

Frequency Reorganization Action Plan (FY2022 version)

Chapter 1. Background and Purpose

To promote the effective utilization of limited and scarce radio wave resources and to cope with the introduction of new radio spectrum usage systems and the increasing frequency demand, since FY2003, the Ministry of Internal Affairs and Communications (MIC) has conducted the survey on actual radio spectrum usage every fiscal year. Based on the evaluation results of the survey, MIC formulated and announced a frequency reorganization action plan in August 2004, and since then, it has reviewed and announced the plan every year. This helps to maintain transparency and foreseeability, and to promote the smooth and steady transition and reorganization of frequencies (see figure below.).

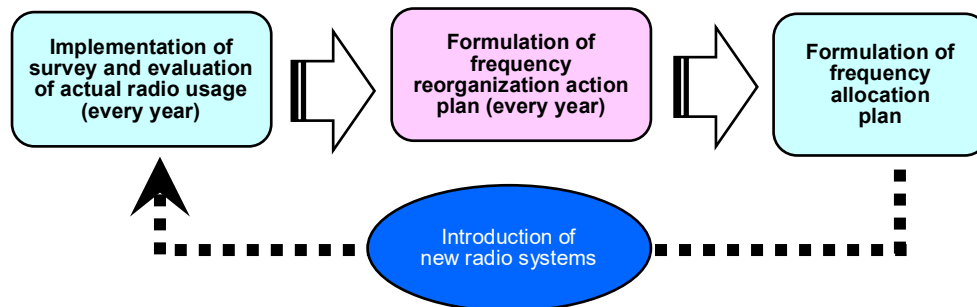


Figure: Frequency migration and reorganization cycle

Specifically, MIC has been developing ‘Radio Opening Up Strategy’ measures based on the Radio Policy Vision (Information and Communications Council, July 2003) since 2003. Due to these measures, the widespread use of various different radio spectrum usage systems, such as wireless LAN and RFID tags, as well as mobile wireless communication systems (wireless systems for mobile phones), has been promoted.

Through the development and growth of radio wave usage up to now there has been a drastic expansion in both network connection opportunities and connection types, and various kinds of services which use the radio wave, such as smartphones and digital home appliances, e-books, electronic money, online distribution of broadcasting contents, etc., have been developed. On the other hand, thanks to advances in broadband services, there have been developments in a range of delivered services that use high-capacity content, and mobile communication traffic has continued to increase year by year. Moreover, the radio waves are being mobilized across various sectors, including regional revitalization, healthcare, and the environment, etc., and their importance as a social infrastructure is also increasing. In particular, in the event of a disaster like the Great East Japan Earthquake, radio wave usage systems, such as satellite mobile phones, have played an essential role as a method of communication during emergencies.

Based on these trends, the following discussions have taken place concerning radio policy for the future.

1. Meetings of the “Study Group on Promotion of Effective Use of the Radio Spectrum” (April to December 2012)

In view of the environmental changes surrounding radio usage, including renewed recognition of the importance and effectiveness of radio systems in the case of a sudden surge in mobile communication traffic or a large-scale disaster, this study group discussed a necessary review of the regulations, and the application of spectrum user fees from the viewpoint of further promoting effective use of the radio spectrum.

2. Meetings of the “Radio Policy Vision Panel” (January to December 2014)

As needs and expectations for the further enhancement of radio communications increase, and in light of the situation where there is a growing emphasis on securing fair and efficient use of the radio spectrum by utilizing developed technologies and by establishing systems and policies that realize the effective and optimal use of limited and scarce radio waves, it was concluded, as a mid to long-term radio policy vision for the 2020s, that the objective should be to secure a frequency bandwidth of approx. 2700 MHz as the frequency for mobile communication systems for mobile phones or wireless LAN, in the frequency band of 6 GHz or less by 2020.

3. Meetings of the “Round-table Conference on Radio Policies 2020” (January to July 2016)

As a result of studies based on the dramatic expansion of M2M (Machine to Machine) systems that allow communication between devices, and sensor networks, the development of an IoT (Internet of Things) society, in which all things are wirelessly connected to the Internet, the rapid expansion of radio wave needs in new areas, including smart homes, smart grids, smart cities and robots, and the need for the introduction and development of pioneering radio systems at the Tokyo Olympic and Paralympic Games held in 2021, it was concluded that the following new frequency allocation goals should be set:

- (1) Frequency bands which are expected to be used for the realization of 5th generation mobile communication systems (5G) are those to be discussed at the World Radiocommunication Conference 2019 (WRC-19) (11 bands from 24.25 to 27.5 GHz and 31.8 to 33.4 GHz, etc.) and other frequency bands (3.6 to 4.2 GHz, 4.4 to 4.9 GHz, and 27.5 to 29.5 GHz, etc.). In view of the trends in other countries, it was deemed appropriate to determine and secure frequency bands and bandwidth needed for the future after further research, etc.
- (2) It was deemed appropriate to encourage further studies directed at formulating the conditions needed for frequency sharing with other existing services, and the establishment of specific measures (schemes) for the efficient and secure implementation of prior adjustment, when allocating mobile communication systems to international standard bands (1.7 GHz, 2.3 GHz, 2.6 GHz and 3.4 GHz bands) drawn up by 3GPP (project to standardize specifications for 3G mobile phones, 3.9G mobile communication systems and 4G mobile communication systems), or when expanding 5 GHz wireless LAN (Wi-Fi) frequencies.
- (3) In order to develop wireless businesses, it was deemed necessary to strategically step up promotion of research and development(R&D) to secure basic technological capabilities, and make environmental improvements, such as system upgrades and securement of needed frequencies, so as to more be able to more confidently predict that free, dynamic business activities will be supported, and a report detailing the policies necessary to achieve these objectives was compiled.

4. Meetings of the “Round-Table Conference on Growth Strategies for the Effective Use of Radio Spectrum” (November 2017 to August 2018)

This round-table conference discussed the progress of state-of-the-art technologies such as IoT, AI (artificial intelligence), robots and self-drive vehicles, and their incorporation into all industries and sectors related to lifestyle in view of the desire to realize "Society 5.0", a new society capable of resolving various problems such as declining birthrates, the aging population, and rural depopulation, and it concluded that the need for radio wave usage was expected to further increase in the future.

Up until now there have been efforts to achieve effective use of the radio spectrum, such as stepping up frequency migration and reorganization to cope with social needs, but there is also need for a future plan covering utilization of the radio spectrum and measures for further effective use of the spectrum more specifically geared towards society and the realization of

Society 5.0.

The round-table, conference which took account of the Regulatory Reform Implementation Plan (cabinet decisions of June 9, 2017 and June 15, 2018) and the New Economic Policy Package (cabinet decision of December 8, 2017), made a comprehensive study of the effective use of public frequencies, measures for effective use of the radio spectrum, including reviewing frequency allocation and migration systems and spectrum user fee systems, a future image of radio usage in the 2030s, and an implementation plan. The round - table conference compiled the following recommendations in its report, which considered measures for effective use of the radio spectrum in the 2020s, in addition to implementation plans for future utilization of the radio spectrum.

(1) Review of the frequency allocation system

It was deemed appropriate to undertake a review of the frequency allocation system, including systematic processes such as mechanisms to ensure the smooth return of frequencies, and a drastic review of the method of allocation, in order to cope with a rapid expansion of radio wave usage needs for the realization of Society 5.0.

(2) Policies for effective use of public frequencies

From the viewpoint of promoting effective use and public-private sharing of frequencies, it was deemed appropriate to promote the visualization of public frequency allocations, review evaluation results and methods of the survey on actual radio spectrum usage, and propose policies for stepping up the reorganization of public frequencies and its sharing with the private sector.

(3) Review of spectrum user fee systems

As radio waves are playing an increasingly bigger role in both our daily lives and in business, it was deemed appropriate to review the spectrum user fee system, including expenditure on spectrum user fees (the scope of radio usage for public benefit services), and optimizing the burden of spectrum user fees.

(4) Policies for effective use of the radio spectrum based on the technological progress

With a view towards the 2020s, when radio usage is expected to become bigger than ever before in terms of how it supports socioeconomics, it was deemed appropriate to study policies for effective use of the radio spectrum concomitant with the progress of new technologies, such as system upgrades for wireless power transmission, system enhancement of deterrent devices, such as mobile phones, etc., reviewing and evaluating regional BWAs, determination of V-High band applications, accelerating the use of survey and research terminals, and reviewing display labels for technical standard conformity certification.

5. Meetings of the “Radio Policy Roundtable in the Age of Digital Transformation” (November 2020 to August 2021)

In Japan, seeing the spread of the novel coronavirus infection disease (COVID-19) as a turning point, the digital transformation of the whole society which is needed for the establishment of a new lifestyle called "New Normal", as well as the maintenance and development of economic activities, is expected to be further promoted.

In this era of digital transformation, it is expected that the industrial sector using radio waves will develop further and the need for radio waves will expand dramatically, while it is required to promote the fairer and more efficient use of radio waves in the future in view of the fact that radio waves are a limited and scarce resource shared by all people.

The Roundtable convened to comprehensively discuss the future image of radio spectrum usage, as well as issues related to radio policies in the era of digital transformation and new target settings, and implementation measures for effective use of radio waves. As a result, it set goals of securing bandwidth at the end of FY 2025 and in the 2030s, and compiled a report

incorporating the following proposals as policies for effective use of radio waves in the era of digital transformation:

(1) Introduction and expansion of wireless systems required in the age of digital transformation

It was deemed appropriate to consider introduction and generalization of wireless systems required in the age of digital transformation, such as the expansion and promotion of 5G, local 5G and other services, facilitation of R&D, intellectual property and standardization regarding Beyond 5G and other services, and promotion of dynamic frequency sharing.

(2) Verification of effective frequency use and policies for frequency allocation

As a result of promoting effective use of radio frequencies, ensuring fair competition in the mobile market, introducing a frequency reallocation system, and reallocating frequencies, it was deemed appropriate to consider policies for verifying effective frequency use and allocating frequencies, such as the migration period and smooth migration when frequencies are migrated to new approved establishments.

(3) Policies for effective use of public frequencies

Based on the verification of the usage status of public frequencies for public services in the national government and local authorities, it was deemed appropriate to promote consideration of the digitalization of public service radio stations, to conduct continuous evaluations by carrying out surveys, including the survey on actual radio spectrum usage, and to consider policies for effective use of public frequencies.

(4) Supervision and management of radio usage in the age of digital transformation

It was deemed appropriate to consider measures for the management and supervision of radio usage in the era of digital transformation, such as ease of terminal licensing procedures, digitalization of licensing procedures, etc., renewal of the integrated radio station administration system (PARTNER: Productive and Reliable Telecommunications Network for Radio Stations), and prohibition of the distribution of radio equipment that does not conform to technical standards.

(5) Review of spectrum user fee systems

It was deemed appropriate to review the purpose and amount of spectrum user fees.

Based on the recommendations in this report, the Act to Partially Amend the Radio Act and Broadcasting Act was submitted in February 2022 and was passed in June 2022 (hereinafter referred to as the "Radio Amendment Act 2022"). The amendments aim to promote the fair and efficient use of the radio waves by taking various measures, including strengthening of the functions of the Radio Regulatory Council, establishment of a system for reallocating frequencies of mobile phones, etc., and review of the spectrum user fee system. The measures also include establishment of responsibility for the approved establishments to install specified base stations at locations other than the installation sites described in the approved plan, and add matters related to ensuring fair use of the radio wave to the items stated in the installation guidelines.

Since the radio system continues to play an important part in the daily lives of Japanese citizens and Japanese socioeconomic activities, both today and in the future, it is essential to secure new radio frequencies that can be allocated to address growing radio wave use needs and new technological trends. In addition, it is increasingly important to promote more effective use of radio waves, which are a limited and scarce shared public resource, as well as sharing among different wireless systems.

Seeing the spread of the novel coronavirus infection disease (COVID-19) as a turning point, the digital transformation of the whole society which is needed for the establishment of a new lifestyle called "New Normal", as well as the maintenance and development of economic activities, is expected to be further promoted.

