Advances in Information and Communication Research 1

Hitoshi Mitomo *Editor*

Telecommunications Policies of Japan

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Advances in Information and Communication Research

Volume 1

Series Editor

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This book series focuses on socioeconomic aspects of information and communication. Information and communication technology (ICT) is now indispensable as an infrastructure supporting the advancement of society. ICT has benefited modern civilization, and its influence has spread over numerous aspects of our life and economy. Along with technological progress, much has happened in this arena, with new developments continuing at a rapid pace.

Constructive use of ICT makes our society more efficient. On the other hand, however, inappropriate use of ICT causes serious social problems that have not been experienced until now. In such a rapidly changing area, our attention tends to be drawn to superficial phenomena rather than gaining deep insight into them. In order to understand the role of ICT in modern life, social science is essential for capturing the impact of the development of networks and the advancement of information and communication services and applications. Social sciences shed light on a variety of issues and provide a framework for promoting the utilization of ICT while avoiding the potential drawbacks.

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Preface

Information and Communication Technology (ICT) is indispensable as a facet of infrastructure supporting the advancement of the society. The modern society has benefitted from ICT, and its influence has spread over various aspects of our lives and economies. Although the market is almost fully privatized, the role of governmental policy is still extremely important for promoting the diffusion of the network, information services, and applications and to enhance the impact of the development since our society is becoming more and more reliant on ICT. ICT policies seek to enhance the telecommunications market, to protect users and thus contribute to making life and society bright and prosperous.

Japan has been one of the leading countries with regard to the deployment of ICT. In addition to technological advances, there has been rapid development of a nation-wide infrastructure of optical fiber and advanced mobile networks. ICT has boosted the economy and sustained society. For ICT deployment, the Ministry of Internal Affairs and Communications (MIC) of Japan has played an important role. Japan has a unique policy framework for ICT in that regulation and promotion have not been separated, unlike many other countries which have an independent regulator.

What is more, telecommunication policies that have been applied in many other countries have not been adopted in this country. For example, spectrum auctions have not been introduced yet. This was often criticized, especially from an economic point of view. However, it is now perceived that spectrum auctions are not the best thing for the advancement of new technology such as 5G. Japan, of course, has learned a lot from the policies of the USA and other advanced countries. In addition, Japan's unique ICT policies have affected the design and formulation of ICT policies in many other countries in various forms. However, since relatively little information has been provided in English, it seems difficult to know so much about these policies.

This book aims to provide a full description of the telecommunications policies of Japan. This is the first collaborative work on providing comprehensive commentaries on the ICT policies of Japan, with contributions by specialists from MIC, industry, and academia, dedicated to the understanding of Japanese telecommunications

policies. It discusses how Japan has addressed a variety of policy challenges ranging from traditional regulatory issues such as the provision of universal service to the latest tasks such as the promotion of the use of cutting-edge technologies, such as 5G, the Internet of things, and Artificial Intelligence. The fourteen chapters of this book reflect the major challenges of how Japan has tackled issues endemic in its telecommunication market.

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Basic ICT Policies

Basic Facts of Japan's Telecommunications Policy

Hideo Tomioka

1 Introduction

Japan's present telecommunications policy took off in earnest with the 1985 liberalization of the telecommunications business. The outcome of this policy has been the competition-fueled invigoration of the telecommunications market, which has spurred the innovation of many and varied services at low prices. In particular, Japan's policy measures created the conditions for the world's most affordable services as regards fixed-line high-speed broadband.

This chapter provides a chronological account of the policy measures beginning with the liberalization that opened the market to new entrants, the later establishment of interconnection rules to ensure fair competition conditions, and the structural measures placed on NTT. This chapter is also intended to give a 360° view of Japan's regulatory framework on telecommunications.

It also briefly discusses the distinctions of Japan's telecommunications policy, which goes beyond mere competition policy implemented by a telecommunications regulatory agency. Japan's telecommunications policy extends to the establishment of strategies on Information and Communication Technology (ICT) by the entire government as well as a policy mix of regulation and promotion.

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2 The Beginnings of the Telecommunications Business in Japan and Its Liberalization

2.1 Start of the Telecommunications Business Through a State-Run Monopoly

The telegraph machine was introduced to Japan in 1854 when US Commodore Perry, who presented it to the Tokugawa shogunate on his second visit to Japan. A public telegram service commenced in 1869, followed by telephone exchange operations in 1876. Both businesses began as state-run monopolies.

This monopolistic management framework over the telecommunications business was maintained in light of the public nature and natural monopoly of the telecommunications business. Another intention was to ensure technical uniformity throughout the country. Particular importance was attached to the view that the telecommunications business was a natural monopoly. Providing telecommunication services via a monopolistic framework was determined to be the best course, because of the social–economic inefficiency of building out multiple networks in the same region, the higher service rates that would be incurred, and the potential for competitors in the telecommunications business to essentially bankrupt each other due to the massive capital investments required.

The telecommunications business continued in this form even after the Second World War until 1952. The Nippon Telegraph and Telephone Public Corporation (hereinafter referred to as NTT PC) was set up that year as a public corporation, i.e., NTT PC assumed the structure of a company that was fully financed by the government. At the same time, the Ministry of Posts and Telecommunications (hereinafter referred to as MPT) undertook the supervision of NTT PC. This policy was adopted on the thinking that providing a degree of managerial independence to NTT PC would encourage efficient management of network expansion while remaining true to the nature of the telecommunications business, as described above (Ministry of Internal Affairs and Communications, hereinafter referred to as MIC 2015).

2.2 Liberalization of the Telecommunications Business

The state-run monopoly of the telecommunications business underwent radical revisions over its almost 100 years of existence. Data communications, emerging through the convergence of computers and telecommunications, were liberalized in stages from the 1970s to the mid-1980s. The telecommunications business proper was fully liberalized in 1985. Liberalization came about specifically with the reorganization of the NTT PC into an incorporated company named the Nippon Telegraph and Telephone Corporation (hereinafter referred to as NTT). The reorganization

was followed by the repeal of the Public Telecommunications Act, which had regulated the telecommunications business operated by NTT PC, and the enactment of the new Telecommunications Business Act. With these legislative moves, the telecommunications business was thrown open to the entry of competitive carriers.

Three central factors contributed to telecommunications business liberalization. First was the erosion of the telecommunications business's natural monopoly, as new technologies became viable, such as optical fiber connections and microwave-frequency connections. The second factor was the advancement and diversification of consumer needs from telecommunication services, which came in tandem with the increasing sophistication of telecommunications technology. These higher consumer demands fueled expectations for the establishment of frameworks permitting the fast and flexible accommodation of their demands. The third factor was that, while NTT PC had achieved its management goal of network and facility expansion, a key policy of the government at the time was streamlining the public sector—and this included the privatization of public corporations. Prime Minister Yasuhiro Nakasone's Cabinet put particular emphasis on carrying out this last point. The Second Extraordinary Administrative Research Council, set up by the government, carried out an examination how to execute this policy (MIC 2015).

The Telecommunications Business Act eliminated former provisions based on the assumption that a designated carrier would provide monopolistic services. In their place, the Act ushered in the principle of competition and introduced a system allowing the provision of more diverse services in order to flexibly accommodate future telecommunication advances. These services would be provided through competition between NTT and new entrants under MPT supervision. The Act defined two telecom operator categories—Type I and Type II—depending on whether or not the carrier owned telecommunications circuit facilities. A permission system applied to Type I carrier entrants, and an authorization system also applied to their primary fee rates. Conversely, Type II carriers could enter the market by either registration or notification, and they faced no ex ante fee regulations.

2.3 The Outcomes of Liberalization

After liberalization, the first new carriers entered the long-distance and international communications markets. In the long-distance communications market, DDI Corporation, affiliated with the Kyocera Group, provided services using microwave communications; Japan Telecom, affiliated with the Japan National Railways Group, utilized optical fiber along rail lines to offer services; the Teleway Corporation, affiliated with the Japan Highway Public Corporation Group, delivered services with optical fiber laid along the medians of expressways. The Teleway Corporation and International Digital Communication entered the international communications market, in which KDD had been assured a monopoly.

From 1988 onward, competitors also began entering the mobile communications market, which NTT PC had launched with the first car-phone services in 1979. The

reduction of handset sizes and other technological advances drove the expansion of mobile phone services.

The new entrants had significant impacts. In the long-distance communications market, for example, the price of a telephone call between Tokyo and Osaka plunged to nearly one-fifth of the pre-liberalization price. Effects were seen in the international communications market too. Japan's international telephone rates had declined to relatively low levels, compared with global prices, by around 1990. Liberalization not only lowered communication fees, but also ushered in various discount services, such as late-night discounts and holiday discounts (MIC 2015).

3 Development of Competition Policy

The MPT did more than just permitting new entrants into the telecommunications business. The Ministry put in place a number of measures, outlined below, to actively encourage competition in the sector. Through these measures, the Ministry established conditions for fair and effective competition.

3.1 Establishment of Interconnection Rules

After telecommunications business liberalization in 1985, the first systems assumed telecom operators would negotiate network interconnections among themselves. On many occasions, however, these negotiations did not go smoothly. Therefore, a new focus of competition policy was enacting rules governing network interconnections.

Measures were taken in 1990 to facilitate interconnections between NTT and competing carriers and to ensure the openness of NTT's networks, but the measures had only limited results. Because of this setback, the Telecommunications Business Act was amended in 1997 to legally oblige Type I carriers—i.e., telecom operators that had set up their own telecommunications circuit facilities—to comply with interconnection requests from other carriers. The amendment also established a system to ensure the fairness and transparency of interconnection charges and interconnection terms and conditions for NTT's "bottleneck" facilities including its subscriber lines. The system worked by requiring NTT to prepare interconnection tariffs concerning interconnections to its bottleneck facilities and obtain the authorization of the MPT. The system further required NTT to break out accounting figures on interconnections to its bottleneck facilities and publicly report the financial state, including incomes and expenditures, pertaining to these interconnections. This series of requirements forced NTT to account for internal interconnections within NTT in the same way as when competitors interconnect with NTT's bottleneck facilities. This new visibility made it possible to monitor for internal cross-subsidization within NTT.

The system created with the 1997 amendment calculated interconnection charges based on actual incurred costs. Interconnection charges did gradually fall due to the

system's introduction, but some limitations remained, such as information asymmetry and the persisting inefficiencies at the incumbent carrier. Consequently, the Telecommunications Business Act was amended in 2000 to adopt long-run incremental cost calculation methods for some interconnection charges.

3.2 Measures Related to NTT's Organization

Discussions and examinations about structural regulations on NTT were going on in parallel with behavioral regulations on the interconnection described above. One particular point of contention for competition policy was how to deal with NTT's organization, which owned bottleneck facilities and thus housed both monopolistic and competitive divisions.

The Second Extraordinary Administrative Research Council, mentioned previously, tasked with signaling a direction for telecommunications business liberalization had recommended that NTT PC be split into separate companies when privatized. NTT, however, ended up being inaugurated as a single company, while examinations into its division continued.

Over this time, NTT spun off its mobile communications arm, NTT Docomo, in 1992, and the company introduced and enforced an internal framework separated into an operational division for long-distance communications and divisions for separate regions. Ultimately, a principle on NTT reorganization was decided in 1996 (MPT 1996) and executed through legal amendments in 1999. The content of the principle was as follows:

1. NTT would be reorganized under a holding company into a long-distance communications company (NTT Communications) and two regional communications companies (NTT East and NTT West, hereinafter collectively referred to as NTT East and West).
2. The holding company would hold all shares of the regional communications companies and would be given special legal status as a company promoting basic research. The holding company would hold all shares of the long-distance communications company.
3. The regional communications companies would be set up as companies with special legal status to handle essentially all intra-prefectural communications and would be made responsible for guaranteeing universal telephone services within their respective territories.
4. The long-distance communications company would be set up as a private company to handle, in general, inter-prefectural communications and would be permitted to newly enter the international communications market.

With this reorganization, NTT East and West essentially only provided intra-prefectural communication services. These service restrictions were partially eased later with a 2001 legal amendment, due to the rise of the Internet, which had no intra-prefectural and inter-prefectural distinctions. The restrictions were relaxed to enable

the provision of new services—namely diverse and inexpensive Internet-based services—in response to the growing technical possibilities driven by technological innovation. These services were hoped to combat high-cost structures and bolster user convenience. The 2001 legal amendment allowed NTT East and West to provide services that crossed prefectural borders on the condition that they received authorizations from MIC, which was formed out of the MPT during the 2001 reorganization of the government's ministries and agencies.

Prior to granting such authorization, the MIC would first investigate the degree of concern that operating the new service would impair the guarantee of fair competition. Next, the Ministry would investigate whether adequate and effective measures would be in place to offset the degree of concern. Finally, the Ministry would confirm whether operating the new service fell within a scope that would not impair the guarantee of fair competition. Each of these judgments would follow specific criteria given in a guideline. The criteria are summarized below.

First, in investigating the degree of concern that operating the new service would impair the guarantee of fair competition, the Ministry weighed the progress of competition in the regional communications market and the relevance between the new service and bottleneck facilities. In addition to these factors, from 2007 onward, the Ministry also weighed the existence of any collaborations with another market-dominant telecom operator.

Next, the measures to offset the degree of concern that NTT East and West had to take were (i) network openness; (ii) disclosure of network information; (iii) assurance of equality of access to essential information; (iv) firewalls on the marketing side; (v) prevention of inappropriate internal cross-subsidization; (vi) impartial treatment of related carriers; and (vii) reports on the status of measures (i) through (vi) (MIC 2011).

This regulatory system was first introduced as an authorization system. The authorization system was later downgraded to a prior notification system with a 2011 legal amendment, which also mandated that NTT East and West erect firewalls between their facilities divisions and marketing divisions. This move is described in the next section.

3.3 Introduction of an Asymmetric Regulatory Framework

The first inklings of an asymmetric regulatory framework were seen in the 1997 legal amendment described above. This amendment applied special regulations on interconnections specifically to NTT (and, later, to NTT East and West in 1999 and beyond), which owned bottleneck facilities. To further shore up conditions for fair competition, the 2001 legislation expressly prohibited anticompetitive acts by market-dominant telecom operators. The designation of NTT East and West and NTT Docomo as market-dominant telecom operators made it clear that the government was pursuing a competition policy founded on asymmetric regulations.

The initial prohibitions on market-dominant telecom operators were as follows:

1. use or provision, beyond agreed to purposes, of information acquired by the carrier pertaining to interconnection operations by other carriers;
2. inappropriate preferential or unfavorable treatment of a specific telecom operator; and
3. inappropriate rules on or interference with the operations of other telecom operators or the operations of equipment manufacturers or dealers.

The 2001 legislation also imposed on NTT East and West a ban on sharing executive officers concurrently with NTT Communications. It also prohibited treating other telecom operators unfavorably and compared to the treatment of NTT Communications, when accepting operations outsourced from other telecom operators.

Regulations on market-dominant carriers were later revised as needed to address market environment changes. For example, as Fiber to the Home (FTTH) services became the primary form of fixed-line communication services, the 2011 legal amendment mandated that NTT East and West erect firewalls between their facilities divisions and marketing divisions. This obligation was dictated to assure continued equivalence between NTT East and West and other telecom operators that provided FTTH services. In addition, as global companies gained strength and influence in communication devices and platforms, a 2015 legal amendment exempted NTT Docomo from the third prohibition given above (MIC 2014).

3.4 Relaxing of Fee Controls

An authorization system initially applied to the fees of all communication services provided by Type I carriers, but the regulations were later relaxed step by step.

The authorization system migrated to a prior notification system in 1995 regarding fees for mobile phone and other mobile communications services. The prior notification system was introduced for mobile communications services before other communication services. The switch was predicated on the fact that a considerable number of mobile carriers had already entered each region—meaning the market was breaking away from the previous de facto monopoly/oligopoly situation. The prior notification system was also intended to encourage the swift provision of diverse mobile services and further competition. As a result, fees did come down and services diversified.

Later, as competition expanded, a 1998 legal amendment replaced the authorization system with a prior notification system regarding all fees for services provided by Type I carriers, in principle. The reasoning was to encourage carriers to actively expand their businesses and to enable carriers to dynamically address the increasingly sophisticated and diverse needs of users. The upshot was the prior notification system now covered fees for long-distance and international calls and other services, in addition to mobile communication service fees.

At the same time, NTT East and West owned the majority of facilities that provided intra-prefectural communications services. This made it difficult for other telecom operators to supply adequate alternative services. Therefore, a price cap on these service fees was introduced and went into operation in 2000. The intention was to effect fee reductions to the same degree as if market mechanisms were in play, while giving NTT East and West incentives to pursue further business efficiencies.

3.5 Establishment of Universal Service Rules

With the liberalization of the telecommunications business, NTT, and, later, post-reorganization NTT East and West, was legally obliged to provide universal telephone services. The mechanism that ensured universal services had initially been maintained by offsetting losses in rural regions with profits from urban and other profitable regions within NTT (and, later, post-reorganization NTT East and West). But as competition marched into regional communications markets, it became increasingly difficult for profitable regions to subsidize nonprofitable regions (MPT 2000a).

Given this predicament, the 2001 Telecommunications Business Act amendment introduced a universal service fund, which actually started operating in 2006. The universal service fund worked by having other telecom operators contribute part of the expenses incurred by NTT East and West in ensuring universal services.

Telecom operators that interconnected with NTT East and West networks contribute funds commensurate with the number of telephone numbers they use. The funds compensate part of the losses NTT East and West incur in providing universal services.

The following services fall under the universal service scope:

- subscription telephone services (basic fees);
- optical Internet Protocol (IP) telephone services equivalent to subscription telephone services;
- pay telephones installed in accordance with MIC standards; and
- emergency calls (calls to 110, 118, and 119).

3.6 Establishment of Rules on Telecommunications Numbers

Telephone numbers and other telecommunications numbers were initially regarded as a technical matter connected to telecommunications networks. With the onset of competition, awareness grew that telecommunications numbers were actually a component of competition policy. This led to the establishment of rules on telecommunications numbers.

The original fixed-line telephone number system in 1936 consisted of segments of digits established by NTT PC that denoted its fee segments at the time (MPT

2000b). Even after NTT PC became NTT and competition was introduced to the telecommunications business in 1985, NTT continued to essentially manage the telephone number system on its own. The MPT did designate telecommunications numbers for individual services, from the need for telecom operators to interconnect, as part of the technical standards on telecommunications facilities based on the Telecommunications Business Act.

With the influx of many new telecom operators and the diversification of services, however, the role required of telephone numbers and other telecommunications numbers came to be seen as increasingly important from the standpoint of ensuring fair competition among carriers. Based on this recognition, the 1997 Telecommunications Business Act amendment set out rules on telecommunications numbers for the first time. In short, the amended Act and ministerial ordinances based on the Act stipulated the establishment of a plan for telecommunications numbers, the obligation to be in conformance with telecommunications number standards, and the procedures pertaining to the designation of telecommunications numbers.

Number portability was one key measure taken in the interest of ensuring fair competition conditions and user convenience. Prior to the institution of number portability, when a user went to change telecom operators, the user's telephone number would inevitably change too. This lack of portability meant the user had to go through the considerable trouble of notifying others about the number change. This constituted a barrier to users changing contracts to other telecom operators. In light of this situation, the MIC introduced number portability for fixed-line telephones in 2001. Number portability let users keep their existing telephone number even after switching telecom operators. Number portability was extended to include mobile phone numbers in 2006.

Another measure, though more concerned with interconnections than the system of telecommunications numbers, worth mentioning was the assurance of dialing parity. Prior to the measure being implemented, to place a long-distance call provided by a new entrant, a user had to dial a four-digit carrier identification number before entering the other party's telephone number. On the other hand, the user could use NTT Communications' long-distance service without dialing a carrier identification number. To resolve this inequality, a priority connection function was launched in 2001. This function allowed users to register their carrier of choice and then place long-distance calls without dialing the carrier identification number.

A slate of later measures has been taken with regard to telecommunications numbers to address technical advances, service diversification, and market conditions. Two of these were the designation of telephone numbers to handle the expansion of mobile phone services and the emergence of IP telephony and M2 M services, and the handling of telecommunications numbers designated by the MIC but never used.

3.7 Establishment of the Unbundling System for Broadband

When providing high-speed Internet access services, particularly Digital Subscriber Line (DSL) services, became feasible, an important theme for competition policy was opening up metal subscriber lines owned by NTT East and West.

Rules were put in place in 2000 concerning the unbundling of NTT East and West metal subscriber lines and the collocation of competitor's DSL equipment in NTT East and West buildings. One key feature of the unbundling system is that it keeps the interconnection fees competitors pay to NTT East and West when providing DSL services to some of the lowest levels compared to other countries. This has enabled competitors to provide services at inexpensive prices. Since the implementation of the unbundling system, subscriber numbers to DSL services have exploded, particularly to those provided by competitors; whereas, NTT East and West's share of the market has tumbled to about one-third.

