Frequency Reorganization Action Plan (revised version for FY 2020)

Chapter 1 Background and Purpose

The Ministry of Internal Affairs and Communications has conducted surveys and evaluations regarding radio wave utilization every fiscal year since FY 2003. This is in order to promote the effective utilization of finite and scarce radio wave resources, and to cope with the introduction of new radio wave utilization systems and the increasing frequency demand. In addition, a frequency reorganization action plan was formulated and announced in August 2004 based on the evaluation results from usage surveys. This has been reviewed and released every year since to maintain transparency and foreseeability, and to promote the smooth and steady transition and reorganization of frequencies (see Fig 1.1).

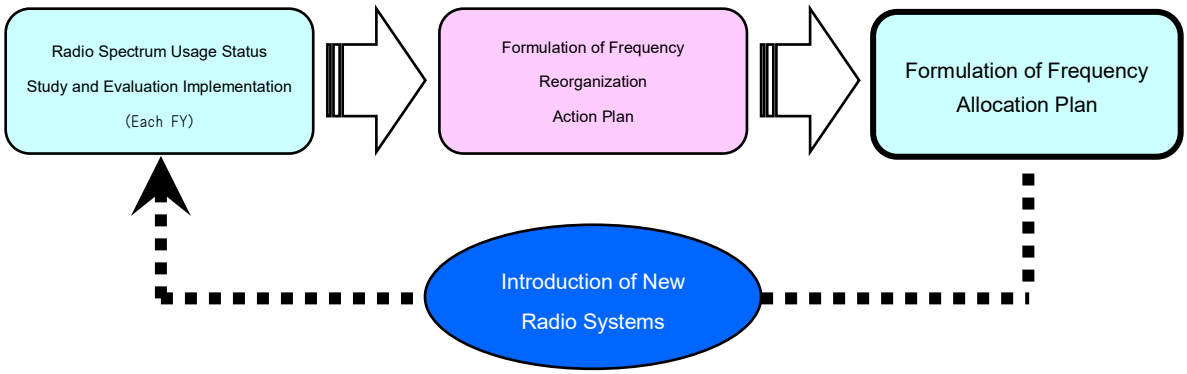


Fig 1.1 Frequency migration and reorganization cycle

Specifically, MIC has been developing 'Radio Opening Up Strategy' measures based on the Radio Policy Vision (July 2003, Information and Communications Council). Using this approach, the use and spread of a range of different radio wave usage systems, such as wireless LAN and RFID tags, as well as mobile wireless communication systems (wireless systems for mobile phones), has continued.

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 radio waves, such as smartphones and digital home appliances, e-books, electronic money, and one-segment broadcasting, etc., have developed. On the other hand, thanks to advancements in broadband services, there have been developments in a range of different delivered services that use large capacity content, and mobile communication traffic continues to increase year by year. Moreover, the use of radio waves is being mobilized across various sectors, including regional revitalization, healthcare, and the environment, etc., and its importance as a social infrastructure is also increasing. In particular, in the event of a disaster like the Great East Japan Earthquake, systems that use radio waves such as satellite mobile phones, will have an essential role to play as a communication method during emergencies.

Based on these trends, the following discussions have been carried out concerning radio policy for the future.

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

In view of the environmental changes surrounding radio spectrum usage, including 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 considered a necessary review of regulation, and the use of radio wave usage fees, from the viewpoint of further promoting the effective use of the radio spectrum.

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

As the 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 both fair and efficient use of the spectrum through the use of developed technologies and by establishing systems and policies that realize the effective and optimal use of finite 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 2700 MHz as the frequency for mobile communication systems for mobile phones or wireless LAN, in a 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 an examination of the background behind the dramatic expansion of M2M (Machine to Machine) systems, where there is 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 maintenance of pioneering radio systems at the Tokyo Olympic and Paralympic Games being held in 2020, it was concluded that the following new frequency allocation goals were needed:

(1) In view of frequency bands which are expected to be used for the realization of 5th generation mobile communication systems (5G), and taking into account the frequency bands (11 bands from 24.25 to 27.5 GHz and 31.8 to 33.4 GHz, etc.) to be considered at the World Radiocommunication Conference 2019 (WRC-19), other indicated frequency bands (3.6 to 4.2 GHz, 4.4 to 4.9 GHz, and 27.5 to 29.5 GHz, etc.), and 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 examination into formulating the

frequency sharing conditions needed for frequency sharing between other existing services, and the establishment of specific measures (schemes) for the efficient and certain enactment of regulations in advance, when allocating mobile communication systems to international standard bands (1.7 GHz band, 2.3 GHz band, 2.6 GHz band, and 3.4 GHz band) 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) It was deemed necessary to strategically step up promotion into research and development to secure foundational technological capabilities, and environmental improvements, such as system upgrades and securement of needed frequencies to enhance predictability to enable free and energetic business activities in order to develop wireless businesses.

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

Up until now there have been efforts to achieve the effective use of the radio spectrum, such as stepping up frequency migration and reorganization to cope with social needs, but there is a need for a future plan for radio wave usage and measures for the further effective use of the spectrum which is more specific towards society and geared toward achieving Society 5.0.

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

(1) Review of the Frequency Allocation System

It was deemed appropriate to conduct 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 allocation method, in order to cope with a rapid expansion of radio wave usage needs for the realization of Society 5.0.

(2) Policies for the Effective Use of Public Frequencies

From the viewpoint of promoting the effective use and public-private sharing of shared public frequencies, it was deemed appropriate to conduct an examination of drives to create awareness of public frequency allocations, review evaluation results and survey methods for radio wave status surveys, and look into policies for stepping up the reorganization of shared public frequencies and shared private use.

(3) Review of Radio Wave Usage Fee Systems

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

(4) Policies for effective Spectrum Use Based on the Progress of Technology

With a view towards the 2020s, when the radio spectrum is expected to form a bigger foundation stone than ever before in terms of how it supports socioeconomics, it was deemed appropriate to examine policies for the effective use of the radio spectrum together 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, evaluation of V-High band applications, and reviewing an acceleration of the use of survey and research terminals and display labels for technical standard conformity certification.

In February 2019, a bill was submitted to the Diet for an Amendment to the Radio Act which was based on recommendations from a report by the Round-Table Conference on Growth Strategies for the Effective Use of Radio Spectrum, and this was enacted in May 2019. The amendment of this law has the intention of making further effective use of the radio spectrum on the important basis of realizing Society 5.0, and included; (1) reviewing the total cost of radio wave usage fees, ② enhancing regulations concerning the acceleration of the use of pre-existing frequencies, ③ establishing regulations on allocation procedures based on the economic value of the frequencies, and ④ enhancing regulations concerning making it quicker to use terminals for surveys and research.

In addition, as an effort to secure bandwidth by the end of FY 2020 in preparation for 5G deployment, and based on a July 2018 report from the Information and Communications Council, there was a system enhancement for the allocation of the 3.7 GHz, 4.5 GHz and 28 GHz bands, and in April 2019 four mobile phone carriers received approval for their plans to set up specific base stations and they were allocated these frequencies.

5. Meetings of the World Radiocommunication Conference 2019 (WRC-19) (October to November 2019)

Many of the radio systems used in Japan are based on the rules of international radio communications (radio communication rules) stipulated by the International Telecommunication Union (ITU), and it also stipulates various rules concerning the use of frequencies and the operation of radio stations. The following is a review of the rules considered at the ITU World Radiocommunication Conference.

Between October 28 and November 22, 2019, the World Radiocommunication Conference 2019 (WRC-19) was held in Egypt, and was attended by approximately 3,300 people from the supervisory agencies of 163 nations, including Japan, as well as private business operators, and research institutes, etc.

The following was discussed as the main agenda; ① the acquisition of frequencies for 5G for international harmonization (the additional identification of frequencies for IMT), ② the consideration of frequency allocations and regulation provisions to enable a new VHF data exchange system (VDES), and ③ discussions over issues concerning wireless access systems, including wireless LAN in the 5150 to 5925 MHz band, and as a result, to revise wireless communication regulations.

Following the results of WRC-19, studies are being carried out, in Japan and elsewhere, on the introduction and upgrading of new wireless systems such as 5G, and as necessary, systems will be upgraded by reviewing the frequency allocation plan.

Since the radio spectrum utilization system continues to form an important foundation block in the daily lives of Japanese citizens, both today and in the future, as well as Japanese socioeconomic activities, it is essential to secure new radio frequencies that can be allocated to address growing radio wave needs and new technological trends. However, it is an increasingly major point that there needs to be a more effective use of radio waves, which are a finite and scarce shared public resource, as well as sharing between different wireless systems.

This frequency reorganization action plan (FY 2020 revised version) is based on the progress of the policies and studies established so far as shown above, and furthermore, the results of the WRC-19. It also reviews efforts to secure frequencies for new radio usage systems and to consider frequency migration policies and migration timing.

In this review, in an identical fashion to the past, and from a viewpoint of transparency and fairness, research and development matters implemented by the Japanese government for the effective use of the radio spectrum are clearly indicated and a public comment procedure is in place.