Furthermore, based on the fact that the development of digital infrastructure such as 5G is

essential for embodying the "Vision for a Digital Garden City Nation" that enables the country to connect to the world by promoting digitalization in rural areas to create a new wave of change, and narrowing the gap between rural and urban areas, the MIC formulated and announced the Infrastructure Development Plan for a Digital Garden City Nation in March 2022.

This frequency reorganization action plan (FY2022 version) is based on the progress of the policies and studies established so far as shown above. It is also based on a review of efforts to secure frequencies for new radio systems, and to consider frequency migration policies and timing.

In this review, in an identical fashion to the past, and from the viewpoint of ensuring transparency and fairness, the degree to which the radio spectrum is being effectively utilized, based on the results of survey on actual radio spectrum usage, was assessed by taking global trends in technological innovations and demand related to radio usage, international trends concerning radio frequency allocation, and other information into account (Radio Act Article 26-2 section 2)". At the same time, R&D implemented by the Japanese government for effective use of the radio spectrum was clearly indicated, and a public comment procedure was put in place.

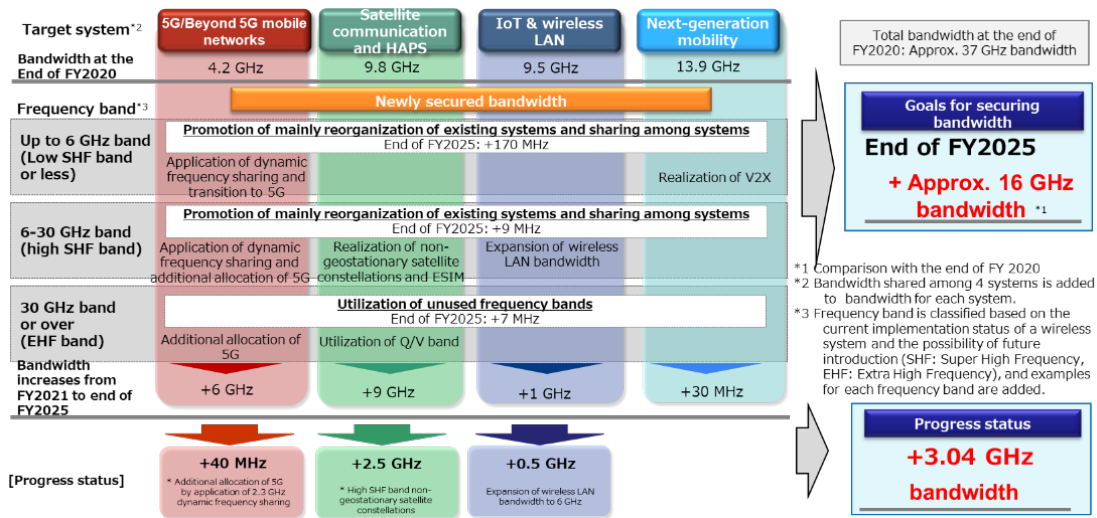
The MIC has the goal of overcoming various problems faced by Japan today, such as the declining birth rate and population accompanied by a shrinking workforce as well as rural depopulation, while also contributing to the revitalization of Japan's economy by steadily implementing this frequency reorganization action plan, promoting full utilization and application of wireless communication technologies, and strengthening Japan's international competitiveness, while at the same time further promoting effective use of the radio spectrum.

Chapter 2. Goals for Securing Frequency Bandwidth

I. Goals for securing frequency bandwidth by the end of FY2025 (from the report of the Radio Policy Roundtable in the Age of Digital Transformation (August 2021))

The immediate goal by the end of FY2025 is to secure bandwidth with an increase of a total of approximately 16 GHz, compared to that at the end of FY2020, on four radio wave systems that particularly require wider bandwidth: mobile phone network systems such as 5G and Beyond 5G, satellite communications and HAPS systems, IoT and wireless LAN systems, and next generation mobile systems.

Illustration of Goals for Securing Bandwidth by the end of FY2025



For the mobile phone network system, it is intended to secure a bandwidth increase of approximately 6 GHz. Candidate bands are expected to include not only LTE (up to 3.5 GHz) and 5G/local 5G (Sub 6 GHz, millimeter-wave band) which have already been allocated to mobile phone networks, but also the 2.3 GHz band, 4.9 GHz band, 26 GHz band, 40 GHz band, etc.

For satellite communication and HAPS systems, it is intended to secure a bandwidth increase of approximately 9 GHz. Candidate bands are expected to be secured by the introduction of mobile satellite communication systems, such as satellite constellations in the Ku band, the extension of bandwidth of broadband satellite communication systems for earth stations in motion (ESIM) using the Ka band, and the use of feeder links for non-geostationary satellites in the Q/V band.

For IoT and wireless LAN systems, it is intended to secure bandwidth increased by approximately 1 GHz. Candidate bands are expected to be 6 GHz, in which it is likely to be able to secure multiple channels each of which achieves up to 10 Gbps of Wi-Fi 6.

For next-generation mobility systems, it is intended to secure a bandwidth increase of approximately 30 MHz. In response to growing expectations for V2X systems in the 5 GHz band, it is intended to secure a certain dedicated bandwidth in order to ensure wide-area coverage and safety required to realize usage in the mobility field, and to achieve transmission speeds of several tens of Mbps.

Toward the realization of these goals of securing bandwidth, it is necessary to further promote frequency reorganization and sharing, taking account of international trends and advances in usage technology, including promotion of effective use of the frequencies of existing wireless systems. In particular, to secure a bandwidth increase of 16 GHz by the end

of FY2025, it is expected that bands required for next-generation radio systems will be secured by actively reorganizing and sharing frequencies of approximately 14 GHz bandwidth assigned for private and public use, and approximately 2 GHz for private use.

II. Progress made in securing bandwidth

For the mobile phone network system, in May 2022, MIC approved an establishment plan for specified base stations for wide use of fifth-generation (5G) mobile communications systems in the 2.3 GHz Band by utilizing dynamic frequency sharing, which enables dynamic and flexible sharing of frequencies with existing wireless systems geographically and temporally. As a result, +40 GHz bandwidth (2330 to 2370 MHz) used as 5G frequency bands has been newly secured.

For satellite communication and HAPS systems, an increase of 2.5 GHz bandwidth in total has been achieved by sharing with existing wireless systems. Of the above increased bandwidth, 2 GHz-bandwidth (10.7 to 12.7 GHz) was secured as downlink (from space to earth) frequencies, and the remaining 0.5 GHz bandwidth (14.0 to 14.5 GHz) was secured as uplink (from earth to space) frequencies for non-geostationary Ku-band satellite systems that use satellite constellations orbiting at an altitude of about 500 km in August 2021, and for non-geostationary Ku-band satellite systems that use satellite constellations polar-orbiting at an altitude of about 1200 km in April 2022.

For IoT and wireless LAN systems, MIC has drafted relevant regulations to allocate 5925 to 6425 MHz as a wireless LAN frequency band by sharing it with existing wireless systems in September 2022, and has thus secured 0.5 GHz bandwidth.

As a means of securing bandwidth, MIC adopted sharing with the 1.34 GHz bandwidth for private and public use, and the 1.7 GHz bandwidth for private use.

Chapter 3 Priority Initiatives

I. Promotion of effective use of frequencies for public services

The Working Group for Publicly-owned Frequencies of the Radio Policy Roundtable in the Age of Digital Transformation held hearings on the progress of initiatives by the relevant ministries and agencies for effective use of frequencies, targeting "systems using frequencies for which demand for other uses has emerged", and "analog systems" among public service radio stations (which are exempt from spectrum user fees) used by the national government and local authorities, and carried out follow-ups on the progress of initiatives for effective use of frequencies (see Tables 1 and 2 below).

With the enforcement of the Radio Amendment Act 2022, it is expected that the Radio Regulatory Council will act as the supervisory authority for the survey on actual radio spectrum usage. These follow-ups, where it is important to make an evaluation from a fair and neutral perspective, will be carried out as a Radio Usage Survey of public service radio stations every year for the time being.

Table 1: Progress of initiatives implemented by relevant ministries and agencies (Systems using frequencies for which demand for other purposes has emerged)

System	Frequency band	Demand for other purposes	Future direction	Progress status
(1) 1.2 GHz band video transmission system	1.2 GHz Band	Broadcasting Auxiliary services etc.	Termination or migration to another wireless system	Decommissioning
(2) 5GHz band fixed wireless access system	5 GHz band	5G	Termination or migration to another wireless system	Migration to alternative means is under consideration.
(3) Weather radar (C-band)	5.3 GHz band	Wireless LAN	Frequency sharing	Consideration of sharing conditions is complete.
(4) 6.5GHz band microwave fixed link	6.5 GHz band	Wireless LAN	Frequency sharing	Consideration of frequency sharing will be continued.
(5) 40GHz band video transmission system	37 GHz band	5G, Satellite	Termination or migration to another wireless system	Decommissioning or to be decommissioned (during 2022)
(6) 40GHz band microwave fixed link	40 GHz band	5G, satellite	Migration to another wireless system	Frequency migration is completed.
(7) 38GHz band fixed wireless access system	38 GHz band	5G, Satellite	Frequency sharing	Consideration of frequency sharing will be continued.

Table 2: Progress of initiatives implemented by relevant ministries and agencies (Analog systems)

System	Frequency band	Future direction	Progress status
(1) Highway advisory information system	1620 kHz band	Digitalization, termination, or migration to another wireless system	Decommissioned, or to be migrated to another wireless system (under consideration)
(2) 60MHz band telemeter for maritime beacon	60 MHz band	Migration to another wireless system	Migration is underway.
(3) Telemeter	60 MHz band/400 MHz band	Digitalization	Engineering tests are underway for the introduction of a digital format.
(4) Flood prevention communication system	60 MHz band/150 MHz band	Digitalization	
(5) Mobile radio communication systems for dam and sediment control	60 MHz band	Digitalization	To be decommissioned (November 2022)
(6) 150 MHz band Anti-Disaster Radio Communication System	150 MHz band	Digitalization or PS-LTE, etc.	
(7) Local communication system (for disaster communications)	150 MHz band	Digitalization or PS-LTE, etc.	The possibility of substitution by PS-LTE is under consideration.
(8) Oil reserve service communication system	150 MHz band	Digitalization or PS-LTE, etc.	Digitalization is in progress.
(9) Disaster intercommunication system	150/400MHz band	PS-LTE, etc.	The possibility of substitution by PS-LTE is under consideration, or it is scheduled to be decommissioned.
(10) 400MHz band Anti-Disaster Radio Communication System	400 MHz band	Digitalization	Digitalization is completed.
(11) Helicopter television communication system	400 MHz band	Digitalization	Engineering tests are underway for the introduction of a digital format.
(12) Weather radio robot	400 MHz band	Digitalization	
(13) 15GHz band helicopter television transmission system	15 GHz band	Digitalization or termination	Digitalization is in progress, or it is scheduled to be decommissioning. (March 2024)

II. Promotion of utilization and application of the V-Low band and V-High band

With regard to the former terrestrial broadcasting frequency of the Open University of Japan (77.1 MHz and 78.8 MHz), revised regulations that allow the frequency to be used as a temporary disaster broadcasting station, etc., in the Kanto region were implemented in June 2022, based on the "Summary Report on Utilization Measures for Broadcast Frequencies (regarding Former Terrestrial Broadcasting Site of the Open University of Japan and V-Low Band)" compiled by the Study Subcommittee on Utilization Measures for Broadcast Frequencies in March 2022.

For the V-Low band (95 to 108 MHz), the necessary bandwidth will be studied based on that report along with the conversion from AM to FM which is expected to become feasible nationwide from 2028 for expanding frequencies for FM broadcasting. For the introduction of an FM disaster prevention information system, tests on frequency sharing with existing wireless systems, etc., will be conducted by FY2023. In addition, surveys will be conducted on the status of migration to FM roadside communication systems or other wireless systems promoted by relevant ministries and agencies. In the light of the status of these studies and tests, a specific allocation policy will be drafted by the end of FY2024.

