

Outline of Report by Radio Policy Roundtable in the Age of Digital Transformation

August 2021

- In light of the expected acceleration of digital transformation in society as a whole required to establish a new normal and maintain and develop economic activities, the Ministry of Internal Affairs and Communications has created the roundtable to examine issues related to radio policies in the age of digital transformation, set new goals and considered measures to achieve these goals.
- The roundtable launched discussions in November 2020 and compiled a report in August 2021.

Radio Policy Roundtable in the Age of Digital Transformation

- 1 Future vision of radio wave utilization
- 2 Radio policy issues in the age of digital transformation
- 3 New goals and measures to promote the effective use of radio waves in the age of digital transformation

Members *Honorifics are omitted. Members other than the chair and acting chairs are listed in the order of the 50 Japanese syllables.

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FUJII Takeo, Professor, Advanced Wireless and Communication Research Center, University of Electro-Communications

FUJIWARA Hiroshi, President, Chairman of the Board of Directors and CEO, BroadBand Tower, Inc.

WG for Publicly-owned Frequencies

- 1 Effective implementation of the survey of actual radio spectrum utilization on publicly-owned frequency bands

2 Others

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WG for Mobile Communication Systems

- 1 How to conduct the survey of actual radio spectrum utilization
- 2 How to allocate frequencies
- 3 Others

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Chapter 1: Present status of radio utilization

Chapter 2: Future picture of radio utilization in the age of digital transformation and establishment of goals for securing bandwidth

1. Ushering in the age of digital transformation and realizing Society 5.0
2. Social situation and other changes
3. Future picture of radio utilization
4. Establishment of goals for securing bandwidth

Chapter 3 Radio utilization policy in the age of digital transformation

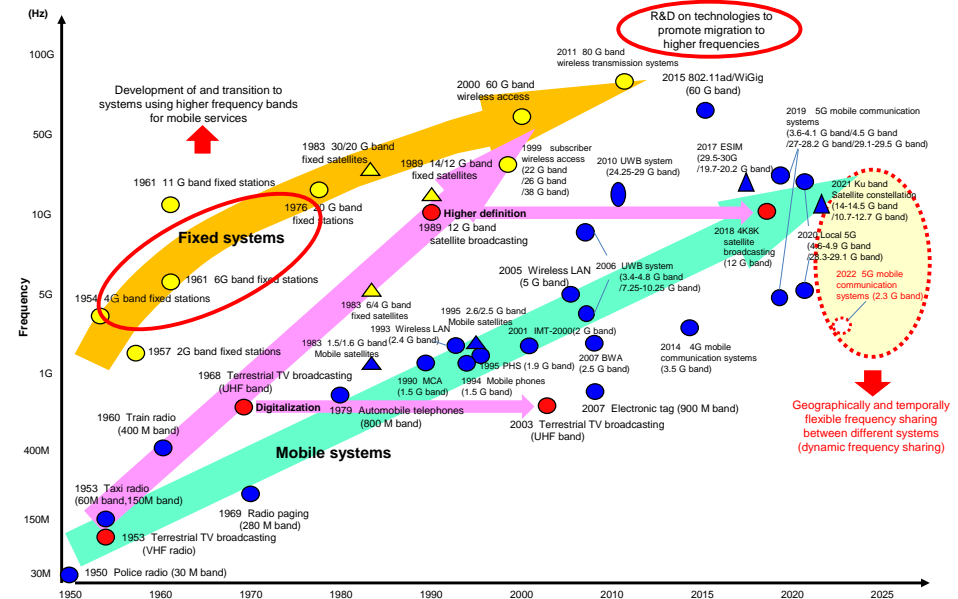
1. Introduction and diffusion of wireless systems required in the age of digital transformation
2. Verification of effective frequency utilization and policy for frequency allocation
3. Policy for effective utilization of publicly-owned frequencies
4. Radio supervision and management in the age of digital transformation
5. Revision of the spectrum user fee system

Chapter 1: Present status of radio utilization

Transition of radio utilization systems and development of mobile communication systems

Transition of radio utilization systems

- In the 1950s, radio utilization concentrated in VHF and other low frequency bands in the public sector. As radio utilization technologies have developed with telecommunications capacity expanded, however, radio utilization has expanded into high frequency bands.
- Effective radio utilization should be promoted through fixed systems' transition to higher frequency bands for reallocation to mobile systems, research and development of technologies for promoting transition to higher frequency bands and utilization of dynamic frequency sharing technology.



Development of mobile communication systems

- Mobile communication systems had offered only analog voice communication in their first generation but have rapidly developed in the past 30 years and been combined with cloud computing, Big Data, Internet of Things, AI (artificial intelligence) and other new technologies to produce various new services.
- The number of mobile phone and BWA (broadband wireless access) subscriptions came to 194.46 million (at the end of March 2021 after adjustment of intra-group transactions).
- Furthermore, mobile communication systems have evolved into faster and larger-capacity systems such as the fifth generation (5G), local 5G and Beyond 5G systems.

As of the end of March 2021

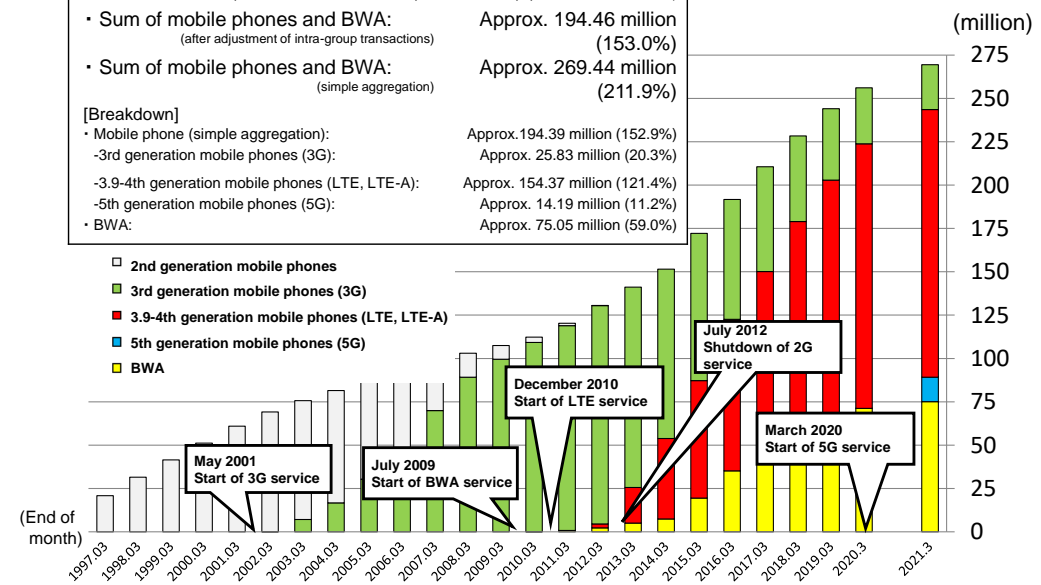
Number of subscriptions (Proportion of the subscribed population*)