This sort of competition policy in relation to DSL services, and the robust competition among carriers carried out on the assumption of the competition policy, has contributed greatly to the growth of DSL services. It has also spurred the migration to FTTH by NTT East and West and helped make Japan's fixed-line broadband environment the world's cheapest and fastest.

3.8 System Amendments to Address IP Expansion

Along with the rapid build-out of DSL and FTTH, IP expansion became a clear trend in the telecommunications market. The advance of IP was seen as a disrupter of network and market structures. Its progress was also viewed as a force that would create multiple focal points for competition—drawing out more innovation and ingenuity from telecom operators—even in the systems that regulate the telecommunications business. Facilitating IP development necessitated lower regulatory levels across the board (MIC 2002a).

In light of this situation, the 2003 Telecommunications Business Act amendment abolished the Type I and Type II carrier categories and further eased market entry controls. In particular, the permission system that had applied to past Type I carriers was repealed. The permission system was replaced with a registration system that applied only when establishing telecommunications circuit facilities on a large scale. A notification system covered all other matters.

Previously, Type I carriers had been granted public utility privileges, which simplified the construction of infrastructure along roadways and on other people's land. But with the end of the Type I and Type II carrier categories, as given above, the MIC started a system that accepted and approved applications for public utility privileges from telecom operators on a case-by-case basis. Prior to giving approval, the MIC investigates whether the telecom operator has the sufficient financial footing and technical competency to execute the operations appropriately and reviews whether the operation plans are sound and rational.

The 2003 amendment annulled most prior fee controls, except for fees for services essential for citizens' livelihoods.

In this way, the government greatly deregulated the industry, apart from regulations on bottleneck facilities and unfair use of market dominance, to further stimulate competition and enable the rapid rollout of services. At the same time, consumer protection rules were instituted to guard the interests of users. Specifically, the MIC imposed accountability obligations on telecom operators and their agents with respect to fees and other conditions on the provision of communication services connected to the daily lives of the citizenry.

The MIC has continued to erect and revise rules, beginning with Telecommunications Business Act amendments, as a means of dealing with market environment changes while maintaining the basic framework discussed so far. One instance was the Telecommunications Business Act's lack, at the time, of a mechanism to monitor mergers and other business combinations from the standpoint of competition policy, as the main telecom operators consolidated and formed an oligopoly of three major groups (MIC 2014). As a result, the Act was amended in 2015 to usher in a system obliging carriers to update their registrations before mergers or stock acquisitions between mobile carriers and other large carriers. The system allows the MIC to review the impact on business operations and fair competition.

4 Addressing the Growth of Mobile Communications

Telecommunications policy since 1985s liberalization has primarily focused on coping with issues surrounding NTT's possession of bottleneck facilities in the fixed-line communications field. Nevertheless, another policy focus that has arisen has been the issues surrounding the mobile communications field, as mobile communications have grown in parallel with the move to IP networks.

This section looks at the matters the MPT/MIC has tackled, primarily within the framework of the Telecommunications Business Act. Matters concerning the Radio Act framework, including frequency allocations, will be dealt with in a separate chapter.

4.1 Formation and Growth of the Mobile Market

As described earlier, NTT was the sole provider in the mobile communications field even after liberalization of the telecommunications business. Competition, however, took off in 1988 with the entry of new carriers. The new carriers' impact was immediate: over 100 percent growth, year on year, in subscriptions to mobile communication services in 1989. The growth rate cooled in subsequent years, to 77.2% in 1990, 58.5 percent in 1991, 24.5% in 1992, and 24.4% in 1993 (MIC 2015).

The biggest growth driver in the mobile phone market was the introduction of the purchase-to-own handset system. Prior to 1985s telecommunications business liberalization, users could only rent phone handsets from NTT PC. After liberalization, users were permitted to purchase and own fixed-line telephones. This development prompted many manufacturers to sell a wider and more diverse range of telephone handsets. Mobile handsets and car-phone handsets, on the other hand, were only available as rentals from telecom operators until 1993.

But given the remarkable advances in telecommunications technology, along with the emergence of many different inexpensive handsets, observers expected the market to expand if competition principles were introduced in this field. Furthermore, introducing a purchase-to-own system for mobile handsets was expected to bring huge benefits to users such as cheaper basic monthly fees for mobile and car-phone services, and competition-driven mobile device innovations—making them smaller, more affordable, and available in more varieties.

For these reasons, a purchase-to-own system for mobile handsets was implemented in 1994, which caused subscription numbers to mobile devices and car phones to skyrocket. Mobile phone services added around 10 million subscriptions a year from 1996 through to 2002. In the 2000s, mobile phone service subscriptions surpassed those of fixed-line phone services, making mobile the leading voice service. And in 1999, NTT Docomo launched i-mode, which kicked off full-fledged services enabling access to a multitude of dedicated mobile phone Web sites. These services continued to drive up mobile phone subscriber numbers. So much so that by the end of 2005, more people were using the Internet from mobile devices than from personal computers (MIC 2015).

4.2 Market Stimulation Centered on Promoting the Entry and Business Expansion of MVNOs

The mobile market was starting to mature in the early 2000s, as mobile phone subscribers had topped 80 million and growth rates had tapered off. The MIC, therefore, sought out policy measures to stimulate the mobile market. One key policy measure the Ministry focused on was encouraging the entry and business expansion of Mobile Virtual Network Operators (MVNOs) (MIC 2015).

The MIC began by setting out guidelines that organized the legal interpretations pertaining to the creation of MVNO businesses. The Ministry also clarified that mobile network operators (MNOs) were obliged to comply with facility interconnection requests from MVNOs (MIC 2002b).

Next, after introducing a system mandating MNOs to maintain separate accounting records for facility interconnections, the Ministry established rules on interconnection fee calculations and put in place a system for opening up MNOs' facilities based on the unbundling concept.

Other policy measures taken to stimulate the overall mobile market were number portability for mobile services instituted in 2006, as described earlier, and the enactment of rules on subscriber identity module (SIM) card unlocking.

SIM locks are a mechanism mobile carriers implement on devices they sell that prevent the insertion and use of SIM cards from other carriers. Such mechanisms not only handicapped user convenience, they also were a factor in curbing competition, as they increased the cost to switch to another carrier's service.

SIM locks were somewhat justified initially, as there were significant differences in specifications among mobile carriers, such as transmission methods, frequencies used, and platforms. But with changes to the mobile communications market environment—namely the widespread adoption of Long-Term Evolution (LTE) and smartphones—carrier specifications essentially converged on a single standard.

If carriers could continue to refuse user requests to disable SIM locks on their mobile devices without a valid reason, it was feared the sound development of telecommunications and the interests of users would be harmed. In view of the situation, the MIC in 2014 signaled that it would make such behavior by carriers the subject of business improvement orders. This had a strong persuasive effect on mobile carriers to make efforts to unlock SIM cards (MIC 2017).

5 Japanese Government's Overall ICT Strategy

As shown so far, the MPT/MIC, as the telecommunications regulator, has led the development and expansion of competition policy in the telecommunications field. The government as a whole, however, has also put a high priority on policy development in the information and communications field.

At the start of the 2000s, ICT was transforming industrial and social structures on a global scale. Since strategic and focused engagement with ICT presented a pressing challenge for Japan as a whole, the government set up the IT Strategic Headquarters, chaired by the Prime Minister and including all Cabinet ministers. The IT Strategic Headquarters formulated the e-Japan Strategy, which declared the government's aim to transform Japan into the world's leading IT nation within five years.

The e-Japan Strategy set out four priority policy fields: (i) ultra-high-speed network infrastructure establishment and competition policy; (ii) e-commerce; (iii) realizing e-government; and (iv) bolstering training of ICT technicians and experts. Regarding policy (i) above, the document sets the target of realizing within five years an environment in which no less than 30 million households would have continuous access to high-speed Internet networks and 10 million households would have continuous access to ultra-high-speed Internet networks. This target was met in under five years, thanks to the MIC's efforts in competition policy and other areas described above.

After witnessing the e-Japan Strategy's success, especially in promoting robust infrastructure build-out, the IT Strategic Headquarters revamped the e-Japan Strategy in 2003 and made a big swing in its strategy focus from infrastructure establishment to

promoting ICT use and application. At the same time, ubiquitous network formation was positioned as a new target vision.

In response to the change in strategic tack, the MIC drew up a vision of the future in which a ubiquitous network society (u-Japan) would be realized by around 2010. u-Japan would give everyone and everything network access at any time from any location, thereby enabling fluid and continuous exchange of information. The Ministry also embarked on a policy, called the u-Japan Policy Package, needed to achieve the u-Japan vision.

The u-Japan Policy Package had three pillars: (i) establishment of ubiquitous networks; (ii) advancement of ICT use and application; and (iii) establishment of ICT usage conditions. The policy also asserted a new target of making Japan a global front-runner in ubiquitous networking by 2010.

The u-Japan concept focused not only on human communications but also on device-to-device communications. In this sense, u-Japan can be commended as paving the way for the Internet of Things, which is now a global phenomenon.

The IT Strategic Headquarters has continued to orchestrate the government's overall ICT efforts, particularly the promotion of ICT use and application in many fields, by devising new ICT strategies as needed and managing their progress. At the same time, the MIC has established and implemented a number of strategies, stemming from the convergence of ICT with other fields and following the rise of new technology and services, such as the Internet of Things, big data, and AI.

6 Development of Promotion Policies

One distinction of Japan's telecommunications policy is its appropriate implementation by coupling certain promotion policies with the competition policy framework described above.

One example of this was the creation for FY 1995 of a special financing system during the initial build-out of optical fiber networks. This system provided very low interest financing to offset the investments made by Type I carriers and cable TV operators in installing optical fiber subscriber networks. Moreover, the MIC prepared subsidy mechanisms for local governments that led the construction of optical fiber networks in regions where networks were unlikely to be constructed through competition among private carriers.

As mentioned above, the government's overall strategy priority in the ICT field has shifted to ICT use and application from the initial goal of infrastructure construction. The MIC has led pilot projects of ICT use and application in fields as disparate as medicine, education, and disaster response. The Ministry, in cooperation with other ministries and agencies, has followed up on these pilot projects with efforts to encourage their commercialization and widespread adoption.

This policy mix of regulations and promotions has enabled the harmonious pursuit and achievement of social and economic objectives in the telecommunications market—such as the elimination of geographic digital divides and the increased user

convenience for citizens in many fields—while ensuring the provision of inexpensive and diverse services through competition.

7 Coping with Negative Aspects of the Internet

As the Internet grew rapidly, its negative aspects also expanded. These negative aspects include harm caused by unauthorized accesses and the circulation of illegal or harmful information.

In response to the rise of these negative aspects, the government enacted several laws to protect users. The first was legislation established in 1999 and entered into force the following year with provisions that prohibited unauthorized accesses and set penalties and other matters. Another piece of legislation was established in 2001 and entered into force the following year that limited the liability of Internet service providers and other companies for damages when information that infringed rights of various kinds was distributed on the Internet or other networks. This law also gave an aggrieved party the right to seek the disclosure of information on individuals who distributed information that infringed rights.

Furthermore, to address the mounting social problem of harm caused by spam, the Act on Regulation of Transmission of Specified Electronic Mail was established in 2002 and entered into force in the same year. And in reaction to a wave of security breaches involving personal information that occurred around 2000, as well as the expansion of e-commerce due to the Internet's growth, the government established the Act on the Protection of Personal Information and all provisions were entered into force in 2005.

These systems and implementation thereof have been revised since their establishment to accommodate technical advances and growth of various services. This, in tandem with regulations to protect users based on the Telecommunications Business Act, is an ever-present theme for telecommunications policy.

8 Conclusion

Since the liberalization of the telecommunications business, the MPT/MIC has dealt with various issues surrounding competition policy while monitoring developments in technology and markets. The Ministry has also tackled issues outside of competition policy, such as promotion policies, user protection policies, and other matters, in a form that addresses the demands of the times, which occasionally have been placed in the government's overall ICT strategy.

The telecommunications field is now considered an important part of the wider ICT field, an ecosystem that consists of upper layers—specifically, content, applications, and platforms. This ecosystem is in the process of transforming into a data-driven one, coupled with the tide of advances in AI and the Internet of Things.

Given this context, the MIC, while recognizing the entirety of this ecosystem within its administrative purview, will continue to seek to execute policies in the telecommunications field, which underpins the ICT ecosystem, that addresses future technological advances and market transformations.

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Broadband Promotion, Elimination of the Digital Divide, and Other Policy Measures in Japan

Takanori Ando

1 Introduction

Access to broadband networks is available in almost every region in Japan, not just large urban centers. This extensive coverage is a result of proactive investments in networks, primarily by the private sector, over more than 30 years since telecommunications were liberalized in 1985. The Ministry of Internal Affairs and Communications (hereinafter referred to as MIC) revisited Japan's progress with broadband in the 2015 White Paper on Information and Communications in Japan.

Japan's broadband infrastructure status, as of March 31, 2017, was as follows. Ultra-high-speed fixed-line broadband networks had a household coverage rate of 99.0%, meaning 570,000 households were without access to ultra-high-speed fixed-line broadband (*Ultra-high-speed fixed-line broadband networks* refers to Fiber to the Home (FTTH)—data communication services intended for households provided over optical fiber, cable TV Internet with (best effort) download speeds of at least 30 Mbps, and Fixed Wireless Access (FWA)—wireless systems that connect telecom operators' central stations or transit lines directly to offices and ordinary households). Even when restricted to just FTTH network access, the household coverage rate was 98.0%, meaning 1.14 million households were without access to FTTH. The coverage rate of ultra-high-speed mobile broadband networks was 99.8%, meaning 250,000 people were without access to ultra-high-speed mobile broadband (*Ultra-high-speed mobile broadband networks* refers to Long-Term Evolution (LTE)—an extension (3.9G) of the third-generation (3G) mobile phone standard that provides faster data communication speeds, and Broadband Wireless Access (BWA)—broadband mobile wireless access systems). When it comes to fixed-line broadband in particular, Japan

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has fostered the conditions to obtain the world's most affordable and fastest services (In a comparison of broadband prices per unit speed (1 Mbps) among OECD countries, Japan had the least expensive prices of all OECD countries.).

Japan's broadband build-out is the result of aggressive, all-out actions, guided by a strategic and cross-governmental promotion framework, that have continued since around 2001—which the 2001 White Paper (2001a) dubs "Broadband Year Zero" (The pioneering conception in 1995 of a special financing system, which offset the investments of Type I carriers and cable TV providers building out optical fiber subscriber networks, had a remarkable impact on later construction of broadband networks.). In the early days of broadband, promoting wider network bandwidths and continuous access was considered the foremost issue for network infrastructure for two reasons: to achieve faster Internet access speeds and to push toward "an advanced ICT networked society."

Broadband's progress, however, passed over certain regions with so-called unfavorable conditions—namely underpopulated areas, remote areas, isolated islands, peninsulas, mountain villages, certain rural areas, and areas subject to heavy snowfalls. Resolving this digital divide gradually increased in importance. Local governments in some areas built optical fiber broadband infrastructure and leased the infrastructure to private carriers through indefeasible right of use (IRU) agreements in order to have broadband services provided. IRU agreements provide long-term stable usage rights that cannot be annulled or voided without the mutual consent of all parties. But these local governments are facing problems when renewing the agreements. Another focus of concern surrounds NTT's plans to fully transition from fixed-line telephone networks to Internet protocol (IP) networks by 2025. Observers question how NTT will move from metal access lines to optical fiber lines.

This chapter provides a chronological summary of the actions taken to facilitate the build-out of broadband infrastructure in Japan, focusing primarily on fixed-line broadband. Most of the chapter will be spent on the government's broadband promotion policy since 2001 and on the efforts to eliminate the digital divide, which has cropped across the country as broadband infrastructure has spread. The chapter will also touch on efforts to promote greater competition among carriers and to spur technological development, systematic steps taken to avoid investment duplications under the universal service system while addressing the migration from fixed-line telephone networks to IP networks, and other related policies.

Unless noted to the contrary, this text uses the terms *broadband* and *ultra-high-speed broadband* as defined in the e-Japan Strategy (formulated by the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (IT Strategic Headquarters in 2001). *Broadband* refers to any Internet network over which music and similar-sized data objects can be downloaded without interruption. *Ultra-high-speed broadband* refers to any Internet network with stable transmission speeds of between roughly 30 and 100 Mbps over which video and similar large data objects can be downloaded without interruption.

2 Construction of the Strategic and Cross-Governmental Promotion Framework and the Course of Broadband Expansion

2.1 An Overview

The broadband build-out in Japan was based on expectations that broadband Internet would serve both as a tool to promote social transformations and as an economic growth engine. Broadband expansion was accomplished and accelerated through a number of factors, including (i) government-wide efforts involving comprehensive goal setting; (ii) a policy mix of competition and stimulus measures taken by the Ministry of Posts and Telecommunications (hereinafter referred to as MPT)/MIC and other individual agencies and ministries; and (iii) competitive expansion by carriers to address market needs.

2.2 Construction of the Strategic and Cross-Governmental Promotion Framework and Goal Setting for Broadband Build-Out

Looking back at 30 years since telecommunications liberalization, the 2015 White Paper (p. 13) offered the following synopsis: "The first Internet connections were mostly dial-up connections that used telephone or ISDN (Integrated Services Digital Network) lines. But later cable TV Internet and DSL (digital subscriber line) connection methods arrived, whose exponentially faster transmission speeds further spurred the popularity of broadband services. The MPT set rules on technical conditions for subscriber-line unbundling and interconnections for DSL in 2000 and for optical fiber in 2001. This prompted the entry of new carriers, such as Yahoo!BB, that provided DSL at low prices starting in 2001. Their entry dramatically lowered broadband rates and pushed up connection speeds. In 2001, Japan led the world in launching FTTH services over optical fiber to ordinary users" (MIC 2015, p. 13).

A strategic and cross-governmental promotion framework was established to keep pace with these developments. What this framework consisted of specifically was the Information and Communications Technology Strategic Headquarters, which was established because "Japan faces the pressing issue of formulating a comprehensive, strategic, and priority initiative in regard to the transformation of industrial and social structures by ICT that is occurring on a global scale in 2000 and 2001 (the IT revolution)." After the finalization of the Basic IT Strategy and the passage of the Basic Act on the Formation of an Advanced Information and Telecommunications Network Society, the IT Strategic Headquarters was formed within the Cabinet, and the e-Japan Strategy and the e-Japan Priority Policy Program were created. The goals that these programs set were "make Japan the world's most advanced IT nation

within five years,", "create an environment that provides always-on connections to high-speed Internet access networks for at least 30 million households and to ultra-high-speed Internet access networks for 10 million households," and "redress discrepancies in access to information caused by geographic factors."

2.3 *Efforts by the Ministry of Internal Affairs and Communications and Carriers in Association with Government-Wide Movements*

The MIC endeavored actively to achieve the goals set for the public and private sectors, as stated in the 2002 White Paper (p. 233): "The MIC (2001b) publicly released the National Broadband Plan in 2001 as a roadmap to the realization of the e-Japan Strategy and the e-Japan Priority Policy Program. The Initiative clearly states a schedule extending to FY (Fiscal Year) 2005 and the allocation of public and private sector roles with respect to the nationwide roll-out of high-speed and ultra-high-speed Internet. It also shares the perspective that private carriers will have built ultra-high-speed network infrastructure and will be providing services over optical fiber networks in nearly all cities by FY 2005" (MIC 2002, p. 233).

The e-Japan Priority Policy Program was revised each year. In 2004, 38 million households could subscribe to high-speed Internet access networks via DSL services and 23 million households could subscribe via cable Internet services, and 18.06 million households could subscribe to ultra-high-speed Internet access networks via FTTH services, thereby achieving the targets ahead of time. Also in 2004, the number of broadband communication lines surpassed the number of narrowband lines.

Given the favorable progress of broadband expansion, "the IT Strategy Headquarters revised the e-Japan Strategy in July 2003. In this process, the Headquarters refocused the strategy away from infrastructure development and toward the promotion of IT use and application. It also positioned formation of a ubiquitous networked society as the goal of the infrastructure development for a new IT society" (MIC 2005, p. 2). The MIC (2004), in response to the shift in focus, drew up a vision of the future in which a ubiquitous networked society (u-Japan) would be realized by around 2010. u-Japan would enable everyone to fluidly and continuously exchange information over networks at any time, from any location, with any device. The Ministry also compiled a policy needed to achieve the u-Japan vision in 2004 called the u-Japan Policy. The u-Japan Policy had three pillars: (i) establishment of ubiquitous networks (with targets of 30 million households with the ability to access high-speed broadband and 10 million households with the ability to access ultra-high-speed broadband); (ii) advancement of ICT use and application; and (iii) establishment of ICT usage conditions. The policy also dispensed with the previous catch-up goals and asserted a new target of making Japan a global front-runner in ubiquitous networking by 2010.