For the V-High band (207.5-222 MHz), based on the "Summary of Policies for the Use of the V-High band" published in April 2019, demonstration tests were conducted to substantiate usage in three cases: (1) the upgrading of broadcasting services, (2) IoT, and (3) the upgrading of communications services. "Results of Demonstration Experiments in the V-High Band" was published in June 2022, and the Study Subcommittee on Utilization Measures for Broadcast Frequencies recommended that studies should be carried out to introduce specific systems for the upgrading of telecommunication services.

With regard to the V-High band, based on the said compilation and the report of the Radio Policy Roundtable in the Age of Digital Transformation (August 2021), the conditions for sharing the 200 MHz band public broadband mobile communications system (public BB) with other systems when its frequency is extended will be examined, and the technical conditions will be finalized by the end of FY2024.

At the same time, technical conditions will be studied as regards the introduction of a narrowband IoT communication system that enables several highly public organizations to share information at multiple locations in the event of a disaster, etc., by using a guard band between the expanded public BB and other systems.

III. Measures for expansion of 5G, etc.

To secure internationally harmonized frequencies in cooperation with other countries such as European countries and the United States, studies will be carried out on additional frequency allocations for mobile communication systems in the bands of 2.6 GHz, 4.9 GHz, 26 GHz, 40 GHz, etc., including the application of dynamic frequency sharing, while taking account of any possible impact on existing wireless systems on the same or adjoining bands.

For the 2.6 GHz band (2.645 to 2.665 GHz band), based on studies of sharing with satellite mobile communication systems implemented in FY2017, the possibility of introducing mobile communication systems, including the application of dynamic frequency sharing at ordinary times and during disasters, will be studied while taking account of the impact on existing wireless systems.

For the 4.9 GHz band (4.9 to 5.0 GHz band), in order to allocate frequencies to 5G by the end of FY2025, the deadline for establishing a new 5GHz band fixed wireless access system (registered station) will be set by the end of FY2025. As for existing wireless systems, studies of migration to other wireless systems using termination promotion measures will be carried out.

For the 26 GHz band (25.25 to 27GHz) and 40 GHz band (37.0 to 43.5GHz), in order to

allocate frequencies to 5G by the end of FY2025, studies of frequency reorganization, including the band applied for dynamic frequency sharing and the use of termination promotion measures, will be conducted based on studies of sharing with existing wireless systems and results of survey on actual radio spectrum usage etc.

For the 22 GHz band (22.0 to 23.6 GHz), the results of survey and evaluation of actual radio usage in FY2021 showed that the number of radio stations has been decreasing as a whole, and the number of radio stations that operate in this frequency band is extremely small compared to those in other frequency bands. Therefore, it is necessary to consider the possibility of using the 22 GHz band as a migration destination when reallocating frequencies in other IMT candidate frequency bands. As a candidate destination for migrating existing wireless systems when reallocating frequencies in the 26 GHz and 40GHz bands, studies on promoting a 22 GHz band fixed wireless access (FWA) system will be carried out.

With regard to frequency bands other than those identified for IMT in the ITU World Radiocommunication Conference 2019 (WRC-19) (24.25 to 27.5 GHz, 37 to 43.5 GHz, 47.2 to 48.2 GHz, and 66 to 71 GHz) and other matters, the possibility of 5G frequency allocations will be considered in the light of studies of ITU, 3GPP, etc., and trends in other countries. For the 27.0 to 27.5 GHz band, frequency allocations were implemented in April 2019 along with the 27.5 to 29.5 GHz band.

For the 7025 to 7125 MHz band, which is an IMT specified candidate frequency band to be covered at the ITU World Radiocommunication Conference 2023 (WRC-23), the possibility of 5G frequency allocations will be studied, while taking account of studies of ITU and 3GPP, etc., and trends in other countries.

For local 5G (4.6 to 4.9 GHz and 28.2 to 29.1 GHz bands), development and demonstrations assuming actual usage scenarios will continue to FY2022 to solve various problems and create new values. Furthermore, the feasibility of wide-area use of local 5G, the simplification of licensing procedures and availability at sea will be studied to ensure more flexible operation. The study results will be compiled during FY2022, and revised regulations will be implemented based on the results.

IV. Measures for further developing wireless LAN

For realization of wireless LAN systems capable of handling increased traffic and diverse user needs in future mobile communications, the sharing of extended frequencies (6425 to 7124 MHz) with other wireless systems will be further studied. Technical conditions will be summarized during FY2023 while taking account of trends in other countries and the IMT specified candidate frequency band (7025 to 7125 MHz) of WRC-23.

Technical conditions for high-power outdoor use of wireless LANs and use of narrowband devices in the 5925 to 6425 MHz range will be studied, including the possibility of frequency sharing.

V. Promotion of studies on V2X

In view of the progress and importance of automated driving systems, including safe driving support systems, consideration of specific frequency usage measures, etc., for introduction of V2X communications in the frequency band (5.9 GHz band), now under international consideration, in addition to the existing frequency band for ITS (760 MHz band, etc.), will begin in FY2022 while giving consideration to existing radio systems in the same frequency band. The consideration will take into account the result of the study on the impossibility of frequency sharing with some existing radio systems, the latest international trends, the technological trends and so on.

On the basis of the result of the consideration, if specific service providers for V2X

communications are identified and introduction of V2X in the above frequency band is decided, frequency allocations to V2X will be implemented around FY2023 after the necessary frequency bandwidth is secured through migration of existing wireless systems or by other means.

VI. Measures for advanced use of satellite communications systems

Regarding non-geostationary satellite systems for mobile phones using the 1.7 GHz /1.8 GHz bands, which are expected to be realized in FY2024 and beyond, necessary studies of technical conditions and appropriate licensing procedures, including frequency sharing, will be carried out while taking account of radio regulations from the perspective of international harmonization.

In light of the fact that the bandwidth used for broadband satellite communications systems for mobile vehicles using geostationary satellites (ESIM: Earth Stations in Motion) has been extended as a result of WRC-19, tests on frequency sharing with existing wireless systems have been conducted to study the technical conditions for these extended bandwidths (17.7 to 19.7 GHz and 27.5 to 29.5 GHz), and a conclusion will be drawn by the end of FY2022.

VII. Promotion of reorganization and migration of other major frequencies

- (1) Study of policies for effective frequency usage after migration of digital MCA systems to advanced MCA systems

It is expected that digital MCA systems will be migrated to advanced MCA land mobile communication systems that started in April 2021, and at the same time new wireless systems will be introduced to the frequencies opened up by the migration.

Technical conditions for the new wireless systems will continue to be studied based on the results from tests implemented in FY2021, including the possibility of phased introduction through frequency sharing initiated during ongoing migration.

- (2) Frequency migration for 1.2 GHz band analog image transmission systems

Revised regulations were implemented in FY2016 in relation to radio stations of unmanned mobile image transmission systems that can transmit images digitally from the air using radio waves in the frequency bands of 2.4 GHz, 5.7 GHz, etc. In response, the deadline for acquisition of new licenses for analog image transmission systems using the 1.2 GHz band will be set by FY2027 with the aim of promoting early migration to the frequency bands of 2.4 GHz, 5.7GHz, etc.

- (3) Study of policies for effective frequency usage after termination of public PHS services using the 1.9 GHz band

Public PHS services using the 1.9 GHz band are scheduled to be terminated at the end of March 2023. In preparation for the termination of public PHS services, technical conditions for effective frequency usage, including further frequency extensions and upgrades of the DECT and TD-LTE systems, and conditions of sharing with existing radio systems, will be summarized during FY2022.

VIII. Promotion of Beyond 5G

Beyond 5G, which is the next-generation information and communication infrastructure scheduled to be introduced in the 2030s, is expected to become the foundation of all industries and social activities. In order to promote Beyond 5G, the "Information and Communications Technology Strategy towards Beyond 5G — With the aim of building a robust and vibrant society in the 2030s —" was compiled in June 2022 by more explicitly defining the strategies of R&D, the intellectual property and standardization, of the "Beyond 5G Promotion Strategy— Roadmap towards 6G" formulated in June 2020. The goal is to allow Japan to take the lead in technological development and realize ultra-high-speed and power-saving communication infrastructures, land-sea-air communication coverage expansion, etc., based on the above

strategy. Specifically, R&D of various technologies, including optical networks, photonic-electronics convergence, and satellite/HAPS networks, will be rapidly accelerated. These results will be practically utilized by society successively from 2025. Moreover, international joint research and international standardization will be strongly promoted.

At present, to support R&D of cutting-edge elemental technologies needed for the realization of Beyond 5G, shared research facilities and equipment, such as test beds, are being installed at the National Institute of Information and Communications Technology (NICT), and open-type R&D programs for which a R&D fund was established in March 2021 are underway. In addition, in close collaboration with initiatives utilizing NICT funding, an effective industry-academia-government collaboration system to support R&D programs conducted for Beyond 5G and those conducted by relevant organizations, both of which use spectrum user fees, will be established.

As for industry-academia-government collaboration, the "Beyond 5G Promotion Consortium" and the "Beyond 5G New Business Strategy Center" have played a central role in promoting Beyond 5G initiatives. In March 2022, the consortium announced the "Beyond 5G White Paper-Message to the 2030s (Version 1.0)," which includes the performance targets required for Beyond 5G. The center has also conducted various activities, such as disseminating information through seminars on topics related to intellectual property and standardization, organizing hackathon events targeting higher educational institutions in the digital field, and holding workshops to train human resources who will execute corporate management strategies that include intellectual property and standardization strategies. The consortium and the center will function as a hub for pushing various efforts forward, including industry-academia-government collaboration, discovery of usage cases, and awareness-raising. Efforts to support demonstrations and training of human resources for R&D and standardization, which contribute to effective use of the radio spectrum, will be further strengthened by utilizing spectrum user fees.

To promote technological developments and demonstration tests in high frequency bands such as terahertz radio waves, the target frequency band of the specified experimental stations were extended up to 1100 GHz in May 2022. Also, confirmation procedures at the time of establishing a specified experimental station in the high frequency band, which had been conducted through inspection of attached documents and preliminary inspection of specified radio equipment, were simplified.

Chapter 4. Reorganization Policy for Different Frequency Bands

I. 335.4 MHz and below

Current usage: Commercial radio in the public sector, aviation and marine communications, AM and FM broadcasting, amateur radio, etc.

Basic policies

Promote the digitization of current analog radio systems from the viewpoint of effective use of the radio spectrum. In addition, consider new possible uses for, and sharing of, the radio wave spectrum.

- For 60/150 MHz band analog disaster prevention administrative radio and 150 MHz band convenience radio, promote migration to a digital system.
- For train radio (150 MHz band), promote introduction of digital systems.
- For V-Low band (95 to 108 MHz), carry out studies of extending and upgrading FM radio frequencies, and their utilization and application for FM disaster prevention information transmission systems, etc.
- For the V-High band (207.5 to 222 MHz), carry out studies on extension of frequencies for 200 MHz public broadband mobile communication systems, and introduction of narrowband IoT communication systems.

Specific initiatives

1. Revised regulations, etc.

(1) Short-wave digital communications [3 to 30 MHz]

- For the introduction of a digital system for short-wave international communications (fixed stations), technical conditions will be summarized by June 2023 based on the progress of introduction of short-wave digital systems in other countries.

(2) Policies on use of V-Low band, etc. [95 to 108 MHz, etc.]

- With regard to the former terrestrial broadcasting frequency of the Open University of Japan (77.1 MHz and 78.8 MHz), revised regulations that allow the frequency to be used as a temporary disaster broadcasting station, etc., in the Kanto region were implemented in June 2022, based on the "Summary Report on Utilization Measures for Broadcast Frequencies (regarding Former Terrestrial Broadcasting Site of the Open University of Japan and V-Low Band)" compiled by the Study Subcommittee on Utilization Measures for Broadcast Frequencies in March 2022.
- For the V-Low band (95 to 108 MHz), the necessary bandwidth will be studied based on that report along with the conversion from AM to FM which is expected to become feasible nationwide from 2028 for expanding frequencies for FM broadcasting. For the introduction of an FM disaster prevention information system, tests on frequency sharing with existing wireless systems, etc., will be conducted by FY2023. In addition, surveys on status of consideration of migration to FM roadside communication systems or other wireless systems that relevant ministries and agencies promote will be conducted. In the light of the status of these studies and tests, a specific allocation policy will be drafted by the end of FY2024. [see Appendix (2-5) (3)].