The Ministry of Internal Affairs and Communications has the goal of defeating the various problems faced by Japan today, such as the declining birth rate and population which is accompanying a shrinking workforce as well as rural depopulation, while also contributing to

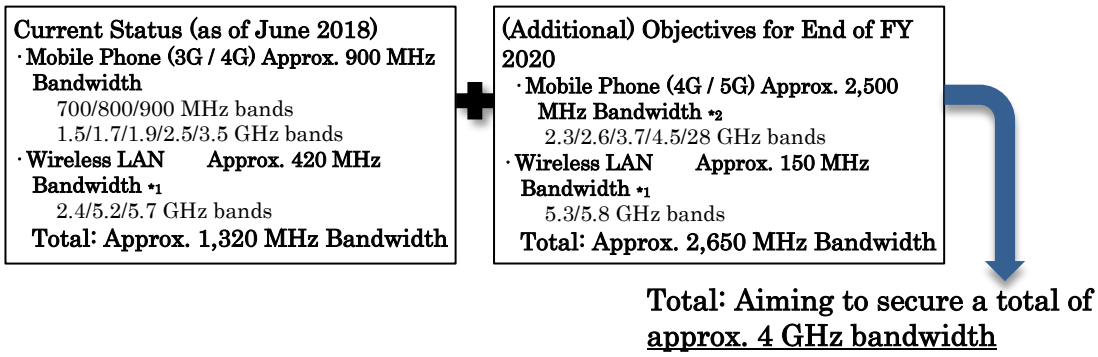
the revitalization of Japan’s economy, through the steady implementation of this frequency reorganization plan by stepping up the thorough utilization and application of wireless communication technologies and by strengthening of Japan's international competitiveness, while at the same time further promoting the effective use of the radio spectrum.

Chapter 2　Frequency Reorganization Objectives (By the End of FY 2020)

I Frequency Reorganization Objectives (from the report of the Round-Table Conference on Growth Strategies for the Effective Use of Radio Spectrum (August 2018))

As immediate objectives for realizing 5G in 2020*, and with due consideration for sharing with other wireless systems, we aim to secure for 5G a frequency with a total of approximately 2.5 GHz bandwidth, with a maximum of 2 GHz bandwidth at the 28 GHz band and a maximum of 500 MHz bandwidth at the 3.7GHz and 4.5GHz bands. Including existing mobile phone frequencies and wireless LAN frequencies that can be used for IoT, we aim to secure approximately 4 GHz of frequency bandwidth by the end of FY 2020.

Fig. 2.1. Illustration of Bandwidth Objectives by the end of FY 2020



*1 Available channels

*2 Achieving this goal is based on the approach to securing mobile phone frequencies outlined in the report by the Information and Communications Council's New Generation Mobile Communication Systems Committee (July 2018);

① the objective for securing 500 MHz bandwidth at the 3.7 GHz and 4.5 GHz bands is to reorganize and share frequencies, with 400 MHz bandwidth for public use and 500 MHz bandwidth for private use,

② the objective for securing 2 GHz bandwidth at the 28 GHz band is to reorganize and share frequencies, with 2000 MHz bandwidth for public and private use.

The above are expected to ensure the bandwidth needed for 5G.

II Progress in Securing Bandwidth

The establishment of specific base stations for the introduction of 5G was approved in April 2019, and a total of 2200 MHz bandwidth, with a new 600 MHz of bandwidth at the 3.6 to 4.1 GHz and 4.5 to 4.6 GHz bands and 1600 MHz of bandwidth at the 29.1 to 29.5 GHz band, was secured as the frequencies for 5G use. In addition, a total of approximately 3.6 GHz of bandwidth frequency, including existing mobile phone frequencies and wireless LAN frequencies that can be used for IoT, has been guaranteed by securing 100 MHz of bandwidth at the 28.2 to 28.3 GHz bands for local 5G in December 2019.

Furthermore, as 4.6 to 4.9 GHz and 28.3 to 29.1 GHz are local 5G candidate frequencies, and there will be additional frequency allocations for local 5G within 2020, it is expected that the initial goal of "securing approximately 4 GHz of bandwidth by the end of FY 2020" will be achieved.

In view of additional frequency allocations for 5G, the 4.9 GHz, 26 GHz and 40 GHz bands are considered to be candidates, and the Information and Communications Council

are undertaking technical studies, which include the sharing conditions for existing wireless systems, with the aim of allocating frequencies within FY 2021.

Chapter 3 Priority Initiatives

Ⅰ Smooth Introduction of 5G

① Studies for Additional Frequency Allocations

Sharing studies are to be carried out on additional 5G frequency allocations, based on the results of the World Radiocommunication Conference 2019 (WRC-19), in the 4.9 to 5.0 GHz band, 26.6 to 27.0 GHz band, and 39.5 to 43.5 GHz band, while taking into account any possible impact on existing wireless systems on the same or adjoining bands, in order to secure internationally harmonized frequencies in cooperation with other countries such as European countries and the United States. In addition, the possibility of 5G frequency allocations, which also take into account the status of studies into ITU and 3GPP, etc., and trends in other nations, will be examined at the 2023 ITU World Radiocommunication Conference (WRC-23) for the IMT specific candidate frequency of 7025 to 7125 MHz.

② 5G in Existing Bands

Required system upgrades are underway, to be completed by the summer of 2020, for 5G introduction (for BWA this is to improve 5G capability) in the frequency band below 3.6 GHz, which is currently being used by 4G and BWA, in order to build a wide 5G area to secure mobility, etc.

③ Studies for Additional Local 5G Frequency Allocations

System upgrades were completed in advance by December 2019 for the 28.2 to 28.3 GHz frequency band for 5G (Local 5G), enabling various bodies and organizations to flexibly build their own 5G spots within their buildings and premises in accordance with individual regional and industrial needs. In the future, sharing studies are to be carried out on additional allocations of 5G frequency candidates in the 4.6 to 4.9 GHz band, and 28.3 to 29.1 GHz band, while taking into account any possible impact on existing wireless systems on the same or adjoining bands.

Ⅱ Promotion of Dynamic Frequency Sharing

In order to secure new frequencies to handle the growing use of IoT and 5G, etc., since 2020, there has been research and development, and demonstration tests, for dynamic frequency sharing and interference avoidance technologies which use databases which enable the realization of advanced frequency sharing with existing radio systems. The dynamic frequency sharing system will be built by FY 2020, while required system upgrades will be implemented through an amendment of the Radio Law, so that dynamic frequency sharing can be implemented from FY 2021.

As an application objective of dynamic frequency sharing, first the operation coordination rule between the primary user of the FPU broadcast auxiliary service and public service radio station on the 2.3 GHz band, and the secondary user, who is assumed to be using a mobile phone, is being studied and additionally the feasibility of frequency

sharing in the 2.6 GHz, 26 GHz and 38 GHz bands is being studied, with a conclusion to be reached within FY 2020.

III Initiatives for a Self-Driving Society

Based on the progress and importance of automatic driving systems (including safe driving support), a study is being carried out, which will finish by the end of FY 2021, into the technical conditions for frequency sharing with needed existing wireless systems, for example when introducing V2X communications, and with consideration for existing wireless systems on frequency bands being studied internationally (5.9 GHz band), in addition to the existing ITS frequency bands (760 MHz band, etc.).

In addition, based on the results of these studies, a conclusion will be reached within FY 2022 regarding frequency allocation policy, such as frequency sharing and migration/reorganization when introducing V2X communications in the same frequency band, etc.

IV Upgrading 5 GHz band wireless LAN

Technical studies are moving forward in regard to sharing conditions, etc., with other wireless systems, in order to achieve 5 GHz wireless LAN systems capable of handling increased traffic in future mobile communications. In particular, based on the results of WRC-19, a study will begin on the technical conditions related to the use of the 5.2 GHz band in vehicles by the end of FY 2020.

V Advanced Use of Satellite Communications Systems

Technical conditions pertaining to frequencies between adjoining existing wireless systems and geostationary satellite systems will be compiled, and required system upgrades completed by the end of FY 2020, for the realization of non-geostationary satellite constellations. In addition, initiatives will be carried out, such as publicity activities, etc., through briefings and more, regarding the introduction of services, and the introduction effect, for rolling out broadband satellite communication systems (19.7 to 20.2 GHz and 29.5 to 30.0 GHz) for Ka band migration.

VI Measures to Expand the Use of VHF Aeronautical Radio Systems

Following the frequency allocation for the VHF band (150 MHz) made by WRC-19 in order to introduce a system (VDES) for the reciprocal exchange of data between ships, and between ships and airplanes, using satellite communications and aeronautical communications, system upgrades are to be studied, such as revising the frequency allocation plan for FY 2020, in order for VDES to be usable within Japan.

VII Promotion of the Effective Use of Shared Public Frequencies

Migration, etc., to new wireless systems in order to accelerate the effective use of radio station spectrums within the country, etc., is to be promoted. Specifically, together with the

implementation of; (i) a study into the introduction of a public safety LTE, (ii) promotion of the shared use of radio equipment such as shared public microphone lines, telemeters, and telecontrols, etc., and (iii) a study into promoting the use of public broadband mobile communication systems, and moving ahead with studies into the institutional aspects of public safety LTE, including frequency allocation, which take into account the results of examination studies carried out in 2019 and the comprehensive demonstrations scheduled to take place in 2020.