*Proportion of the number of subscriptions to the total population of 127.13 million)

- Sum of mobile phones and BWA: (after adjustment of intra-group transactions) Approx. 194.46 million (153.0%)
- Sum of mobile phones and BWA: (simple aggregation) Approx. 269.44 million (211.9%)

[Breakdown]

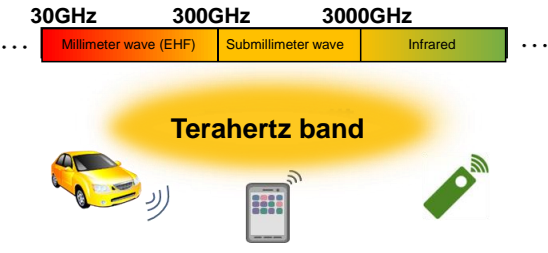
- Mobile phone (simple aggregation): Approx. 194.39 million (152.9%)
 - 3rd generation mobile phones (3G): Approx. 25.83 million (20.3%)
 - 3.9-4th generation mobile phones (LTE, LTE-A): Approx. 154.37 million (121.4%)
 - 5th generation mobile phones (5G): Approx. 14.19 million (11.2%)
- BWA: Approx. 75.05 million (59.0%)



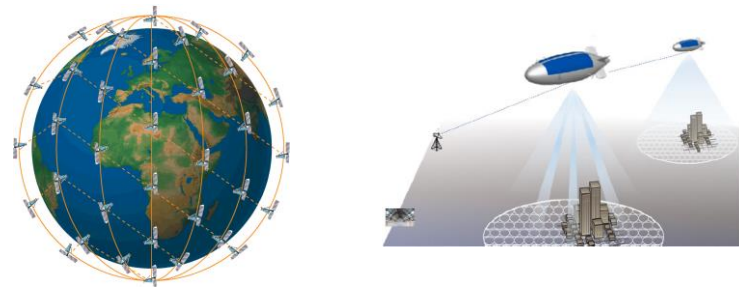
Number of subscriptions: based on MIC press release material "Publication of quarterly data on the number of subscriptions and share of telecommunication services" Total population: population, demographics and number of households based on the Residential Basic Book (as of January 1, 2020)

- As the digital transformation of society and economy is assumed to make progress in realizing Society 5.0, **technologies to accelerate digitalization will play key roles** towards the age of digital transformation. Against the backdrop of AI and Big Data development requiring larger capacity and ultra-low latency, hopes are placed on the innovation of network technologies.
- The trends of mobile communication system technology feature the expansion of capacity and coverage.** For networks, capacity expansion is making progress along with functional advancement through virtualization and network slicing.

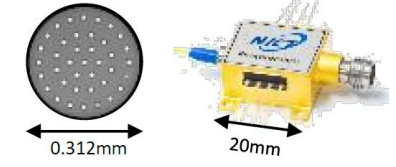
■ **Wireless communication capacity expansion (communication using terahertz bands)**



■ **Coverage expansion (Satellite constellation, HAPS, etc.)**

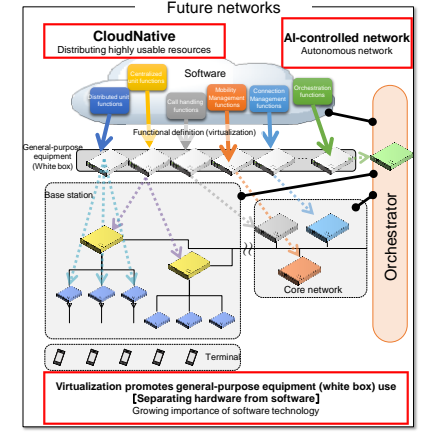


■ **Network capacity expansion (Multicore fibers, etc.)**

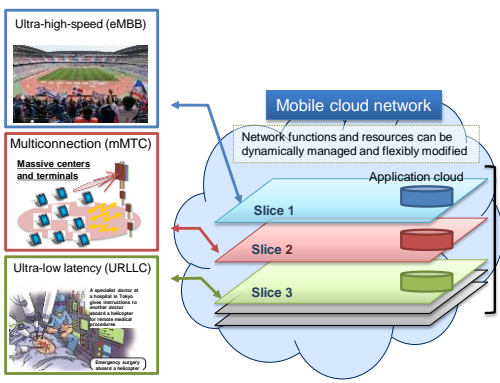


Source: Document presented by the National Institute of Information and Communications Technology at the fifth meeting of the Radio Policy Roundtable in the Age of Digital Transformation

■ **Virtualization**



■ **Network slicing**



<Network technology trends>

Area	Technology domain	Present	-2030	2030-
Mobile communication systems	Band extension	Millimeter-wave communication	Terahertz communication	
	Non-terrestrial networks		Low-orbit satellite constellation/HAPS	
	LPWA/wireless LAN	Wi-Fi6, etc.	Next-generation IoT, wireless LAN protocols, etc.	
Network technologies	Network slicing	Network virtualization	AI-based slicing	Zero-touch operation [※]

* Automation of processes from the detection of network failure and quality deterioration to the completion of responses to them.