A movement was seen among carriers to set broadband build-out targets in response to the government's actions. For example, NTT created a vision in 2002 that summarized its initiatives to roll out optical broadband, looking five to ten years into the future, and set out a medium-term business strategy in 2004 with a target of reaching 30 million optical users by 2010 (which was approximately half the number of subscriber telephones at the time) (NTT downgraded this target in 2007 to 20 million optical users in line with actual market demand.). And as the national construction of optical fiber progressed, NTT East and West and other telecom operators helped push broadband adoption through advances in technology development (such as the development of optical fibers that could withstand bending for easier in-home installation) and driving down costs.

2.4 Progress of Broadband

The 2015 White Paper (p. 22) traced the developments in fixed-line telephone networks. "At the beginning of the 2000s, the industry rapidly shifted from long-used metal lines to fiber optics as the primary technology for fixed-line communication networks. This proactive conversion to fiber optics for last-mile access networks was unprecedented, even internationally. Prices continued to fall, with the lowest prices reaching the 2,000-yen mark in 2005, and use continued to grow. Fixed-line broadband migrated en masse to FTTH, with total FTTH subscriptions outstripping DSL subscriptions in 2008" (MIC 2015, p. 22). As this details, FTTH became the main form of fixed-line broadband, with over 25 million FTTH subscription lines by FY 2013. At their peak, telephone subscriber lines reached a high-water mark of 60 million, but at the end of FY 2013, over half of these—just under 36 million—were broadband lines (total of optical fiber, DSL, and cable Internet). And over half of these connections used optical fiber.

Areas where broadband could be accessed also expanded in this period. The household coverage rate of broadband—i.e., the percentage of households within service areas—was 95.2% in 2007. The coverage rate was 83.5% when limited to FTTH and other ultra-high-speed broadband networks.

To recap, since 2001, called "Broadband Year Zero" in the 2001 White Paper, cable Internet and DSL first widely popularized broadband. Then, broadband migrated to FTTH, becoming faster and gaining more capacity in the process.

3 Core Network Advances to Meet Broadband Expansion

3.1 Efforts to Improve Core Networks to Meet the Growing Speeds and Capacities of Line Equipment and Facilities

As we have seen, FTTH and other communication line equipment and facilities progressively became faster and capable of handling more data. The evolution of technologies for core networks to cope with these speeds and capacities helped to drive broadband expansion (see Fig. 1 for a timeline of NTT East and West's telecommunication networks).

NTT East and West, for example, had constructed their core FLET'S network in 1999. This was the platform on which they offered B FLET'S, FLET'S ADSL, and other broadband services. FLET'S, however, was a best-effort network with no guarantees of communication quality. Furthermore, the provided services varied depending on whether the final access line was metal or optical fiber.

NTT East and West began offering a commercial service in 2008 called Next-Generation Network (hereinafter referred to as NGN). Services provided over NGN included services identical to existing B FLET'S services (best-effort optical broadband services, optical IP telephony services, videoconferencing, etc.). But NGN also included bandwidth-guaranteed services that used QoS (quality of service: the management of service quality such that functions provided over networks operate stably) measurements. Bandwidth-guaranteed services included high-quality optical IP telephony and high-quality videoconferencing. KDDI, which got a late start in converting its core network to IP, announced its CDN (Content Delivery Network: which replaced telephone networks with softswitches) and Softbank announced Ultra 3G.

NTT East and West's NGN was special in that it restricted access lines to optical fiber only. This was an unprecedented move, even internationally. BT in Europe had launched a next-generation network called twenty-first Century Network (hereinafter

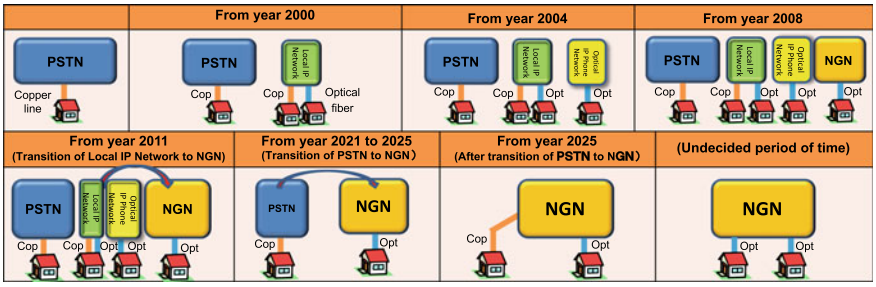

Fig. 1 A timeline of NTT east and west's telecommunication networks. *Source* Information and Communications Council (2017). Approaches to facilitate the migration of fixed-line telephone networks: report. http://www.soumu.go.jp/main_sosiki/joho_tsusin/policyreports/joho_tsusin/denki_seisaku/02tsushin10_04000361.html

referred to as 21CN), but 21CN was using metal access lines at the time. NGN was intended to be an efficient, fast, and large-capacity network that could maximize the advantages of optical access lines. Its central tenet was the reliability and stability of telephone networks with the economy and flexibility of IP networks.

3.2 Efforts to Toward Opening Core Networks to Promote Their Use and Application

Following the efforts to improve core networks, the Information and Communications Council (2008) issued a reply to an inquiry that assembled an approach to the interconnection rules pertaining to the next-generation networks. The approach's purpose was to encourage service competition in broadband and promote the use and application of networks.

The Information and Communications Council pointed out the following: "NTT East and West's NGN is assumed to become the nation's chief communication network. Achieving the conditions whereby competing carriers can make use of the NGN to provide without delay creative, original, and diverse services is a crucial issue in the interest of guaranteeing fair competition and improving user convenience" (Information and Communications Council 2008). In the wake of the Council's reply, competition rules were instituted on NTT East and West's provision of services over NGN.

The draft of the Council's reply was met with considerable interest, receiving 145 public comments. The prime point of contention was the relationship of core networks with the bottleneck characteristics of access lines. Competing carriers insisted NGN be made open. Their main arguments were that NGN was implemented in an integrated fashion with bottleneck access lines and that NGN's scale made it dominant. For their part, NTT East and West argued that any impact stemming from the bottleneck characteristics of access lines had been isolated by the opening up of access lines and other facilities. Therefore, other carriers could construct networks free of any impact from access lines. Consequently, the question of whether NTT East and West holds a large share of access lines has no direct relation on the decision of whether the network constitutes a bottleneck.

After deliberating on the issue, the Information and Communications Council (2008) wrote in its final report that NGN is a facility implemented in an integrated fashion with access lines having bottleneck characteristics. Furthermore, it stated that interconnections to this facility are essential for the business expansion of other telecom operators and are essential from the perspective of ensuring user convenience. Consequently, the Council ruled that the establishment was necessary of competition rules to open up NGN.

The arrangement of policies and measures on core networks outline above can be commended for playing a beneficial role, in the midst of mounting awareness, with the growth of broadband, of the importance of using and applying broadband.

4 Competition Policy and Other Systematic Responses to Broadband Expansion by the MIC and Other Ministries

4.1 Efforts to Arrange Conditions for Infrastructure Construction and Its Use and Application

The systematic responses by the MIC and other parts of government played a key role in connection with the shift to optical access lines, which underpin broadband networks, and the promotion of their use and application. These systematic responses had the effect of facilitating rapid infrastructure build-out, use, and application by carriers.

With the goal of advancing the build-out of optical fiber networks essential to the establishment of ultra-high-speed Internet and encouraging competition in facilities—as well as complying with the Facilitation of Line Construction document put together by the IT Strategic Headquarters and others in 2001—the MIC, the Ministry of Economy, Trade and Industry, and the Ministry of Land, Infrastructure, Transport and Tourism worked together to produce the Guidelines for Use of Poles, Ducts, Conduits, and Similar Facilities Owned by Public Utilities. The Guidelines served as operating criteria for approvals and decisions in negotiations over the right of telecom carriers to use other people's land that was established in the Telecommunications Business Act. The Guidelines compiled a standard handling method to be observed by facility owners and carriers when an owner of utility poles, ducts, conduits, or similar facilities leases the facilities to a certified telecom operator. The standard handling method included application procedures for the lease of the facilities, acceptable reasons for rejecting an application, the term of leases (five years as a rule), and compensation for facility leases. The Guidelines were designed in this way to facilitate line construction by carriers.

The MIC took other initiatives to arrange conditions to further push competition in the FTTH market and to promote growth of broadband services. These initiatives included working toward opening up access lines, in addition to core networks (NGN) described above, and striving to reduce interconnection fees of optical fiber provided by NTT.

As part of this process, the Information and Communications and Posts Administrative Council (2012) took up the question of the advisability of setting interconnection fees in units of branch lines in 2012. The Council, in its reply, shared the recognition that "Although the foundation of competition policy is to strive to maximum the interests of users through the promotion of competition that lowers fees and diversifies services, it is important to maintain an appropriate balance between competition in facilities (i.e., assurance of investment incentives) and competition in services" (Information and Communications and Posts Administrative Council 2012).

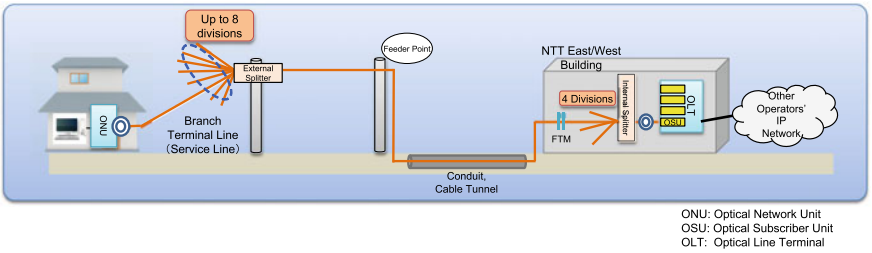

Fig. 2 Shared access methods (subscription optical fiber lines). *Source* Information and Communications and Posts Administrative Council (2012). Advisability of setting interconnection fees per branch line. http://www.soumu.go.jp/main_sosiki/joho_tsusin/policyreports/joho_tsusin/yusei/setsuzoku/02kiban03_03000102.html

Subscription optical fiber lines for detached homes can currently accommodate up to eight users per core (i.e., eight branch lines) by means of shared access methods, as shown in Fig. 2. In these cases, interconnection fees when other carriers lease optical lines are set per core. An issue is how to handle situations where a carrier that leases optical fiber on a per-core basis takes on risks if the accommodation rates of subscription optical fiber cannot be increased.

Discussions at the Council focused on whether one core should be split into branches for the determination of interconnection fees. NTT East Japan stated that as follows: With shared access methods, competition in optical broadband services has expanded due to the promotion of initiatives to lower interconnection fees per core and to arrange conditions for easy access to these cores. The company further argued: Interconnection carriers with optical broadband services making use of shared access methods are actually capturing two to three users per core. Therefore, other companies have more than sufficient leeway to enter the FTTH market. NTT West Japan stated that as follows: The western area of Japan, where FTTH facility competition is especially intense, tends to have the highest FTTH household coverage rates in the country. Therefore, competition in facilities is functioning effectively in expanding household coverage rates. Competing carriers countered these arguments, saying as follows: Service operators have been using and competing in ADSL, but they cannot adequately enter the FTTH market because of rules on bulk leasing. These rules are a substantial barrier to entry.

Based on the thinking stated above, the deliberations sorted out the issue in a way that will lower the risks to carriers using facilities. But at the same time, carriers will be incentivized to lower the per-core interconnection fees. They will also be incentivized to invest in facilities making it easier to raise the accommodation rates of subscription optical fiber. This can be done by expanding optical wiring subdivisions—i.e., the optical cable wiring segment covered by one feeder point and the basic management unit for access-type optical facilities—and, thereby, increasing the number of households serviced by one optical fiber core.

5 Arrangement of Conditions to Eliminate the Digital Divide and Further Broadband Expansion

5.1 Efforts to Eliminate the Digital Divide

As broadband expansion progressed, eliminating regions without broadband became a critical issue.

The IT Strategic Headquarters determined an infrastructure policy to eliminate broadband-zero regions by a target year of FY 2010 in its 2006 New IT Reform Strategy. In turn, the MIC created in 2006 the Next-Generation Broadband Strategy 2010, in which it sets an infrastructure-construction target of achieving a household coverage rate of over 90% for ultra-high-speed broadband.

The 2010 White Paper (2010a, p. 265) summarizes the Ministry's efforts: "With the goal of eliminating broadband-zero areas and areas with poor mobile phone reception by FY 2010, the MIC set up the Strategic Council on Bridging the Digital Divide in 2007 to lay out concrete steps to bridge the digital divide. The Council formulated the Strategy on Bridging the Digital Divide in 2009 as a master plan for the elimination of the digital divide" (MIC 2010a, p. 265). Most of the remaining broadband-zero areas (approximately 640,000 households, or 1.2% of all households, at the end of FY 2009) were regions where private carriers alone would not undertake broadband infrastructure construction. To eliminate these areas, the FY 2009 supplementary budget was used to fund the build-out of FTTH and other broadband networks through public construction for around 340 projects requested by municipalities (at a total cost of about 230 billion yen). It was expected that these projects would bring broadband access to about 340,000 new households.

With these efforts, it was expected that broadband-zero areas would be eliminated before the end of FY 2010. The remaining issue, however, was that broadband usage was not progressing at a sufficient rate (the optical broadband adoption rate was around 33%) even as broadband infrastructure construction was advancing nationwide.

Assistance measures at the time for broadband infrastructure construction included subsidized projects and the expansion and extension of tax breaks for telecom operators. For subsidized projects in particular, budget amounts were increasing and the rate was rising of grants to local governments in especially difficult situations. To accelerate infrastructure build-out in disadvantaged regions, subsidized projects were instituted in FY 2011 to partially cover expenses incurred by local governments in building ultra-high-speed broadband infrastructure.

5.2 Arrangement of Conditions to Further Broadband Expansion

Seeing that the Strategy on Bridging the Digital Divide's target was nearly attained, the MIC (2010b) released "Realizing *The New Broadband Super Highway Plan"* to set the target of "realizing broadband service use at all households by the target year of 2015," which would be achieved by further accelerating infrastructure establishment and usage. In 2010, the Ministry established a basic policy, which arranged the measures and their schedules needed to realize the New Broadband Super Highway Plan. It also created a process table, which mapped out the promotion of infrastructure construction in disadvantaged areas, the promotion of competition policy, and the promotion ICT use and application through regulatory reforms and other measures.

In addition, the Ministry requested the Information and Communications Council to look at approaches to arrange conditions that would promote widespread broadband adoption. The Ministry received a reply from the Council in 2011. The Council's reply called for, in addition to public support measures as incentives to accelerate infrastructure build-out (i.e., setting up assistance for broadband infrastructure construction on the premise that it will be used by the public sector), the creation of a comprehensive structure that would measure and verify the progress toward achieving broadband adoption metrics and the degree of compliance with fair competition requirements, among other factors. The reply maintained that such a structure would be a cornerstone in realizing a smooth transition from telephone networks to IP networks while promoting various efforts needed to stimulate competition among carriers (such as promoting competition in facilities by opening up line facility infrastructure).

Incidentally, NTT East and West released Public Switched Telephone Network Migration: A General Outlook in 2010, a document that outlined the companies' plans to start a systematic transition from telephone networks to IP networks starting around 2020 and finishing around 2025 (NTT 2010).

6 Changes to the Universal Service System in Response to Broadband Expansion

6.1 Revisions to the Universal Service System in Response to Broadband Expansion

As broadband expanded into more parts of the country, the possibility emerged that the obligation, under the universal service system, to provide metal subscriber telephone lines would inhibit the build-out of optical fiber. To avoid this possibility, the scope of the universal service system's measures was revised.

Subscription telephone services, public telephones installed in accordance with the MIC standards, and emergency calls—110 (police), 118 (maritime incidents and accidents), and 119 (fire)—were defined as universal services because they are essential communication services for the livelihood of citizens that should be provided in all locations in the country. Legislation obliged NTT East and West to provide these universal services to all parts of the country, including high-cost areas. To address the unfair burden on NTT East and West, a universal service fund was created in FY 2002 and started operating in FY 2006 that required other carriers to assume some of the costs needed to ensure the provision of universal services (i.e., the costs to provide universal services in high-cost areas).

The MIC put together a document in 2010 on handling future broadband expansion entitled Realizing the New Broadband Super Highway Plan: Basic Directions. Based on the questions raised in this document, the Ministry requested the Information and Communications Council in 2010 to examine approaches to the universal service system during the transition period until broadband services are available nationwide.

The Council's reply began by laying out the basic issues. First, optical IP telephone services using 0AB to J numbers are expected to replace subscription telephone services, even as subscription telephone services and optical IP telephone services coexist in the fixed-line telephone market during the transition period until broadband services are available nationwide. Second, as subscription telephone services are defined as universal services, NTT East and West must continue to maintain the provision of subscription telephone services even in regions where optical IP telephone services equivalent to subscription telephones services are provided through publicly built and privately operated FTTH networks. Because of these issues, the reply continued, under the universal service system, the obligation to provide metal subscriber telephone lines may inhibit the build-out of optical fiber. To avoid this possibility, the reply recommended that optical IP telephone services equivalent to subscription telephone services be defined as a universal service. Such an approach would provide NTT East and West with more freedom and prevent duplicate investments and other unnecessary expenditures. This change to the universal service system was expected to avoid the construction of metal lines in new residential developments, enable preparations for future removal of metal lines, and encourage construction of optical fiber lines.

6.2 Responses to the Migration of Fixed-Line Telephone Networks to IP Networks

NTT, in 2015, released The Future of Fixed-Line Telephone, which was an update in some ways of its previous Public Switched Telephone Network Migration: A General Outlook document (NTT 2015). The new document unveiled a plan to transition all fixed-line telephone networks to IP networks by 2025 (see Fig. 3 for an illustration of the public switched telephone network (PSTN) to IP transition). This document gave

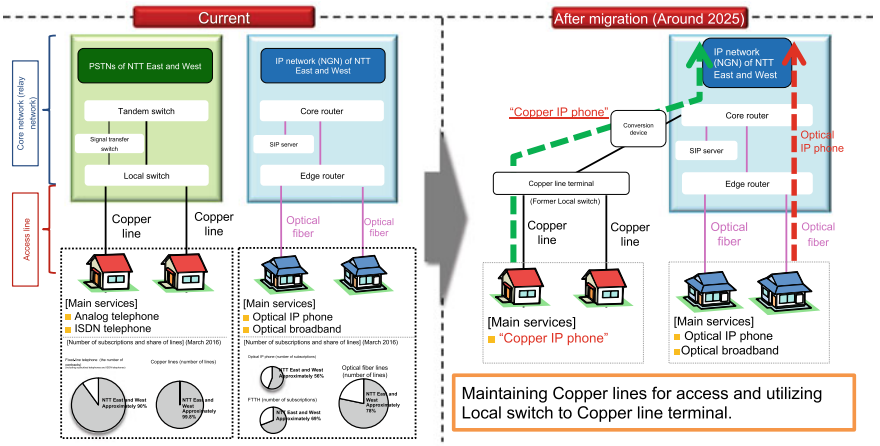

Fig. 3 Smooth migration of PSTN to IP network. *Source* Information and Communications Council (2017). Approaches to facilitate the migration of fixed-line telephone networks: report. http://www.soumu.go.jp/main_sosiki/joho_tsusin/policyreports/joho_tsusin/denki_seisaku/02tsushin10_04000361.html

a convincing picture the Migration of Fixed-Line Telephone Networks provided by PSTN and metal lines, being provided by NGN and optical fiber.

NTT East and West's PSTN is the nation's core communications infrastructure. It functions as an intermediary network for communications between carriers, including IP telephones and mobile telephones. PSTN also provides the competition platform for many carriers to expand their businesses.

The MIC recognized that the form of IP networks after this transition and how the transition is performed will have an enormous impact on users and carriers. Therefore, the Ministry requested the Information and Communications Council in 2016 to consider how to manage a smooth fixed-line telephone network migration. The Council vigorously debated the issue for 18 months and in 2017 issued its first and second replies.

The deliberations on how to migrate fixed-line telephone networks smoothly to IP networks included, in part, system and technology examinations of how to handle metal lines and the future possibilities of using optical fiber lines and wireless access.

The Council's reply listed the advantages of migration. "Migration to IP networks will foster the use of inexpensive telephone services that are independent of physical distances. It will also further the shift to optical access lines, over which broadband and other advanced and diverse services will be provided" (Information and Communication Council 2017).

The reply also mapped out clear migration processes and schedules as far as 2025. The specific roadmap called for the start of stepwise interconnections between carriers' IP networks in January 2021, after preparations by carriers, and the completion of migrating facilities from PSTN to IP networks by January 2025. As for service migration, the roadmap set January 2024 as the date for migrating en masse from

metal telephone lines (subscriber telephone and ISDN telephone lines provided by NTT East and West) to metal IP telephone lines. It also called for public notifications about the migration to start by January 2022 at the latest.