(3) VHF aeronautical radio systems [150 MHz band]

- Following the results of WRC-19 regarding a system for reciprocal exchange of data between ships, and between ships and airplanes, using satellite communications and aeronautical communications (VDES), a revised frequency assignment plan was made in January 2021. Studies by ITU, IMO, etc., have been continued, and further studies will be carried out to ensure that VDES will be introduced smoothly while keeping an eye on international trends.

- (4) Public Broadband Mobile Communication Systems [200 MHz band]
 - Toward expansion of the 200 MHz public broadband mobile communication system (public BB), in order to ensure communication in areas where disruption may occur in an emergency disaster through mutually complementary relationships with PS-LTE, the system will be used more effectively based on the results of tests carried out in FY 2021.
- (5) V-High band [207.5 to 222 MHz]
 - For the V-High band (207.5-222 MHz), based on the "Summary of Policies for the Use of the V-High band" published in April 2019, demonstration tests were conducted to substantiate usage in three cases: (1) the upgrading of broadcasting services, (2) IoT, and (3) the upgrading of communications services. "Results of Demonstration Experiments in the V-High Band " was published in June 2022, and the Study Subcommittee on Utilization Measures for Broadcast Frequencies recommended that studies should be carried out to introduce specific systems for the upgrading of telecommunication services.
 - With regard to the V-High band, based on the said compilation and the report of the Radio Policy Roundtable in the Age of Digital Transformation (August 2021), the conditions for sharing the 200 MHz band public broadband mobile communications system (public BB) with other systems when its frequency is extended will be examined, and the technical conditions will be finalized by the end of FY2024.
 - At the same time, technical conditions will be studied as regards the introduction of a narrowband IoT communication system that enables several highly public organizations to share information at multiple locations in the event of a disaster, etc., by using a guard band between the expanded public BB and other systems.
- (6) Public service radio stations using an analog system [60 MHz /150 MHz /400 MHz bands]
 - For telemeters (60/400 MHz bands), mobile radio communication systems for dam and sediment control (60 MHz band), and flood control (60/150 MHz bands), tests aimed at introduction of a digital format will start in FY2022, and the test results will be compiled by FY2024 [see Appendix (2-6) (i)].

2. Management of frequency reorganization progress, etc.

- (1) Municipal Disaster Prevention Administrative Radio [60 MHz band]
 - With regard to municipal disaster prevention administrative radio (60 MHz band (only for the broadcast system)), information on the advantages of digitalization and other alternative means and possible financial measures will be given to local authorities, and surveys on the age of existing radio equipment will be conducted in FY2022. The aim is to promote early migration to a digital format, etc., together with the renewal of some remaining analog equipment.
- (2) VHF band aeronautical mobile (R) service radio [117.975 to 137 MHz] (R: for civil aviation)
 - Since the VHF band for aeronautical mobile (R) service radio has become congested in recent years, surveys on usage trends will be conducted in FY2022, and a channel plan for band narrowing will be studied while considering introduction and replacement plans for radio equipment by license holders.
- (3) Municipal Disaster Prevention Administrative Radio and Prefectural Disaster Prevention Administrative Radio [150MHz band]
 - For prefectural disaster administrative radio (150 MHz band), the status of frequency migration will be periodically checked, and systems migrated to the 260 MHz band together with replacement of equipment.
 - For municipal disaster prevention administrative radio, information on a new digital system that enables construction of more affordable systems for which technical standards were established in November 2014 and the merits of digitalization will be notified to all local authorities, and systems migrated to a digital system (260 MHz band) together with

replacement of equipment.

- The use of PS-LTE will also be studied based on the preferences of local authorities.

(4) Train radio [150 MHz band]

- For train radios that use the 150 MHz band, increasing interest in improving train safety and transport efficiency due to congested schedules in the metropolitan area has led to a desire for more sophisticated train radios, and there is demand for a shift from inductive radios (high-frequency use equipment) that use the long wave band, so an early shift from analog to digital (150 MHz band) systems will be promoted, using frequencies left after the shift to firefighter radios, etc.

(5) Convenience radio [150 MHz band]

- Rollout of digital system convenience radio, which was able to be newly allocated in December 2012, will continue, and migration from an analog system will be promoted.

(6) Public service radio stations using an analog system [1620 kHz/60 MHz/150 MHz bands]

- For highway advisory information systems (1620 kHz), studies of how they should be phased out or migrated to other wireless systems have been progressing, and their status will continue to be followed up.
- For 60MHz band telemeter for maritime beacon, migration to other wireless systems has been progressing, and its migration status will continue to be followed up.
- 150 MHz band anti-disaster radio communication system will be phased out by November 2022.
- For Local communication system (for disaster communications) (150 MHz band), the possibility of substitution by PS-LTE will be studied.
- For oil reserve service communication system (150 MHz band), digitalization has progressed, and its status will continue to be followed up.
- For disaster intercommunication system used for mutual communication between disaster prevention organizations (150 MHz band), the Emergency Communications Association, which consists of disaster prevention organizations, will continue to study the possibility of utilizing PS-LTE as an alternative means of communication.

II. 335.4 to 714 MHz

Current usage: Terrestrial television broadcasting, commercial radio in the public sector, aviation and marine communications, taxi radios, etc.

Basic policy

Promote digitalization and frequency migration, and consider use of post-migration frequencies for land-based systems, including self-owned radio systems for public services and general services, etc.

- For 350/400 MHz band convenience radio, 400 MHz band analog disaster prevention administrative radio and taxi radio, promote migration to a digital system.

Specific initiatives

1. Revised regulations, etc.

(1) Terrestrial broadcasting [UHF band]

- For terrestrial broadcasting, tests of technologies for expanding transmission capacity, high compression and transmission efficiency improvement will be conducted up to FY2022, aimed at more effective use of broadcasting frequencies and realization of new broadcasting services (ultra-high definition broadcasting, etc.). Based on the results of the above tests, technical conditions for a new broadcasting system will be compiled by the end of FY 2023. In addition, technical studies on station installation conditions for broadcasting systems and SFN relays will be conducted [see Appendix (2-5) (i)].

(2) Public service radio stations using an analog system [400 MHz band]

- For helicopter television communication system (400 MHz band) and weather radio robot (400MHz band), tests aimed at the introduction of a digital system will start in FY2022, and test results will be compiled by FY 2024 [see Appendix (2-6) (i)].

2. Management of frequency reorganization progress, etc.

(1) Convenience radio [350 MHz /400 MHz bands]

- Regarding analog convenience radio stations (for which the frequency assignment plan as of September 2021 stipulates that use of the frequency will be terminated in November 30, 2024), migration to a digital system will be promoted. To deal with the increasing number of digital convenience radio stations, efforts will be made by the end of FY2022 to secure necessary frequencies and to consider relay technologies to improve convenience.

(2) Marine horn [350 MHz band]

- Considering the uneven regional distribution and downward trend in the number of radio stations, efforts will be promoted to complete migration within FY2022.

(3) Municipal Disaster Prevention Administrative Radio and Prefectural Disaster Prevention Administration Radio [400 MHz band]

- For prefectural disaster prevention administrative radio, the frequency migration status will be checked periodically, and migration to a digital system (260 MHz band) together with the replacement of equipment will be promoted.
- For municipal disaster prevention administrative radio, information on the merits of digitalization and a new digital system that enable the creation of more affordable systems, for which technical standards were established in November 2014, will be given to local authorities, and early migration to a digital system (260 MHz band) together with renewal of equipment will be promoted.
- The use of PS-LTE will also be studied based on the preferences of local authorities.

(4) Taxi Radio [400 MHz band]

- For analog taxi radio, early migration from an analog system to a digital one will be promoted in order to upgrade communications, and to use frequencies more effectively.

(5) MCA for regional development [400 MHz band]

- For analog MCA for regional development, early migration from an analog system to a digital one will be promoted to upgrade communications and use frequencies more effectively, and its use will be promoted as an alternative to 350 MHz band marine horn systems.

(6) Train radio [400 MHz band]

- For train radio, because an advanced train control system is desired due to growing interest in safer train operation and more efficient transport, studies of frequencies needed to introduce a 400 MHz band radio-based train control system into increasingly congested urban railways in the metropolitan area will be carried out.

(7) Public service radio stations using an analog system [400 MHz band]

- For 400MHz band anti-disaster radio communication system, digitalization was completed.

(8) Disaster intercommunication system [400 MHz band]

- For the disaster intercommunication system used for mutual communication between disaster prevention organizations (400 MHz band), the Emergency Communications Association, which consists of disaster prevention organizations, will continue to study the possibility of utilizing PS-LTE as an alternative means of communication.

III. 714 to 960 MHz Band

Current usage: Mobile communication systems, including 4G/5G, (700 MHz/ 800 MHz/ 900 MHz bands), MCA land mobile communication systems, and 920 MHz low-power wireless systems (RFID tag system).

Basic policy

Facilitate further expansion and promotion of mobile communication systems, including upgrade to 5G.

- With regard to digital MCA land mobile communication systems, the timing of migration to advanced MCA land mobile communication systems, which started in April 2021, will be studied. Along with this, technical conditions for a new wireless system using frequencies opened up by such migration will also be studied, including the possibility of its phased introduction through frequency sharing initiated during ongoing migration.
- The 700 MHz band was allocated to 3 mobile phone carriers in June 2012 and their services have started. Initiatives to prevent TV reception interference in the frequency band will continue to be promoted.

Specific initiatives

1. Revised regulations, etc.

(1) Mobile communication systems [800 MHz/ 900 MHz bands]

- Regarding 800/900 MHz mobile communication systems, in response to recent needs for airspace use of mobile phones by drones, etc., revised regulations were implemented in 2020 to enable airspace use by FDD at an altitude of less than 150 m above the ground. Initiatives to expand usage, including use at an altitude of 150 m or higher, will continue to be studied.

(2) Studies of policies for effective frequency use after migration of digital MCA to advanced MCA [800 MHz /900 MHz bands]

- Digital MCA land mobile communication systems, advanced MCA land mobile communication systems which started in April 2021 will be migrated, and it is expected that a new wireless system will be introduced early to the frequencies opened up by the migration. Technical conditions for a new wireless system will continue to be studied, including migration timing and the possibility of phased introduction through frequency sharing initiated during ongoing migration, based on the results from tests implemented in FY2021.

2. Management of frequency reorganization progress, etc.

(1) Personal radio [903 to 905 MHz]

- The frequency allocation deadline for personal radio was November 30, 2015 and licenses for new radio stations were no longer issued from that date. Although radio stations that had been licensed before the allocation deadline were allowed to operate until their license expired, all personal radio licenses were cancelled or expired in December 2021, and reorganization of the 900 MHz band was completed.

Future topics to be addressed

- (1) To permit tight use of multiple wireless communication systems such as local 5G, wireless LAN and IoT systems in narrow spaces such as inside facilities, etc., R&D will be pursued to establish wireless resource virtualization and management technology to ensure wireless communication within the guaranteed arrival time for applications with high real-time characteristics, and delay guarantee technology to optimally control an entire area network, even when multiple applications with different communication requirements are mixed [see

Appendix (2-3) (ii)].

- (2) As for 920 MHz band passive RFID systems, R&D on the technologies, which enable to simultaneously and precisely acquire data from a large number of electronic tags with sensor even if electronic tags are scattered over a wide area or are installed on a high-speed moving object, are promoted [see Appendix (2-3) (i)].

IV. 960 MHz to 3.4 GHz Band

Current usage: Intensely used by many radio stations, including 4G/5G (1.5 GHz/ 1.7 GHz/ 2 GHz/ 2.3 GHz bands), satellite communication systems such as Inmarsat, air and ship radar systems, specified low-power radio stations, PHS, wireless LAN, broadband mobile wireless access (BWA) systems and rural subscriber radio.