2. Social situation and other changes

- **The COVID-19 pandemic has triggered the acceleration of digitalization.** At-home consumption, remote working and companies' responses to digitalization have become indispensable along with permanent measures for business continuity plans exploiting ICT to make contributions to maintaining national life and economic activities.
- **Wireless communications** have provided such values as remote communications and automation through remote control, promoting the separation between human mobility and economy in a manner to **contribute to the sustainability of society and economy.**
- As cyber and real spaces are expected to be fully synchronized in the future society, digital infrastructure including **next-generation radio systems** are likely to **become even more important** along with the utilization of IoT, Big Data, AI and other digital technologies.

<u>Category</u>	<u>Examples of digitalization</u>	<u>Examples of wireless system utilization</u>
Digitalization of communications	<ul style="list-style-type: none"> ➤ Telework ➤ Web distribution and virtual reality utilization ➤ Various remote services 	<ul style="list-style-type: none"> ➤ Remote communications using mobile systems (teleconferencing, etc.) ➤ Wi-Fi use at home, etc.
Contactless provision of services and goods	<ul style="list-style-type: none"> ➤ e-commerce utilization ➤ Home-deliver service ➤ Digital service utilization (video distribution, etc.) 	<ul style="list-style-type: none"> ➤ Cashless payment (contactless interface, etc.) ➤ Digital services taking advantage of larger capacity and ultra-low latency (e-sports, etc.)
Labor-saving/rationalization	<ul style="list-style-type: none"> ➤ Robot (AGV*, etc.) utilization ➤ Unattended shops, factories, etc. ➤ Drones and automated driving 	<ul style="list-style-type: none"> ➤ Transition from wired local networks to wireless ones for remote control ➤ Safe/secure remote surveillance and control for automated driving

*AGV stands for Automatic Guided Vehicle, meaning unmanned carriers and robots.

3. Future picture of radio utilization

- The development of wireless technologies is expected to bring about progress in the diversification of information use in the industry sector and promote wireless industry and society. As **the roles of radio waves become even more important**, the realization of a new wireless society will provide a breakthrough in resolving Japan's social challenges.
- Towards the age of digital transformation in which radio utilization needs will expand, diversify and advance, radio systems for supporting the next generation will be classified into seven categories, based on future use cases and network requirements. **Goals will be established for securing bandwidth for the four categories for which particularly large bandwidth will be required.***

*As for the remaining categories of radio systems, additional bandwidth will have to be secured if required.

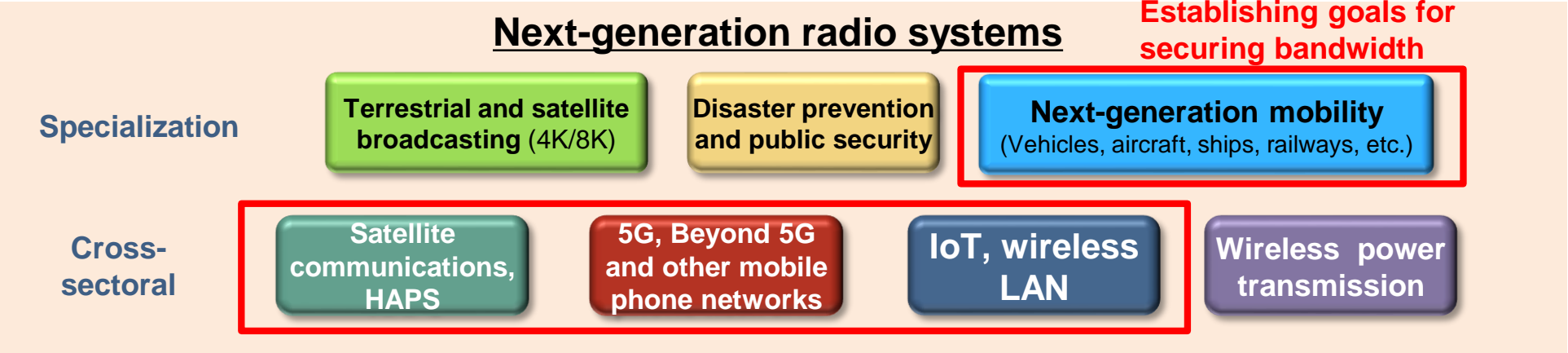
Potential user needs (including expectations and requirements regarding wireless systems)

Use case	Area	Place	Functions/apps	Data category	Device category
Network requirements	Large capacity Throughput/transmission speed and capacity, etc.		Ultra-low latency and synchronousness Transmission latency, etc.		Electricity savings and smaller sizes Multiple connections, energy efficiency of transceivers
	Highly efficient data distribution Cooperation with edge computing technology, etc. Efficient network utilization, etc.		Wide ranges and mobility Nationwide coverage Secure connection coverage, etc.		Safety and reliability Separate administration and control of services, etc.
	Autonomous emergence Autonomous, distributed and cooperative networks without manual intervention, local production and consumption of network resources, etc.		Flexibility and elasticity Quick network provision meeting specific services and requirements, etc.		Expandability Network application in untapped areas, etc.



Next-generation radio systems

Establishing goals for securing bandwidth



4. Establishment of goals for securing bandwidth

- Seek to secure **a total increase of about 16 GHz bandwidth by the end of FY2025***1 in preparation for the expansion and diversification of radio utilization needs
- Seek to secure **a total increase of about 102 GHz bandwidth by the 2030s***1 toward future Beyond 5G services