The Council's reply listed problems with IP network migration. NTT had indicated its plan to maintain metal lines even after migrating to IP networks and providing, for the time being, metal IP telephone services that connected to the NGN via conversion devices. On this matter, the reply recommended that "NTT decide and announce as early as possible when metal IP telephone services will be terminated in the interest of predictability" (2017). The reply recommended further reductions in optical fiber interconnection fees to better smooth the transition of access lines from metal to optical, and it called for an expanded scope for the four-year advance notice rules on the removal of metal lines. The reply also recommended the introduction of two frameworks: one to handle service terminations appropriately that will occur with the migration to IP networks and another to correctly manage and use telecommunication numbers during the IP network transition.

NTT, in regard to the universal service system, requested that it is able to select the best method from several options, including optical fiber and wireless, for access lines when it is inefficient in the future to lay metal cables again in rural areas, for example, that need facility upgrades. This request is in the interest of curbing new investment for the provision of fixed-line telephones and to provide voice calls as efficiently as possible. Other carriers responded to NTT's request, noting that NTT East and West were the legal entities to provide fixed-line telephone services everywhere in the country and stating that before expanding the universal service system to include voice calls using wireless (mobile networks) that are not defined as universal services at present, careful discussions are needed about various issues, from both a system standpoint and a technical standpoint.

The Information and Communications Council's reply stated that: "In the interest of assuring the efficiency and technical neutrality of the means of providing fixed-line telephone services as a universal service, it is necessary to examine the advisability of providing fixed-line telephone services equivalent in price and quality to existing subscription telephone services by the use of optical fiber and wireless" (Information and Communications Council 2017). The reply went on to point out the necessity of examining technical standards and existing systems (the Telecommunications Business Act and the NTT Act) on quality equivalent to analog telephones and how emergency calls will be handled. The reply concluded that "the MIC must study these points in question" (2017).

Metal lines are installed nationwide and are subject to compensation under the universal service system. Moving from metal lines to optical fiber lines or wireless further highlights the importance of deciding how to revise the related systems in response.

7 Promoting the Build-Out of Optical Fiber Infrastructure by Municipalities in Disadvantaged Regions and Related Issues

7.1 Measures to Eliminate Digital Divides in Disadvantaged Regions

Installing new optical fiber networks requires tremendous expense. Consequently, private carriers have not built optical fiber networks in disadvantaged areas where profitability is doubtful, such as underpopulated areas. This has fostered geographic digital divides in terms of the creation of opportunities for high-speed and ultra-high-speed Internet access.

On the other hand, the central and local governments have constructed optical fiber networks in the interest of managing public facilities and bringing information technology to their regions. Unlike those built by private carriers, these optical fiber networks exist not only in urban areas but also, to a certain extent, in underpopulated and other disadvantaged areas.

The central government instituted standard procedures for the opening up to telecom operators of optical fiber networks built and owned by local municipalities in 2002. The procedures were created out of the recognition that the effective use of existing optical fiber networks built and owned by entities other than telecom operators was necessary in order to form the world's most advanced information and communications network. The standard procedures related to IRU agreements, the most frequently used agreements by local municipalities and the easiest to use to ensure construction of stable networks. The procedures clarified that optical fiber networks built and owned by local municipalities that had become disused for a variety of reasons could be used for purposes other than their original public purposes.

This arrangement and the use of the aforementioned assistive measures to eliminate digital divides led to a 99.0% coverage rate for fixed-line ultra-high-speed broadband infrastructure as of March 31, 2017. This was a definite uptick from the 96.4% rate on March 31, 2012. Nevertheless, the rate is still only 86.5% in Kagoshima prefecture. Infrastructure build-out has been delayed, primarily in prefectures with many remote islands or mountainous areas.

7.2 Further Efforts to Eliminate Disadvantaged Areas Without Broadband Infrastructure

Most areas without ultra-high-speed broadband infrastructure are areas that are disadvantaged in some form. Furthermore, local governments with jurisdiction over such areas generally lack financial means. Therefore, the central government needs to provide further economic assistance to eliminate broadband-zero areas.

Many local governments in disadvantaged areas have used subsidies to build out optical fiber and other infrastructure and then provide the infrastructure to a telecom operator through an IRU agreement. These local governments, however, face the problem of handling the infrastructure after the IRU agreement runs out. There are an increasing number of arrangements in which carriers take over infrastructure through an IRU agreement and use that infrastructure to provide services within the local government's area. The problem is that IRU agreements are fixed-term leases of infrastructure (generally 10 years) and that the local government must arrange a method of tendering the infrastructure again at the end of the IRU term in order to maintain the stable provision of optical IP telephone services as a universal service. In fact, a large number of local governments that have built infrastructure in the past are facing IRU agreement renewals between 2018 and 2021. Around three-quarters of the 260-odd local governments in this situation have not determined a renewal method.

The IT Strategic Headquarters (2017) released the Declaration to be the World's Most Advanced IT Nation: Basic Plan for the Advancement of Public and Private Sector Data Utilization in 2017. One target in the Declaration is: "We will continue to provide support to allow local governments with jurisdiction over less-favored areas, such as remote islands, to develop and secure ultra-high-speed broadband infrastructure and aim to reduce the number of local governments lacking fixed-line ultra-high-speed broadband infrastructure from 41 (as of the end of FY 2016) to 25 by the end of March 2021" (IT Strategic Headquarters 2017).

The MIC organized the Study Group on Regional ICT Infrastructure Development Strategies, given the situation described above, given the structural changes in our population—namely a declining population, low birthrate, and aging population, and given the advancing nature of ICT use and application. The Study Group's purview, in light of the expected roll-out of commercial 5G in 2020, was to study a broad range of methods of utilizing 5G, optical fiber, and other technologies as ICT infrastructure in local regions and to establish new strategies to promote their expansion into local regions.

The Study Group arranged A Basic Approach for Strategies to Promote Regional ICT Infrastructure Development. It reiterated that the fundamental principle is construction and operation of regional ICT infrastructure by private carriers. But it then stated that "the central and local governments should implement public assistance for those parts of disadvantaged areas requiring ICT infrastructure development, with considerations for needs, cost performance, and other factors" (MIC 2018) and that "public assistance should ensure flexible methods of regional ICT infrastructure development, including funding development by private carriers and other entities" (2018). The Study Group also worked out a Package of Measures for Regional ICT Infrastructure Development and recommended support for areas without ICT infrastructure development—i.e., financial support given to local governments (for the development of optical fiber to support advanced wireless environments, the development of mobile phone and other service areas, development of Wi-Fi environments, development of cable TV networks, etc.)—and support for studies by local governments of ICT infrastructure development (development of flexible ICT infrastructure through coordination of wired and wireless modalities). Based on the report

by the Study Group, subsidized projects have been instituted in FY 2019 to partially cover expenses incurred by local governments and private carriers in building ultra-high-speed broadband infrastructure.

8 Conclusion

The execution of Japan's broadband build-out since "Broadband Year Zero"—i.e., around 2001—has progressed steadily. This progress has occurred in tandem with consistent and strategic goal setting by the government as a whole, systematic response, such as competition promotion measures and stimulus measures, by the MPT/MIC and other government bodies, and technical development and competitive expansion by carriers.

Broadband infrastructure has spread nationwide and has evolved into ultra-high-speed broadband. At the same time, the government has pushed ahead with initiatives to eliminate the digital divide that exists in disadvantaged areas. These initiatives have included ongoing financial and tax assistance from the central government and assistance through local government IRU agreements. Nevertheless, the importance of these initiatives is expected to grow. Currently, in addition to studying optical fiber infrastructure development, the government is watching the progress of 5G and other wireless technologies, which were not discussed at length in this chapter, and is considering applying these technologies to the digital divide problem. In any regard, continued efforts will be required.

On a global level, Japan's broadband infrastructure development is quite advanced, but we are still behind in terms of the widespread use and application of broadband services.

One of the country's policy aims is to create the world's most advanced IT nation. Given our current circumstances, a central part of this policy aim continues to be resolving societal issues through the use and application of IT. This necessitates furthering the development of infrastructure that will underpin the advancement and diversification of broadband technology and promoting the use and application of broadband services. Further initiatives by the public and private sectors in these areas are expected.

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Development of Regulatory Systems Concerning Interconnection

Masaki Fukuda

1 Introduction

The interconnection between the telecommunications facilities of one telecommunications carrier (hereinafter may be referred to as "carrier") and those of another carrier has been utilized as a method to construct a network that enables telecommunications between facilities of one carrier and those of another carrier (Ministry of Internal Affairs and Communications (hereinafter may be referred to as "MIC"), 2016a, pp. 7–8). The policies concerning such interconnections have been developed through regulatory systems established in the Telecommunications Business Act (Act No. 86 of 1984; hereinafter may be referred to as "TBA"). This chapter discusses the development of such systems for overviewing the development of policy frameworks concerning such interconnections.

"Interconnection" means a mutual electric connection between telecommunications facilities (machines, equipment, wires, cables, or other electrical facilities for the operations of telecommunications (TBA Art.2(ii)); hereinafter may be referred to as "facilities") and is interpreted as being required to enable telecommunications (hereinafter may be referred to as "telecom") between such connected facilities (Tagaya, Okazaki, Okazaki, Toyoshima, & Fujino, 2008, p. 152).

In implementing an interconnection between facilities of one carrier and those of another carrier (hereinafter may be referred to simply as "interconnection"), an agreement on the said interconnection (hereinafter may be referred to as "interconnection agreement") is concluded between the said carriers (TBA Art. 35(1) and (2)). In an interconnection agreement, agreement details such as the amount of money to be received or paid by the parties and the terms and conditions of interconnection

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(hereinafter may be referred to collectively as "agreement details") are specified (TBA Art. 35(3) and (4)). The conclusions and contents of interconnection agreements are at least for the time being left to negotiations between the parties (MIC, 2016b, p. 3).

In cases of interconnection implementation, respective carriers, taking the point of interface specified in the agreement as the responsibility demarcation point, may conclude contracts directly with their users on the provisions of telecom services (hereinafter may be referred to as "services") within the respective sections where their own facilities are used, and thereby may provide the said services directly to users based on the respective contracts (MIC, 2016a, pp. 7–8, p. 16). The responsibilities for the users to fulfill the said contracts are to be borne directly by the respective carriers (MIC, p. 16).

In TBA at present, is established a set of general regulatory systems concerning interconnections together with respective sets of special regulatory systems concerning interconnections with Category I designated telecom facilities as defined in TBA Art. 33(2) (facilities designated pursuant to the provision of TBA Art. 33(1); hereinafter may be referred to as "Cat. I DTFs") and with Category II designated telecom facilities as defined in TBA Art. 34(2) (facilities designated pursuant to the provision of TBA Art. 34(1); hereinafter may be referred to as "Cat. II DTFs").

Cat. I DTFs, at present, comprise fixed terminal system transmission line facilities (transmission line facilities, hereinafter may be referred to as "TLFs") one end of which is connected to a user's facilities (excluding mobile terminal facilities defined in TBA Art. 12-2(4)(ii)(b) (user's facilities comprised of moving radio equipment for radio stations; hereinafter referred to as "MTFs") installed at a specific site; hereinafter may be referred to as "FTSTLFs"), and relevant facilities installed by NTT EAST or NTT WEST. Cat. II DTFs, at present, comprise TLFs, one end of which is connected to MTFs for cellular radio communications or broadband wireless access systems (limited to those of WiMAX + 2 or AXGP; hereinafter referred to as "BWA"), and relevant facilities installed by NTT DOCOMO, KDDI, SoftBank, or Okinawa Cellular Telephone.

This chapter is structured as follows: The next section discusses the fundamental policies on the regulatory systems concerning interconnections. Sections 3, 4, and 5 discuss the respective developments of the general systems concerning interconnections and the special systems concerning interconnections with Cat. I DTFs and with Cat. II DTFs. Section 6 briefly mentions the systems concerning wholesale telecom services that are functionally similar to the systems concerning interconnections. Section 7, in place of a conclusion, provides a summary of this chapter and future issues.

2 Fundamental Policies on the Regulatory Systems Concerning Interconnections

2.1 General Systems Concerning Interconnections

The telecom business is regarded as a business with high public nature since it provides telecom services that are indispensable for the human lives and societal or economic activities (Telecom Legislation Study Group (hereinafter referred to as "TLSG"), 1987, pp. 4–5). Also pointed out as the nature of the telecom business is that telecom markets are prone to monopoly due to network externality, etc. (Telecom Bureau, 2018, p. 3), and that it might be problematic for a user to switch networks to use because of network constraints (TLSG, p. 252).

Interconnection is regarded as beneficial for users and carriers and as having the effects of increasing the public interest. This is because, once an interconnection is implemented, such benefits may occur as follows: The range of partners from/to whom users can conduct telecom, those of the locations from/to which users can conduct telecom, and those of services available to users may be expanded; investments to provide services may be lessened; the operation rates of facilities may be improved (MIC, 2016b, p. 1; Tagaya et al., 2008, pp. 169–179, p. 187; Tanaka, 1997, p. 69; TLSG, 1987, p. 106, p. 108).

Moreover, if interconnection is implemented, advantages due to network externality, network constraint, etc., may be relaxed, and thereby, competition on the merits may be amplified. Furthermore, in providing services, it is often necessary for carriers competing with one another to interconnect their facilities and mutually cooperate (Information and Communications Council (hereinafter referred to as "ICC"), 2001, p. 1). Hence, it is recognized as important to establish an environment enabling smooth interconnections in promoting fair competition (ICC, 2009, p. 1).

While the interconnection is recognized as a matter of carriers' freedom, unless otherwise regulated (Tagaya et al., 2008, p. 198), an interconnection agreement is recognized as a matter to be concluded through negotiations between the concerned parties, and the contents of such an agreement are recognized originally as being determined by such negotiations (TLSG, 1987, p. 106, pp. 108–109). If interconnections are left only to such negotiations in a competitive environment, there may occur a risk that interconnections may not suit the public interest (Telecommunications Council (hereinafter referred to as "TC"), 1996, p. 7). For example, it has been pointed out that should one party who has an advantage over the other in negotiations concerning an interconnection refuse the said interconnection or unfairly force conclusion of an agreement comprising contents disadvantageous to the other party, fair competition might be impeded, and thereby, user convenience might be impaired (TLSG, 1987, p. 108: Japan Fair Trading Commission (hereinafter referred to as "JFTC") & MIC, 2018, p. 9).

Taking these matters into account, in TBA at present, in order to ensure smooth interconnections, a set of regulations have been established including an obligation to

interconnect (TBA Art. 32), a system of orders to start or restart negotiations concerning the conclusion of an interconnection agreement (hereinafter may be referred to as "orders to negotiate") (TBA Art. 35(1) and (2)), a system of awards on agreement details (TBA Art. 35(3)-(10)), and a system of orders to improve business activities concerning interconnections (TBA Art. 29(1)(x)) (JFTC & MIC, 2018, p. 9).

2.2 Special Systems Concerning Interconnections with Designated Facilities

Category I designated telecom facilities and Category II designated telecom facilities (hereinafter may be referred to collectively as "designated facilities" in this section), respectively, comprise terminal system transmission line facilities (TLFs, one end of which is connected to a user's facilities; hereinafter may be referred to as "TSTLFs"), etc., installed by carriers having a large number of subscriber circuits (refer to telecom circuits of TSTLFs) within certain areas. Telecom is an activity unable to be performed without subscriber circuits. Hence, other carriers might be hindered from entering telecom markets or excluded from them depending on the possibility of interconnections with TSTLFs, etc., installed by carriers having a large number of subscriber circuits, the amount of money to be received by the said carriers (hereinafter referred to as "interconnection charges") or the terms and conditions of interconnection on the said interconnections or the progress of negotiations with the said carriers (TC, 1996, p. 9; TC, 2000b, p. 13).

Carriers having a large number of subscriber circuits are recognized as having strong bargaining powers for negotiations concerning interconnections with the TSTLFs, etc., installed by them and have advantages over other parties; hence, it might be difficult to reach some agreed conclusions under reasonable terms and conditions on such interconnections by negotiations (ICC, 2009, p. 2, p. 11). If the contents of interconnection agreements are improper, the effects of increasing the public interest expected regarding interconnections might not be obtained (Tagaya et al., 2008, p. 170, p. 187).

Taking these matters into account, in TBA at present, to ensure smooth interconnections with the facilities to be the sources of such strong bargaining powers, the following systems have been established (ICC, 2009, p. 2; JFTC & MIC, 2018, p. 9): The Minister for Internal Affairs and Communications (including the Minister for Posts and Telecommunications before January 5, 2001, hereinafter referred to as "the Minister") may designate TSTLFs, etc., installed by the carriers having occupation rates in excess of certain standards in the number of subscriber circuits within certain areas by category of TSTLFs; upon the carriers installing the designated facilities are imposed a set of regulations concerning interconnections with the said facilities, such as an obligation to establish interconnection tariffs on the interconnection charges and the terms and conditions of interconnection (hereinafter referred to as "interconnection charges, etc.") and obtain authorizations by the Minister or file notifications

with the Minister by category of designation, a prohibition to conclude or amend agreements not complying with authorized or notified interconnection tariffs on the said interconnections with other carriers (hereinafter referred to as "obligation to comply with interconnection tariffs"), etc. (TBA Arts. 33, 34, etc.). Regarding interconnections with the designated facilities, both the general systems and the relevant special systems are applied (MIC, 2016b, p. 1).

3 General Systems Concerning Interconnections

This section provides an overview of the respective developments of the obligation to interconnect, the system of orders to negotiate, the system of awards on agreement details, and the system of orders to improve business activities concerning interconnections.

3.1 Obligation to Interconnect

The obligation to interconnect (hereinafter may be referred to as "OTI" in this section) is an obligation of a carrier to accept, in principle, a request from other carriers to interconnect the facilities of the requesting carrier with the telecom circuit facilities (TLFs connecting between places of transmission and of reception and switching facilities installed as an integral part of the said TLFs as well as their adjunct facilities (TBA Art. 9(1)(i)); hereinafter referred to as "circuit facilities" in this section) installed by the said carrier (TBA Art. 32). The exceptions of the OTI are limited only to cases where the said interconnection is likely to hinder smooth provision of services; where the said interconnection is likely to harm the requested carrier's interests unreasonably; and where justifiable grounds exist as specified by an Ordinance of the MIC (including an Ordinance of the Ministry of Posts and Telecommunications established by January 5, 2001, hereinafter may be referred to as "Ordinance") (TBA Art. 32(i)-(iii)). The said justifiable grounds specified by the said Ordinance consist of cases where requesting carriers fail or may fail to pay the amount of money to be borne for the said interconnection and where the installations or modifications of TLFs to accept the said interconnection are extremely difficult technologically or economically (Ordinance for Enforcement of the Telecommunications Business Act (Ordinance of the MPT No. 25 of 1985 (hereinafter referred to as "OETBA") Art. 23).

The OTI was established in 1997 (TBA Art. 38 at that time) from a viewpoint of securing the public interest, in response to proposals by TC (1996), considering the successive occurrences of disputes between carriers due to difficulties in negotiations concerning interconnections at points other than existing interconnection points, etc. (ICC, 2001, p. 18; ICC, 2015, p. 1; Telecommunications Dispute Settlement Commission (hereinafter referred to as "TDSC"), 2017, p. 81). The said proposals

comprised (i) that, without justifiable grounds, Type I telecom carriers (hereinafter referred to as "Type I carriers") were to be obligated to conclude interconnection agreements with other carriers for improved user convenience and promotion of fair competition, considering the high public nature of Type I carriers' networks and the difficulty to ensure interconnections suitable to the public interest only by the negotiations between parties (TC, p. 7), and (ii) that interconnections with essential facilities (see Sect. 4) were to be provided at all technically feasible points (TC, p. 11). Hence, imposition of the OTI was applicable only on Type I carriers before the amendment of TBA in 2003. By the said amendment, the OTI was renovated and became applicable to carriers in general (TBA Art. 32), along with the abolition of the distinction between Type I and Type II telecom businesses.

Actually, the OTI, unlike the phrase in TC (1996, p. 7), has been prescribed not as an obligation to "conclude an interconnection agreement" but as an obligation to "accept a request to… interconnect" since 1997. Also, it has been prescribed to be applicable not only to interconnections with essential facilities but broadly to interconnections with circuit facilities in general. Regarding the makeup of the OTI, the elements are explained as comprising the obligation to conclude agreements on requested interconnections and the obligation to maintain the said agreements (*SoftBank Telecom v. NTT EAST*, 2014, pp. 112–3; Tagaya et al., 2008, p. 152).

Regarding the conclusion of an agreement in the case of accepting a request to interconnect, at least for the time being, this is left to negotiations between the parties concerned, and the contents of the agreement are to be determined based on the agreed conclusions reached as results of the negotiations (in case an award on agreement details is rendered, as specified by the said award (TBA Art. 35(7); ICC, 2009, p. 2; MIC, 2016b, pp. 1–3). Therefore, the OTI is naturally interpreted to include the obligation to negotiate matters concerning conclusions of agreements on requested interconnections.