Basic policy

Consider policies for further expansion and promotion of mobile communication systems, including upgrade to 5G, and for effective use of frequencies to meet further demand for non-geostationary satellite systems for 5G and mobile phones.

- For the 1.7 GHz band, the 1710 to 1750 MHz / 1805 to 1845 MHz band was allocated to 2 mobile phone carriers in April 2018, and the 1765 to 1785/1860 to 1880 MHz band in areas other than the Tokyo-Nagoya-Osaka area was allocated to a mobile phone carrier in April 2018. Quick, smooth frequency migration of existing wireless systems will continue to be promoted through the use of accelerated termination measures.
- With regard to non-geostationary satellite systems for mobile phones using the 1.7 GHz /1.8 GHz bands, necessary studies of technical conditions and appropriate licensing procedures, including frequency sharing, will be carried out, while taking account of radio regulations from the perspective of international harmonization.
- In light of the fact that the public PHS service using the 1.9 GHz band is scheduled to be terminated at the end of March 2023, studies on further efficient use of this frequency band will be carried out.
- With regard to broadband wireless access (BWA) systems using 2.5 GHz, studies of the approval of their use for voice transmission as an additional option for data transmission, will be carried out.

Specific initiatives

1. Revised regulations, etc.

(1) Mobile communication systems [1.7 GHz/ 2 GHz/ 2.6 GHz bands]

- For 1.7/2 GHz mobile communication systems, in response to recent needs for airspace use of mobile phones by drones etc., revised regulations were implemented in 2020 to enable airspace use by FDD at an altitude of less than 150 m above the ground. Initiatives to expand usage, including use at an altitude of 150 m or higher, will continue to be studied.
- For the 2.6 GHz band (2.645 to 2.665 GHz), based on the results of sharing with satellite mobile communication systems implemented in FY2017, studies of the possibility of introducing mobile communication systems, including the application of dynamic frequency sharing at ordinary times and during disasters, will be carried out while taking account of their impact on existing wireless systems.

(2) Studies of policies for effective frequency use after termination of 1.9 GHz band public PHS services

- Public PHS services using the 1.9 GHz band are scheduled to be terminated at the end of March 2023. In preparation for the termination of public PHS services, technical conditions for effective frequency use, including further frequency extensions or upgrade of DECT and TD-LTE systems, and conditions of sharing with existing radio systems, will be summarized during FY2022.

(3) Non-geostationary satellite systems for mobile phones [1.7 GHz /1.8 GHz bands]

- Regarding non-geostationary satellite systems for mobile phones using the 1.7 GHz /1.8 GHz bands, which are expected to be realized in FY2024 and beyond, necessary studies on technical conditions and appropriate licensing procedures, including frequency sharing, will be carried out, while taking account of radio regulations from the perspective of

international harmonization.

(4) Broadband wireless access (BWA) systems [2.5 GHz band]

- Regarding broadband wireless access (BWA) systems using 2.5 GHz band (2.545 to 2.645 GHz), of approval of their use for voice transmission as an additional option to data transmission will be studied.

2. Management of frequency reorganization progress, etc.

(1) Image transmission systems [1.2 GHz band]

- Revised regulations were implemented in FY2016 in relation to radio stations of unmanned mobile image transmission systems that can transmit images digitally from the air using radio waves in the frequency bands of 2.4 GHz, 5.7 GHz, etc. In response, the deadline for acquisition of new licenses for analog image transmission systems using the 1.2 GHz band will be set by FY2027 with the aim of promoting early migration to the frequency bands of 2.4 GHz, 5.7GHz, etc.

(2) Public service radio stations using an analog system [1.2 GHz band]

- With regard to 1.2 GHz band video transmission system, follow-ups on the progress of initiatives for promoting effective use of frequencies in relevant ministries and agencies were conducted, and it was confirmed that all these stations had been decommissioned.

(3) Public service radio stations [1.7 GHz band]

- As the current frequency band used by public service radio stations is supposed to be decommissioned by March 31, 2025, quick frequency migration to the 4.5 GHz band, etc., will be promoted through use of termination promotion measures.

(4) Rural subscriber radio [2 GHz band]

- Demand for 2 GHz band rural subscriber radio has been decreasing due to migration to other wireless systems or other reasons, except in remote islands and mountainous areas. Therefore, migration to other systems, such as VHF band subscriber digital wireless systems which were upgraded in July 2020, will be promoted with the aim of completing migration in FY2030.

Future topics to be addressed

(1) To permit tight use of multiple wireless communication systems such as local 5G, wireless LAN and IoT systems in narrow spaces such as inside facilities, R&D will be pursued to establish wireless resource virtualization and management technology to ensure wireless communication within the guaranteed arrival time for applications with high real-time characteristics and delay guarantee technology to optimally control an entire area network, even when multiple applications with different communication requirements are mixed [see Appendix (2-3) (ii)] (relisted).

(2) To avoid interference explosions due to increased traffic in wireless LAN systems, etc., R&D will be pursued regarding intelligent propagation path control technologies that coordinate active array antenna technology and IRS (Intelligent Reflecting Surface) technology, as well as interlayer access control technology that allows grasping of the wireless environment and efficiently managing wireless resources [see Appendix (2-3) (iv)].

V. 3.4 to 7.125GHz band

Current usage: 4G and 5G (3.4 GHz/ 3.5 GHz/ 3.7 GHz/ 4.5 GHz bands), local 5G (4.5 GHz band), FPU, STL/TTL/TSL, wireless access systems, wireless LAN, weather radar, DSRC, satellite communications, fixed microwave lines, etc.

Basic policy

To expand and promote 5G and local 5G, which have already been allocated, secure necessary frequencies to meet further demand for 5G, etc., design effective radio spectrum usage measures to expand the use of wireless LAN that can meet diverse user needs, and secure frequency bands that can meet the need for internationally harmonious ITS communications, further studies of frequency sharing measures with existing wireless systems will be conducted.

- Allocations were made to 4 mobile phone carriers for the 3.7 GHz band (3600 to 4100 MHz) in April 2019. From now on, frequency sharing with existing radio systems will be promoted for the further expansion of 5G, both R&D and international standardization activities, will be continuously promoted.
- To introduce local 5G in the 4.6 to 4.9 GHz band, revised regulations were implemented in December 2020. From now on, initiatives for further use of the bandwidth will be promoted.
- For 5.9 GHz band V2X, studies of specific radio usage measures, etc., will be carried out, while taking account of existing wireless systems, and domestic and overseas technological trends.

Specific initiatives

1. Revised regulations, etc.

(1) Mobile communication systems [4.5 GHz/ 4.9 GHz bands]

- For the 4.9 GHz band (4.9 to 5.0 GHz band), in order to allocate frequencies to 5G by the end of FY2025, the deadline for establishing a new 5GHz band Fixed wireless access system (registered station) will be set by the end of FY2025. As for existing wireless systems, studies of migration to other wireless systems using termination promotion measures will be carried out.
- For local 5G (4.6 to 4.9 GHz and 28.2 to 29.1 GHz bands), development and demonstrations assuming actual usage scenarios will continue to FY2022 to solve various problems and create new values. Furthermore, the feasibility of wide-area use of local 5G, the simplification of licensing procedures and availability at sea will be studied to ensure more flexible operation. The study results will be compiled during FY2022, and revised regulations will be implemented based on the results.

(2) Unmanned aircraft systems (UAS) [5 GHz band]

- To promote effective frequency use in the 5 GHz frequency band (5030 to 5091 MHz) allocated to control communications of unmanned aircraft, international standardization concerning relay communication systems using unmanned aircraft flying at high altitude and other measures will be moved forward.

(3) Next-generation high-performance radar, etc. [5 GHz/ 9.7 GHz bands]

- Phased array antennas are expected to enable us to observe, in a short time period, torrential rains, etc., which have recently been increasing, and to install weather radar in various places. Technical studies of band narrowing of 9.7 GHz weather radar equipped with these antennas and channel plans for 5 GHz high-performance weather radar (C-band weather radar) will be carried out, and technical conditions will be summarized by the end of FY2022.

(4) V2X [5.9 GHz band]

- In view of the progress and importance of automated driving systems, including safe driving support systems, consideration of specific frequency usage measures, etc., for introduction of V2X communications in the frequency band (5.9 GHz band), now under international consideration, in addition to the existing frequency band for ITS (760 MHz band, etc.), will begin in FY2022 while giving consideration to existing radio systems in the same frequency band. The consideration will take into account the result of the study on the impossibility of frequency sharing with some existing radio systems, the latest international trends, the technological trends and so on.

On the basis of the result of the consideration, if specific service providers for V2X communications are identified and introduction of V2X in the above frequency band is decided, frequency allocations to V2X will be implemented around FY2023 after the necessary frequency bandwidth is secured through migration of existing wireless systems or by other means.

(5) Wireless LAN systems [6 GHz band]

- For realization of wireless LAN systems capable of handling increased traffic and diverse user needs in future mobile communications, the sharing of extended frequencies (6425 to 7125 MHz) with other wireless systems will be further studied. Technical conditions will be summarized during FY2023 while taking account of trends in other countries and the IMT specified candidate frequency band (7025 to 7125 MHz) of WRC-23.
- Technical conditions for high-power outdoor use of wireless LANs and use of narrowband devices in the 5925 to 6425 MHz range will be studied, including the possibility of frequency sharing. [see Appendix (2-3) (iii)].

(6) Fixed wireless communication systems [6 GHz/ 6.5 GHz/ 7.5 GHz bands]

- Fixed wireless communication systems using radio spectrum in the 6 GHz, 6.5 GHz and 7.5 GHz bands have been used as a means of providing telecommunications services to island areas, etc., where it is difficult to lay optical fiber networks or ensure communications in the event of a disaster. Studies of technologies to realize further upgrades of these communication systems and improvement of communication quality through frequency sharing with wireless LAN systems, etc., will be promoted, and the technical conditions will be summarized during FY2024 [see Appendix (2-4) (iii)].

2. Management of frequency reorganization progress, etc.

(1) Audio STL, etc. [3.4 GHz band]

- For audio STL, etc. (audio STL/TTL/TSL and monitor/control lines), frequency migration to the M-band (6570 to 6870 MHz) or N-band (7425 to 7750 MHz) in principle had been promoted through termination promotion measures. The deadline for completion of migration at November 30, 2022 was moved up, and use of the frequency band was terminated in the third quarter of FY2021 (for audio FPU, frequency migration has already been completed).

(2) Systems for public service radio stations using frequencies for which demand for other purposes has emerged [5 GHz /5.3 GHz /6.5 GHz bands]

- For 5 GHz band Fixed wireless access systems, studies of migration to an alternative means have been carried out, and the status of these studies will be examined.
- For weather radar (C-band) (5.3 GHz band), studies of further band narrowing and introduction of interference reduction technologies will be promoted in order to facilitate frequency sharing, and usage status will be surveyed.
- For 6.5GHz band microwave fixed link, studies of frequency sharing with wireless LAN systems will continue to be carried out, and usage status will be examined.

