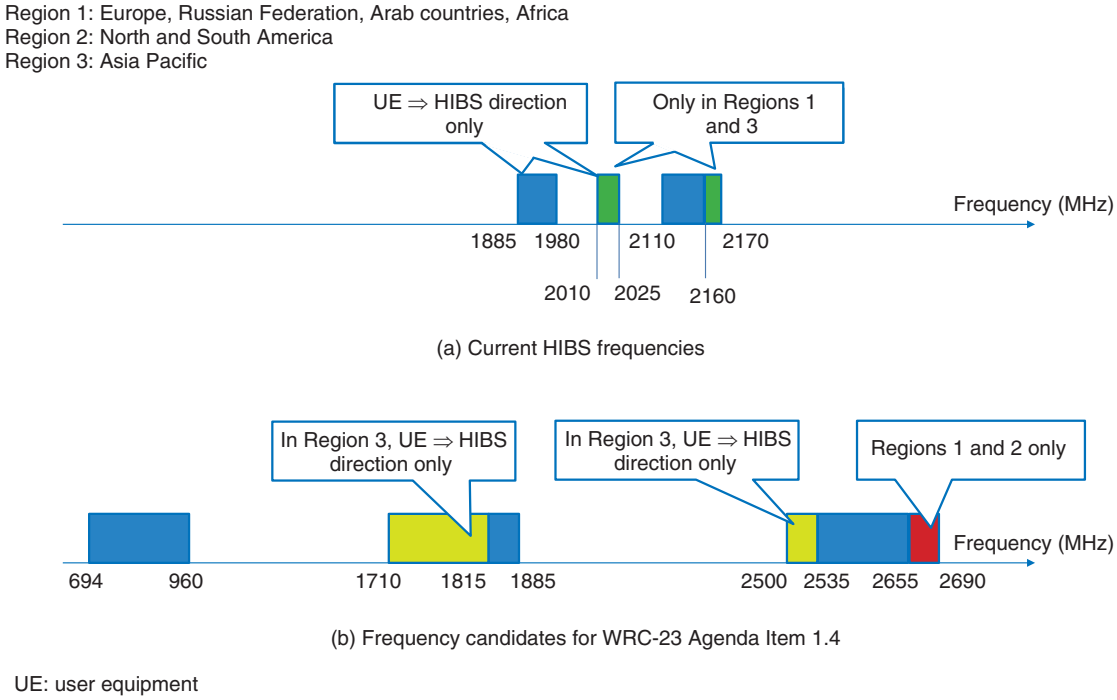


Fig. 3. Frequencies for HIBS.

candidate frequencies below 2.7 GHz, as shown in **Fig. 3(b)**.

WP 5D is conducting preliminary technical studies to determine (i) whether these candidate frequencies will harmfully interfere with other wireless systems if they are used for IMT or HIBS and (ii) what conditions are necessary to avoid such interference. Experts on other wireless systems, such as satellite systems, are also participating in detailed discussions as well as experts on IMT. On the basis of the results of these studies, WRC-23 will make the final decisions on whether to identify additional frequencies for IMT (Agenda Item 1.2), and whether to identify additional frequencies for HIBS (Agenda Item 1.4).

3. Future prospects

The year 2022 is important in regard to studies for the 2023 Radiocommunication Assembly (RA-23) and WRC-23 to be held in 2023. The draft texts for discussions at the Second Session of the 2023 Conference Preparatory Meeting (CPM*3 23-2), which is the preparatory meeting for WRC-23, will be completed in 2022.

Among the agenda items at WRC-23, such as additional identification for IMT, some discussions on the future deployment of 5G and Beyond 5G, such as 5G Evolution and 6G [4], are important from the viewpoint of Japan as a whole. Regarding discussions other than the WRC-23 agenda, for example, discussions on a wireless LAN, which is an important access method along with 5G, will have a significant impact on future wireless access. As the demand for the wireless spectrum is increasing yearly, in addition to the above discussions, various discussions on a wider range of frequency bands are expected. We would therefore like to continue to promote ITU-R activities with an awareness of international coexistence.

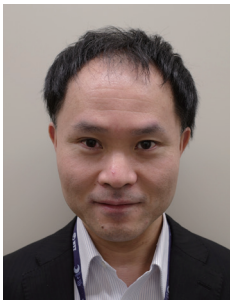
References

[1] A. Hashimoto, "International Standardization of Wireless Communications," Japan ITU Association, Sept. 2014 (in Japanese).
[2] J. Iwatani, S. Otsuki, Y. Asai, and H. Imanaka, "Activities to Revise the Radio Regulations on 5-GHz-band Wireless LANs at WRC-19 and ITU-R," NTT Technical Review, Vol. 18, No. 6, pp. 51–57, June

*3 CPM: Preparatory meeting for the WRC. The 1st session of the CPM is usually held immediately after the previous WRC, and the 2nd session of the CPM is usually held about six months before the WRC. At the 2nd session of the CPM, the CPM Report will be prepared. The CPM Report is submitted to the WRC and contains technical studies, solutions based on the studies, and examples of RR revisions.

2020.
https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr202006gls.html
[3] Y. Ito, N. Sakamoto, and H. Shin, "2019 ITU Radiocommunication Assembly 2019 (RA-19), World Radiocommunication Conference (WRC-19) Report," NTT DOCOMO Technical Journal, Vol. 22, No. 1, pp. 45–51, July 2020.
[4] DOCOMO 6G White Paper,
https://www.nttdocomo.co.jp/english/corporate/technology/whitepaper_6g/

Shinya Otsuki
Senior Research Engineer, Wireless Access Systems Project, NTT Access Network Service Systems Laboratories.
He received a B.E., M.E., and Ph.D. in communication engineering from Osaka University in 1993, 1995, and 1997. He joined NTT in 1997. From 1997 to 2008, he studied wireless access systems, wireless LAN systems, and wireless systems for Internet services in trains. From 2008 to 2011, he was involved in international standardization efforts in evolved packet core and services using Internet Protocol multimedia subsystems at NTT Service Integration Laboratories. He has been with NTT Access Network Service Systems Laboratories since 2011 and been contributing to the activities of Working Parties 5A and 5C in Study Group 5 of ITU Radiocommunication Sector. He received the ITU-AJ International Activity Encouragement Award from the ITU Association of Japan in 2014. He is a member of IEEE and the Institute of Electronics, Information and Communication Engineers (IEICE).



Junichi Iwatani
Research Engineer, Wireless Access Systems Project, NTT Access Network Service Systems Laboratories.
He received a B.E. and M.E. in electronics engineering from the University of Tokyo in 1994 and 1996. Since joining NTT Wireless Systems Laboratories in 1996, he has been engaged in R&D of wireless access systems. From 2006 to 2008, he researched the Next-Generation Network in NTT Service Integration Laboratories. In 2010, he joined NTT Communications, where he was involved in developing global network services. Since 2013, he has been with NTT Access Network Service Systems Laboratories, where he has been engaged in research and standardization of wireless LAN systems. From 2017 to 2019, he was involved in activities to revise the Radio Regulations of 5-GHz-band wireless LAN systems for WRC-19 at ITU-R meetings. He received the ITU-AJ Encouragement Award from the ITU Association of Japan in 2018. He is a member of IEICE.

Nobuki Sakamoto
Manager, Spectrum Planning Office, NTT DOCOMO, INC.
He received a B.E. and M.E. from the University of Tokyo in 1998 and 2000 and joined NTT DOCOMO in 2000. He is currently responsible for spectrum planning and coordination issues for IMT systems and ITU-R activities.