Ⅷ Studies into Wireless Power Transfer Systems

The Information and Communications Council is considering the possibility of introducing spatial transmission wireless power transfer systems using the 920 MHz, 2.4 GHz, and 5.7 GHz bands, assuming indoor use in factories, etc., and prerequisite laws for radio equipment, and its systematic implementation in FY 2020. In addition, the Information and Communications Council will begin an examination in FY 2020 of proximity-coupled type wireless power transmission, with a desire to expand type designations with regard to equipment that uses high frequency waves. They will consider the technical conditions needed to ensure that the level of leaked radio waves does not affect other wireless communications.

Ⅸ Expansion of Spectrum Usage Status Surveys

From the 2020 spectrum usage status survey there will be a steady implementation of surveys that are based on the changing survey cycle, and the enactment of priority investigations, etc., in order to ensure fairness and transparency in them, and to report on the implementation policy for surveys before they begin to the Radio Control Deliberation Council, so as to provide for further effective use of the radio spectrum. In addition, there will be a review of study items and evaluation contents, which take into account future study themes in the 2019 survey, in regard to the status of spectrum usage pertaining to mobile phones, etc.

Chapter 4 Reorganization Policy for Each Frequency Range

I 335.4 MHz or less

(Current situation) Used for self-owned radio in the public sector, aviation and marine communications, medium wave and FM broadcasting, multimedia broadcasting, and amateur radio, etc.

Basic Policy

To promote the digitization of current analog radio systems from the viewpoint of the effective use of the radio spectrum. In addition, to consider new possible uses for, and sharing of, radio spectrum bands.

- Promotion of a migration to a digital format (60 MHz (limited to broadcast systems) and 260 MHz bands) for analog disaster administrative radio (60 MHz and 150 MHz bands).
- Promotion of a migration to a digital format for mobile radio used in flood control of roads (150 MHz band).
- Promotion of the introduction of a digital format for train radio (150 MHz band).
- Promotion of a migration to a digital format for convenience radio (150 MHz band).
- Consideration for policies on the practical and effective use of the V-High band (207.5 to 222 MHz).

Specific Initiatives

1. System Upgrades

① Short-range Digital Communications [3 to 30 MHz]

- To examine the possibility of introducing a digital format for short-range international communications (fixed station) based on the status, etc. of the introduction of short-range digital systems in other countries.

② Broadcast Relay Radio (Fixed station) [60/160 MHz band]

- To step up migration to a digital format, and consider frequency sharing, including use of the congested 60/160 MHz band, for broadcast relay radio (fixed station) (60/160 MHz band).

③ Municipal Disaster Administrative Radio (Broadcast system) [60 MHz band]

- To carry out a technical study for a format to unify the radio spectrum used, by synchronization of the broadcast timing at the point of retransmission through relay stations, etc., and system development related to this same format in FY 2020, in order for the further effective use of the radio spectrum used by relay stations, etc., for the 60 MHz band municipal disaster administrative radio (broadcast system). (See attachment (2-5) ③)

④ VHF Aeronautical Radio System [150 MHz band]

- Following the frequency allocation for the VHF band (150 MHz) made by WRC-19 in

order to introduce a system (VDES) for the reciprocal exchange of data between ships, and between ships and airplanes, using satellite communications and aeronautical communications, system upgrades are to be studied, such as revising the frequency allocation plan for FY 2020, in order for VDES to be usable within Japan. (Relisting)

⑤ Public Broadband Mobile Communication Systems [200 MHz band]

- To study technical conditions, such as the conditions for frequency sharing related to introducing an LTE format, etc., based on the content of a technical consideration for the introduction of a public safety LTE, to expand the use of 200 MHz public broadband mobile communication systems. (See attachment (2-5) ⑤)

⑥ V-High Band [207.5 to 222 MHz]

- A "Sub-study Review Group for Policies on the Use of Broadcast Frequencies" was established under the “Study Group on Problems Surrounding Broadcasting” for policies on the use of the V-High band (207.5 to 222 MHz), and on April 26, 2019, a "Summary of Policies for the Use of the V-High band" was published. With these in mind, and following the introduction of a system for specific experimental testing stations, etc., in the V-High band in July 2019, demonstration tests, etc., are being stepped up, with a completion goal set for the end of 2020, for the early implementation of proposals to improve broadcasting and communication services. In addition, based on a basic policy on utilization measures for broadcast frequencies drawn up on January 29, 2020, a Bill to Amend Part of the Radio Law was enacted in April 2020 to add an allocation procedure based on the economic value of frequencies for mobile reception terrestrial broadcasting. The frequency allocation policy shall be improved, based on the results of the above demonstration tests, and with full consideration for frequency use needs, etc.

⑦ Wideband Power Line and Transportation Communication Equipment [2 to 30 MHz]

- In July 2019, the Information and Communications Council submitted their report on wideband power line and transportation communication equipment with respect to the technical conditions used within ships, underwater, and in factories (3 phase, 3 wire systems), based on use requests. Following this, system development is being conducted for the first half of FY 2020. Outdoor use of this system continues to be considered.

2. Progress Management for Frequency Reorganization

① Municipal Disaster Administrative Radio [60 MHz band]

- Technical standards were established in February 2015 for municipal disaster administrative radio (60 MHz band (limited to the broadcast system)), and in addition to a new digital format that enables a cheaper than ever before system to be built, the advantages of digitalization have been made known to local authorities, and an early migration to a digital format, in line with when equipment is upgraded, is to be promoted.

② VHF band Aeronautical Mobile (R) Service Radio [117.975 to 137 MHz]

- Since in recent years the VHF band for aeronautical mobile (R) service radio has become congested, the band is being tightened with consideration for introduction and replacement plans for radio equipment by licensees.

③ Municipal Disaster Administrative Radio and Prefectural Disaster Administrative Radio [150 MHz band]

- The frequency migration status is being periodically checked for the prefectural disaster administrative radio (150 MHz band), and a migration to the 260 MHz band alongside the replacement of equipment is being stepped up.
- Technical standards were established in November 2014 for municipal disaster administrative radio, and in addition to a new digital format that enables a cheaper than ever before system to be built, the advantages of digitalization have been made known to local authorities, and a migration to a digital format (260 MHz), in line with when equipment is upgraded, is to be promoted.

④ Flood Control and Traffic Mobile Radio [150 MHz band]

- The migration of the Ministry of Land, Infrastructure, Transport and Tourism's flood control and traffic mobile radio from an analogue format to a digital format (150 MHz band), using sites after the migration of the fire department's radio, will be completed by May 2021.

⑤ Train Radio [150 MHz band]

- With the growing interest in the safe operation of trains, which is accompanying a crowded train schedule in the Tokyo metropolitan area, an early migration of train radio using the 150 MHz band from an analogue format to a digital one (150 MHz band) is being pushed forward using sites after the migration of the fire department's radio. This is because of a desire for improvement, together with demand for a transition from inductive radio (high frequency equipment) that uses longwave bands.

⑥ Convenience Radio [150 MHz band]

- The rollout of digital format convenience radio, made possible by new allocations in December 2012, will continue, and the migration from an analogue format will be promoted.

⑦ Frequency Migration for International VHF [150 MHz band]

- The frequency migration of existing radio stations using the VHF frequency band will be completed by March 31, 2020, in order to introduce data communication systems into part of the international VHF frequency band.

Future Themes to be Addressed

① Technical studies are underway, based on the details of completed survey studies between FY 2017 and FY 2018, concerning the introduction of FM synchronous

broadcasting, along with system upgrades to be completed within FY 2020, in order to contribute to the efficient use of FM broadcast frequencies.

II 335.4 to 714 MHz

Current usage status: Used for terrestrial television broadcasting, self-owned radio in the public sector, aviation and marine communications, and taxi radio, etc.

Basic Policy

To promote digitalization and frequency migration, as well as to consider the use of post-migration frequencies, for land-based systems, self-owned radio systems such as public services and general services, etc.

- Promotion of a migration to a digital format (260 MHz band) for analog disaster administrative radio (400 MHz band).
- Promotion of a migration to a digital format (150 MHz) for mobile radio used for flood control and traffic (400 MHz band).
- Promotion of a migration to a digital format for convenience radio (350/400 MHz band).
- Promotion of a migration to a digital format for taxi radio (400 MHz band).

Specific Initiatives

1. Progress Management for Frequency Reorganization

① Convenience radio [350/400 MHz band]

- In August 2008, the rollout of a digital format, with established technical standards, for convenience radio was stepped up, and a plan made for the migration from the analogue format (with the end of the use of the frequency stipulated to be November 30, 2022, in the frequency allocation plan).

② Marine Horn [350 MHz Band]

- There are plans for alternative migration to other wireless systems by 2022, based on the expiration date of the old standards, in addition to regional uneven distribution and the downward trend in the number of radio stations.

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

- The frequency migration status is being periodically checked for the prefectural disaster administrative radio, and a migration to a digital format (260 MHz band) alongside the replacement of equipment is being stepped up.
- Technical standards were established in November 2014 for municipal disaster administrative radio, and in addition to a new digital format that enables a cheaper than ever before system to be built, the advantages of digitalization have been made known to local authorities, and a migration to a digital format (260 MHz), in line with when equipment is upgraded, is to be promoted.