Future topics to be addressed

- (1) For broadband wireless communication system configuration and network connection management and control technologies, which are needed for the sharing of mobile phone carrier 5G base stations, R&D will be carried out from FY2020 to FY2022 in order to improve the efficiency of frequency usage [see Appendix (2-1) (i)].
- (2) R&D will be pursued to further enhance 5G features, particularly “ultra-high speed”, “ultra-low latency” and “multiple simultaneous connection”, and to realize further improvements in “high energy efficiency” and “high reliability” [see Appendix (2-1) (ii)].
- (3) With the aim of securing communications effectively using high-frequency bands, R&D on coordinated control of IRS (Intelligent Reflection Surface) and relay communication terminals will be promoted to construct an optimal propagation path that avoids radio wave obstructions lying between base stations and mobile terminals, and to effectively use resources in the high frequency bands [see Appendix (2-1) (iii)].
- (4) To allow base stations consisting of multiple different vendors to take mutual advantage of the 5G features of "ultra-high speed" and "ultra-low latency", more effective use of radio waves will be promoted by conducting comprehensive demonstration tests on cooperative and collaborative operation between base stations, ensuring interoperability of base stations, and reducing radio wave interference by multiple base stations [see Appendix (2-1) (iv)].
- (5) To permit tight use of multiple wireless communication systems such as local 5G, wireless LAN and IoT systems in narrow spaces such as inside facilities, R&D will be pursued to establish wireless resource virtualization and management technology to ensure wireless communication within the guaranteed arrival time for applications with high real-time characteristics, and delay guarantee technology to optimally control an entire area network, even when multiple applications with different communication requirements are mixed [see Appendix (2-3) (ii)] (relisted).
- (6) To avoid interference explosions due to increased traffic in wireless LAN systems, etc., R&D will be pursued regarding intelligent propagation path control technologies that coordinate active array antenna technology and IRS (Intelligent Reflecting Surface) technology, as well as interlayer access control technology that allows grasping of the wireless environment and efficiently managing wireless resources [see Appendix (2-3) (iv)] (Relisted).
- (7) To cope with future traffic increases due to the expanded use of wireless LAN systems by IoT, technological studies of conditions for sharing with other existing wireless systems will be promoted.
- (8) The DSRC system, which is mainly used for ETC (electronic toll collection) on toll roads, has several channels that can be utilized. However, there is uneven use of channels that are actually used. In the future, surveys on how frequencies are used and the status of that usage will be conducted, and studies of the possibility of sharing with other wireless systems will be carried out based on the usage status.
- (9) Regarding the 7025 to 7125 MHz band, which is the IMT specified candidate frequency band to be covered at WRC-23, the possibility of 5G frequency allocations will be studied in view of the progress of studies of ITU, 3GPP, etc., and trends in other countries.

VI. 7.125 to 15.25 GHz band

Current usage: Various radar systems, satellite communications, satellite broadcasting, FPU, STL/TTL/TSL, fixed microwave lines, etc.

Basic policy

Pursue advanced satellite broadcasting to realize the upgrading of various radar systems, and a smooth transition from 2K broadcasting to 4K broadcasting.

- For band narrowing of 9.7GHz weather radar equipped with phased array antennas, technical studies of channel plans, etc., will be carried out.
- For the new 4K/8K satellite broadcasting, efforts to develop of an appropriate reception environment will be made through surveys and analyses on the impact on existing wireless systems that use the same band as the intermediate frequencies of the receiving equipment. In order to realize a smooth transition from 2K broadcasting to 4K broadcasting in satellite broadcasting, revised regulations will be implemented based on the results of tests.

Specific initiatives

1. Revised regulations, etc.

(1) Next-generation high-performance radar systems, etc. [5 GHz/ 9.7 GHz bands]

- Phased array antennas are expected to enable us to observe, in a short time period, torrential rains, etc., which have recently been increasing, and to install weather radar in various places. Technical studies of band narrowing of 9.7 GHz weather radar equipped with these antennas and channel plans for 5 GHz high-performance weather radar (C-band weather radar) will be carried out, and technical conditions will be summarized by the end of FY2022 (Relisted).

(2) X-band coastal surveillance radar systems [9 GHz band]

- Stable operation of high-performance radar systems in the meteorological field and the introduction of next generation high-performance radar systems will be accelerated, as well as to meet increasing demand for coastal surveillance radar systems. For that purpose, technical standards for coastal surveillance radar systems will be formulated by FY2023 after examining frequency bandwidth extension and upgrading radar systems, including multiple bandwidth responsive models, in parallel with studies of frequency sharing in the 9.7 GHz band for meteorological radar systems [see Appendix (2-4) (i)].

(3) General-purpose weather radar systems [9.4 GHz band]

- Based on the results of surveys and studies of frequency sharing among radio stations for the purpose of implementing dynamic frequency allocation, technical studies will be carried out to enable dynamic sharing in view of location, time, etc., and technical conditions for these radar systems will be summarized by the end of FY 2022.

(4) Ultra-high definition television broadcasting (4K/8K broadcasting) [12 GHz band]

- Following the start of commercial broadcasting for new 4K/8K satellite broadcasting in December 2018, in order to avoid any impact on existing wireless systems by the intermediate frequencies of receiving equipment, subsidy projects for repairs of receiving equipment that may affect these systems had been implemented up to FY2021.

From FY2022, efforts for development of an appropriate reception environment will be made through surveys and analyses of the impact on existing wireless systems [see Appendix (2-5) (ii)].

In addition, to allow a smooth transition from 2K broadcasting to 4K broadcasting in satellite broadcasting, in order to upgrade video encoding systems for 2K broadcasting and install them on the same transponders as 4K broadcasting, revised regulations will be implemented by FY2024 based on the results of tests.

VII. 15.25 to 31 GHz band

Current usage: 5G, local 5G (28 GHz band), various radar systems, satellite communications, wireless access systems, etc.

Basic policy

Consider policies for effective frequency use to enable the expansion and promotion of 5G and local 5G, for which allocations have been made, and to secure necessary frequencies that meet further demand for 5G and satellite communication systems.

- Allocations were made to 4 mobile phone carriers for the 27.0 to 28.2 GHz band, and the 29.1 to 29.5 GHz band, in April 2019. From now on, frequency sharing with existing radio systems will be promoted for the further expansion of 5G, and R&D will be continuously pursued. For the 26 GHz band (25.25 to 27 GHz), further studies of frequency allocations to 5G will be conducted.
- To introduce local 5G in the 28.3 to 29.1GHz band, revised regulations were implemented in December 2020. From now on, initiatives for further use of the bandwidth will be promoted.
- Studies of how to introduce 5G in new candidate frequency bands will be carried out.

Specific initiatives

1. Revised regulations, etc.

(1) Mobile communication systems [26 GHz band, etc.]

- For the 26 GHz band (25.25 to 27GHz) and 40 GHz band (37.0 to 43.5GHz), in order to allocate frequencies to 5G by the end of FY 2025, frequency reorganization studies, including use of the band applied for dynamic frequency sharing and termination promotion measures, will be carried out based on the results of sharing with existing wireless systems and the survey on actual radio spectrum usage.
- For frequency bands other than those identified for IMT in WRC-19 (24.25 to 27.5 GHz, 37 to 43.5 GHz, 47.2 to 48.2 GHz, and 66 to 71 GHz), the possibility of frequency allocations to 5G will be studied in light of the progress of studies of ITU, 3GPP, etc., and trends in other countries. With regard to the 27.0 to 27.5 GHz band, frequency allocations were implemented in April 2019 along with the 27.5 to 29.5 GHz band.
- For local 5G (4.6 to 4.9 GHz and 28.2 to 29.1 GHz bands), development and demonstrations assuming actual usage scenarios will continue to FY2022 to solve various problems and create new values. Furthermore, the feasibility of wide-area use of local 5G, the simplification of licensing procedures and availability at sea will be studied to ensure more flexible operation. The study results will be compiled during FY2022, and revised regulations will be implemented based on the results. [see Appendix (2-1) (v)] (Relisted).

(2) Broadband geostationary satellite communication systems for mobile vehicles [17.7 to 19.7 GHz and 27.5 to 29.5 GHz]

- In light of the fact that the bandwidth used for broadband satellite communication systems for mobile vehicles using geostationary satellites (ESIM) has been extended as a result of WRC-19, tests on frequency sharing with existing wireless systems have been conducted to study the technical conditions for these extended bandwidths (17.7 to 19.7 GHz and 27.5 to 29.5 GHz), and a conclusion will be drawn by the end of FY 2022 [see Appendix (2-2) (iii)](Relisted).

2. Management of frequency reorganization progress, etc.

(1) Systems for public service radio stations using frequencies for which demand for other purposes has emerged [15GHz]

- For 15GHz band helicopter television transmission system, decommissioning or

digitalization has been progressing, and their status will continue to be surveyed.

Future topics to be addressed

- (1) In order to meet the need for diverse satellite communication applications, such as use of the Internet in aircraft and communications in the event of a disaster, R&D on technologies that enable flexible control of satellite (Ka band) resources (frequency bands, and beam location and shape) will be pursued [see Appendix (2-2) (i)].
- (2) To permit tight use of multiple wireless communication systems such as local 5G, wireless LAN and IoT systems in narrow spaces such as inside facilities, R&D will be pursued to establish wireless resource virtualization and management technology to ensure wireless communication within the guaranteed arrival time for applications with high real-time characteristics, and delay guarantee technology to optimally control an entire area network, even when multiple applications with different communication requirements are mixed [see Appendix (2-3) (ii)] (Relisted).
- (3) For broadband wireless communication system configuration and network connection management and control technologies, which are needed for the sharing of mobile phone carrier 5G base stations, R&D will be carried out from FY2020 to FY2022 in order to improve the efficiency of frequency usage [see Appendix (2-1) (i)](Relisted).
- (4) R&D will be pursued to further enhance 5G features, particularly “ultra-high speed”, “ultra-low latency” and “multiple simultaneous connection”, and to realize further improvement in “high energy efficiency” and “high reliability” [see Appendix (2-1) (ii)](Relisted).
- (5) With the aim of securing communications effectively using high-frequency bands, R&D on coordinated control of IRS (Intelligent Reflection Surface) and relay communication terminals will be pursued in order to construct an optimal propagation path that avoids radio wave obstructions lying between base stations and mobile terminals, and to effectively use resources in the high frequency bands [see Appendix (2-1) (iii)](Relisted).
- (6) To allow base stations consisting of multiple different vendors to take mutual advantage of the 5G features of "ultra-high speed" and "ultra-low latency", more effective use of radio waves will be promoted by conducting comprehensive demonstration tests on cooperative and collaborative operation between base stations, ensuring interoperability of base stations, and reducing radio wave interference by multiple base stations [see Appendix (2-1) (iv)] (Relisted).
- (7) With regard to the 22 GHz band (22.0 to 23.6 GHz), the results of survey and evaluation of actual radio spectrum usage in FY2021 showed that the number of radio stations has been decreasing as a whole, and the number of radio stations that operate in this frequency band is extremely small compared to those in other frequency bands. Therefore, it is necessary to consider the possibility of using the 22 GHz band as a migration destination when reallocating frequencies in other IMT candidate frequency bands. As a candidate destination for migrating existing wireless systems when reallocating frequencies in the 26 GHz and 40GHz bands, studies on upgrading a 22 GHz band fixed wireless access (FWA) system will be carried out.

VIII. 31 GHz and above

Current usage: Various radar systems, FPU, wireless access systems, etc.

Basic policy

Promote the studies of effective radio usage measures for securing the necessary frequencies to meet the further demand for 5G, and promote the development of basic technologies and new radio spectrum usage systems in order to facilitate the further use of unused frequency bands, including the terahertz band.

- For the 40GHz band (37.0 to 43.5GHz), further studies of frequency allocations to 5G will be carried out.

Specific initiatives

1. Revised regulations, etc.

(1) Mobile communication systems [40 GHz band, etc.]

- For the 26 GHz band (25.25 to 27GHz) and 40 GHz band (37.0 to 43.5GHz), in order to allocate frequencies to 5G by the end of FY 2025, frequency reorganization studies, including use of the band applied for dynamic frequency sharing and termination promotion measures, will be carried out based on the results of sharing with existing wireless systems and the survey on actual radio spectrum usage. (Relisted).
- For frequency bands other than those identified for IMT in WRC-19 (24.25 to 27.5 GHz, 37 to 43.5 GHz, 47.2 to 48.2 GHz, and 66 to 71 GHz), the possibility of frequency allocations to 5G will be studied in light of the progress of studies of ITU, 3GPP, etc., and trends in other countries. With regard to the 27.0 to 27.5 GHz band, frequency allocations were implemented in April 2019 along with the 27.5 to 29.5 GHz band (Relisted).

(2) Foreign object debris detection radar system in runway [92 to 100 GHz]

- To ensure the availability and safety of critical infrastructure such as airport runway surveillance, etc., studies of technical conditions and regulatory reforms will be carried out in FY2022 geared toward the introduction of foreign object debris detection radar system in runway using high-speed, high-precision imaging technologies (92 to 100 GHz).