It is pointed out by TDSC (2017, p. II-81) that even in the case a carrier already has been implementing interconnections with another carrier, and the said carrier's obligation to accept requests from the said another carrier to implement interconnections at points other than the existing interconnection points is not excused due to the said fact. The reasons pointed out are as follows: that the establishment of OTI was triggered by disputes such as the case above; that the OTI was established in response to a proposal that interconnections with essential facilities were to be provided at all technically feasible points; etc. (TDSC, p. II-81).

3.2 System of Orders to Negotiate

In TBA before amendment in 1997 was established a system of order to conclude an interconnection agreement (hereinafter referred to as "OCIA" in this section). The system of OCIA was such an unobtrusive system that, in cases where negotiations between carriers (excluding cases where one or both of parties were General Type II telecom carriers and cases where both of parties were Domestic Special Type

II telecom carriers) on interconnection failed or were unable to be held, with the result that one party filed a petition, the Minister, on the said interconnection, was able to order to conclude an agreement only if the Minister found that the said interconnection was particularly necessary and appropriate to increase the public interest (TBA Art. 39(1) before the amendment in 1997).

Regardless of the OTI established by the amendment of TBA in 1997, the conclusion of an agreement in the case of accepting a request to interconnect is, at least for the time being, still left to negotiations between parties. Hence, at the time of establishment of the OTI, the system of OCA was replaced by the system of orders to negotiate (hereinafter may be referred to as "OTN" in this section). The system of OTN has been one that, in cases where a carrier who is requested by another carrier to conclude an agreement on interconnection refuses to hold negotiations or the said negotiations fail, with the result that the requesting carrier files a petition, the Minister shall or may order the requested carrier to start or restart the said negotiations under certain requirements.

Just after establishment of the system of OTN, the said system was categorized as follows: (i) a system for cases where the requested carrier was a Type I carrier (i.e., a carrier with the OTI at that time) (TBA Art. 39(1) at that time), and (ii) a system for other cases (similar to the previous system of OCIA, excluding cases where one or both parties were General Type II telecom carriers and cases where both parties were Domestic Special Type II telecom carriers) (TBA Art. 39(2) at that time).

Along with abolition of the distinction between Type I and Type II telecom businesses by the amendment of TBA in 2003, regarding both systems of OTN, both parties who may file a petition and the addressee of the orders were expanded to carriers in general (TBA Art. 35(1) and (2)). The system of OTN set forth in TBA Art. 35(1), as with the OTI, is applicable to interconnections with circuit facilities. The system of OTN set forth in TBA Art. 35(2) is applicable to interconnections other than interconnections with circuit facilities.

The system of OTN set forth in TBA Art. 35(1) on interconnections with circuit facilities is a suppressive system that the Minister shall issue an OTN, except when the Minister finds that it falls under any of the cases listed in the items of TBA Art. 32 (i.e., exceptions to the OTI). This system is explained as being a system to secure the OTI (Tagaya et al., 2008, p. 192), whereas in fact it secures only the obligation to negotiate between the parties from among the elements of OTI.

The system of OTN set forth in TBA Art. 35(2) is evaluated as succeeding the system of OCIA (Tagaya et al., 2008, pp. 203–204). The requirements of this OTN are the same as those of the previous OCIA except for the range of parties. The reason such an unobtrusive system similar to the system of OCIA has been adopted is said to be from the viewpoint of limiting restrictions on the carriers' freedom of business activities (Tagaya et al., p. 198).

3.3 System of Awards on Agreement Details

The system of awards on agreement details established in TBA before amendment in 1997 was that, only in cases where an OCIA for the requested interconnection had been issued, and the negotiations on the agreement details failed or were unable to be held, based on the application by either party, the Minister was able to render an award (TBA Art. 35(2)-(8) before the amendment in 1997). The said system required, in order to apply for an award, to obtain an OCIA before the application for an award, even in the case that negotiations for the said interconnection had been held, but only the negotiations on agreement details had not reached an agreed conclusion. It was pointed out that it might not be possible to ensure prompt interconnections and to promote competition sufficiently by the said system (TC, 1996, p. 7).

By the amendment of TBA in 1997, the system of awards also was renovated. The renovated system of awards was categorized as follows: The system of awards for cases where the carrier requested interconnection was for a Type I carrier (TBA Art. 39(3) at that time) and the system for cases where an OTI had been issued in advance, similar to the previous system of awards (TBA Art. 39(4) at that time). Under the said system set forth in TBA Art. 35(3) at that time, a carrier requesting a Type I carrier to interconnect could apply to the Minister for an award in cases where the negotiations on the agreement details failed, while the applying carrier was no longer required to obtain an OTI before the application for the said award. Under the said system set forth in TBA Art. 35(4), in cases where either kind of OTI had already been issued in advance and negotiations on agreement details failed, either or both parties could apply to the Minister for an award.

Along with the abolition of the distinction between Type I and Type II telecom businesses by the amendment of TBA in 2003, in lieu of the previous provision of TBA Art. 39(3), regarding not only interconnections with circuit facilities but interconnections in general, a carrier requesting interconnection to a carrier of any kind could apply for an award to the Minister in cases where negotiations on agreement details for the requested interconnection failed (TBA Art. 35(3) after the said amendment). The provision of Art. 39(4) before the amendment has been succeeded to the provision of the current provision of Art. 35(4).

Since the establishment of TBA, the effect of an award has been that the negotiations between the parties shall be deemed to have reached an agreed conclusion as specified by the award (TBA Art. 39(7) at present). The said effect implies that a relationship between the parties on claims and obligations under private law shall be formulated afterward as specified by the award (Tagaya et al., 2008, pp. 200–201; TLSG, 1987, p. 109). The system of awards is also evaluated as a system securing the OTI (*Softbank Telecom v. NTT EAST*, 2014, p. 113).

In 2018, to facilitate negotiations on the amount of money to be received or paid by the concerned parties (excluding authorized interconnection charges, etc.), the MIC (2018a) announced a policy to render an award unless otherwise agreed by the parties, basically in accordance with the amount of money calculated based on

proper costs plus proper profits under efficient management, taking into account the situation of competition in the markets, etc.

3.4 System of Orders to Improve Business Activities

In cases where the Minister finds that a carrier hinders other carriers from properly conducting their business activities by treating certain carriers in an unfair and discriminatory manner in interconnecting or by conducting other unfair operations related to activities on interconnections and is thereby likely to seriously impair the public interest, the Minister may order the said carrier to improve the methods of conducting its business activities or take other measures within the limits necessary for ensuring the public interest (TBA Art. 29(1)(x)). As the said "other unfair operations related to activities on interconnections," anticompetitive behaviors hindering smooth interconnections (e.g., intentional delays of interconnections, demands to submit documents not related to interconnections) are assumed (TC, 1996, p. 28).

At the time of its establishment of the system in 1987, the Minister might issue an order only in cases where the Minister found that a Type I carrier or a Special Type II carrier had treated certain carriers in an unfair and discriminatory manner in interconnecting and was thereby likely to seriously impair the public interest (TBA Arts. 36(2) and 37 at that time). In 1997, in response to a proposal by TC (1996, p. 28), the grounds on which the said order might be issued to Type I carriers set forth in TBA Art. 36(4) at that time were expanded as broad as the grounds at present (ICC, 2001, p. 25). By the amendment of TBA in 2013, along with the abolition of the distinction between Type I and Type II telecom businesses, the system was integrated into the present system.

4 Systems Concerning Interconnections with Category I Designated Telecommunications Facilities

Category I designated telecom facilities (Cat. I DTFs; called as "designated telecom facilities" before the amendment of TBA in 2001) are recognized as "essential facilities": facilities essential to be interconnected with the facilities of other carriers for developments of their businesses and for securement or improvement of user convenience (hereinafter, such nature of facilities may be referred to as "nature of bottleneck" or "bottleneck nature") (Tagaya et al., 2008, p. 161; TC, 1996, p. 9; TC, 2000b, p. 7). So far, only fixed terminal system transmission line facilities (FTSTLFs) installed by NTT EAST and NTT WEST (NTT, before its reorganization in June 1999) and the facilities they install integrally with the said FTSTLFs have been evaluated as essential facilities with the nature of bottleneck and designated as Cat. I DTFs (TC, 1996, p. 10; TC, 2000b, pp. 11–12).

The set of systems concerning interconnections with Cat. I DTFs was established in 1997 in response to TC (1996), in light of the recognition that carriers installing such essential facilities were to attain overwhelming bargaining powers in negotiations concerning interconnections with the essential facilities and hold an overwhelmingly advantageous position over other carriers, etc., for imposing asymmetric regulations on such carriers to ensure the speediness of such interconnections as well as the properness, impartiality, transparency of interconnection charges, etc. (TC, p. 9; ICC, 2009, p. 2, p. 14; ICC, 2014, Ref. 50).

The set of systems concerning interconnections with Cat. I DTFs comprises the system for designation of Cat. I DTFs, the system concerning interconnection tariffs specifying the interconnection charges, etc., on the said interconnections, and the system concerning accounting with regard to the said interconnections (hereinafter referred to as "interconnection accounting" in this section), etc. (TBA Art. 33) as well as the system concerning the plans for changes of and/or additions to the functions of Cat. I DTFs (hereinafter referred to as "plans for provision of network functions" in this section) (TBA Art. 36). Hereinafter, this section overviews respective developments of these systems.

4.1 Designation of Category I Designated Telecommunications Facilities

Category I designated telecom facilities (Cat. I DTFs) consist of facilities that the Minister designates by public notice as facilities whose interconnections with the facilities of other carriers are essential for improvement of user convenience and comprehensive and reasonable developments of telecommunications (i.e., facilities with the nature of bottleneck) from among respective aggregates of the following facilities for each area specified by an Ordinance in considering usage of services and prefectural districts (generally speaking, for a respective prefectural area, since 1997): (i) FTSTLFs installed by one carrier, in cases where the ratio of the number of telecom circuits of the said FTSTLFs (hereinafter referred to as "fixed subscriber circuits" in this section) to the total number of all fixed subscriber circuits installed in the said area exceeds the ratio specified by an Ordinance (one-half, since 1997) and (ii) facilities specified by an Ordinance and installed in the said area by the said carrier integrally with the said FTSTLFs (TBA Art. 33; OETBA Art. 32-2(1)-(3)).

The facilities specified by the said Ordinance comprise facilities for switching, etc. (one accommodating FTSTLFs directly; one used for communications in the relevant area), TLFs installed between buildings where the said facilities for switching, etc., are installed, etc., with which interconnections are essential for improved user convenience and comprehensive and reasonable development of telecom (i.e., facilities with the nature of bottleneck) (OETBA Art. 23-2(4)).

The reasons that the standard on the ratio of the number of fixed subscriber circuits is more than one-half in the respective area are attributed to the following facts: (i)

that a carrier with fixed subscriber circuits meeting the said standard always holds more fixed subscriber circuits than any other carrier in the said area and thereby holds an advantageous position in negotiations over the said any other carrier and (ii) that carriers cannot provide services to a majority of subscribers unless the said carriers interconnect their facilities to the networks with fixed subscriber circuits meeting the said standard, and so the said interconnections are essential for the business development of other carriers and user availability regarding various services (TC, 1996, p. 8; ICC, 2008, pp. 9–10).

Regarding the FTSTLFs meeting, the standard on the ratio of the number of fixed subscriber circuits and the facility installed integrally with the said FTSTLFs, whether to implement new designations and continue existing designations of such facilities (including whether to amend the Ordinance as necessary), would be determined individually based on whether the said facilities have the nature of bottleneck, focusing on the functions of the facilities (ICC, 2008, p. 9; MIC, 2012, p. 5).

In 1997, FTSTLFs were comprehensively designated as Cat. I DTFs regardless of the kind of materials (metal or optical fiber) and the kind of services intended to be provided by the respective FTSTLFs, while, from among the facilities specified by the said Ordinance, only facilities used for the provision of voice transmission services or private leased circuits were designated. In 2001, in response to a proposal by TC (2000b, pp. 26–27)that the bottleneck nature of facilities should be judged regardless of the kind of services intended to be provided by the said facilities, the facilities specified by the said Ordinance were also comprehensively designated in principle, by negative list style individually excluding facilities without the nature of bottleneck (e.g., those available for the interconnecting carriers from competitive markets) from among the facilities specified by the said Ordinance.

In the individual judgments on the bottleneck nature of facilities, the various grounds that have been taken into account are as follows: market trends; the importance of the said facilities; the demands for interconnection with the said facilities; the ratio of the number of users that would be accommodated by the said facilities to the number of the total users; the availability of alternative networks of other carriers by users; the probability that other carriers would actually install alternative facilities in a short period, including the availability by those carriers of equipment for alternative facilities from competitive markets; whether the said facilities have been laid on such scarce bases as utility poles, pipe lines, etc.; whether the carriers installing the said facilities would have a more advantageous position than other carriers in terms of construction work, expenses, procedures, etc., for installing or updating the said facilities; whether smooth interconnections with the said facilities have been ensured; and requests from other carriers to establish uniform interconnection charges (e.g., TC, 2000b, p. 19; ICC, 2007, pp. 8–9; ICC, 2008, p. 9, pp. 12–14, pp. 18–19; ICC, 2009, pp. 40–43; MIC, 2014, pp. 21–22).

The facilities installed by mobile network operators (hereinafter referred to as "MNOs") have not been recognized as essential facilities with the nature of bottleneck. This is because, according to recent studies, at least three carriers in each area have installed their own facilities including TSTLFs and have constructed their own networks comparable to one another throughout Japan, and thereby, as for mobile

communications networks including their subscriber circuits, mutually alternative networks have been available for users and carriers; and that in the mobile communication markets, both the facility-based competition and service-based competition have been active (ICC, 2009, pp. 12–13).

4.2 Interconnection Tariffs and Interconnection Accounting

Regarding interconnections between Cat. I DTFs and the facilities of other carriers, a set of obligations is imposed on carriers installing Cat. I DTFs. The set of obligations includes as follows: the obligation to establish interconnection tariffs on the interconnection charges, etc., and to obtain authorizations from the Minister in principle (the same applies when the said carriers intend to amend such interconnection tariffs) (TBA Art. 33(2)); the obligation to comply with interconnection tariffs (TBA Art. 33(9)); and the obligation to announce authorized interconnection tariffs (TBA Art. 33(11)).

Relatedly, the following systems have been established as well: the system of orders to apply for authorization to amend authorized interconnection tariffs in cases where the said tariffs have been found to become inappropriate due to changes in the circumstances after authorization (TBA Art. 33(6)), and, as the exceptional system of the obligation to comply with interconnection tariffs, the system of authorization to conclude or amend an interconnection agreement under interconnection charges, etc., different from those specified in authorized tariffs (hereinafter referred to as "non-tariff-based interconnection agreement" in this section) (TBA Art. 33(10)).

Carriers installing Cat. I DTFs have also been obligated to keep interconnection accounting and announce the status on the income and expenditure concerning interconnections, etc. (TBA Art. 33(13)) and to keep records of the amount of traffic, etc., for respective functions (TBA Art. 33(12)).

Hereafter in this subsection, the main developments of systems concerning interconnection tariffs and interconnection accounting will be overviewed.

Authorization to Establish or Amend Interconnection Tariffs

Regarding the establishment or amendment of interconnection tariffs, the Minister shall grant authorization in cases where the Minister finds an application for authorization complying with all of the following items (TBA Art.33(4)): (i) the matters listed below are specified properly and explicitly: technical conditions required at the standard interconnection points specified by an Ordinance; interconnection charges for respective functions; matters concerning the responsibilities of the carrier installing the Cat. I DTFs and the responsibilities of the other carriers interconnecting their facilities with the said Cat. I DTFs (hereinafter may be referred to as "interconnecting carriers" in this section); the distinctions of carriers according to which charges for services (hereinafter may be referred to as "service charges") are to be specified; and other matters specified by an Ordinance as necessary for smooth interconnections with Cat. I DTFs; (ii) the interconnection charges are fair

and appropriate in light of the amounts calculated with the methods to calculate proper costs plus proper profits under efficient management; (iii) such terms and conditions are not disadvantageous in comparison with those applicable to cases where the carrier installing Cat. I DTFSs interconnects its own facilities with the said Cat. I DTFs; and (iv) the interconnection tariffs do not treat certain carriers in an unfair and discriminatory manner.

Standard Interconnection Points

The standard interconnection points are to be specified by an Ordinance from among interconnection points where interconnections with the facilities of other carriers are technically and economically feasible (TBA Art. 33(4)(i)(a)). At present, 13 kinds of points are listed in an Order (OETBA Art. 23-9-4). As the reason for ensuring interconnections at technically and economically feasible points, it is pointed out that, unless interconnecting carriers interconnect at the most efficient points in the provision of services, the said carriers might be forced to bear expenses for transmission lines to the points, etc., and thereby the burdens might be passed on to their users (Tagaya et al., 2008, p. 164).

In view of enabling various carriers to implement interconnections in various ways so that they can provide services utilizing their ingenuities, it is desirable that points of interconnection be installed at points where interconnections are easy to implement (ICC, 2008, p. 32). Therefore, based on the proposal by TC (1996) that interconnections with essential facilities should be provided at all technically feasible points (TC, p. 11), a policy was announced that standard interconnection points should be timely and adequately increased according to the needs of other carriers as long as excessive economic burdens would not be imposed on the carriers installing Cat. I DTFs (ICC, p. 32).

Unbundling

In Japan, "unbundling" means a set of measures by a carrier in interconnecting its facilities with the facilities of other carriers to make it possible for the said other carriers to use only the functions essential for the said other carriers' provision of services from among the functions of its facilities making up its networks (TC, 1996, p. 21). In cases where interconnection charges are unbundled for respective functions (i.e., in cases where interconnection charges for respective functions are specified), the interconnecting carriers no longer need to pay interconnection charges pertaining to functions unrelated to the provision of services (ICC, 2008, p. 21; Tagaya et al., 2008, p. 164).

Interconnection charges pertaining to Cat. I DTFs (except those specified in non-tariff interconnection agreements) are required to be specified properly and explicitly, for the respective functions specified by an Ordinance, in the interconnections tariffs (TBA Art. 33(4)(1)(b) and (10)). At present, about forty functions are listed as functions to be unbundled in Art. 3 of the Ordinance for Category I Designated Telecommunications Facilities Interconnection Charges (Ordinance of the MPT No. 64 of 2000; hereinafter referred to as "Ord. for Cat. I DTFIC" in this section). Regarding functions that are not unbundled, interconnection charges are not set for those

functions, and respective parties of the interconnections individually set their service charges for the sections using their facilities (ICC, 2008, p. 6).

For determining whether respective functions should be unbundled, in light of the recognition that unbundling contributes to making possible various ways of interconnection and to promoting competition (TC, 1996, p. 21), the standard adopted is basically that a function shall be unbundled in instances where another carrier has requested unbundling of the said function and the unbundling of the said function is technically feasible (ICC, 2009, p. 16, p. 18).

Calculation of Interconnection Charges and Accounting

In addition to the obligation to unbundle, the interconnection charges pertaining to Cat. I DTFs are required to be fair and appropriate in light of the amounts calculated with the methods specified by an Ordinance (Ord. for Cat. I DTFIC) as methods to calculate proper costs plus proper profits under efficient management, provided, however, that a carrier installing Cat. I DTFs may be excluded from the provisions of the said Ordinance by obtaining permission from the Minister, if there are special grounds (TBA Art. 33(4)(ii); Ord. for Cat. I DTFIC Art. 3). As the said calculation methods, "the actual expense methods" consisting of the following steps have been adopted in principle: processing of interconnection accounting; calculation of costs and profits of interconnection charges and calculation of interconnection charges (ICC, 2015, p. 2, p. 70; "actual expense" refers to the expense actually required for management and operation of Cat. I DTFs (TC, 2000a, p. 1)). The outline of the actual expense method is as follows.

In the processing of interconnection accounting, the said carrier's assets, expenses, and revenues on the said carrier's telecom business shall be classified into the Cat. I DTFs management department (a unit of accounting that keeps records of assets and expenses for the Cat. I DTFs and their management and operation as well as of the revenues related to interconnections with the Cat. I DTFs and provisions of the Cat. I DTFs) and the Cat. I DTFs usage department (a unit of accounting that keeps records of assets and expenses for telecom business activities such as the sales of services (except the Cat. I DTFs and their management and operation) as well as of the revenues related to the said activities) to keep accounts; thereby, the statement of expenses by facilities' classification shall be formulated (Ordinance for Category I Designated Telecommunications Facilities Interconnection Accounting (Ordinance of the MPT No. 91 of 1997 (hereinafter referred to as "Ord. for Cat. I DTFIA" in this section) Arts. 5(1), 6(1), 9, etc.). The expenses shall be attributed to the relevant facilities' classifications, reflecting their relevance to the interconnections (Ord. for Cat. I DTFIA Art. 9; TC, 1996, p. 18).