*1 From FY 2020-end

Target systems*2	5G/Beyond 5G mobile networks	Satellite communications/HAPS	IoT/wireless LAN	Next-generation mobility
FY2020-end	4.2 GHz bandwidth	9.8 GHz bandwidth	9.5 GHz bandwidth	13.9 GHz bandwidth
Band*3	Additional bandwidth to be secured			
-6GHz band (Up to low SHF band)	Focusing on realignment of existing systems and promotion of shared use FY2025-end: +170 MHz bandwidth / 2030s: +300-380 MHz			
	Dynamic frequency sharing and transition to 5G		Expansion of IoT/wireless LAN band	V2X realization
6-30 GHz band (High SHF band)	Focusing on realignment of existing systems and promotion of shared use FY2025-end: +9 GHz bandwidth / 2030s: +10-13 GHz			
	Dynamic frequency sharing and additional 5G frequency allocation	Non-geostationary satellite constellation and ESIM realization	Expansion of wireless LAN band	
30- GHz band (EHF band)	Utilization of unused frequency bands FY2025-end: +7 GHz bandwidth / 2030s: +59-89 GHz			
	Additional frequency allocation and Beyond 5G realization (terahertz band, etc.)	Q/V band utilization and HAPS realization	Gigabit-class wireless LAN	High-performance radar
FY2021- FY2025-end	+6 GHz bandwidth	+9 GHz bandwidth	+1 GHz bandwidth	+30 MHz bandwidth
FY2021- 2030s	+38-52 GHz bandwidth	+18-26 GHz bandwidth	+7-10 GHz bandwidth	+6-14 GHz bandwidth

Total bandwidth at FY 2020-end
About 37 GHz

Goals for securing bandwidth

FY2025-end
+ About 16 GHz bandwidth*1

2030s
+About 102 GHz bandwidth*1

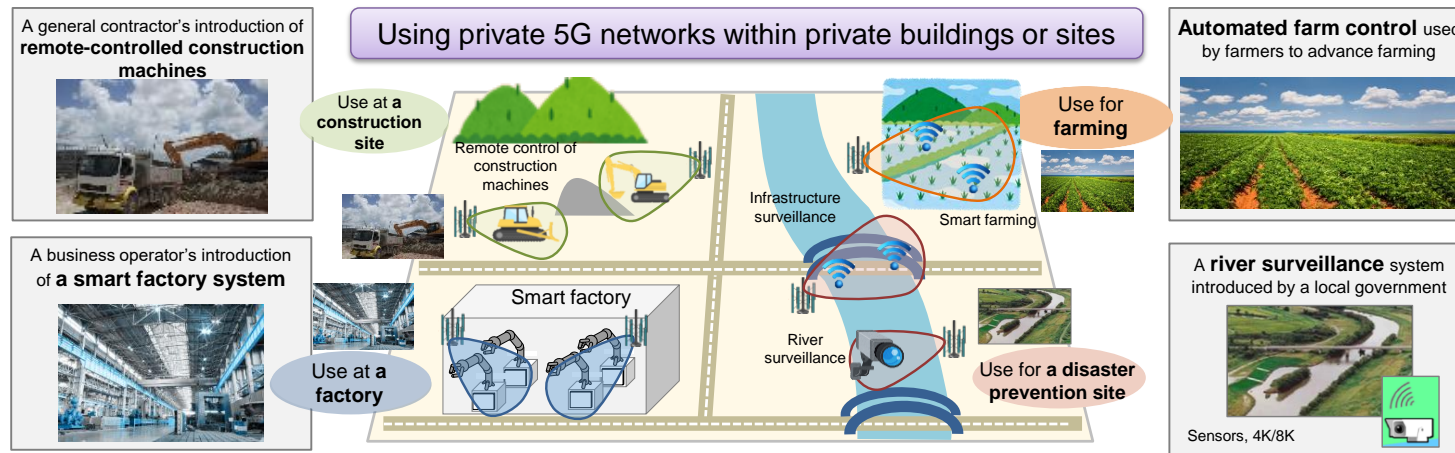
*1 From FY2020-end

*2 Bands shared among the four system categories are integrated for each category.
*3 Based on the present status and future potential regarding wireless system implementation, frequency bands are classified into two: SHF (Super High Frequency) and EHF (extra high frequency). Examples are given for each band class.

1. Introduction and diffusion of wireless systems required in the age of digital transformation

(1) Diffusion and promotion of 5G, local 5G and other services

- The government should proactively and immediately take measures to realize an environment where 5G and other ICT infrastructure would be put to full use, developing an environment for full nationwide 5G services quickly to **achieve one of the world's best 5G communication networks**.
- The government should deepen the consideration of **a subsidization scheme for joint maintenance** utilizing the equipment of infrastructure sharing business operators in disadvantaged areas and **infrastructure sharing rules**.
- **Towards around 2025** when local 5G licenses would be renewed for the first time, the government should **deepen the consideration of wider-area services** based on the utilization status under the current system.
- The government should consider how to handle service providers' utilization of their own and others' lands, including revisions to local 5G service introduction guidelines, **while taking note of the characteristics of millimeter wave and Sub6 frequencies**. It should also continue considering the simplification of licensing procedures.



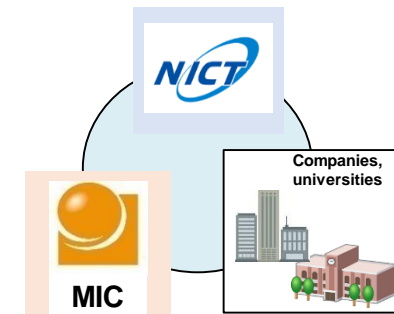
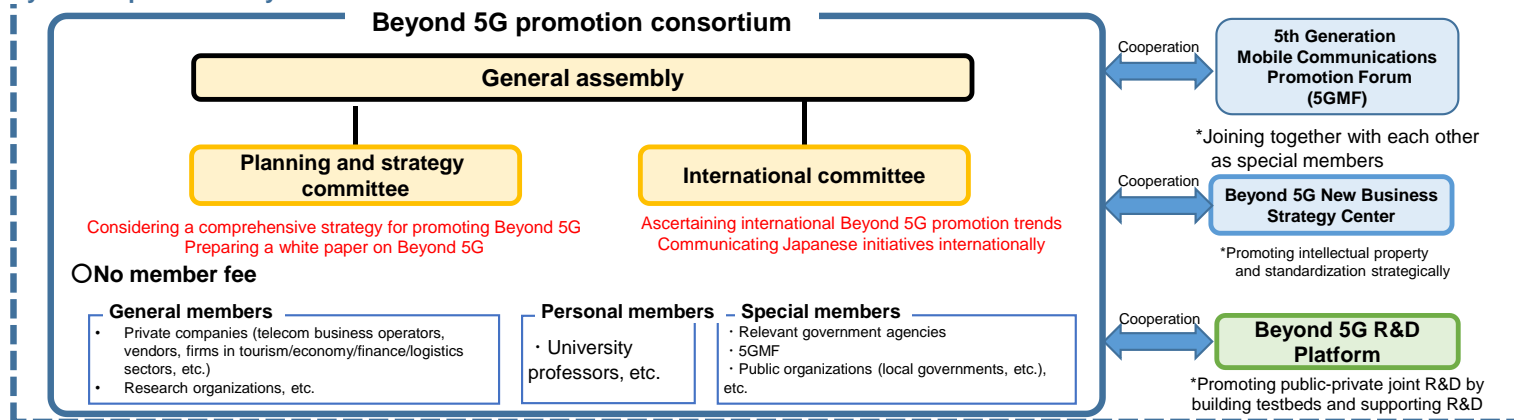
- The government should review how to publicize the safety of radio waves in the age of 5G and Beyond 5G services and **consider standard methods for measuring the intensity of radio waves and a mechanism for surveillance and publication** while referring to foreign trends.