④ Mobile Radio for Flood Control and Traffic [400 MHz band]

- The migration of the Ministry of Land, Infrastructure, Transport and Tourism's flood control and traffic mobile radio from an analogue format (400 MHz band) to a digital

format (150 MHz band), using sites after the migration of the fire department's radio, will be completed by May 2021.

⑤ Taxi Radio [400 MHz band]

- An early migration from an analogue format to a digital one is being stepped up for analogue taxi radio in order to improve communications and to use the frequency more effectively.

⑥ MCA for Regional Development [400 MHz band]

- An early migration from an analogue format to a digital one is planned for analogue MCA for regional development in order to use the frequency more effectively, and its use is being pushed forward as an alternative system for the 350 MHz band marine horn.

⑦ Train radio [400 MHz band]

- Needed studies are underway on the introduction of a 400 MHz band train control system for train radio due to growing interest in the safe operation of trains and a desire for improved train control systems.

Future Themes to be Addressed

Technical studies concerning terrestrial broadcasting, such as transmission capacity expansion technologies, technologies for improved high-compression and transmission efficiency, and SFN relay technologies, etc., are underway for the realization of a more effective use of broadcasting frequencies, with a view towards future broadcasting, and new broadcasting services (ultra-high definition broadcasting, etc.). (See annex (2-3) ①)

III 714 to 960 MHz Band

Current usage status: Used for 4G, etc., (700/800/900 MHz bands), 800 MHz band MCA terrestrial mobile communication systems, and 920 MHz low-power wireless systems (RFID tag system), etc., in mobile communication systems.

Basic Policy

To push forward the further spread and promotion of mobile communication systems, beginning with upgrading to 5G.

- Allocations were made to 3 mobile phone carriers in June 2012 for the 700 MHz band, and services have just begun. Initiatives will be undertaken in the future for measures to prevent TV reception interference in the frequency band.
- Initiatives to upgrade to 5G will be promoted for the 700/800/900 MHz bands.
- In anticipation of the advent of the IoT era, initiatives to expand the use of wireless systems, beginning with 920 MHz band low-power wireless systems, and platform standardization will be promoted for the spread of systems such as sensor networks, etc.

Specific Initiatives

1. System Upgrades

① Mobile Communication Systems [700/800/900 MHz bands]

・Mobile communications systems in the 700/800/900 MHz bands, which are currently used by 4G, will need to be used as frequencies for 5G, and the needed system upgrades will be carried out by the summer of 2020.

・In order to handle the usage needs of the aerial use of mobile phones using recent technological developments such as drones in mobile communication systems in the 800/900 MHz bands, the necessary system upgrades will be carried out to enable aerial use within 2020.

② Low-Powered Wireless Systems [915 to 930 MHz]

・ Since May 2019 technical conditions have been studied for medium power type active low-power wireless systems and the introduction of frequency hopping, which doesn't require carrier sense, and two methods for Low Duty Cycle. This is in order to improve the environment for the flexible use of IoT devices in Japan and their spread around the world. A partial report was received by the Information and Communications Council at a meeting held on January 21, 2020. Based on this report, a system upgrade based on technical standards is being aimed for around June 2020.

2. Progress Management for Frequency Reorganization

① Personal Radio [903 to 905 MHz]

・ The allocation deadline for personal radio was November 30, 2015 and licenses for new radio stations are no longer issued, but it was decided that radio stations that were

licensed before the allocation deadline can operate until their license expires. There are continued public information releases on procedures for quickly shutting down for radio stations that are no longer in operation.

Future Themes to be Addressed

① Research and development of technologies for the effective use of the radio spectrum is being promoted for the optimal control of the entire IoT system, including IoT devices and both wired and wireless networks, through the application of network virtualization technologies and platform technologies, etc., in order to support ultra-simultaneous connections and low delays in IoT systems. (See annex (2-2) ①)

② Research and development is moving ahead for technologies to control frequencies and communication methods, etc., in line with the radio wave environment, and technologies to realize highly reliable radio communication by dividing existing channels and making them redundant, in order to enable the dense use of wireless LAN and radio communication systems for IoT systems in narrow spaces inside facilities, etc. (See annex (2-1) ②)

③ Research and development is moving ahead for technologies to reduce communication volumes and suppress unnecessary communications in order to handle frequency tightening measures which accompany increases in transmission data in wireless LAN and IoT systems. (See annex (2-2) ②)

④ A study into migration timing, etc. is being stepped up for digital MCA terrestrial mobile communication systems. This is in conjunction with a study into the technical conditions of new wireless systems using frequencies generated by the migration to an advanced MCA terrestrial mobile communication system. (See annex (2-1) ⑨)

IV 960 MHz to 3.4 GHz Band

Current usage status: Congested use in countless radio stations, including 4G (1.5/1.7/2 GHz bands), satellite communication systems such as Inmarsat, air and ship radar, specified low-power radio stations, PHS, wireless LAN, wideband mobile radio access systems (BWA) and rural subscriber radio.

Basic Policy

The promotion of initiatives to increase the use of 4G mobile communication systems in order to handle the demand for frequencies, and the effective use of the spectrum, starting with upgrading to 5G.

- Allocations were made to 2 mobile phone carriers in April 2018 for 1.7 GHz (1710 to 1750 and 1805 to 1845 MHz). In the future, the rapid and smooth migration of existing wireless systems will be promoted through the use of end-of-life promotion measures.
- Initiatives to upgrade to 5G, as well as upgrades of new BWA systems compatible with 5G, will be promoted for the 1.5/1.7/2 GHz bands.
- In anticipation of the advent of the IoT era, initiatives to expand the use of radio systems, beginning with mobile phone systems, wireless LAN, and drones, as well as develop technologies to control traffic, etc. and achieve platform standardization will be promoted for the spread of systems such as sensor networks, etc.
- As the public PHS service using the 1.9 GHz band is due to finish at the end of March 2023, consideration will be given to using the former sites for this same frequency band.

Specific Initiatives

1. System Upgrades

① Mobile Communication Systems [1.5 / 1.7 / 2 / 2.5 GHz bands]

i. Mobile communications systems in the 1.5/1.7/2 GHz bands, which are currently used by 4G, and mobile communication systems in the 2.5 GHz band used by BWA, will need to be upgraded to 5G or BWA systems compatible with 5G, and the needed system upgrades will be carried out by the summer of 2020.

ii. In order to handle the usage needs of airborne mobile phone users using recent technological developments such as drones, etc., in mobile communication systems in the 1.7/2 GHz band, the necessary system upgrades will be carried out within 2020 to enable airborne use.

② Mobile Communication Systems [2.3/2.6 GHz band]

・ The possibility of introducing mobile communication systems, including dynamic frequency sharing applications, will be examined for the 2.3 GHz band. This will be based on the results of a joint study carried out with public service radio stations (fixed and mobile) in FY 2018. The possibility of introducing mobile communication systems

will be examined for the 2.6 GHz band. This will be based on the results of a joint study carried out with satellite mobile communication systems in FY 2017. (See annex (2-1) ①)

③ L-band Non-Geostationary Satellite Altitude System [1.6 GHz band]

- System upgrades will be carried out during FY 2020 to enable the introduction of L-band non-geostationary satellite altitude systems.

④ Digital Cordless Phones [1.9 GHz band]

- Technical standards will be established in 2020 for the necessary technical conditions for using frequency sharing with public PHS services in order to expand the frequencies which can be used by TD-LTE type sXGP systems.

2. Progress Management for Frequency Reorganization

① Unmanned Mobile Image Transmission Systems [1.2 GHz band]

- Following system upgrades pertaining to radio stations with unmanned mobile image transmission systems, which are capable of image transmission from the sky using frequency radio waves such as the 2.4 GHz and 5.7 GHz bands, it is being recommended that analog image transmission systems using the 1.2 GHz band, use the 2.4 GHz and 5.7 GHz bands in the future.

② Public Service Radio Stations (1.7 GHz band)

- As the current frequency band used by public service radio stations will end by March 31, 2025, they are being quickly migrated to the 4.5 GHz band using end-of-life promotion measures.

③ Rural Subscriber Radio [2 GHz band]

- In light of the decreasing demand outside of remote islands and mountainous areas, the migration of rural subscriber radio (2 GHz band) to another frequency band is being studied, this includes using a VHF band subscriber radio system.

Future Themes to be Addressed

① Research and development is underway in technologies for the effective use of the radio spectrum for the optimal control of the entire IoT system, including IoT devices and both wired and wireless networks, through the application of network virtualization technologies and platform technologies, etc., in order to support ultra-simultaneous connections and low delays in IoT systems. (See annex (2-2) ①) (Relisted)

② Research and development is moving ahead for technologies to control frequencies and communication methods, etc., in line with the radio wave environment, and technologies to realize highly reliable radio communication by dividing existing channels and making them redundant, in order to enable the dense use of wireless LAN and radio communication systems for IoT systems in narrow spaces inside facilities, etc. (See annex (2-1) ②) (Relisted)

③ Research and development is moving ahead for technologies to reduce communication

volumes and suppress unnecessary communications in order to handle frequency tightening measures which accompany increases in transmission data in wireless LAN and IoT systems. (See annex (2-2) ②) (Relisted)

④ Studies are underway to clarify the technical standards and operation conditions for permitting dynamic sharing of the 1.2 GHz band, which takes into account both location and time, etc., as a frequency sharing method with existing radio station systems, such as public service radio stations, etc. (See annex (2-1) ⑦)

V 3.4 to 4.4 GHz Band

Current situation: Used for 4G (3.4/3.5 GHz bands), audio STL, and audio FPU, etc.