2. Management of frequency reorganization progress, etc.

(1) Systems for public service radio stations using frequencies for which demand for other purposes has emerged [38GHz /40 GHz bands]

- For the 38 GHz band fixed wireless access system, studies of frequency sharing with 5G will be carried out, and surveys of usage status will continue to be conducted.
- For the 40GHz band video transmission system, it was confirmed that its decommissioning has been completed or is scheduled to be completed during FY2022.
- For the 40 GHz band microwave fixed link, its migration to other wireless systems has been completed.

Future topics to be addressed

(1) R&D of wireless communication infrastructure technologies in the terahertz band will be pursued toward the realization of ultra-high speed transmissions of tens of Gbps using terahertz waves. Furthermore, R&D of video transmission technologies, standardization and market research, will be pursued in order to enable their utilization and application for high-definition video transmission [see Appendix (2-5) (iv)].

(2) To realize higher-capacity transmission of mobile communication systems by utilizing high frequency bands that can secure ultra-wide bandwidth, R&D will be pursued on front-end IC technology integrated with antennas that enable high output in high frequency bands, compound semiconductor technology, and wireless system device configuration technology in

high frequency bands [see Appendix (2-1) (vi)].

- (3) To realize fixed wireless systems that respond to the rapid increase in communication volume due to the development of 5G, etc., R&D of wireless technology in the ultra-high frequency band (350 to 600 GHz), and mutual conversion technology with optical fiber signals, will be pursued [see Appendix (2-4) (ii)].
- (4) To realize high-capacity fixed wireless systems, technical studies will be carried out toward the introduction of OAM (Orbital Angular Momentum) mode multiplexing transmission technology (a technology that increases the number of signals transmitted simultaneously by transmitting signals on radio waves which have different OAM modes (radio vortex rotation speeds) in the millimeter waveband [see Appendix (2-4) (iv)].
- (5) To achieve Society 5.0, high-capacity, simultaneous multi-connection technology for transmission of high-definition video and sensing information, etc., is required for upgrading communication tools such as AR and VR and mobility in the fields of education, medical care, etc. For that purpose, R&D will be carried out on wireless LAN transmission technologies using terahertz-band MIMO, which can transmit an enormous amount of information [see Appendix (2-3) (v)].

IX. Initiatives related to reorganization of other frequencies and radio wave usage, etc.

(1) Promotion of Beyond 5G

Beyond 5G, which is the next-generation information and communication infrastructure scheduled to be introduced in the 2030s, is expected to become the foundation of all industries and social activities. In order to promote Beyond 5G, the "Information and Communications Technology Strategy towards Beyond 5G — With the aim of building a robust and vibrant society in the 2030s —" was compiled in June 2022 by more explicitly defining the strategies of R&D, the intellectual property and standardization, of the "Beyond 5G Promotion Strategy— Roadmap towards 6G" formulated in June 2020. The goal is to allow Japan to take the lead in technological development and realize ultra-high-speed and power-saving communication infrastructures, land-sea-air communication coverage expansion, etc., based on the above strategy. Specifically, R&D of various technologies, including optical networks, photonic-electronics convergence, and satellite/HAPS networks, will be rapidly accelerated. These results will be practically utilized by society successively from 2025. Moreover, international joint research and international standardization will be strongly promoted.

At present, to support R&D of cutting-edge elemental technologies needed for the realization of Beyond 5G, shared research facilities and equipment, such as test beds, are being installed at the National Institute of Information and Communications Technology (NICT), and open-type R&D programs for which a R&D fund was established in March 2021 are underway. In addition, in close collaboration with initiatives utilizing NICT funding, an effective industry-academia-government collaboration system to support R&D programs conducted for Beyond 5G and those conducted by relevant organizations, both of which use spectrum user fees, will be established.

As for industry-academia-government collaboration, the "Beyond 5G Promotion Consortium" and the "Beyond 5G New Business Strategy Center" have played a central role in promoting Beyond 5G initiatives. In March 2022, the consortium announced the "Beyond 5G White Paper--Message to the 2030s (Version 1.0)," which includes the performance targets required for Beyond 5G. The center has also conducted various activities, such as disseminating information through seminars on topics related to intellectual property and standardization, organizing hackathon events targeting higher educational institutions in the digital field, and holding workshops to train human resources who will execute corporate management strategies that include intellectual property and standardization strategies. The consortium and the center will function as a hub for pushing various efforts forward, including industry-academia-government collaboration, discovery of usage cases, and awareness-raising. Efforts to support demonstrations and training of human resources for R&D and standardization, which contribute to effective use of the radio spectrum, will be further strengthened by utilizing spectrum user fees.

To promote technological developments and demonstration tests in high frequency bands such as terahertz radio waves, the target frequency band of the specified experimental stations was extended up to 1100 GHz in May 2022. Also, confirmation procedures at the time of establishing a specified experimental station in the high frequency band, which had been conducted through inspection of attached documents and preliminary inspection of specified radio equipment, were simplified.

(2) Response based on assessment of the degree to which the radio spectrum is being utilized effectively

Before enforcement of the Radio Amendment Act 2022, in order to promote fair and efficient use of the radio spectrum, an assessment of the degree to which the radio spectrum is being utilized effectively had been conducted by the Minister for Internal Affairs and Communications, based on the results of survey on actual radio spectrum usage. The Act stipulates that the assessment shall be conducted by the Radio Regulatory Council, which is composed of

members who have a wide range of experience and knowledge, in order to conduct more appropriate assessments that respond to technological developments, etc.

In the future, based on the assessment by the Radio Regulatory Council, initiatives for review of the contents of the actual usage survey in the next fiscal year will be implemented as necessary, and frequency reorganization in bands where there is a high need for radio usage will be accelerated.

(3) Measures for reallocation of mobile phones and frequencies

In accordance with the Radio Amendment Act 2022, a system that enables reallocation of frequencies used by base stations for commercial telecommunications services, such as mobile phones, was introduced. In that system, frequencies can be reallocated if the results of the assessment of what degree the radio spectrum is being utilized effectively conducted by the Radio Regulatory Council do not meet certain standards, if the Minister for Internal Affairs and Communications decides it necessary to conduct a reallocation review based on conflicting applications, or if it is deemed necessary to reallocate mobile phone frequencies, etc., in order to ensure fair and efficient use of the radio spectrum.

In view of this, studies of the basic migration period and migration costs, as well as who should bear such costs when reallocation is implemented, will be carried out. If necessary, a needs survey on the use of frequencies for mobile phones and the nationwide Broadband Wireless Access System (nationwide BWA) will be conducted.

(4) New allocation methods for mobile phone frequencies

In view of the potential advantages and measures to address the disadvantages of frequency allocation methods of foreign countries, studies of new allocation methods for mobile phone frequencies that further reflect the economic value and promote the effective use of radio waves will be conducted. After a conclusion is drawn during 2022, necessary actions will be taken.

(5) Promotion of effective use of shared public frequencies (promotion of adoption of PS-LTE)

Regarding PS-LTE, which can be used jointly by relevant ministries and agencies, further effective use of public frequencies is expected by promoting the introduction of PS-LTE, and therefore, PS-LTE will be operated in FY 2022 in cooperation with the relevant ministries and agencies, and technical verification will be performed after ensuring safety, improved reliability and security. Furthermore, even after the start of operation, efforts will be made to promote PS-LTE by, for example, listening to and reflecting the operational and functional requirements of not only national agencies but also local authorities, designated public institutions and other disaster management-related organizations.

(6) Realization of high-precision radio wave emulator in cyberspace

A high-precision radio wave emulator will be created by FY2023 by conducting research development and demonstration tests aimed at securing a testing environment where actual radio wave propagation can be simulated for new radio wave systems, including Beyond 5G. The purpose is to enable Japan to take the lead in technology development, secure internationally viable frequencies, and stimulate high-level use of existing wireless systems [see Appendix (2-7) (iv)].

(7) Promotion of safe radio wave usage at medical institutions

In order to promote safe and secure radio wave usage in medical institutions, surveys on the impact of radio waves on medical devices, etc., will be carried out, and various initiatives, including public awareness activities through regional councils, will be promoted.

(8) Overseas promotion of radio systems

From the viewpoint that Japan has excellent technology in terms of radio systems, with the aim of facilitating overseas promotion of those systems, starting with Asian countries, initiatives for expansion and promotion of Japan's radio systems through public-private partnerships, such as surveys on technological trends inside and outside the country, and demonstration tests in foreign countries, will be carried out.

(9) Radio communication systems using high-altitude platform station (HAPS)

Regarding high-altitude platform systems (HAPS), whereby communications can be achieved between the ground and a base station installed on an unmanned aircraft which stays at an altitude of approximately 20 km above the ground, R&D will be pursued to develop a flexible communication service that is highly resilient to disasters, and that enables flexible implementation of an advanced information infrastructure in rural areas. This service will be realized by a fixed communication system that uses the 38 to 39.5 GHz band, and a mobile communication system that uses a frequency band of 6 GHz or below. Studies of revised regulations will be promptly carried out in FY2023 or after [see Appendix (2-2) (ii)].

(10) Studies of wireless power transfer systems

With regard to the beam wireless power transmission systems, revised regulations were implemented in May 2022 to allow the use of 920 MHz, 2.4 GHz and 5.7 GHz frequency band equipment as radio station in indoor facilities such as factories that meet certain requirements. In order to study the possibility of expanding the operating environment in the future, the progress of technology and research, the timing of commercialization, and the status of efforts for practical application will be followed up. Looking at future expansion of usage requirements, R&D will be pursued in technologies for suppressing interference to other wireless systems that may occur with the beam wireless power transmission systems to mobile devices and large numbers of IoT connected devices, as well as technologies for upgrade that meet needs for higher capacity and multiplication of power transmission [see Appendix (2-7) (v)].

With regard to proximity-coupled wireless power transmission, it is desirable to expand the model designation for high-frequency equipment, and studies of technical conditions will be carried out so that the level of radio wave leakage does not affect other wireless communications.

(11) Studies of test methods for advanced radio equipment

In September 2021, in order to respond to diversifying radio equipment, a "Commentary on the Methods for Measuring the Electric Field Strength of Radio Stations with Significantly Weak Emission as Defined in Article 6, Paragraph 1, Item 1 of the Regulations for Enforcement of the Radio Law (Ministry of Posts and Telecommunications Notification No. 127 of 1988), 'Paragraph 2 Installation Conditions for Equipment under Measurement' and 'Paragraph 5 Measurement Methods'", was published. In addition, as radio equipment without aerial (antenna) terminals is rapidly increasing due to increasing sophistication and miniaturization, surveys and studies will be conducted to establish a test method using radiation measurements, etc., while taking account of consistency with conventional measurement methods and overseas measurement methods, so that such radio equipment can receive technical standards conformity certification appropriately [see Appendix (2-7) (ii)].

(12) Studies of measurement methods at installation sites of large electronic devices in order to maintain a good radio environment

There is a risk of radio wave leakage from equipment that use high frequency waves, including large electronic devices at factories and large diagnostic equipment at hospitals, which can interfere with other radio communications. In recent years, these types of equipment have become larger and deliver higher power performance, so the establishment of measurement methods suitable for those devices has become indispensable. Engineering tests on such methods will therefore be conducted at installation sites, and a measurement guideline will be prepared based on the test results and published by the end of FY2023 [see Appendix (2-7) (iii)].

(13) Proper utilization of European and American standard test data on wireless LAN, etc.

With regard to certification of wireless devices such as wireless LAN, studies of proper utilization of European and American standard test data by registered certification authorities will be conducted during FY2022.

Research and Development for the Realization of New Radio Spectrum Applications

(1) Overview

As radio spectrum usage continues to develop and grow across a wide range of sectors in society and frequency bands become congested, it is essential to steadily implement R&D in three particular fields, while taking account of Japan's crowded frequency use. These three fields are: (1) technologies for the efficient use of frequencies; (2) technologies to promote the shared use of frequencies, and (3) technologies that promote migration to higher frequencies. Chapter 4 of the Frequency Reorganization Action Plan clarifies which R&D topics Japan must address depending on frequency classifications from the perspective of frequency migration and reorganization.

In this Appendix, R&D tackled by the MIC is classified by field and shown in a list, from the perspective of enabling improved efficiency and growth in diverse industrial sectors by further growth and development of radio spectrum usage.