In this process, the said carrier shall keep accounts of transactions between these departments concerning the use of Cat. I DTFs by the transfer of interconnection charges described in the authorized interconnection tariffs (Ord. for Cat. I DTFIA Art. 5(2)). This is intended to ensure the equivalence between the amount of interconnection charges to be paid by interconnecting carriers and the amount of money to be borne by the Cat. I DTFs management department applicable to cases where

the said carrier interconnects its own facilities with its own Cat. I DTFs (ICC, 2001, p. 34; TC, 1996, p. 16).

The interconnection accounting as such not only provides data to be used for the calculations of the costs, etc., of the interconnection charges but also functions to check and deter cross-subsidization by the said carrier between the said departments as well (Study Group concerning the Accounting System of Telecommunications Business, 2007, p. 3).

The calculation of costs and profits of interconnection charges shall be implemented for the respective unbundled functions by adding the management and operation costs of the Cat. I DTFs pertaining to the said functions calculated based on the expenses described in the statement of expenses by facilities' classification to the total amount of profits based on the assets and expenses for which accounts are maintained in the Cat. I DTFs management department, in principle (Ord. for Cat. I DTFIA Arts. 7, 8(1), etc.; ICC, 2015, pp. 2–3).

By the interconnection accounting, expenses unnecessary for the management and operation of the Cat I. DTFs, such as the sales expenses (excluding those to be attributed to Cat I. DTFs for some explicit reasons), are to be excluded from the costs (Study Group concerning the Accounting System of the Telecommunications Business, 2007, p. 3; TC, 1996, p. 18). This is because interconnection charges are regarded as charges for use of facilities and so the said costs are regarded to be calculated based on expenses pertaining to facilities (ICC, 2009, p. 23).

The calculation of interconnection charges shall be implemented for the respective unbundled functions by dividing the total amounts of costs and profits pertaining to the said functions by the amount of traffic, etc., pertaining to the said functions in principle (Ord. for Cat. I DTFIA Art. 14(1) and (2); ICC, 2015 p. 2). The structure of interconnection charges shall be established as to be reasonable, taking how the management and operation costs of the Cat. I DTFs pertaining to the said interconnection charges are generated into consideration (Ord. for Cat. I DTFIC Art. 14(3)).

In calculations by the actual expense methods as such, in principle, the calculation periods of costs and profits of interconnection charges shall be one year; the said costs, etc., shall be calculated based on the results of the interconnection accounting (i.e., as the said costs, the historical costs are calculated) as described above; as the amount of traffic, etc., the latest actual values shall be used (Ord. for Cat. I DTFIC Arts. 8(2), 9(2), 14(2), etc.; ICC, 2015, p. 3). Such methods are known as "the historical cost methods" and have been used for the interconnection charges pertaining to the functions of metal FTSTLFs, trunk dark fibers, etc. (Study Group concerning the Calculation of Interconnection Charges (hereinafter referred to as "SGCIC" in this section), 2017, p. 98).

However, in calculating interconnection charges pertaining to functions by which interconnecting carriers intend to provide new services whose demands are expected to substantially increase in the future or in cases when it is necessary to mitigate rapid fluctuations of interconnection charges, "the future cost methods" may be used instead of the historical cost methods: At that time, the calculation period for the costs and profits is to be determined to be a period not exceeding 5 years; the said costs, etc., are to be calculated based on reasonable predictions of the amount of

expenses, etc.; the reasonable predicted values of the future amount of traffic, etc., are to be used (Ord. for Cat. I DTFIC Arts. 8(2), 9(2), 14(2), etc.; ICC, 2015, p. 3). The future cost methods have been used for the interconnection charges pertaining to the functions of subscriber dark fiber, NGN, etc. (SGCIC, 2017, p. 98).

Furthermore, for the calculation of interconnection charges pertaining to the functions of PSTN, in light of the difficulty to exclude the inefficiency in the previous management and operation of monopolistic facilities by the actual expense methods, in response to TC (2000a), "the long-run incremental expense methods" have been adopted instead of the actual expense methods since the amendment of TBA in 2000 (ICC, 2001, p. 35)): Calculation of the said interconnection charges shall be based on the assets calculated assuming reorganization of relevant Cat. I DTFs into more effective ones with the use of advanced and new technologies that are generally available and the incremental expenses, calculated on the said assumption, per increase of the amount of traffic, etc., pertaining to services through interconnections with the said Cat. I DTFs (TBA Art. 33(5); Ord. for Cat. I DTFIC Arts. 6, 7, etc.).

Interconnection charges pertaining to functions equivalent to the functions of facilities used for private leased circuit services are to be calculated neither by the actual expense methods nor by the long-run incremental expense methods but by subtracting the amount equivalent to the sales expenses from the amount of relevant service charges (Ord. or Cat. I DTFIC Arts. 8(3), etc.).

In cases where the level of service charges for services provided by a carrier installing Cat. I DTFs and the level of interconnection charges pertaining to the functions used to provide the said services are extremely close, or where the level of the said interconnection charges exceeds the level of the said service charges, unfair competition due to price squeeze may occur (SGCIC, 2017, p. 98). Hence, since 1999, verification that the relationship between the said service charges and the said interconnection charges is not anticompetitive has been implemented (Id.). In 2007, the legislative basis for this verification was established in Ord. for Cat. I DTFIC as follows: The level of interconnection charges shall be set so that the said interconnection charges will not cause unfair competition between a carrier installing Cat. I DTFs and interconnecting carriers (Ord. for Cat. I DTFIC Art. 14(4) at that time).

In 2017, SGCIC (2017, pp. 53–54) pointed out that, in a attempt to deter the said unfair competition due to price squeeze only by reducing the said interconnection charges, a level of the said interconnection charges inconsistent with the Ord. for Cat. I DTFIC might be set. Accordingly, the said provision on the said verification was amended in 2018 (Ord. for Cat. I DTFIC Art. 14-2 after amendment). In the amended provision, it is provided that, in cases where the level of the service charges themselves may cause unfair competition, it is sufficient to set the interconnection charges to the lowest level within the range permitted by other provisions of Ord. for Cat. I DTFIC.

In this verification, for respective service brands, it is verified whether the difference between the total amount of incomes from service charges for services within the said respective brands and the total amount of interconnection charges pertaining to the functions for providing the said services transferred by the Cat. I DTFs

management department plus the total amount of interconnection charges paid to other carriers is below the amount equivalent to the sales expenses collected from the service charges (MIC, 2018b, p. 2). Additionally, for respective service items within the service brands selected by the MIC, it is also verified whether the amount of service charges for the said respective items exceeds the total amount of interconnection charges transferred by the said department and those paid to other carriers for the said respective items (MIC, 2018b, p. 3).

In this verification, in cases where the said differences concerning the said service brands or the service charges for service items within the service brands selected by the MIC are below the respective baseline amounts, the carrier installing Cat. DTFs is required to present rationales that the interconnection charges will not cause unfair competition due to price squeeze or to take measures to resolve the situation on its own (MIC, 2018b, p. 3). The MIC has announced as its policy that it will take measures to correct the said situation based on the provisions of TBA, in cases where the said interconnection charges are found to cause unfair competition due to price squeeze regardless of the response by the said carrier (Id.).

Matters Specified by an Ordinance as Necessary for Smooth Interconnections with Category I Designated Telecommunications Facilities

Matters specified by an Ordinance as necessary for smooth interconnections with Cat. I DTFs (TBA Art. 33(4)(i)(e)) include miscellaneous matters such as the procedures, etc., request to interconnect (e.g., the procedures for the said request and the response; for disclosure of information necessary for the said request, and for conclusion and cancelation of an agreement; related standard periods), etc.; the procedures, etc., for collocation (installment by an interconnecting carrier of equipment necessary for interconnections) in buildings, etc., of the carrier installing Cat I DFTs (e.g., the procedures request to consider and the response; for disclosure of information on the vacant spaces available for collocation and for works; the amount of money and the conditions to be borne by an interconnecting carrier; related standard periods); the amount of money to be paid to an interconnecting carrier concerning works, maintenance, or other operations by the carrier installing Cat. I DTFs; and matters concerning the responsibilities of respective carriers, etc. (OETBA Art. 23-4(2)).

Obligation to Comply with Interconnection Tariffs and Its Exception

The obligation to comply with interconnection tariffs is imposed on carriers installing Cat. I DTFs: Any carrier installing Cat. I DTFs, in principle, shall neither conclude nor amend interconnection agreements with other carriers on interconnections with the Cat. I DTFs that it installs, unless in accordance with its interconnection tariffs authorized by the Minister pursuant to the provision of TBA Art. 33(2) (TBA Art. 33(9)). Exceptions are cases where there are special circumstances that make it difficult to comply with the authorized interconnection tariffs; in such a case, a carrier installing the Cat. I DTFs, upon authorization by the Minister, may conclude or amend a non-tariff-based agreement on the said interconnection as described above (TBA Art. 33(10)).

Regarding the relationship between a request to interconnect with Cat. I DTFs under interconnection charges, etc., which differ from those specified in the authorized tariffs and the obligation to comply with interconnection tariffs, it is understood that the provisions of TBA Art. 32 (the obligation to interconnect) and Art. 35(1) (the system of orders to negotiate) are to be applicable even to a request to interconnect under such conditions. This understanding is based on the following reasons: The first reason is that, under TBA, interconnection tariffs may be amended based on the results of negotiations between carriers; the second is that the negotiations concerning the conclusion of an agreement are considered separate matters from the contents of the said agreement based on the results of the negotiations; the third is that the system of non-tariff-based agreement has been established as an exceptional system of the obligation to comply with interconnection tariffs (TDSC, 2017, pp. II-80-II-82).

4.3 Plans for Provision of Network Functions

The system concerning the plans for provision of network functions was established in response to TC (1996, p. 25) by the amendment of TBA in 1997 in light of recognition that smooth interconnections might be hindered in cases where the carrier installing essential facilities constructs its networks without assuming that they are to be interconnected with the facilities of other carriers or without reflecting the views of other carriers (ICC, 2001, p. 46).

The contents of the system are: (i) Carriers installing Cat. I DTFs are obligated to notify the Minister of plans for a change or addition of functions (except those specified by an Ordinance) of Cat. I DTFs (the same applies in cases where carriers installing Cat. I DTFs intend to amend the notified plans); carriers installing Cat. I DTFs are also obligated to announce the notified plans, to hold notice and briefing sessions for carriers who offered in advance (TBA Art. 36(1); OETBA Arts. 24 through 24-5); (ii) in cases where the Minister finds that the implementation of a notified plan is likely to hinder smooth interconnections with some Cat. I DTFs, the Minister may recommend that the carrier installing the said Cat. I DTFs amends the said plan (TBA Art. 36(3)).

The routers, etc., used for constructing IP networks such as NGN are listed in the said Ordinance (OETBA Art. 24-5) as functions that this system is not to be applied to, in view of recognition that most of these routers, etc., have been developed on the premise of being interconnected (OETBA Art. 25-5; ICC, 2001, pp. 95–96). However, the MIC (2019) has announced that the ordinance (OETBA) will be amended in order to apply the said system to these routers, etc., as well, in view of recognition that smooth interconnections with these routers, etc., have not been necessarily realized in actuality.

5 Systems Concerning Interconnections with Category II Designated Telecommunications Facilities

The set of systems concerning interconnections with Category II designated telecom facilities (Cat. II DTFs) was established in 2001, in response to TC's report in 2000, in light of the relatively strong bargaining powers of carriers with relatively large numbers of subscribers in mobile communication services markets that had been oligopolistic and problematic for new entries in the market due to the finite rarity of frequency (TC, 2000b, p. 13; ICC, 2001, p. 31; ICC, 2009, p. 92; ICC, 2011, p. 94). The set of systems imposes asymmetric regulations on such carriers to ensure expedited interconnections as well as the properness, impartiality, and transparency of interconnection charges, etc. (ICC, 2011, p. 94; ICC, 2014, Ref. 50).

The present set of systems concerning interconnections with Cat. II DTFs comprise the system of designation of Cat. II DTFs (TBA Art.34(1)), the system concerning interconnection tariffs specifying the interconnection charges, etc., on the said interconnections (TBA Art.34(2) - (6)), the system concerning accounting regarding the said interconnections (hereinafter referred to as "interconnection accounting" in this section) (TBA Art. 34(7)), and so on. Hereinafter, this section is devoted to an overview of the respective developments of these systems.

5.1 Designation of Category II Designated Telecommunications Facilities

Category II designated telecom facilities (Cat. II DTFs) consist of facilities that the Minister designates by public notice as facilities that shall be ensured to be interconnected appropriately and smoothly with the facilities of other carriers from among the respective aggregates of the following facilities: (i) TLFs that are installed by one carrier and connected to specified mobile terminal facilities defined in TBA Art. 12-2(4)(ii)(d) (MTFs as specified by an Ordinance; hereinafter referred to as "SMTFs" in this section), in cases where the ratio of the number of the said SMTFs connected to the said TLFs to the total number of SMTFs connected to all TLFs of the same kind installed in the same area as the said carrier's service area using the said TLFs exceeds the ratio specified by an Ordinance (at present, one-tenth), and (ii) facilities specified by an Ordinance and installed by the said carrier to provide their services (TBA Art. 34(1); OETBA Art. 23-9-2(1) and (2)).

At the time of establishment of the system, SMTFs consisted only of MTFs for cellular radio communications (OETBA Art. 23-9-2(2) at that time). Since then, taking into account ICC's proposal in 2014 that the share for designation should be considered including the numbers of SMTFs of BWA, etc., in addition to the numbers of mobile phone based on the recognition that cellular services and BWA services have become similar (ICC, 2014, p. 25), MTFs for BWA were additionally specified as SMTFs in 2016 (OETBA Art. 4-4(1)).

The said facilities specified by the said Ordinance include Category II designated terminal system switching facilities (switching facilities directly accommodating TLFs directly connected to SMTFs), Category II designated trunk system switching facilities (switching facilities for communications to SMTFs in the service areas), certain TLFs (radio equipment of radio stations transmitting radio waves to or receiving radio waves from SMTFs, TLFs installed between such radio equipment and buildings in which Category II designated terminal system switching facilities are installed, TLFs installed between such buildings and buildings in which Category II designated trunk system switching facilities are installed) (OETBA Art. 23-9-2(3)).

The standard on the ratio of the number of SMTFs connected to TLFs, at the time of establishment of the system, was specified as one-fourth taking into account that three or four carriers were competing in the provision of cellular phone services within their respective areas (MIC, 2001, pp. 9–10 of Anx. 1 in Atch. 1). In 2012, the standard was amended to one-tenth. This amendment was based on a proposal by the ICC to impose the set of regulations concerning interconnections with Cat. II DTFs on the top three MNOs in light of the shrinking disparity among them in bargaining power, the significant difference in bargaining power among the top three MNOs and the fourth-ranked MNO, the strong bargaining powers of MNOs (other than MNOs with a considerably low shares) against mobile virtual network operators (hereinafter referred to as "MVNOs" in this section), etc. (ICC, 2011, pp. 97–100; Information and Communications and Posts Administrative Council, 2012, pp. 9–10).

Respectively, the facilities of NTT DOCOMO Group carriers (merged into NTT DOCOMO in 2008) and Okinawa Cellular Phone have been designated since 2002, the facilities of KDDI since 2009, and the facilities of SoftBank since 2012 as Cat. II DTFs, regardless of the distinction of the generation of wireless communication represented (2G, 3G, 4G, etc.).

5.2 Interconnection Tariffs and Interconnection Accounting

Regarding interconnections between Cat. II DTFs and the facilities of other carriers, a set of obligations is imposed on carriers installing Cat. II DTFs. The set of obligations includes as follows: the obligation to establish interconnection tariffs on the interconnection charges, etc., and to file notifications with the Minister prior to their implementations (the same applies when the said carriers intend to amend such interconnection tariffs)(TBA Art. 34(2)); the obligation to comply with interconnection tariffs (TBA Art. 34(4)); and the obligation to announce the notified interconnection tariffs (TBA Art. 34(5)). The system of orders to amend notified interconnection tariffs falling under certain grounds (TBA Art. 34(4)) has also been established.

Since FY 2010, carriers installing Cat. II DTFs are obligated to keep interconnection accounting and announce status on income and expenditure concerning interconnections, etc. (TBA Art. 34(6)).

Hereafter in this subsection, the main developments of systems concerning interconnection tariffs and interconnection accounting will be overviewed.

Order to Amend Notified Interconnection Tariffs

Unlike carriers installing Cat. I DTFs, carriers installing Cat. II DTFs are not obligated to obtain authorizations from the Minister for establishment or amendment of interconnection tariffs. Nor are these carriers obligated to notify the Minister of plans for any change or addition of functions of Cat. II DTFs. As for the reasons, it is pointed out that Cat. II DTFs do not comprise facilities with the nature of bottleneck, etc. (ICC, 2009, p. 15; ICC, 2014, pp. 28–29). Regarding interconnections with Cat. II DTFs, the rapidity of such interconnections as well as the properness, impartiality, and transparency of the interconnection charges, etc., is to be secured ex post facto by the system of orders to amend notified interconnection tariffs (hereinafter may be referred to as "OAIT" in this section).

At the time of establishment of the system of OAIT, the cases where OAIT might be issued were limited to: (i) cases where matters concerning the responsibilities of the respective carriers were not specified properly and explicitly; (ii) cases where the interconnection charges exceeded the amount of money calculated proper costs plus proper profits under efficient management; (iii) cases where the interconnection tariffs imposed unreasonable terms and conditions on the other carriers; or (iv) cases where the interconnection tariffs treated certain carriers in an unfair and discriminatory manner (TBA Art. 38-3(3) at that time).

By the amendment of TBA in 2003, taking actual cases of disputes between carriers into account (Tagaya & Okazaki, 2005, pp. 87–88, p. 93), the cases listed below were added as the cases where OAIT might be issued: cases where technical conditions required at the interconnection points were not specified properly and explicitly and cases where the distinctions of carriers according to which service charges were to be specified were not specified properly and explicitly (TBA Art. 34(3)(i) and (iii) at that time). At the time of the amendment, however, standard interconnection points at which technical standards were required to be specified were not provided as a matter to be specified by an Ordinance.

In 2009, ICC made this proposal: Regarding standard interconnection points, taking into account that issues concerning standard interconnection points had not often been regarded as problematic in light of fair competition, formulations of consents by negotiations between carriers should be respected and the matters for carriers to keep in mind in such negotiations should be specified in guidelines by MIC (ICC, 2009, p. 19); regarding methods of calculating interconnection charges, taking into account that respective carriers installing Cat. II DTFs adopting different methods, guidance concerning methods should be specified in the guidelines by MIC (ICC, pp. 19–21); regarding unbundling, taking into account the increase of functions that carriers installing Cat. II DTFs were unilaterally requested by other carriers to provide (e.g., functions of data communications), frameworks of unbundling should be specified in the guidelines by MIC (ICC, pp. 17–18). In 2010, guidelines in line with these proposals were published by MIC (2010).

Even after the announcement of the guidelines, problems occurred, such as prolonged negotiations, because unbundled functions, methods of calculating interconnection charges, etc., were still freely determined by carriers installing Cat. II DTFs (Ishitani, 2015, p. 11). Hence, taking a report by ICC in 2014 into account, TBA was amended in 2015 (Ishitani, p. 7, pp. 10–11) so as to provide that standard interconnection points and methods of calculating interconnection charges were to be, respectively, specified by respective Ordinances, as well as to add the cases listed below as the cases where OAIT might be issued: cases where the interconnection charges for the respective functions specified by an Ordinance were not specified properly and explicitly and cases where matters specified by an Ordinance as necessary for smooth interconnections with Cat. II DTFs were not specified properly and explicitly (TBA Art. 34(3)(i)). Additionally, among incumbent cases where the said orders might be issued, the cases concerning unreasonable terms and conditions imposed on other carriers were replaced with the current cases: cases where such terms and conditions were disadvantageous in comparison with those applicable to cases where the carrier installing Cat. II DTFSs interconnects its own facilities with the said Cat. II DTFs (TBA Art. 34(3)(iii)).

Standard Interconnection Points and Unbundling

Since the enforcement of TBA amended in 2015, the standard interconnection points are to be specified by an Ordinance from among interconnection points where interconnections with the facilities of other carriers are technically and economically feasible similar to the case of Cat. I DTFs (TBA Art. 34(3)(i)(a)). At present, three kinds of points are listed by an Order (OETBA Art. 23-9-4). The functions to be unbundled (i.e., functions for which interconnection charges shall be specified in the interconnection tariffs) also are to be specified by an Order (TBA Art. 34(3)(i)(b)). At present, functions to transmit and exchange voices and other sounds, functions to transmit and exchange data, functions for number portability, and functions to transmit short messages are listed by an Order, Ordinance for Category II Designated Telecommunications Facilities Interconnection Charges (Ordinance of the MIC No. 31 of 2016; hereinafter referred to as "Ord. for Cat. II DTFIC" in this section).