1. Introduction and diffusion of wireless systems required in the age of digital transformation

(2) Promoting R&D, intellectual property and standardization regarding Beyond 5G and other services

- An effective industry-academia-government collaboration mechanism is required to **efficiently support Beyond 5G and other R&D projects of relevant organizations using spectrum user fee revenue.**
- The government should **use spectrum user fee revenue to support demonstration projects for standardization and human resources development and to enhance international joint research** with companies and research institutes from Japan's strategic partners including the United States, the European Union and Germany.
- **R&D projects should be implemented for high frequency ranges** where it is easy to secure large bandwidth, which is indispensable for high-speed communications services. The government should deepen the consideration of **simplifying licensing procedures for experimental stations.**
- A mechanism is required to further promote industry-academia-government collaboration projects including those **for implementing basic research** targeting commercialization over a medium to long term **in parallel with application research.**

Beyond 5G promotion system



(3) Promoting dynamic frequency sharing

- **As for dynamic frequency sharing in the 2.3 GHz band**, the Ministry of Internal Affairs and Communications should take measures such as the enactment of Ministerial Orders for relevant regulations and systems and the consideration of frequency allocation procedures to **make practical use within FY2021.**

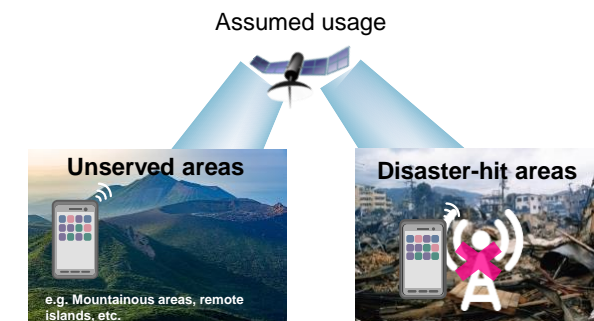
1. Introduction and diffusion of wireless systems required in the age of digital transformation

(4) Responses to open and virtual wireless networks

- The government should **consider realizing testbeds*** that would be effective for considering open base stations.
*Systems, facilities, etc., for confirming and testing base station components' conformity to open standards
- **It is required to intensively support the global expansion of open and virtual 5G network initiatives.**
- The government should **consider the feasibility of simplification** by verifying and preparing specific conditions for base station devices **for efficient tests for screening base stations.**

(5) Responses to worsening natural disasters

- The government should promote demonstrations to **fully operate from FY2022 public safety LTE (PS-LTE)** to be used jointly by disaster prevention organizations.
- To maintain an environment where people can get important information such as disaster and evacuation information through broadcasting, the government should promote **initiatives to eliminate areas with difficulties in receiving television signals and enhance resistance to disasters.**
- The government should **consider specific measures to simplify licensing procedures for space cellular services** to allow existing mobile phones to communicate with satellites.



Space cellular services

(6) Wireless human resources required in the age of digital transformation

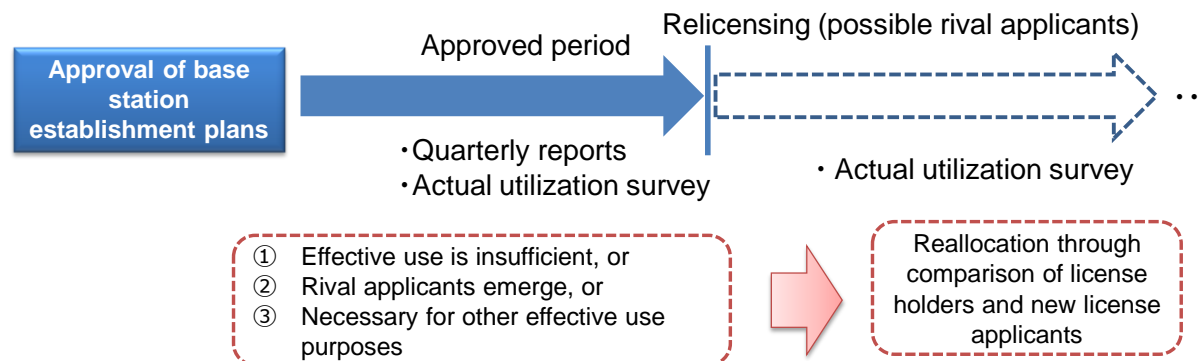
- The government should **consider revising the radio operator system for the age of digital transformation.**
- The government should promote initiatives to improve the convenience of taking national examinations for radio operator qualification, including **the introduction of online examinations.**

(1) Relationship between promotion of effective radio utilization and mobile market competition

- **The securement of fair competition** to vitalize the mobile market and provide more people with benefits apparently **amounts to the promotion of public** welfare provided as the purpose of the fair and efficient utilization of radio waves in Article 1 of the Radio Act.
- In allocating frequencies, the government should **assess initiatives for securing fair competition** and **introduce a system for preferential treatments for new market participants** as necessary.