Basic Policy

The promotion of initiatives for the effective use of the spectrum, beginning with the adoption of 4G/5G mobile communication systems, etc. to meet frequency demand, and upgrading to 5G.

- Allocations were made to 2 mobile phone carriers in April 2018 for the 3.4 GHz band (3400 to 3480 MHz). In the future, the rapid and smooth migration of existing wireless systems will be promoted through the use of end-of-life promotion measures.
- Initiatives to upgrade to 5G will be promoted for the 3.4/3.5 GHz bands.
- Allocations were made to 4 mobile phone carriers in April 2019 for the 3.7 GHz band (3600 to 4100 MHz). In the future, frequency sharing with existing radio systems will be promoted for the further rollout of 5G, and both research and development and international standardization activities will be continuously promoted.

Specific Initiatives

1. System Upgrades

① Mobile Communication Systems [3.4/3.5 GHz band]

・ Mobile communications systems in the 3.4/3.5 GHz bands, which are currently used by 4G, will need to be used as frequencies for 5G, and the needed system upgrades will be carried out by the summer of 2020.

② Mobile Communication Systems [3.7 GHz band]

・ The features of 5G, that it has ultra high-speed, low latency and enables multiple simultaneous connections, will be further developed, and in addition, research and development will be promoted to realize further enhancement of its high energy efficiency and high reliability. (See annex (2-1) ⑤)

2. Progress Management for Frequency Reorganization

① Audio STL and audio FPU [3.4 GHz band]

・ As the use of the current frequency band used by audio STL (audio STL/TTL/TSL and monitor and control lines) and audio FPU will end by November 30, 2022, end-of-life promotion measures are being used for a frequency migration. As a general rule, audio STL will correspond to the M band (6570 to 6870 MHz) and N band (7425 to 7750 MHz), and audio FPU to the B band (5850 to 5925 MHz) and D band (6870 to 7125 MHz).

Future Themes to be Addressed

① Research and development is moving ahead on technologies to reduce communication volumes and suppress unnecessary communications in order to handle frequency tightening measures which accompany increases in transmission data in wireless LAN and IoT systems. (See annex (2-2) ②) (Relisted)

② Research and development of wideband radio communication system configuration technologies and network connection management and control technologies, which are needed for the sharing of mobile phone carriers' 5G base stations, will be carried out from 2020 to 2022 in order to improve the efficiency of the use of the spectrum. (See annex (2-1) ⑩)

VI 4.4 to 5.85 GHz Band

Current usage status: Used for wireless access systems, wireless LAN, and weather radars, etc.

Basic Policy

To urgently promote measures for the effective use of the spectrum in existing systems to secure the needed frequencies for the rollout of 5G which has already been allocated, and to handle further demand for 5G and local 5G mobile communication systems, etc.

- An allocation was made to 1 mobile phone carrier in April 2019 for the 4.5 GHz band (4.5 to 4.6 GHz). In the future, frequency sharing with existing radio systems will be stepped up for the further rollout of 5G, and research and development will continue.
- To step up consideration for sharing pre-existing wireless systems to introduce 5G or local 5G in the 4.6 to 5.0 GHz band.
- To examine an upgrade of 5 GHz band wireless LAN to handle future traffic increases.

Specific Initiatives

• System Upgrades

① Mobile Communication Systems [4.5 GHz/4.7 GHz/4.9 GHz bands]

i. To step up consideration for sharing existing wireless systems on the same or separate adjacent frequencies to introduce 5G or local 5G in the 4.7 GHz band (4.6 to 4.9 GHz). In addition, development demonstrations, based on the use case of a range of sectors, will be undertaken, and the introduction of local 5G promoted, to solve regional problems and to utilize 5G for diverse needs. (See annex (2-1) ⑪) (Relisted)

ii. To step up consideration for sharing existing wireless systems at the 4.9 GHz band (4.9 to 5.0 GHz) as a 5G candidate frequency.

iii. The features of 5G, that it has ultra high-speed, low latency and enables multiple simultaneous connections, will be further developed, and in addition research and development will be promoted to realize further enhancement of its high energy efficiency and high reliability. (See annex (2-1) ⑤) (Relisted)

② Wireless LAN [5 GHz band]

• To push ahead with technical consideration for sharing conditions, etc. with other wireless systems in order to achieve 5 GHz wireless LAN systems capable of handling increased traffic in future mobile communications. In particular, based on the results of WRC-19, to begin a study into the technical conditions related to the use of the 5.2 GHz band in vehicles by the end of FY 2020.

③ Unmanned Aircraft Systems (UAS) [5 GHz Band]

• Research and development and international standardization is moving ahead concerning relay communication systems using unmanned aircraft flying at high altitude in order to effectively utilize the 5.0 GHz frequency band (5030 to 5091 MHz), which is

shared for control communications of unmanned aircraft.

Future Themes to be Addressed

① Research and development is underway concerning technologies for effective frequency use of the 5.7 GHz band unmanned mobile image transmission system to enable real-time transmission of ultra-high definition (4K) video from multiple drones, and full duplex communications using the same frequency. (See annex (2-3) ④)

② Research and development is underway in technologies for the effective use of the radio spectrum for the optimal control of the entire IoT system, including IoT devices and both wired and wireless networks, through the application of network virtualization technologies and platform technologies, etc., in order to support ultra-simultaneous connections and low delays in IoT systems. (See annex (2-2) ①) (Relisted)

③ Research and development is moving ahead for technologies to control frequencies and communication methods, etc., in line with the radio wave environment, and technologies to realize highly reliable radio communication by dividing existing channels and making them redundant, in order to enable the dense use of wireless LAN and radio communication systems for IoT systems in narrow spaces inside facilities, etc. (See annex (2-1) ②) (Relisted)

④ Research and development is moving ahead for technologies to reduce communication volumes and suppress unnecessary communications in order to handle frequency tightening measures which accompany increases in transmission data in wireless LAN and IoT systems. (See annex (2-2) ②) (Relisted)

⑤ To cope with future traffic increases, such as the expansion of the use of wireless LAN by IoT, etc. from 2020, a technical examination of sharing conditions with other existing wireless systems is underway.

⑥ Research and development of wideband radio communication system configuration technologies and network connection management and control technologies, which are needed for the sharing of mobile phone carriers' 5G base stations, will be carried out from 2020 to 2022 in order to improve the efficiency of the use of the spectrum. (See annex (2-1) ⑩)

VII 5.85 to 23.6 GHz Band

Current usage status: Used for various radars, satellite communications, satellite broadcasting, FPU, and STL/TTL/TSL, etc.

Basic Policy

To further promote the development of basic technologies and new radio spectrum use systems in order to further step up the utilization of unused frequency bands in high-microwave bands.

- To study the technical conditions needed to enable outdoor use of the ultra-wideband (UWB) wireless system, which is limited to indoor use in the 7 to 10 GHz band.

Specific Initiatives

1. System Upgrades

① Ultra-Wideband (UWB) Radio Systems [7 to 10 GHz band]

• A ministerial ordinance was promulgated and enforced in May 2019 for some frequency bands (7.587 to 8.4 GHz). The technical conditions for outdoor use of other frequency bands will be studied in FY 2020 based on the results of a study during FY 2019 that considered, from a technical viewpoint, the possibility of frequency sharing with other systems. A system upgrade will follow in FY 2021. (See annex (2-1) ⑧)

② Next Generation High-Performance Radar (5 GHz band and 9 GHz band)

• Technical studies are ongoing on narrowband for 9 GHz meteorological radars equipped with phased array antennas and a channel plan for 5 GHz band high-performance meteorological radars, in order to observe short localized downpours which have increased in recent years, and to enable the installation of meteorological radars across the country. The technical standards for this will be formulated by FY 2022.

③ Ultra High-Definition Television Broadcasting (4K / 8K Broadcasts) [12 GHz band]

• Following the start of commercial broadcasting for new 4K8K satellite broadcasts in December 2018, an appropriate reception environment is being addressed through a subsidy system for repairs of receiving equipment that may affect broadcasts, and a public awareness campaign on needed leakage countermeasures. This is to avoid an impact on existing wireless systems by the intermediate frequencies of receiving equipment. (See annex (2-3) ②)

In addition, video encoding systems for 2K broadcasts are being enhanced, and the technical problems when installing on the same transponder as 4K broadcasts are being verified, in order to achieve a smooth transition from 2K to 4K in satellite broadcasting.

④ Satellite Constellation [Ku/Ka band]

• Technical conditions pertaining to frequencies between adjoining existing wireless systems and geostationary satellite systems will be compiled, and required system upgrades completed by the end of FY 2020, for the realization of non-geostationary

satellite constellations.

⑤ Commercial Broadcasting Radio Stations and Fixed-Satellite Services [5.9 GHz band]

- Based on the progress and importance of automatic driving systems (including safe driving support), a study is being carried out, which will finish by the end of FY 2021, into the technical conditions for frequency sharing with needed existing wireless systems, for example when introducing V2X communications, and with consideration for existing wireless systems on frequency bands being studied internationally (5.9 GHz band), in addition to the existing ITS frequency bands (760 MHz band, etc.,).