For determining whether respective functions should be unbundled, such unobtrusive criteria have been adopted in MIC's guidelines as: from among functions falling under the criteria equivalent to the criteria on functions of Cat. I DTFs that should be specified as to be unbundled by an Ordinance, only functions pertaining to services of high necessity and importance (e.g., functions pertaining to services with high convenience for users, functions pertaining to services desired to be provided by various carriers from a viewpoint of fair competition, and functions pertaining to services actually used by a large number of users) should be specified as to be unbundled by an Ordinance (MIC, 2017, p. 13).

Calculation of Interconnection Charges and Interconnection Accounting

Regarding interconnection charges pertaining to Cat. II DTFs, as one of the grounds on which OAIT might be issued, in addition to the ground on unbundling, are listed the cases where the interconnection charges exceeding the amounts of money calculated

by the methods specified by an Ordinance (Ord. for Cat. II DTFIC) as methods of calculating proper costs plus proper profits under efficient management, provided, however, that a carrier installing Cat. II DTFs may be excluded from the provisions of the said Ordinance by obtaining approval from the Minister, if there are special grounds (TBA Art. 34(3)(ii); Ord. for Cat. II DTFIC Art. 3).

The said methods of calculation, in principle, consist of these three steps: processing of interconnection accounting; calculation of costs and profits; and calculation of interconnection charges. Since the announcement of MIC's guidelines in 2010, the actual cost method based on historical costs has been adopted as the framework of the methods of calculating interconnection charges and associated costs and profits as follows.

The system concerning interconnection accounting pertaining to Cat. II DTFs has been established as a minimum regulation in response to a proposal by ICC to establish such system so as to improve the verifiability of interconnection charges taking into account the viewpoint of transparency of interconnection charge calculations and the viewpoint of control of regulatory costs (ICC, 2009, pp. 28–29; ICC, 2011, p. 94). In the said interconnection accounting, unlike the case of Cat. I DTFs, assets, expenses, and revenues are classified not by facilities but by service types in keeping of accounts (Ordinance for Category II Designated Telecommunications Facilities Interconnection Accounting (Ordinance of the MIC No. 24 of 2011); hereinafter referred to as "Ord. for Cat. II DTFIA" in this section).

The costs and profits of interconnection charges shall be calculated, for the respective unbundled functions, based on the assets and expenses for which the relevant accounts are maintained in the interconnection accounting (Ord. for Cat. II DTFIC Arts. 5, 6 (1) and (2), etc.). Interconnection charges are regarded as charges for use of facilities, and hence sales expenses, etc., are to be excluded from the said costs in principle (MIC, 2017, pp. 17-18). The interconnection charges shall be calculated for the respective unbundled functions by dividing the total amounts of costs and profits pertaining to the functions by the actual values of the amounts of traffic, etc., pertaining to the calculation periods of the costs and profits (Ord. for Cat. II DTFIC Art. 11(1) and (2)).

The calculation periods of costs and profits shall be one year (Ord. for Cat. II DTFIC Art. 8(3)). Interconnection charges shall be calculated, at the time of completing interconnection accounting, based on the results of interconnection accounting and the actual values of the amounts of traffic, etc. (Ord. for Cat. II DTFIC Art.16(1)). The actual values are to be finalized in the next fiscal year, and hence the interconnection charges for respective years shall be paid based on the actual values of the respective previous fiscal years and shall be settled ex post facto (Ord. for Cat. II DTFIC Art. 16(2)). Regarding this matter, in light of the lack of foreseeability for MVNOs on the final amounts of payments, etc., a study has been underway on the adoption of the future cost method to ensure fair competition between MNOs and MVNOs (*Study Group,* 2019, pp. 15–16, pp. 21–22, p. 24).

Regarding the structure of interconnection charges, it has been provided that the said structure shall be established as to be reasonable, taking into consideration how the management and operation costs of the Cat. II DTFs pertaining to the said

interconnection charges are generated (Ord. for Cat. II DTFIC Art. 11(3)). In 2007, in response to an application from an MVNO for an award regarding the structure of interconnections charges on requesting interconnections with Cat. II DTFs installed by an MNO, the Minister rendered an award to adopt a flat rate structure proportional to the bandwidths of the interconnected circuits in view of the ease for the said MVNO to provide various services if the said flat rate structure was adopted, in view of the difficulty for the said MVNO to provide flat rate services competing with those provided by the said MNO if a measured rate structure proportional to the traffic was adopted, etc. (TDSC, 2017, p. II-121).

Regarding the level of interconnection charges, it has been provided that the said level should be set so that the said interconnection charges might not cause unfair competition between the carrier installing Cat. II DTFs and other carriers (Ord. for Cat. II DTFIC Art. 11(4)). Regarding the method of verification of the relationship between interconnection charges and relevant service charges, a study is underway (*Study Group,* 2019, pp. 24–29).

The properness of interconnection charges is to be verified based on documents concerning the basis of calculating interconnection charges submitted by carriers installing Cat. II DTFs at the time of their notification of relevant interconnection tariffs (OETBA Art. 23-9-3; Review Group concerning Promotion of Fair Competition in the Mobile Markets, 2018, p. 41). An obligation to submit the said documents has been established in response to ICC's report in 2009 (ICC, 2009, pp. 27–28).

Matters specified by an Ordinance as Necessary for Smooth Interconnections with Category II Designated Telecommunications Facilities

The matters specified by an Ordinance as necessary for smooth interconnections with Cat. II DTFs (TBA Art. 34(3)(i)(e)) include miscellaneous matters such as procedures, for a request to interconnect, etc.; procedures, etc., for collocations; procedures for provision of service usage management systems or SIM cards by the carrier installing Cat. II DTFs; functions of the said systems; types and functions of the said SIM cards; the amount of money to be paid by an interconnecting carrier concerning works, maintenance, and other operations by the carrier installing Cat. II DTFs; and matters concerning the responsibilities to be borne by respective carriers regarding troubles concerning the provisions of services by the carrier installing Cat. II DTFs due to congestion, accident, etc. (OETBA Art. 23-9-5).

6 Systems for Wholesale Telecommunications Services

As a method of constructing a network enabling telecom between facilities of one carrier and those of another by a means other than a method of interconnections, the method of wholesale telecommunications services (hereinafter may be referred to as "wholesale services") can be used (MIC, 2016a, pp. 7–8, p. 13). By this method, one carrier who concludes a contract with another carrier to receive provision of a wholesale service from the said another carrier receives the provision of the said

wholesale service as a user of the said wholesale service, and thereby the said carrier is able to construct a network for providing its own services by combining its own facilities and those of the network of the said another carrier used for providing the said wholesale service (Id.). In constructing this kind of networks, interconnections and wholesale services have been flexibly combined based on the preferences of the parties (ICC, 2014, Ref. 42).

Regarding wholesale services, similar to interconnections, in cases where the Minister finds that a carrier hinders other carriers from properly conducting their business activities by treating certain carriers in an unfair and discriminatory manner in providing wholesale services or by conducting other unfair operations related to activities on providing wholesale services and is thereby likely to seriously impair the public interest, the Minister may order the said carrier to improve the methods of conducting its business activities or take other measures within the limits necessary for ensuring the public interest (TBA Art. 29(1)(x)).

Regarding wholesale services, however, unlike the obligation to interconnect applicable to interconnections with any kind of circuit facilities, only limited kinds of services (universal telecom services prescribed in TBA Art. 7 and telecom services by carriers who obtained approvals set forth in TBA Art. 117(1) from the Minister for public utility privileges, etc.) are subjected to the obligation to provide services (TBA Art. 25, 121(1), etc.). Moreover, the said obligation to provide services does not force carriers to provide wholesale services under conditions not having been applied to other carriers or end users (MIC, 2017, pp. 5-6). Additionally, the system of orders to negotiate concerning wholesale services (TBA Art.39) is an unobtrusive system similar to the system of orders to negotiate set forth in TBA Art. 35(2) concerning interconnections other than interconnections with circuit facilities.

Since the enforcement of TBA amended by the Act No. 26 of 2015, in order to ensure properness, impartiality, and transparency of wholesale services toward promoting fair competition (Telecom Bureau, 2018, p. 2), when a carrier installing Cat. I DTFs or Cat. II DTFs commences provision of a wholesale service by using the said Cat. I DTFs or Cat. II DTFs, the said carrier is obligated to file a notification without delay to the Minister on the fact of the said commencement, the type of the said wholesale service and other information specified by an Ordinance (such as the contents and the service charges) (TBA Art. 38-2; OETBA Arts. 25-7, etc.); the Minister shall compile the information in the said notification and publish the compiled information via the Internet, etc. (TBA Art. 39-2 (c)).

However, no carrier is obligated to establish tariffs in providing any kind of wholesale services unless the said wholesale services are either universal telecom services set forth in TBA Art. 7 or designated telecom services set forth in TBA Art. 20. Nor are carriers obligated to unbundle their network functions in providing any kind of wholesale services.

Hence, it may be pointed out that the set of systems concerning interconnections formulates the baseline for construction of networks, while the systems concerning wholesale service provide an alternative option for the said baseline. For reasons of space, further discussion on the systems and policies concerning wholesale services must be left for another occasion.

7 Conclusion

In this chapter, after overviewing the fundamental policies on the regulatory systems concerning interconnections established in TBA, the developments of the said systems were overviewed. The said systems may well be summarized as systems that ensure smooth interconnections for enabling carriers to construct networks properly and reasonably.

Attention regarding functions of regulatory systems concerning interconnections tends to be directed to the function of formulating level playing fields enabling fair competition among carriers in the provision of services. However, it is noteworthy that for both the general systems concerning interconnections and the special systems concerning designated facilities, are such functions expected not only from an economic law perspective, but also from the perspective of functions that contribute to ensuring improved user convenience, thereby ensuring and increasing the public interest, as has been discussed in this chapter.

According to the purpose of TBA prescribed in Art. 1, the said public interest to be ensured and increased by the regulatory systems concerning interconnections is to be understood as being matters fostering the sound development not of the telecom business but of telecom itself and the convenience for citizens (i.e., actual and potential, and direct and indirect users), in light of the public nature of telecom business. Therefore, regulatory systems concerning interconnections should be formulated and operated as systems with functions to ensure and improve the said public interest toward the level expected in light of the said public nature. Such unique functions cannot be substituted by the general competition law.

The formulation and operation of the regulatory systems concerning interconnections have continued to be at the center of the developments of policies shaping the telecom business. Issues concerning interconnections will change along with the changes of circumstances related to telecom. The changes of circumstances will include the spread of advanced technologies (e.g., 5G wireless communication technology); the growth of IoT; the increase and advancement of utilization of AI and big data; and so on. The regulatory systems concerning interconnections require to be reviewed continuously according to such changes.

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Radio Spectrum

Spectrum Management

Tomoo Nemoto

1 Introduction

This chapter describes the legal framework of radio frequency spectrum management and typical policy issues around radio frequency spectrum allocation and assignment.

The radio frequency spectrum is theoretically infinite, but practically it is finite and rather scarce, mainly because of the characteristics of radio waves. Recent technological development overcomes the practical limitation and expands the part of the radio frequency range that we are able to use. This expansion induces frequency redeployment as the expansion of a city induces land readjustment. As soaring land prices shift a population from central urban areas to suburbs, increasing demand of mobile communication services shifts other services from the frequency bands where demand is concentrated to the higher-frequency bands.

The practical limitation of the radio frequency spectrum also urges governing administrations to select with care the best-suited licensee(s) among applicants. With regard to the licensee selection process, especially for the implementation of some commercial services, mobile communication services being one such example, some countries adopt the auction method, which is based on comparison by the monetary values involved. Japan, however, adopts the selection method known as a "Beauty Contest." Thus, in addition to the aforementioned "legal framework," this chapter also explains the policy background of spectrum management and analyzes the differences between the two methods of licensee selection.

This chapter is closely related to the following chapter, particularly with regard to licensee selection and relevant issues concerning mobile communication services.

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2 Radio Act and Spectrum Management

2.1 The Radio Act

The Radio Act governs frequency spectrum management in Japan. The Radio Act basically prohibits the emission of radio waves without a radio station license. Even so, several exceptions and special rules exist related to radio frequency spectrum usage. All of the rules are justified regulating principles promoting the public welfare by ensuring fair and efficient use of radio waves.

The Radio Act, established on May 2, 1950, has been modified more than eighty times since its establishment. The Act stipulates rules concerning the procedures governing obtaining a radio station license, technical requirements, procedures for certification of conformance, qualifications pertaining to operating a radio station, and other operational rules and procedures. Many operational regulations necessary under the Radio Act take the form of ministerial ordinances, ministerial notices, and directives, which are internal but published circulars. The Minister for Internal Affairs and Communications has the competence for these regulations.

The purpose of the Radio Act is stipulated as to promote the public welfare by ensuring the fair and efficient usage of radio waves. Imaizumi (2002, p. 15) explains that the fair usage of radio waves is an expression used for indicating the principle of licensee selection by considering both the extent to which the purpose of a radio station contributes to the public welfare and the necessity of the radio station. This is the underlying reason for employing a comparative review in the licensee selection. (For further discussion on licensee selection, please read Sects. 5–7). Imaizumi also explains that the expression efficient usage of radio waves is intended to mean to refrain from using radio waves unnecessarily or in an inefficient manner.

2.2 Radio Waves and Usage Defined

The Radio Act defines “radio waves” as electromagnetic waves of frequencies not exceeding 3000 GHz. Electromagnetic waves are basically produced by oscillation or fluctuation of electric currents. Electromagnetic waves are efficiently emitted and received under good electrical resonance conditions. Most of the antenna elements are adjusted as 1/4 or 1/2 wavelength so as to resonate well with the waves. This means that radio waves at a lower frequency require a very long antenna; such a long antenna physically detracts from portability. On the other hand, at higher frequency, the antenna is so small that it sometimes is unable to receive sufficient electric power from radio waves and so a dish-shaped reflector to aggregate weak signals might be required.

The propagation characteristics of radio waves also defer with their frequencies. At a lower frequency, radio waves can be diffracted around obstacles and can reach behind them. In contrast, at a higher frequency, diffraction is less likely and radio

waves are blocked by obstacles. Nevertheless, the higher the frequency of radio waves, the greater will be the amount of information that can be transmitted.

As a result of the interrelation among the frequencies of radio waves, which has a high correlation with antenna length and propagation characteristics, the preferable frequency for a particular radio communication service would be determined within a specific range of the radio frequency spectrum where we could achieve a good balance of these characteristics. Therefore the radio frequency range for practical use is limited. In fact, demands are concentrated into the moderate range of the spectrum. The most concentrated range lies roughly between VHF (Very High-Frequency: 30–300 MHz) and SHF (Super High-Frequency: 3–30 GHz). SHF is a lower part of the so-called microwave range, which lacks a clear definition.

Identification of the radio frequency band to be used for a specific purpose is based on a variety of factors, not limited to the ones mentioned above, plus restrictions such as other difficulties including complex signal processing. Even if a higher transmission rate is demanded for a certain radio communication service, regardless of propagation characteristics, for instance, the manufacture of signal processing circuits and associated devices having the required accuracy can be problematic. Thus, some products fail to satisfy demand due to technical barriers. This means that the usable bands of the radio frequency spectrum are expanded over a higher range by technological innovation. For example, frequency bands used for personal mobile communication services have expanded from "800/900 MHz and 1.5 GHz" for Personal Digital Cellular (PDC) to "700/800/900 MHz, 1.5/1.7/2/3.5 GHz" for Long Term Evolution–Advanced (LTE-Advanced). The PDC is a 2G (second generation) mobile communication system which uses time-division multiple access (TDMA) technologies and $\pi/4$-quadrature phase shift keying (QPSK) digital modulation for transmission of 42 kbps. LTE-Advanced is a 4G (fourth generation) mobile communication system using single carrier frequency division multiple Access (SC-FDMA) technology for uplinking, orthogonal frequency division multiplex (OFDM)-based technology for downlinking and adaptive modulation of binary phase shift keying (BPSK), QPSK, 16 quadrature amplitude modulation (QAM), and 64QAM for the transmission of 1 Gbps or more. More accurate and more complex signal processing technologies have achieved LTE-Advanced.

Radio waves are basically used for providing a practical means of communication over a distance, even for the communication between two fixed points, where the fixed line, mostly an optical fiber line for a high transmission rate, can be installed. The transmission rate of optical fibers is quite high, and today the use of optical fiber is widespread nationwide. Nevertheless, when someone wants to have a personal dedicated connection line for some reason, fixed communication by radio waves can be a good solution. The cost is calculated according to the number of the radio stations rather than "distance," and installation and maintenance costs can be reduced when the distance between two points is sufficient. In addition, generally a radio communications system is much easier to install than a wireline system, an economical advantage of radio communication services. Formerly, radio stations were operated for long-distance telephone calls as their use at that time was considerably cheaper than connecting telephone network hubs by electric wirelines.

Another advantage of radio communication is its robustness. Radio communication requires neither wirelines nor cables to deliver signals, which can be problematic in times of a natural disaster, such as a flood or a landslide. Therefore, many governmental agencies or other organizations in charge of security or disaster mitigation have their own radio stations for inter-agency communication.

Radio communication also releases users formerly bound to each access point of wireline, and it allows for the freedom of movement. This advantage of radio communication is sometimes accompanied the ease of automatically establishing a network connection. Users are also freed from plugging in cables or other manipulations. This convenience has removed cables from our offices and living rooms.

The usage of radio waves is not limited to fixed and mobile communications. Radio waves are also used to detect objects. A radar system emits radio waves and processes their reflections from a distant object. Analyzing the reflected signals provides information such as the distance and velocity of a distant object. The suitability of the frequency range of the radio waves depends on the targeted object, and, in principle, a wider bandwidth provides more precise information. Even for radar systems, there are preferences in selection of the frequency band. Some radar applications require a very wide frequency band for high precision, while other applications require high transmission power for delivering pulses over a long distance. Thus, the frequency bands for radar systems occupy a specific part of the radio frequency spectrum. Although radar has evolved from very simple devices to advanced system capable of complex signal processing, radar's evolution does not seem rapid at all when compared alongside that of radio communications systems. This is probably because the operation of radars tends to be more restricted by the laws of physics.

2.3 Radio Station

The Radio Act defines as a "radio station" as a facility composed of two elements: radio equipment and radio equipment operator. Moreover, radio equipment is defined as the electric equipment used to transmit and/or receive radio waves. Nevertheless, the definition of radio station excludes a station used solely for receiving purposes. This is reasonable exclusion considering that most of the rules and regulations of the Radio Act are established to avoid or eliminate interference or disturbance caused by transmission of radio waves. This transmission is clearly distinguished from electromagnetic induction; therefore, some radio frequency identifiers (RFIDs) using electromagnetic induction are not radio stations even though they can establish communication between terminals without use of a wireline.

There is minor mismatching surrounding this definition of radio station in comparison with international regulations. For instance, equipment delivering electric energy by radio waves must be classified as radio equipment because it transmits radio waves and is regulated by the Radio Act. However, in the definition of the Radio Regulations of the International Telecommunication Union (hereinafter referred to as ITU), it is unclear whether the transmission of radio waves corresponds to any of

the radio communication service because it might not deliver an associated sign or signal. Nevertheless, the definition by Radio Act is more practical since even radio waves delivering no information can interfere with other communications and so they should be regulated appropriately.

The Radio Act also stipulates rules concerning the operation of radio stations. Kawashima and Ito (1951, pp. 195–198) explain that the rules including major operational obligations are listed as (1) interference prevention, (2) communication secrecy protection, (3) communication procedure and method, (4) using pseudo antenna in testing, and (5) listening for emergency communication. The last two [i.e., (4) and (5)] are sub-obligatory according to Kawashima and Ito. The first obligation of interference prevention is imposed on operators of radio stations, effectively when the same frequency is shared, and it obliges the operators not to cause harmful interference to the operations of other radio stations. The second obligation of communication secrecy protection is due to Article 21 of the Constitution of Japan. The communication procedure and method are regulated basically so as to ensure the fair and efficient usage of radio waves, and the third obligation by the Radio Act is essential to guaranteeing fair and efficient usage.

Radio stations shall be supervised by the Minister: The individual actions of the Minister's supervision are basically taken in cases of an illegality, but are not limited to illegalities. Also included are the actions to prevent a future illegality and those that enhance matters in the public interest. Imaizumi (2002, pp. 335–336) classifies the Minister's supervision into three categories as (1) supervision for public interests (e.g., orders requesting frequency or transmission power change), (2) supervision against illegal operation (e.g., orders of temporary suspension of transmission), and (3) general supervision (e.g., special inspections for radio stations, requests for reports).

2.4 Spectrum Redeployment

Radio communication services have advanced dramatically. Some decades ago, I could ring someone's pager to let him know that I needed him to contact me. The message sent to his pager was a one-way communication at first, composed of numeric characters only. He could not transmit a return response, and so there was no way of knowing whether or not my message had been received if I didn't received a return call. Some years later, I could call him directly on a cellular phone. Eventually, we could exchange messages, photos, and even movies. A broader bandwidth made these latter conveniences possible. Today, we can communicate almost anywhere, thanks to the wide coverage of mobile communication services.