(2) R&D topics

(2-1) Mobile communication systems

- (i) For broadband wireless communication system configuration and network connection management and control technologies, which are needed for the sharing of mobile phone carriers' 5G base stations, R&D will be conducted from FY2020 to FY2022 in order to improve the efficiency of frequency usage. [See also: AP Chapter 4. V. Future Topics to be Addressed (1), VII. Future Topics to be Addressed (3)].
- (ii) R&D will be pursued to further enhance 5G features, particularly "ultra-high speed", "ultra-low latency" and "multiple simultaneous connection", and to realize further improvements in "high energy efficiency" and "high reliability". [See also: AP Chapter 4. V. Future Topics to be Addressed (2), VII. Future Topics to be Addressed (4)].
- (iii) With the aim of effectively securing communications using high-frequency bands, R&D on coordinated control of IRS (Intelligent Reflection Surface) and relay communication terminals will be pursued in order to construct an optimal propagation path that avoids radio wave obstructions lying between base stations and mobile terminals, and to effectively use the resources in high frequency bands. [See also: AP Chapter 4.V. Future Topics to be Addressed (3), VII. Future Topics to be Addressed (5)].
- (iv) To allow base stations consisting of multiple different vendors to take mutual advantage of the 5G features of "ultra-high speed" and "ultra-low latency", more effective use of radio waves will be promoted by conducting comprehensive demonstration tests on cooperative and collaborative operation between the above base stations, ensuring interoperability of base stations, and reducing radio wave interference by multiple base stations. [See also: AP Chapter 4.V. Future Topics to be Addressed (4), VII. Future Topics to be Addressed (6)].
- (v) To solve regional problems and utilize 5G for diverse needs, development demonstrations based on usage cases for various sectors and the introduction of local 5G will be promoted. [See also: AP Chapter 4.V. Specific Initiatives: 1. Revised regulations, etc. (1), VII. Specific Initiatives: 1. Revised regulations, etc. (1)].
- (vi) To realize higher-capacity transmission of mobile communication systems by utilizing high frequency bands that can secure ultra-wide bandwidth, R&D will be pursued on front-end IC technology integrated with antennas that enable high output in high frequency bands, compound semiconductor technology, and wireless system device configuration technology in high frequency bands. [See also: AP Chapter 4 VIII. Future Topics to be Addressed (2)].

(2-2) Satellite communications and HAPS

- (i) R&D of technologies that permit flexible control of frequency bandwidth, and the location and shape of communication satellite beams (Ka band), will be pursued. The aim is to meet recent needs for diverse satellite communications by various users, such as an aircraft broadband environment and nautical communication demand for ocean resource development, and securing communications in the event of a disaster. [See also: AP Chapter 4. VII. Future Topics to be Addressed (1)].
- (ii) With regard to high-altitude communication platform stations (HAPS), whereby communications can be achieved between the ground and a base station installed on an unmanned aircraft which stays at an altitude of approximately 20 km above the ground, R&D will be pursued to achieve a flexible communication service that is highly resilient to disasters, and that enables flexible development of an advanced information infrastructure in rural areas. This service will be achieved by a fixed communication system that uses the 38 to 39.5 GHz band, and a mobile communication system that uses the 6 GHz frequency band or below. [See also: AP Chapter 4. IX. Initiatives related to the reallocation of other frequencies and radio wave usage, etc. (9)].
- (iii) In light of the fact that the bandwidth used for broadband satellite communication systems for mobile objects using geostationary satellites (ESIM: Earth Stations in Motion) has been extended as a result of WRC-19, technical conditions for frequency sharing with existing wireless systems in the extended bands (17.7 to 19.7 GHz and 27.5 to 29.5 GHz) have been conducted. [See also: AP Chapter 4.VII. Specific Initiatives: 1. Revised regulations, etc. (2)].

(2-3) IoT and wireless LAN

- (i) As for 920 MHz band passive RFID systems, R&D on the technologies, which enable to simultaneously and accurately acquire data from a large number of electronic tags with sensor even if electronic tags are scattered over a wide area or are installed on a high-speed moving object, are promoted [See also: AP Chapter 4.III. Future Topics to be Addressed (2)].
- (ii) To permit tight use of multiple wireless communication systems such as local 5G, wireless LAN and IoT systems in narrow spaces such as inside facilities, R&D will be pursued to establish wireless resource virtualization and management technology to ensure wireless communication within the guaranteed arrival time for applications with high real-time characteristics, and delay guarantee technology to optimally control an entire area network, even when multiple applications with different communication requirements are mixed. [See also: AP Chapter 4. III.Future Topics to be Addressed (1), IV.Future Topics to be Addressed (1), V.Future Topics to be Addressed (5),VII. Future Topics to be Addressed (2)].
- (iii) To meet needs for higher communication speeds in homes, offices, schools, etc., studies will be carried out regarding technical conditions for expanding the frequency bandwidth to the 6 GHz band (5925 to 7125 MHz) for wireless LAN, in the light of testing by the IEEE and other countries. [See also: AP Chapter 4.V. Specific Initiatives: 1. Revised regulations, etc. (5)].
- (iv) To avoid interference explosions due to increased traffic in wireless LAN systems, etc., R&D will be pursued regarding intelligent propagation path control technologies that coordinate active array antenna technology and IRS (Intelligent Reflecting Surface) technology, as well as interlayer access control technology that allows grasping of the wireless environment and efficiently managing wireless resources. [See also: AP Chapter 4.IV. Future Topics to be Addressed (2),V. Future Topics to be Addressed (6)].
- (v) To achieve Society 5.0, high-capacity, simultaneous multi-connection technology for transmission of high-definition video and sensing information, etc., is required for upgrading communication tools such as AR and VR and mobility in the fields of education, medical care, etc. For that purpose, R&D will be carried out on wireless LAN transmission technologies

using terahertz-band MIMO, which can transmit an enormous amount of information. [See also: AP Chapter 4.VIII. Future Topics to be Addressed (5)].

- (vi) To promote the effective use of frequency resources by improving the efficiency of radio frequency utilization on the time and spatial axes, R&D will be promoted to improve time and position accuracy by miniaturizing atomic clocks so that they can be mounted on small terminals, and synchronising and managing time information on each terminal to an accuracy approximately 100 times higher than before.

(2-4) Fixed communication systems · Radar systems

- (i) Due to the growing demand for new installations of X-band coastal surveillance radar systems and their upgrades to solid-state element types, it is expected that frequencies for those systems will become more congested. To solve this, technical conditions for upgrading X-band coastal surveillance radar systems, including multi-band systems, will be studied. [See also: AP Chapter 4.VI. Specific Initiatives: 1. Revised regulations, etc. (2)].
- (ii) To realize fixed wireless systems that respond to the rapid increase in communication volume due to the development of 5G, etc., R&D will be carried out on wireless technology in the ultra-high frequency band (350 to 600 GHz), and mutual conversion technology with optical fiber signals. [See also: AP Chapter 4.VIII. Future Topics to be Addressed (3)].
- (iii) Technical studies will be carried out to provide telecommunications services to areas where it is difficult to install optical fiber networks, such as islands, to further upgrade fixed wireless communication systems using radio waves in the 6GHz/6.5GHz/7.5GHz bands, which are used as a means of communication during disasters, etc., and to improve communication quality through frequency sharing with wireless LANs and other means. [See also: AP Chapter 4. V. Specific Initiatives: 1. Revised regulations, etc. (6)].
- (iv) To realize high-capacity fixed wireless systems, technical studies will be carried out toward the introduction of OAM (Orbital Angular Momentum) mode multiplexing transmission technology (a technology that increases the number of signals transmitted simultaneously by transmitting signals on radio waves which have different OAM modes (radio vortex rotation speeds) in the millimeter waveband [See also: AP Chapter 4. VIII. Future Topics to be Addressed (4)].

(2-5) Broadcasting

- (i) Technical studies will be carried out on transmission capacity expansion technology, high compression and transmission efficiency improvement technology, and SFN relay technology, etc., with a view to further effective use of terrestrial television broadcasting frequencies and realization of new broadcasting services (ultra-high definition broadcasting, etc.) on these frequencies. In particular, based on the results of engineering tests to be conducted by FY2022, technical conditions for the broadcasting system will be examined, and a partial report will be submitted to the Information and Communications Council by the end of FY2023. In the future, technical studies will be carried out on the placement and relay of broadcasting stations. [See also: AP Chapter 4. II. Specific Initiatives: 1. Revised regulations, etc. (1)].
- (ii) With the increasing popularity of new 4K8K broadcasting in the 12 GHz band, research and analysis on the impact on existing radio systems that use the same band as the intermediate frequencies of satellite broadcasting reception equipment will be carried out. [See also: AP Chapter 4.VI. Specific Initiatives: 1. Revised regulations, etc. (4)].
- (iii) Engineering tests will be carried out on frequency sharing with existing radio systems, etc., with a view to introducing an FM disaster prevention information system, based on the ' Summary Report on Utilization Measures for Broadcast Frequencies (regarding Former Terrestrial Broadcasting Site of the Open University of Japan and V-Low Band)' compiled in March 2022 by the Study Subcommittee on Utilization Measures for Broadcast Frequencies.

[See also: AP Chapter 4I. Specific Initiatives: 1. Revised regulations, etc. (2)].

- (iv) Toward the realization of ultra-high speed transmissions of tens of Gbps using terahertz waves, R&D will be carried out on wireless communication infrastructure technologies in the terahertz waveband. Further, in order to enable their utilization and application for high-definition video transmission, R&D will be carried out on video transmission technologies, standardization activities, and market research, [See also: AP Chapter 4VIII. Future Topics to be Addressed (1)].

(2-6) Public use

- (i) Concerning "analog systems" among the public service radio stations used by the Government, technical studies will be carried out in cooperation with the national government and local authorities to introduce digital systems, etc. that can be commonly adopted for each system, after clarifying the requirements for each system, while also taking account of the possibility of using shared systems such as PS-LTE that utilize the public network and other existing systems. [See also: AP Chapter 4.I. Specific initiatives: 1. Revised regulations, etc. (6),II. Specific initiatives: 1. Revised regulations, etc. (2)].

(2-7) Radio wave usage environment

- (i) In view of more downsized radio equipment and more precise built-in electronic devices, R&D will be carried out on new technologies to suppress unwanted radio waves, which can be implemented in small wireless equipment.
- (ii) A method of measuring radio equipment without connecting it to the aerial terminal (radiometric measurement) has been attracting attention in recent years as a test method for radio equipment, and technical studies necessary to establish a rational and practical radiometric measurement method will be being carried out. [See also: AP Chapter 4.IX. Initiatives related to the reallocation of other frequencies and radio wave usage, etc. (11)].
- (iii) Radio leakage from equipment using radio frequencies may cause interference to other communications. In recent years, these facilities have become larger and more powerful, and it has become essential to establish a measurement method suitable for this, so technical studies will be carried out. [See also: AP Chapter 4IX. Initiatives related to the reallocation of other frequencies and radio wave usage, etc. (12)].
- (iv) R&D of radio wave simulation system technologies will be carried out to construct a radio wave propagation environment in cyberspace and evaluate wireless systems in real time under various conditions. [See also: AP Chapter 4.IX. Initiatives related to the reallocation of other frequencies and radio wave usage, etc. (6)].
- (v) R&D will be pursued in technologies for suppressing interference to other wireless systems that may occur with the beam wireless power transfer systems to mobile devices and large numbers of IoT connected devices, as well as technologies for upgrade that meet needs for higher capacity and multiplication of power transmission [See also: AP Chapter 4. IX. Initiatives related to the reallocation of other frequencies and radio wave usage, etc. (10)].

(2-8) Cybersecurity

- (i) In order to prevent unauthorized communications caused by attacks that misuse IoT devices and to ensure cybersecurity in the IoT environment, R&D will be carried out on technologies that render IoT malware harmless and non-functional.
- (ii) R&D will be carried out on new-generation cryptographic technologies that do not compromise the characteristics of wireless communications such as 5G, such as ultra-high speed, high capacity and multiple connections, while ensuring security for large-scale quantum computers.