  In addition, based on the results of these studies, in cases where V2X communications are to be introduced on the same frequency band, there is a goal to allocate frequencies to V2X in FY 2023 after the necessary frequency bandwidth has been secured by migrating existing wireless systems, etc.

⑥ X Band Coastal Surveillance Radars (9 GHz band)

- Studies into expanding frequency bandwidth will be carried out, and technical standards formulated by the end of FY 2023, for coastal surveillance radars in parallel with a study into frequency sharing in the 9.7 GHz band for meteorological radars. This is in order to accelerate the stable operation of high-performance radars in the meteorological field, and the promotion of an introduction environment for next generation high-performance radars, in order to handle increasing demand for coastal surveillance radars.

Future Themes to be Addressed

① Research and development will be stepped up on technologies that enable the flexible control of satellite (Ka band) resources (frequency band, and irradiation beam location and shape) in order to meet the needs of a range of satellite communication applications, such as using the internet in aircraft and communications in the event of a disaster. (See annex (2-5) ①)

② Development of compact and weight reduced high-performance antennas, etc. is to be stepped up to meet the expansion in demand for high-speed communication services through satellite communications within aircraft. (See annex (2-5) ②)

③ Studies will be carried out to clarify technical standards and the operation conditions for permitting dynamic sharing of the 9 GHz band which takes into account both location and time, etc., as a frequency sharing method with existing radio station systems, such as public service radio stations, etc. (See annex (2-1) ⑦)

VIII 23.6 GHz and Above

Current usage status: Used for various radars, satellite communications, and wireless access systems, etc.

Basic Policy

To urgently move forward with policies for the effective use of the spectrum in existing systems to secure the needed frequencies for the rollout of 5G which has already been allocated, and to handle further demand for 5G and local 5G mobile communication systems, etc. In addition, and at the same time, to step up development of basic technologies and new radio spectrum use systems in order to further promote the use of unused frequency bands in the millimeter wave band.

- Allocations were made to 4 mobile phone operators in April 2019 for 27.0 to 28.2 GHz and 29.1 to 29.5 GHz. In the future, frequency sharing with existing radio systems will be stepped up for the further rollout of 5G, and research and development will continue.
- A local 5G system was established in December 2019 in the 28.2 to 28.3 GHz band. Studies are to be stepped up into sharing existing wireless systems and development demonstrations on the local 5 G candidate frequency band of 28.3 to 29.1 GHz.
- To move ahead with studies to share existing wireless systems in order to introduce 5G or local 5G in new candidate frequency bands.

Specific Initiatives

1. System Upgrades

① Satellite Constellation [Ku/Ka band]

- Technical conditions pertaining to frequencies between adjoining existing wireless systems and geostationary satellite systems will be compiled, and required system upgrades completed by the end of FY 2020, for the realization of non-geostationary satellite constellations.

② Mobile Communication Systems [28/40 GHz band]

i. To step up studies into sharing existing wireless systems at the 26.6 to 27.0 GHz bands, as new 5G candidate frequencies, and consider a frequency reorganization, including using end-of-life promotion measures.

ii. The 28.2 to 28.3 GHz frequency band had a system upgrade as a priority in December 2019. Studies are being carried out into sharing with mobile phones, etc., which use a separate adjoining frequency band, for 28.3 to 29.1 GHz (as an additional local 5G candidate frequency band), while taking into account the impact on existing wireless systems on the same frequency band. In addition, development demonstrations, based on the use cases of a range of sectors, will be undertaken, and the introduction of local

5G promoted, to solve regional problems and to utilize 5G for diverse needs. (See annex (2-1) ⑪) (Relisted)

iii. • The possibility of introducing mobile communication systems, including dynamic frequency sharing applications, will be examined for the 40 GHz band (39.5 to 43.5 GHz) as a new 5G candidate frequency. This will be based on the results of a study into sharing with existing wireless systems, etc. carried out in FY 2018.

iv. The possibility of 5G frequency allocations, which also take into account the status of studies into ITU and 3GPP, etc., and trends in other nations, will be examined in regard to frequencies other than 1, and 2, out of the IMT designated frequency bands (24.25 to 27.5GHz, 37 to 43.5 GHz, 47.2 to 48.2GHz and 66 to 71 GHz) at WRC-19. Frequency allocation was carried out in April 2019, together with 27.5 to 29.5 GHz, for 27.0 to 27.5 GHz. (See annex (2-1) ④)

v. Research and development is to be propelled in regard to base station configuration technologies that achieve low power and miniaturization, base station coordination technologies for high speed migration, and maintenance and verification technologies for interoperability between base station equipment, for flexible base station deployment in the rollout of 5G. (See annex (2-1) ③)

vi. The features of 5G, that it has ultra high-speed, low latency and enables multiple simultaneous connections, will be further developed, and in addition, research and development will be promoted to realize further enhancement of its high energy efficiency and high reliability. (See annex (2-1) ⑤) (Relisted)

③ Broadband Satellite Communications Systems for Migration (19.7 to 20.2 GHz and 29.5 to 30.0 GHz)

• In addition, initiatives will be carried out for the rollout of migrated broadband satellite communication systems (19.7 to 20.2 GHz and 29.5 to 30.0 GHz) that were systemized and launched in 2017.

④ The introduction of high-speed and high-precision imaging technologies (92 to 100 GHz) will be studied in FY 2020, with system upgrades in FY 2021, to ensure the availability and safety of critical infrastructure such as airport runway surveillance, etc.

Future Themes to be Addressed

① Research and development will be stepped up on technologies that enable the flexible control of satellite (Ka band) resources (frequency band, and irradiation beam location and shape) in order to meet the needs of a range of satellite communication applications, such as using the Internet in aircraft and communications in the event of a disaster. (See annex (2-5) ①) (Relisted)

② Development of compact and weight reduced high-performance antennas, etc. is to be stepped up to meet the expansion in demand for high-speed communication services through satellite communications within aircraft. (See annex (2-5) ②) (Relisted)

③ Research and development is being stepped up for technologies to control frequencies and communication methods, etc., in line with the radio wave environment, in order to enable the dense use of wireless LAN and radio communication systems for IoT systems in narrow spaces inside facilities, etc. (See annex (2-1) ②) (Relisted)

④ The following research and development will be stepped up to accelerate the utilization of unused frequency bands, such as the millimeter wave band, etc.

i. Research and development into wireless communication infrastructure technologies for the realization of ultra high-speed transmissions of tens of Gbps using terahertz waves. Furthermore, the research and development of video transmission technologies, standardization activities, and market research, to achieve their utilization and application for high-definition video transmission. (See annex (2-1) ⑥)

ii. Research and development is to be propelled forward for high-speed, high-precision millimeter-wave band multi-band imaging technologies for visualizing things previously unseen, to quickly detect all kinds of items of a dangerous nature, and to ensure safety and security in public spaces. (See annex (2-4) ①)

iii. Research and development is to be stepped up for the realization of terahertz spectroscopy systems, with the aim of achieving the early practical application of wireless systems using high frequency waves, and in order to contribute to the enhancement of Japan's international competitiveness. (See annex (2-6) ④)

⑤ Research and development of wideband radio communication system configuration technologies and network connection management and control technologies, which are needed for the sharing of mobile phone carriers' 5G base stations, will be carried out from 2020 to 2022 in order to improve the efficiency of the use of the spectrum. (See annex (2-1) ⑩) (Relisted)

IX. Initiatives Related to the Reorganization of Other Spectrums and Radio Wave Usage, etc.

① Expansion of Surveys into the Spectrum Usage Status

From the 2020 spectrum usage status survey there will be a steady implementation of surveys that are based on the changing survey cycle, and the enactment of priority investigations, etc., in order to ensure fairness and transparency in them, and to report on the implementation policy for surveys before they begin to the Radio Control Deliberation Council, so as to provide for further effective use of the radio spectrum. In addition, there will be a review of study items and evaluation contents, which take into account future study themes in the 2019 survey, in regard to surveys over the status of spectrum usage pertaining to mobile phones, etc. (Relisted)

② Promotion of the Effective Use of Shared Public Frequencies

Migration, etc. to new wireless systems in order to accelerate the effective use of radio station spectrums within the country, etc. is to be promoted. Specifically, together with the implementation of (i) a study into the introduction of a public safety LTE, (ii) promotion of the shared use of radio equipment such as shared public microphone lines, telemeters, and telecontrols, etc., and (iii) a study into promoting the use of public broadband mobile communication systems, and moving ahead with studies into the institutional aspects of public safety LTE, including frequency allocation, which take into account the results of examination studies carried out in 2019 and of comprehensive demonstrations scheduled to take place in 2020. (Relisted)

③ Promoting Dynamic Frequency Sharing

In order to secure new frequencies to handle the growing use of IoT and 5G, etc. since 2020, there has been research and development, and demonstration tests, for dynamic frequency sharing and interference avoidance technologies that use databases which enable the realization of advanced frequency sharing with existing radio systems. The dynamic frequency sharing system will be built by FY 2020. Specifically, there will be consideration, including system enhancements, for realizing dynamic frequency sharing in the frequency bands of 2.3 GHz, 2.6 GHz, 5.8 GHz, 5.9 GHz, 26 GHz, 28 GHz, and 38 GHz. (Relisted)

④ Realization of High-Precision Radio Wave Simulation Systems in Virtual Space

In regard to Beyond 5G, for which studies have already began as a next generation communication system, research and development, and demonstration tests, are being conducted for the realization of a test environment that can reproduce in simulations the propagation of radio waves in the real world. This is being carried out in order to promote technological development under Japanese leadership with the aim of securing internationally viable frequencies, and in addition to accelerate the advanced use of existing radio systems. The high-precision radio wave simulation system will be constructed by FY 2023.