(2) Introducing frequency reallocation

- As for allocated frequencies for expired establishment plans for specified base stations, the government should introduce **a mechanism to reallocate such frequencies** through comparison of existing license owners and new license applicants by setting license deadlines for existing license owners in such cases where the utilization of the allocated frequencies is insufficient or the existing license owners face competition from new license applicants.
- However, it must be noted that the introduction of the mechanism does not seek equality of the results but aims to secure equality of the opportunity and provide a fair competitive environment to acquire frequencies.

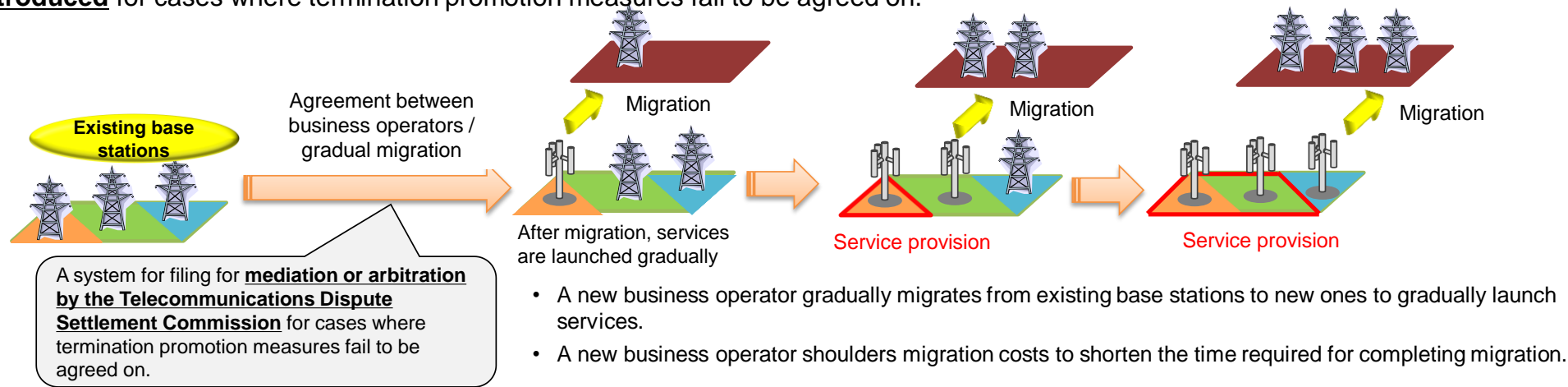


In any of the three cases

2. Verification of effective frequency utilization and policy for frequency allocation

(3) Periods for frequencies' migration and smooth migration methods for cases frequencies are migrated to new attested establishers as a result of frequency reallocation

- Periods for frequencies' migration to new attested establishers must be determined on a case-by-case basis. If there is a need for early migration, it is appropriate to **use termination promotion measures for smooth migration.**
- A system for filing for mediation or arbitration by the Telecommunications Dispute Settlement Commission should be introduced** for cases where termination promotion measures fail to be agreed on.



(4) How to handle so-called platinum frequency bands and roles of mobile network operators

- The so-called platinum frequency bands should be subjected not to any exceptional or special measure but to **a universal reallocation system for all frequency bands.**
- Individual issues (including filter insertion, repeater replacement and concerns about impacts on users) should be **immediately considered further from the summer of 2021.**
- Mobile network operators (e.g., less than 6 GHz) that are to establish specific base stations are required to **make utmost efforts to establish radio stations to allow wireless communications to be implemented throughout** the area for which frequencies for any specific base station are available.
- As for the so-called platinum frequency bands, mobile network operators are required to cover wide areas by **establishing radio stations at sites behind high-rise buildings and other disadvantaged areas.**

Chapter 3 Radio utilization policy in the age of digital transformation

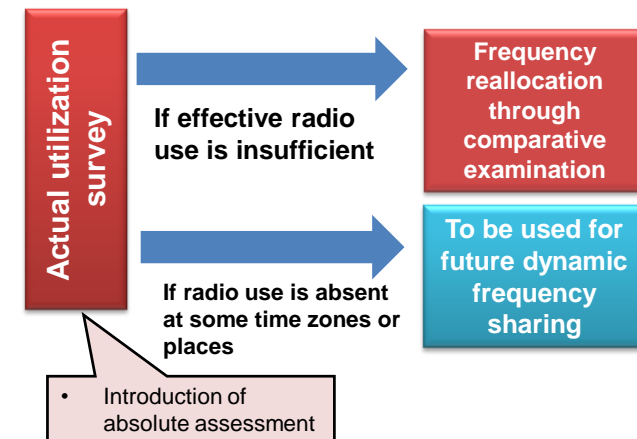
2. Verification of effective frequency utilization and policy for frequency allocation

(5) Reviewing BWA

- As for regional BWA services, it is appropriate to ascertain needs for such services and **consider such measures as shifting to nationwide services in regions where regional services remain unused** for five years.
- The government should **consider admitting BWA voice services** in addition to data transmission services.

(6) Improving the survey of actual radio spectrum utilization

- To secure transparency and objectivity of the assessment for the survey of actual radio spectrum utilization, the government should **consider third party assessment**.
- To assess how each frequency for mobile and nationwide BWA services is used, the government should consider introducing **band-wise traffic as an assessment indicator**.
- To link the results of the survey of actual radio spectrum utilization for mobile and nationwide BWA services to the reallocation of frequencies through comparative examination, the government should set transparent and objective standards and **introduce absolute assessment**.



(7) Frequency reorganization initiative

- The government should **promote dynamic frequency sharing between different systems, frequency migration and reorganization for existing wireless systems systematically and steadily**, while considering their impacts on existing wireless system licensees and users.

(8) Frequency allocation based on economic values of frequencies

- The government should steadily operate **the specified base station establishment fee system** applied from April 2021 and **securely verify the status of operations** including assessment measures.
- The government should **continue to consider a spectrum auction system**, while checking recent cases and trends in foreign countries and the advantages and disadvantages of the system. In considering the system, the government should conduct specific and comprehensive studies on cases including **foreign countries' responses to disadvantages of the auction system**.