⑤ Promotion of Safe Radio Wave Utilization at Medical Institutions

Initiatives are being promoted to carry out public awareness activities through regional councils, etc., alongside an investigation into the effects of radio waves on medical equipment, etc., in order to promote safe and secure radio wave utilization in medical institutions.

⑥ Deterring Distribution of Equipment that does not Conform to Technical Standards

Under the Radio Law, manufacturers, importers, and distributors are obliged to ensure that they do not distribute equipment that does not conform to technical standards. However, in anticipation of the IoT era, the Radio Law was revised to enhance the effectiveness of deterrents against the distribution of such equipment, and, together with a review of the conditions for recommendations and decrees, guidelines are being drawn up to clarify the details of the specific obligated efforts to be made by manufacturers, importers and distributors. In addition, in terms of obtaining evidence that equipment conforms to technical standards, and taking into account that many things are controlled by firmware which has been loaded with multiple functions within the same housing, the written document form prescribed by ministerial ordinance to be submitted to a registered certification authority is to be revised, and a mechanism will be established whereby the applicant himself or herself should recognize that they are not allowed to emit any radio waves outside the scope of the application.

⑦ Overseas Development of Radio Systems

From the viewpoint that Japan has excellent technology in terms of radio systems, initiatives are to be carried out to promote the dissemination, including overseas field trials, etc. of Japan's radio systems based on the global development strategy, compiled by the "Council on Overseas Development of Radio Systems", to build a comprehensive strategy through public-private partnerships in order to promote global expansion, starting with Asian countries.

⑧ Use of Aerial Mobile Communications Systems Loaded on Unmanned Aircraft

Technical condition studies are underway concerning the use of mobile communication systems and wideband mobile radio access systems loaded onto unmanned aircraft. These take into account verification studies on the impact, etc. of the use of terrestrial mobile communication systems conducted up until 2019, and international studies, etc. on 3GPP, etc. For some frequencies, the system enhancements needed for the use of mobile phones while flying is being developed during 2020.

⑨ Radio Communication Systems Using High-Altitude Communication Platforms (HAPS)

Research and development will begin from FY 2020 on high-altitude communication platforms (HAPS), whereby communications can be achieved between a base station installed on an unmanned aircraft, at an altitude of approximately 20 km, and the ground, in order to achieve a flexible communication service that is highly resilient against disasters and which can flexibly realize the development of advanced information infrastructure in rural

areas. This will use 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 less, and will be considered for a quick systemic implementation from FY 2023. (See annex (2-5) ⑥)

⑩ Examination of Wireless Power Transfer Systems

The Information and Communications Council is considering the possibility of introducing spatial transmission wireless power transfer systems using the 920 MHz, 2.4 GHz, and 5.7 GHz bands, assuming indoor use in factories, etc., and prerequisite laws for radio equipment, and its systematic implementation in FY 2020. In addition, the Information and Communications Council will begin an examination in FY 2020 of proximity-coupled type wireless power transmission, with a desire to expand type designations with regard to equipment that uses high frequency waves. They will consider the technical conditions needed to ensure that the level of leaked radio waves does not affect other wireless communications.

⑪ Examination Concerning Testing Methods for advanced Radio Equipment

Since radio equipment has become both advanced and miniaturized, and there has been a rapid increase in radio equipment which do not have antenna terminals, the establishment of testing methods using radiometry and other means will be studied and considered, while taking into consideration conventional measurement methods and consistency with overseas measurement methods, so that such radio equipment can properly receive technical regulations conformity certification. In addition, studies will begin from FY 2020 to reflect on related regulations which take into account the results of technical tests, particularly in regard to measurement methods for the electric field strength of weak radio equipment, in order to cope with diversifying radio equipment.

⑫ Studies into Measurement Methods at Locations Installed with Large Electronic Equipment in order to Maintain a Good Radio Environment

There is a risk of radio wave leakage from electronic devices 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 electronic devices have become both larger and with greater and higher output, and as suitable measurement methods in these have become indispensable, a technical study will start from FY 2020 regarding measurement methods where they have been established.

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 research and development in three particular fields, while taking into account 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 a migration to higher frequencies. Chapter 3 of the Frequency Reorganization Action Plan clarifies which research and development themes Japan must address depending on frequency demarcations, from the perspective of frequency migration and reorganization.

In this annex we classify and highlight the research and development that the Ministry of Internal Affairs and Communications is conducting in this regard into "the qualitative and quantitative expansion of mobile communications," and "the expansion of machine-to-machine communications (M2M) without human intervention," from the perspective of enabling efficiency and growth in a range of industrial sectors, set against the background of a future that features growing and developing radio spectrum use.

(2) Research and Development Themes

(2-1) Qualitative and Quantitative Expansion of Mobile Communications

As it is widely expected that High-speed and large-capacity wireless networks achieve further advancements represented by the spread of 4th generation mobile communication systems (IMT-Advanced: 4G), which have enabled the realization of communication speeds comparable to optical fiber, and that ownership of a range of communication devices, including both smartphones and wearable devices, will continue to climb, the following needs to be addressed.

① Studies concerning frequency sharing conditions between the 2.3 GHz frequency band 4G systems and existing wireless systems such as public service radio stations, and between the 2.6 GHz band 4G systems and future satellite communication systems. [Related: AP Chapter 4, Section IV - Specific Initiatives - System Upgrades ②]

② Research and development for technologies to control frequencies and communication methods, etc., depending on the radio wave environment, and technologies to realize highly reliable radio communication by dividing existing channels and making them redundant, in order to enable the dense use of wireless LAN and radio communication systems for IoT systems in narrow spaces inside facilities, etc. [Related: AP Chapter 4, Section III - Themes to be Addressed in Future ②, Section IV - Themes

to be Addressed in Future ②, Section VI - Themes to be Addressed in Future ③, and Section VIII Themes to be Addressed in Future ③]

③ Research and development regarding base station configuration technologies that achieve low power and miniaturization, base station coordination technologies for high speed migration, and maintenance and verification technologies for interoperability between base station equipment, for flexible base station deployment in the roll out of 5G. [Related: AP Chapter 4, Section VIII - Specific Initiatives - System Upgrades ②, v,]

④ Studies into the possibilities of frequency allocations to 5G, which also take into account the status of studies into ITU and 3GPP, etc., and trends in other nations, of frequencies other than 26.6 to 27.0 GHz and 39.5 to 43.5 GHz, out of the IMT designated frequency bands (24.25 to 27.5 GHz, 37 to 43.5 GHz, 47.2 to 48.2 GHz and 66 to 71 GHz) at WRC-19. [Related: AP Chapter 4, Section VIII - Specific Initiatives - System Upgrades ②, iv]

⑤ The promotion of Research and Development which improves the features of 5G that it has ultra high-speed, low latency and enables multiple simultaneous connections, and which realizes the further enhancement of its high energy efficiency and high reliability. [Related: AP Chapter 4, Section V - Specific Initiatives - System Upgrades ②, Section VI - Specific Initiatives - System Upgrades ①, iii, and Section VIII - Specific Initiatives - System Upgrades ②, vi]

⑥ Research and Development into terahertz wireless communication infrastructure technologies for the realization of ultra high-speed transmissions of tens of Gbps using terahertz waves and research and development in video transmission technologies, standardization activities, and market research in order to achieve their utilization and application for high-definition video transmission. [Related: AP Chapter 4, Section VIII - Themes to be Addressed in Future ⑤ ii]

⑦ Studies to clarify technical standards and the operation conditions for permitting dynamic sharing of the 1.2 GHz and 9 GHz bands which takes into account both location and time, etc., as a frequency sharing method with existing radio station systems, such as public service radio stations, etc. [Related: AP Chapter 4, Section IV - Themes to be Addressed in Future ④ and Section VII - Themes to be Addressed in Future ③]

⑧ Studies into the technical conditions needed for radio equipment to enable, as a priority, outdoor use of the ultra-wideband (UWB) wireless system, which is limited to indoor use, with limiting them to certain frequency bands (7.587 to 8.4GHz). A system upgrade which took place in May 2019. Continuous studies into technical conditions to expand the available outdoor frequency bands. [Related: AP Chapter 4, Section VII - Specific Initiatives - System Upgrades ①]

⑨ Studies into the technical conditions for new wireless systems that use idler frequencies generated by the migration of a digital MCA terrestrial mobile communication system, together with studies into migration timing, etc. to advanced MCA terrestrial mobile communication systems. [Related: AP Chapter 4, Section III - Themes to be Addressed in Future ④]

⑩ Research and development into wideband radio communication system configuration technologies and network connection management and control technologies needed for the sharing of mobile phone carriers' 5G base stations, which will be carried out from 2020 to 2022 in order to improve the efficiency of the use of the spectrum. [Related: AP Chapter 4, Section VI - Themes to be Addressed in Future ⑥ and Section VIII - Themes to be Addressed in Future ⑤]

⑪ Development demonstrations, based on use cases for a range of sectors and promotion of the introduction of local 5G to utilize 5G for diverse needs and to solve regional problems. [Related: AP Chapter 4, Section VI - Specific Initiatives - System Upgrades ①, i, and Section VIII - Specific Initiatives - System Upgrades ②, ii]

(2-2) Expansion of Machine-to-Machine Communications (M2M) Without Human Intervention

Due to the rapid expansion of M2M systems, known as communications between devices, and wireless sensor networks, it is widely expected that a new type of society is on the verge of being realized where all things, including people, various home appliances and equipment, homes, cars, trains, and infrastructure, can be connected wirelessly, and as such the following needs to be addressed.

① Research and development into technologies for the effective use of the radio spectrum for the optimal control of the entire IoT system, and which unifies IoT devices and both wired and wireless networks, through the application of network virtualization technologies and platform technologies, etc. in order to support IoT's ultra-simultaneous connections and low delays in IoT systems which use the 920 MHz, 2.4 GHz, and 5 GHz frequency bands. [Related: AP Chapter 4, Section III - Themes to be Addressed in Future ①, Section IV - Themes to be Addressed in Future ①, and Section VI - Themes to be Addressed in Future②]

② Research and development into technologies to reduce communication volume, and suppress unnecessary communications, in order to handle frequency tightening which accompanies the increase in transmission data in wireless LAN and IoT systems. [Related: AP Chapter 4, Section III - Themes to be Addressed in Future ③, Section IV - Themes to be Addressed in Future ③, Section V - Themes to be Addressed in Future ①, Section VI - Themes to be Addressed in Future ④]

③ Research and development into wireless communication technologies that realize ultra-high reliability and low latency in millimeter-wave bands to enable the securing of wideband. This is in order to realize wireless robots, etc., which are expected to be introduced into the nursing and medical care, etc. sectors where there are labor shortages.

(2-3) Progress in the Use of High-Definition Video and Integration with Communication Services

It is expected that high-quality broadcasts enable a viewing experience with both extremely high definition and a real feeling of 'being there,' and that mobile viewers of such broadcasts will continue to increase on large displays and tablets. Therefore, the following needs to be addressed.

① Technical studies on terrestrial broadcasting, such as transmission capacity expansion technologies, technologies for improved high-compression and transmission efficiency, and SFN relay technologies, etc., for the realization of a more effective use of terrestrial television broadcasting frequencies, and new broadcasting services (ultra-high definition broadcasting, etc.) on the same frequencies. [Related: AP Chapter 4, Section II - Themes to be Addressed in Future]

② Technical studies on frequency sharing between intermediate frequencies used by television broadcasting systems and existing wireless systems for the smooth introduction of ulta high-definition television broadcasting (4K / 8K broadcasting) in the 12 GHz band. [Related: AP Chapter 4, Section VII - Specific Initiatives - System Upgrades ③]

③ Technical studies on contributing to the use of effective frequency use by linking multiple transmission lines for satellite broadcasts and communications, etc., and studies on video encoding methods, etc., in order to efficiently use the transmission bandwidth for satellite broadcasts.

④ Research and development into technologies for effective frequency use of the 5.7 GHz band unmanned mobile image transmission system to enable real-time transmission of ultra-high definition (4K) video from multiple drones, and full duplex communications using the same frequency. [Related: AP Chapter 4, Section VI - Themes to be Addressed in Future ①]

(2-4) Ensuring the Security and Safety of Wireless Systems and Improving Resilience

With the diagnosis of social infrastructure through M2M and sensor networks, and the need to cope with the aging and maintenance of this infrastructure, the following will need to be addressed.

① Research and development into high-speed, high-precision multi-band imaging technologies to visualize things which have been invisible up to now, using millimeter-wave bands, in order to quickly detect all kinds of dangerous items, and to ensure safety and security in public spaces. [Related: AP Chapter 4, Section VIII - Themes to be Addressed in Future ④ ii]

② Research and development from FY 2020 into technologies to obtain sensor information simultaneously and accurately in the situation where sensing is carried out at high speed and where a large number of RFID tags with sensor functions are installed over a wide area, in the 920 MHz band for passive RFID tag systems.

(2-5) Securing Emergency Lifelines in Public Sectors and Broadcast and Communication Methods

The use of the radio spectrum is absolutely essential during disasters in securing the provision of highly public services, such as ensuring emergency lifelines, and broadcast and communication methods. There are high expectations for advancements (such as enabling broadband) in the use of the radio spectrum for securing safety by making full use of wireless systems, improving resilience, and securing essential functionality for the public sector. Therefore, the following will need to be addressed.

① Research and development into technologies that enable the flexible control of the frequency bandwidth and the location and shape of irradiation beams of communication

satellites (Ka band), in order to meet the needs of a range of satellite communications by a range of users which has increased in recent years, such as nautical communication demand for an aircraft broadband environment and nautical resource development, and securing communications in the event of a disaster. [Related: AP Chapter 4, Section VII - Themes to be Addressed in Future ① and Section VIII - Themes to be Addressed in Future ①]

② Development into plate-shaped active electronic scanning array antennas that can be mounted on small or medium-sized aircraft, known as regional jets, and research and development to improve narrowband frequency efficiency, in order to cope with the expansion in demand for high-speed communication services, through satellite communications, within aircraft. [Related: AP Chapter 4, Section VII - Themes to be Addressed in Future ② and Section VIII - Themes to be Addressed in Future ②]

③ Technical studies for a format to unify the used radio spectrum, by synchronization of the broadcast timing at the point of retransmission through relay stations, etc., in order for the further effective use of the radio spectrum used by relay stations, etc., for the 60 MHz band municipal disaster administrative radio (broadcast system). [Related: AP Chapter 4, Section I - Specific Initiatives - System Upgrades ③]

④ In order to realize aviation of unmanned aircraft outside of visual view and over third parties, research and development is needed in technologies to enable wide-area and long-distance wireless communications via high-altitude aircraft in areas, which have insufficient communication infrastructure such as mountainous regions, remote islands, and marine areas, etc., and technologies for the effective use of the radio spectrum to reduce interference risks and radio interference over urban areas. [Related: AP Chapter 4, Section IX - Initiatives Related to the Reorganization of Other Spectrums and Radio Wave Usage]

⑤ Technical studies to secure communication functions in areas where there is communication disruption, such as when there is a disaster, in order to introduce a shared using model for public safety LTE (PS-LTE) by multiple public organizations. [Related: AP Chapter 4, Section I - Specific Initiatives - System Upgrades ⑤]

⑥ Research and development will be conducted on high-altitude communication platforms (HAPS), whereby communications can be achieved between the ground and a base station installed on an unmanned aircraft at an altitude of approximately 20 km above the ground, to achieve a flexible communication service which is highly resilient against disasters and which can flexibly realize the development of advanced information infrastructure in rural areas. This will use 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 less. [Related: AP Chapter 4, Section IX - Initiatives Related to the Reorganization of Other Spectrums and Radio Wave Usage ⑨]

(2-6) Progress of Radio Spectrum Use Other than Communications

Currently, radio waves are used in a wide range of fields such as for positional measurements and sensors using radars and positioning satellites. In addition, there is a growing need to introduce wireless power transmission systems, which enable fast and easy charging by using wireless technology, for home appliances and electric vehicles (EV), and so, with great expectations for development in a range of products, the following will need to be addressed.

① A review, based on the status of radio equipment and measurement instruments in recent years, into testing methods for technical standards compliance certificates, etc., and measurement methods for weak radio stations. In addition, in light of changes in the technological condition of high-frequency equipment, research and development and technical studies into ensuring that leaking electromagnetic fields generated by high-frequency equipment do not interfere with radio stations.

② With concerns about future traffic increases and frequency tightening in mind, research and development into technologies to flexibly control wireless networks, depending on the level of radio wave noise in specific areas and the status of the spectrum use environment, such as radio propagation characteristics.

③ Taking into account the miniaturization of built-in electronic devices and the increasing compact size of radio equipment, etc., research and development into new technologies that can be mounted on small radio equipment and can suppress unnecessary radio waves.

④ Research and development for the realization of terahertz spectroscopy systems, with the aim of achieving the early practical application of wireless systems using high frequency waves, and contributing to the enhancement of Japan's international competitiveness. [Related: AP Chapter 4, Section VIII - Themes to be Addressed in Future ④ iii]

⑤ In recent years there has been growing attention on emission measurement methods (radiometry) that do not need to be connected to an antenna terminal as a test method for radio equipment, so technical studies are needed to establish rational and practical use of radiometry methods.

(2-7) Enhanced Cybersecurity

While IoT devices continue to spread, there exists the issue that growing numbers of IoT devices connected to networks do not have sufficient security measures. Therefore, the following needs to be addressed.

① Research and development into wide area network scan technology that enables automatic estimation of the status of frequency usage, and reduces traffic, in order to improve security without interfering with the normal communications of IoT devices.

② Research and development of technologies that make malware harmless and non-

functional in order to prevent unauthorized communications caused by attacks that misuse IoT devices, and to ensure cybersecurity in the IoT environment.