3. Policy for effective utilization of publicly-owned frequencies

(1) Verifying publicly-owned frequency use

- The government should **check the directions** of effective frequency use measures for government-operated public service radio stations, including **abolition, frequency migration, frequency sharing and digitalization**.
- Through this process, **the ~1,200 MHz bandwidth** for which demand has arisen in other areas than public services **would be made available** for 5G mobile phone, wireless LAN and other services.
- Relevant government agencies follow:
Cabinet Office; National Police Agency; Fire and Disaster Management Agency; Ministry of Agriculture, Forestry and Fisheries; Ministry of Economy, Trade and Industry; Ministry of Land, Infrastructure, Transport and Tourism; Japan Meteorological Agency; Japan Coast Guard; Ministry of Defense

(2) Promoting consideration on digitalization of public service radio stations, etc.

- The government should **consider technological conditions for digitalization and other common measures** available for analog systems and **comprehensively and promptly verify and assess the feasibility of replacing** those public service radio stations with PS-LTE and other shared systems or other existing systems.

Summary overview of interviews with relevant government agencies

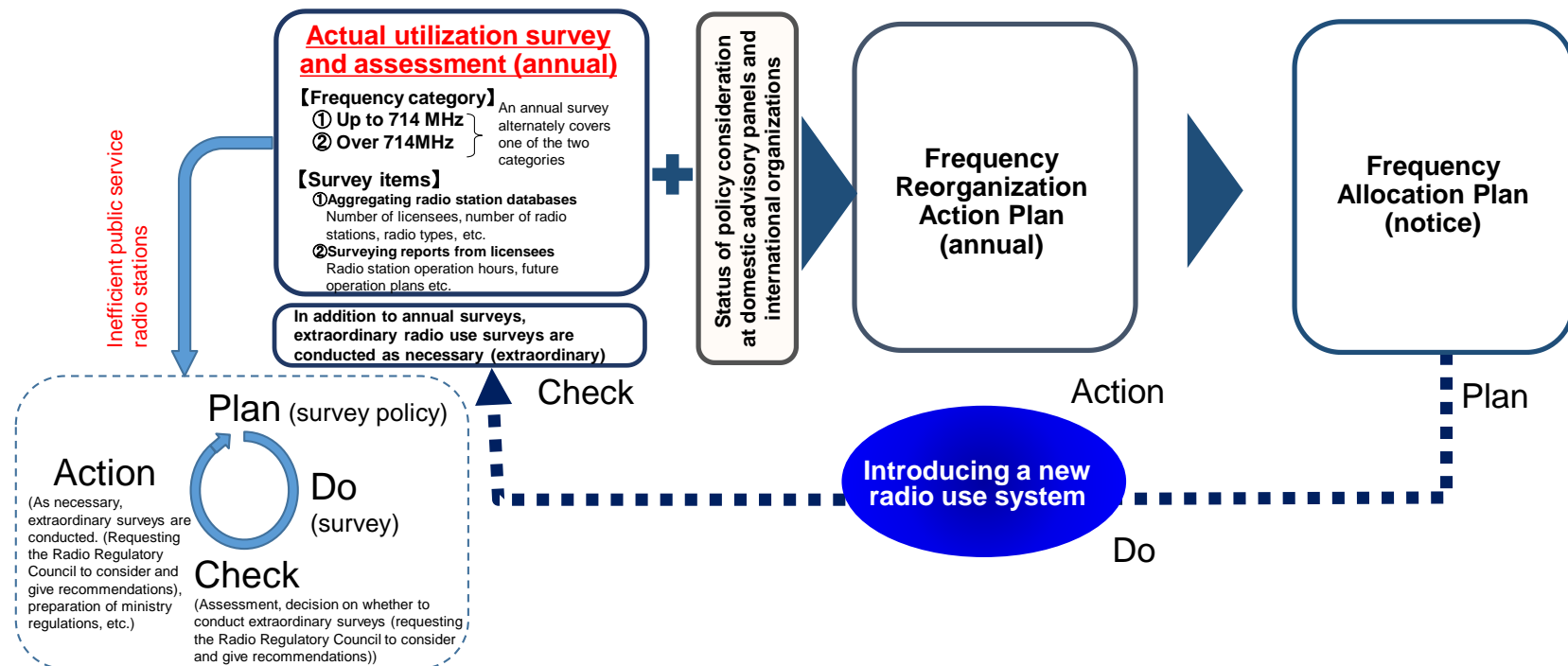
Category	Systems	Future direction
Systems for which demand has arisen in other areas than public services	① 1.2 GHz band mobile image transmission systems	◎ Abolition
	② 5 GHz wireless access systems	◎ Abolition
	③ Weather radar (C band)	○ Frequency sharing
	④ 6.5 GHz band fixed microwave systems	○ Frequency sharing
	⑤ Portable television systems	◎ Abolition
	⑥ 40 GHz band fixed microwave systems	◎ Frequency migration
	⑦ 38 GHz band FWA	○ Frequency sharing
	⑧ Unpublished system A	◎ Frequency migration
	⑨ Unpublished system B	○ Frequency sharing
Analog systems	① Highway advisory information systems	○ Digitalization (Abolition for 1 agency)
	② 60 MHz band telemeters	◎ Abolition
	③ Telemeters	○ Digitalization
	④ Flood prevention systems	○ Digitalization
	⑤ Mobile radio systems for dam and sediment control	○ Digitalization
	⑥ Road flood control systems	◎ Abolition
	⑦ 150 MHz central disaster prevention systems	○ Digitalization
	⑧ Local communication systems (for disaster communications)	○ Digitalization
	⑨ Meteorological service voice communication systems	○ Digitalization
	⑩ Oil reserve systems	○ Digitalization
	⑪ 150 MHz band disaster communication systems	○ Digitalization (Abolition for 1 agency)
	⑫ 400 MHz band link circuit (for road flood control)	◎ Abolition
	⑬ 150 MHz central disaster prevention systems	○ Digitalization
	⑭ Helicopter communication systems	○ Digitalization (Abolition for 2 agencies)
	⑮ Meteorological radio robots	○ Digitalization
	⑯ Helicopter telecommunications systems	○ Digitalization (Abolition for 1 agency)
	⑰ MCA system (K-COSMOS)	◎ Abolition
	⑱⑲⑳㉑㉒ Unpublished systems C/D/E/F/G	○ Digitalization

3. Policy for effective utilization of publicly-owned frequencies

(3) Implementing continuous assessment through the survey of actual radio spectrum utilization

- The government should **continuously follow up on** the progress in initiatives given in (2) and consideration on frequency sharing regarding systems subjected to the interviews and **develop a PDCA (plan-do-check-action) cycle to continuously assess** public service radio stations in line with the introduction of a system for collecting spectrum user fees from public service radio stations.

Frequency reorganization cycle



(4) Initiatives for more effective use of publicly-owned frequencies

- The government should tackle **the advancement and standardization of internationally common systems** including those for aircraft and ships and encourage **local governments as licensees for public service radio stations to promote the advancement and standardization of these stations.**

(1) Easing terminal licensing procedures

- While the system to license each business operator to use mobile phone terminals is maintained, the Ministry of Internal Affairs and Communications should **consider how licensing procedures could be eased.**

(2) Digitalization of licensing procedures and renewal of Productive and Reliable Telecommunications Network for Radio Stations (PARTNER)

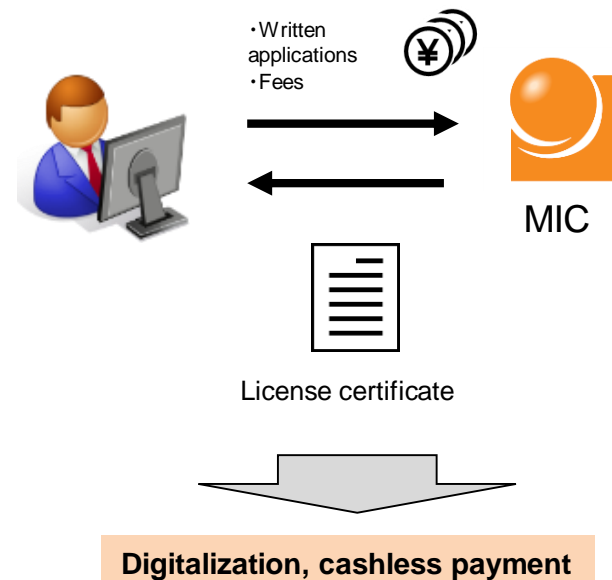
- In the age of digital transformation, the government **should promote the further digitalization of radio station licensing procedures, the digitalization of license certificates and the cashless payment of license application and other fees,** while considering user needs, cost-effectiveness, etc.

(3) Preventing the distribution of wireless devices that do not conform with technical regulations

- The government should take strict measures based on recommendation and order systems after the revision of the Radio Act and urge mobile network operators and internet shopping mall operators to **implement proactive initiatives based on guidelines** as they are obliged to make best efforts to do so.
- The government should also **continue to follow up** on those business operators in a timely manner and consider **the scope of best effort obligations** and additional regulations under the Radio Act **in anticipation of thorough institutional reforms.**

(4) Monitoring newly used radio waves such as millimeter waves

- The government should **establish radio wave monitoring methods** meeting **the characteristics of 5G network radio waves** (including high frequency waves). Given that propagation distances for 5G frequency bands are shorter, the government should **develop radio wave monitoring arrangements centering on mobile monitoring** suitable for searching for jamming sources.

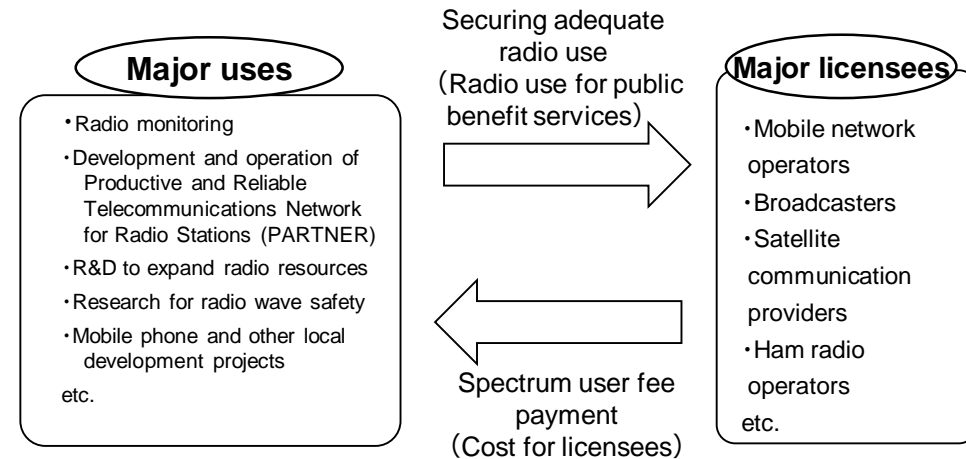


5. Revision of the spectrum user fee system

(1) Overview of the spectrum user fee system

- Under the Radio Act, **the spectrum user fee system is reviewed at least every three years*** and measures are taken based on the results of the review when deemed necessary.

*The current spectrum user fees have been implemented since FY2019. In FY2022, three years will pass from the latest review.



(2) Use of the spectrum user fee revenue

- Basically, spectrum user fee revenue should be used steadily in line with the current administrative work for spectrum users' common benefit.**
- However, an effective industry-academia-government collaboration mechanism is required to use spectrum user fee revenue for **supporting Beyond 5G R&D and relevant organizations' R&D projects efficiently.**
- While some roundtable members called for using and expanding spectrum user fee revenue proactively, others noted that the government should refrain from expanding the fees unreasonably and try to ease the burden on licensees. **Therefore, the total expenses for spectrum users' common benefit** (total spectrum user fee revenue) should be **maintained at the current level (75 billion yen).**

(3) Calculation of the spectrum user fee

- The current **calculation framework of the spectrum user fee should be maintained** for the calculation for the next period (assumed for FY2022-2024).
- The government should consider easing the procedures related to spectrum user fee payment (through such measures as the modification of procedures for monthly reports on the number of terminals).