The transition of radio communication services and technological development always makes the administrative restructuring of frequency spectrum allocations and assignments necessary. In recent years, it is necessary to create vacant frequency bands because, with most frequency bands already assigned to radio stations, it was

not possible to accommodate new radio communication services. You might remember the implementation of digital terrestrial TV broadcasting following the closure of analog transmission. The frequency bands formerly used for analog terrestrial TV broadcasting are currently used for other purposes. Some mobile communication services are one of the purposes. To vacate a frequency band, the expiration date of frequency use is set for operating radio stations. After the expiration date, the frequency band becomes vacant and can be reassigned for new radio station use. This is so-called spectrum redeployment (or frequency reallocation or restructuring of the spectrum allocation). In most of the cases, the original purpose of the vacating radio stations did not change; these radio stations were simply transferred to another frequency band, sometimes in a more sophisticated form (e.g., digitized, or higher multiplexed) as a transition of terrestrial TV broadcasting.

Spectrum redeployment is often experienced in a preparation process for the implementation of a new generation of mobile communication services. Basically, mobile communication is more advantageous than fixed communication, which is why mobile demand is expanding rapidly. Nevertheless, the numerous technological constraints have hindered the transition to mobile communication, and a new generation of mobile communication is implemented as new technologies launch complex signal processing, capacity, and connectivity to higher levels. The mobile communication systems have evolved by successive degrees reflecting both expanding demand and technological developments; at every step, a system basically has required another dedicated frequency band. The constant evolution in radio communication technologies emphasizes the need for continuous restructuring of spectrum allocation.

3 Spectrum Allocation

3.1 International Frequency Allocation

To discuss restructuring of the spectrum allocation, we should begin with the origin of the spectrum allocation. As radio waves propagate in free space, radio stations assigned the same frequency as another station or in the vicinity of another station can cause harmful interference. The condition of sharing frequency depends on the radio communication services. For instance, cellular phones can share frequency with fixed satellite services, which is the communication service between fixed points via satellite. The uplink from an earth station to its satellite does not interfere with cellular phone communication because the directional antenna of the earth station is set toward the satellite; radio waves transmitted by cellular phones are very weak at the satellite orbit or the point of reception. Nevertheless, for the downlink from the satellite to the earth station, frequency sharing can be problematic. The radio waves transmitted by the satellite are very weak at the surface of the ground and might not interfere with cellular phone signals. However, interference from cellular phones to

an earth station might not be ignored because radio waves from cellular phones are stronger than satellite radio waves to an earth station. This kind of interference often occurs across national borders.

To minimize the probability of interferences and assign frequencies efficiently, frequency allocations should be determined under international coordination through meetings and conferences of the ITU, the United Nations' specialized agency. Generally, the ITU revises the Table of Frequency Allocations as a part of the Radio Regulations every three or four years. The Radio Regulations are considered the international rule book of radio communications, complementing the Constitution and Conventions of the ITU.

The Table of Frequency Allocations indicates what frequency band is allocated to what radio communication service. For instance, in the 2016 edition (International Telecommunication Union 2016), "10.55–10.6 GHz" is globally allocated to "Fixed Service" and "Mobile Service (except aeronautical mobile)" on a primary basis, and "Radiolocation" on a secondary basis. The Radio Regulation stipulates that radio stations of a secondary service shall not cause harmful interference to stations of primary services and cannot claim protection from harmful interference from stations of primary services. In this instance, the technical conditions and operating rules for secondary services would be more stringent than those for primary services at the national level.

The ITU divides the world into three regions having frequency allocations that can differ regionally: Region 1 (Europe and Africa), Region 2 (the Americas), and Region 3 (Asia and Oceania). In addition, alternative allocations can be implemented in specific regional areas if agreed to in the form of the footnotes in the official documentation. This flexibility allows for exceptional kinds of allocations based on the agreement of the administrations concerned.

3.2 Discussion on Revision of Table of Frequency Allocation

Regarding discussion on the revision of the Table of Frequency Allocation, a reference model consisting of a set of parameters (such as transmission power, antenna gain, the necessary bandwidth, modulation, antenna height, interference ratio, and other related matters) should be specified for each relevant service. These parameters are to be used in the frequency-sharing study inputs (i.e., simulations or calculations) to identify sharing criteria between services newly allocated in the same or close spectrum band(s). The sharing study will make sure neither service is subject to harmful interference (i.e., whether the level of interference from one to the other meets a certain sharing criterion). With agreement on allocation, the relevant parameters and sharing criteria will underlie the technical or operational norms or regulations, or some might be incorporated as footnotes in the Table of Frequency Allocations.

3.3 National Frequency Allocations

Member states of the ITU basically shall assign frequencies to radio stations in accordance with the Table of Frequency Allocations. Many member states have their own national frequency allocation tables, as is the case of Japan. The Radio Act stipulates that the Minister shall prepare the Frequency Assignment Plan. The Frequency Assignment Plan includes the national frequency allocation table, which lists all the assignable frequency bands. The table is in line with international frequency allocations. Every frequency assignment must be carried out according to this plan.

The Frequency Assignment Plan comprises (1) the assignment plan of frequencies used by radio communication services (e.g., Fixed Service, Mobile Service, Broadcasting Service, Amateur Service, and others), (2) the assignment plan of frequencies by purpose of radio stations (e.g., telecommunications business services, public services), (3) conditions for frequency use (e.g., maximum permitted transmission power), and (4) specified frequencies designated through the approval for Establishment Plan for Specified Base Stations. The plan also includes the deadline of the frequency to be vacated as a condition for frequency use.

The MIC introduced the Frequency Assignment Plan in the amended Radio Act of the year 2000 (Ministry of Justice 2016). At the time, the radio frequency spectrum was congested due to heavy use and competition among telecom competitors, especially in the mobile sector, was intense. The Frequency Assignment Plan was devised to promote efficient use of the radio frequency spectrum and to improve information disclosure for more transparent radio station licensing procedures.

Another aim of formulating and proclaiming the plan was to encourage more companies to enter the radio communication-related market as its latest status and future plans concerning assigning frequencies according to radio stations purpose were clarified. More effective use of the radio frequency spectrum was also expected because revising the plan required that discussions be held with the Radio Regulatory Council. Because revision of the Frequency Assignment Plan can weigh heavily on the business operations of the licensee of a radio station, it is essential that companies follow fair and transparent procedures.

The Minister reflects the Frequency Assignment Plan, which includes conditions for frequency use, in the technical requirements set to avoid harmful radio interference. Technical requirements are basically written in the form of either an Ordinance Regulating Radio Equipment, or a relevant public notice. Technical requirements are stipulated according to their necessity, and in many cases they concern frequency tolerances, bandwidth frequencies, and the intensity of higher harmonic waves.

But in cases where the requirements are to be satisfied by parameters such as assignable frequencies and maximum transmission power, which are designated by the Minister, requirements are included in licensing criteria. Licensing criteria were originally intended to provide instructions to help officials make impartial and efficient decisions in the radio station licensing process. These decisions are not limited to deciding whether or not the licenses should be granted, but they also include selection of the frequencies to be designated on the licenses. Nevertheless, as for

license-free radio stations, their frequencies are stipulated in either Ordinance Regulating Radio Equipment or relevant public notices. These differences in formality are closely related to procedures concerning radio station licensing and certification of conformity.

3.4 Survey of Actual Radio Spectrum Use

It is very important to obtain the public's understanding by investigating and evaluating precisely the situation of radio spectrum usage, and making results known to the public before preparing or changing the Frequency Assignment Plan. For this purpose, the Radio Act stipulates that the Minister shall order the survey of Actual Radio Spectrum Utilization. In this survey, frequency ranges are divided into three parts: (1) 714 MHz or less, (2) more than 714 MHz and 3.4 GHz or less, and (3) over 3.4 GHz. One of the three is subject to the survey every year, so a survey round is completed every three years. The cycle of three years was determined in consideration of the reduction of burden on radio station licensees and the subject of the survey against the background of the rapid development of technology. The cycle is almost in line with the cycle of ITU revision of the Table of Frequency Allocations.

The matters surveyed include the number of radio stations operating in the frequency bands in question, the traffic volume of radio communications, the usage modes of the radio equipment, and so on. This is done in order to grasp the actual status of radio spectrum utilization, such as whether new technologies are being used efficiently. The survey is conducted basically by requesting radio station licensees to fill in a questionnaire survey form. This questionnaire is supplemented by another survey on measuring actual radio wave emissions.

4 Frequency Assignment and Licensing

4.1 Licensing Radio Stations

Frequencies are assigned to radio stations basically by means of the designation on licenses. The Radio Act, in principle, requires that every person desiring to establish a radio station obtains a license from the Minister of Internal Affairs and Communications. In order to obtain a license, the person has to submit an application that includes the "construction design" (a set of technical specifications of the radio station which will be examined for conformity against the technical regulations), as well as other documents including relevant information such as the purpose of radio station, type of radio waves emitted, desirable frequency range, and transmission power.

The Minister examines its conformity to technical regulations (i.e., the conformity of the construction design to technical regulations stipulated in the Radio Act and relevant ordinances), feasibility of frequency assignment, and, when the Minister finds neither contravention nor problem, a provisional license will be granted to the applicant. On the provisional license, the Minister designates the frequency of radio waves, the transmission power, the call sign, and other conditions. Thus, provisional licensing includes frequency assignment. The frequency assignment is provisional at this stage, but it is followed by definitive licensing in almost all cases. This shows that the basic process of licensing radio stations under the Radio Act is on a first-come-first-served basis. There is no selection of applicants, since the Minister simply issues the provisional license when the frequency assignment desired by an applicant is feasible.

Having obtained a provisional license, an applicant can establish a radio station pursuant to the conditions designated on the license. The radio station operator can carry out tests by transmitting radio waves with the provisional license. In a case of unacceptable harmful interference or other unexpected difficulty, the Minister can revise designated conditions, such as frequency, on the application. The Minister will inspect the radio station on the completion of construction work. This inspection is mainly to determine whether the actual radio equipment is consistent with the construction design, as well as the actual qualifications of persons who will operate the radio station. The Minister grants an applicant a license when no discrepancy is observed in the inspection. Except for some ship and aircraft stations, a radio station license is not indefinite. The validity period of the license is contained on the certificate of the radio station license.

These procedures, including provisional licensing, might seem troublesome to the non-professional users of handheld radio equipment. However, radio equipment is used by the police, fire brigades, ambulance teams, and most other public-service organizations that require designated frequencies and other parameters before a radio station is constructed. Any changes made after the completion of construction work can be costly. While these situations are rare, they do occur, and so the procedures are taken to avoid wasting time and resources.

In principle, radio station licenses were to be obtained by each radio station. Nevertheless, mobile stations of the same standard and controlled by base stations, such as mobile phones, are not significantly increasing the probability of radio interference as their number grows. As for such mobile stations, individual procedures (i.e., individual examinations and inspections) are less necessary to mitigate the risk of interference. Also, the application documents for such mobile stations can be needlessly large. Therefore, the Radio Act allows single inclusive licensing, called as a "Blanket License," for a plurality of specific radio stations. Specified radio stations are required not to transmit unless the emitted radio waves are controlled by base stations and to use only equipment bearing a Technical Regulation Conformity Mark (described later in this section). Radio stations specified for a Blanket License are allowed to submit a single inclusive application covering two or more radio stations identical to (1) purpose; (2) necessity for establishing the radio stations; (3) person(s) with whom radio communications are conducted; (4) type of radio waves

and desirable frequency range and antenna power; and (5) construction design of the radio equipment. The Blanket License has simplified licensing procedures, especially the procedures for mobile phones and mobile data communication services and has contributed to their rapid expansion.

Regarding radio equipment to be used for small-scale radio stations specified applicable by ministerial ordinance, the Radio Act also stipulates the rules for certification of conformity to technical regulations. The rules allow registered certification bodies, or certified dealers or manufacturers, to affix a mark certifying technical regulation conformity of the specified radio equipment when its conformity to technical regulation is confirmed either directly or indirectly (more information on the Technical Regulation Conformity Mark is provided later in this section). The Radio Act exempts an applicant using certified radio equipment from the usual provisional licensing and inspection routine and allows following much easier licensing procedures.

The radio station licensee must pay to the Government Spectrum User Fee. Revenues from the collection of the fees are used for administrative tasks with the direct objective of benefiting radio stations as a whole in matters concerning ensuring the proper usage of radio waves. According to the government's "Radio Policy 2020 Conversation Report," (Ministry of Internal Affairs and Communications 2016) the total revenues for the three fiscal years between 2014 and 2016 are around 210 billion JPY. Average yearly revenue is 70 billion JPY, 30 billion JPY of which goes to cover constant work costs, such as management of the databases radio stations and radio monitoring. The work covered by this amount does not depend on the type of radio station, and the cost burden is shared equally by all radio stations except stations classified as making a valuable contribution in the public's interest. The remaining 40 billion JPY of yearly revenues is allocated to cover measures to increase the value of the radio frequency spectrum, such as research and development on frequency sharing. The costs of these measures are imposed after being appropriately divided according to the degree of congestion of the frequency band, bandwidth, and transmission power. The radio station occupying the wider frequency band is assigned a larger quota. The radio station licensee has to pay the sum total of quotas assigned to his radio stations for both costs of the constant works and measures to increase the value of the radio frequency spectrum.

The Spectrum User Fee can pile up at times on machine-to-machine (M2M) systems and similar systems composed of a considerable number radio stations, because the quota assigned for constant works is equally assigned among stations. Concerns that this practice would hinder the deployment of M2M systems resulted in the amendment of the Radio Act and the setting a cap on the fee for these systems and making the fee negligible for M2M operators who use a large number of radio communication devices.

4.2 Specified Low-Power Radio Stations

A Technical Regulation Conformity Mark basically replaces, or reduces the necessity of, the process of checking the conformance to technical regulations, such as the Minister's examination of a construction design and inspection of a radio station. When a radio station exclusively using radio equipment that has a Technical Regulation Conformity Mark operates with under low transmission power, and the radio station is also equipped with specific functions that avoid causing radio interference or other disturbance (e.g., operating at the channel designated upon receiving a specific call sign), the probability of unacceptable harmful interference must be extremely low.

This kind of radio station is called a "Specified Low-Power Radio Station," and the Radio Act exempts it from a radio station licensing. Nor does it require a qualification to operate, since testing in the process of certification verifies that the radio equipment does not transmit illegal radio waves. Many of the products used in everyday life, such as Wi-Fi terminals, belong to this category.

Because of the license exemption, the frequency assignment to specified low-power radio stations takes effect through technical regulations. As a specified low-power radio station operates using functions that avoid causing interference or disturbance, it is possible for it to share the same specific frequency with other radio stations of similar type. This means that the assignment of a specific frequency to a specified low-power radio station does not affect the feasibility of another assignment to a similar radio station, and that the assignment of the specific frequency is always feasible. Therefore, such specific frequency is to be stipulated in the technical regulations so that registered certification bodies, dealers, and manufacturers can provide their own services and run their businesses efficiently.

The frequency assignment is a very simple and open procedure. Its only drawback is the difficulty in spectrum redeployment. Since specified low-power radio stations operate without a license, there is no way to set the expiration of a validity date, normally done at the time of renewal of a license.

4.3 Extremely Low-Power Radio Stations

Radio waves are emitted not only by radio equipment, but also by other sources. These waves, which can be observed as noises at the receiver end, are called "radio noises" or simply "noises." Home electric appliances are well-known sources of radio noises. Radio noises come from a variety of artificial sources, including electrical and electronic equipment, power transmission lines, and internal combustion engine ignition systems. They also come from natural sources, such as lightning discharges, atmospheric gases, and hydrometeors, and even celestial radio sources, such as galaxies.

Every radio station is designed so that communication signals can be maintained at a low-power level but higher than the noises of its frequency. This means that radio noises apparently to some extent are acceptable to radio stations. The extremely low-power radio station, which has a signal strength attenuated to the noise level within a very limited area, can be operated without substantial interference. Therefore, the extremely low-power radio station is exempted from radio station licensing procedures. Nor do these stations have to conform to other technical regulations as long as their signal strength is extremely low. Some short-range communication devices, such as keyless entry systems, fall in this category.

It is meaningless to discuss frequency assignment in the extremely low-power radio station environment because under the Radio Act these stations are able to operate almost entirely free of regulation by the ministerial ordinances.

4.4 Technical Regulation Conformity Mark

The Technical Regulation Conformity Mark now plays an important role in the sale and distribution of radio equipment. With the exception of mobile phones, which are normally operated under a Blanket License, most radio equipment used in everyday life is exempted from a radio station license on certain conditions which include affixation of the official conformity mark (which indicates that equipment conforms to technical standards under the Radio Act) to radio equipment, a transmission power limitation, and functions that avoid radio interference. There are a number of ways to obtain the Technical Regulation Conformity Mark for radio equipment.

The most basic way is to request certification by a registered certification body. The certification body affixes the mark to radio equipment only after conformity is confirmed by examination. Stringent testing methods ensure the credibility of the certification. Applicable equipment is specified by regulation; equipment requiring complex examination is excluded.

Nevertheless, for the radio equipment that is mass produced, affixation of the mark by a certification body is not practical. In this case, the Radio Act sets the procedures for the certification of construction design of radio equipment. Persons who deal in radio equipment, mainly the manufacturers and importers, can request a registered certification body to certify that the construction of each piece of radio equipment conforms to the construction design. The certification body issues construction design certification after confirming conformance through examination. In addition to the construction design, the conformity examination also validates the method used to ensure conformity of the radio equipment based on the construction design. Thus, after a person obtains these conformities according to the methods of examination used by the certification body, the construction design certification mark can be affixed to radio equipment.

As for very specific radio equipment, such as the handy terminal of a cellular phone, which is not likely to cause the interference or disturbance, the Radio Act allows self-confirmation of conformity by manufacturers or importers.

4.5 Mutual Recognition Agreement (MRA)

The Mutual Recognition Agreement (hereinafter referred to as MRA) is a bilateral agreement between Japan and another countries or regions enabling mutual acceptance of certifications. Under this scheme, the foreign certification body, which is registered by the administration in another country or region which has concluded an MRA with Japan, is allowed to certify radio equipment (including construction design certification) based on technical regulations under the Radio Act. Certification by a foreign certification body is correspondingly applied to the certification under the Radio Act. Conversely, the Minister can also grant approval to the Japanese certification body so that this certification body can conduct certification business activities for radio equipment to be exported. This radio equipment certified by a Japanese certification body is regarded as corresponding to certification under the legislative umbrella of the other country or region.

Thus, MRA country and region partnership speeds business procedures along, enabling a manufacture who desires to export his products to bypass obtaining the necessary certification from a certification body in the destination country, which can be time consuming and costly, and have the necessary certification done by a Japanese certification body before exportation, and vice versa.

Japan has concluded MRAs with the European Union, the USA, and Singapore. At the time of this writing, the MRA with Singapore has not been utilized since its conclusion in 2002. The other MRAs are contributing significantly to international trade of radio equipment. According to the Ministry of Internal Affairs and Communications (2017), regarding exports of radio equipment from Japan, the number of certifications obtained under MRAs rose from 18 in 2006 to 271 in 2016. As for imports, the number jumped from 433 in 2006 to 3539 in 2016.

It has recently been observed that some Asian manufactures are obtaining the certifications of European certification bodies in order to export their products to Japan. Manufacturers are choosing low-cost and convenient certification bodies through global comparisons. This observation suggests that MRAs may become a factor in intensifying competition among the international certification bodies.

4.6 Measures for Inbound Equipment

A huge number of radio communication devices, such as mobile phones and Wi-Fi terminals, are circulating around the globe. Inbound tourists can bring their devices to Japan free of certification. Most of the devices are harmless because they are based on the internationally recognized standards. But, even a harmless radio communication device brought into Japan should be subject to confirmation if the transmission power of that device exceeds the criteria set for an extremely low-power radio station. Still, it is somewhat inappropriate to have inbound tourists obtain Japanese certification

considering their short stay in Japan. The large number of visitors to Japan is reflected in a Radio Act amendment that introduced an exception for such inbound devices.

The Radio Act stipulates that the specified radio equipment carried by a person entering Japan should be regarded as correspondingly to a certified device under the Radio Act, on the condition that the specified radio device is based on a standard equivalent to technical regulations of the Radio Act and that the device is for the personal use of the visitor. This special treatment is valid only for 90 days from the date of entry into Japan. The Minister has specified the targeted radio equipment in a ministerial notice. At the time of this writing, the notice includes Wi-Fi and Bluetooth equipped devices.

On the other hand, foreign-made mobile phones can be used in Japan as long as they can be operated under the Blanket License of a Japanese mobile operator having ministerial permission, which is granted when mobile phones of foreign make conform to the technical regulations of the Radio Act.

5 Spectrum Assignment Policies and Licensee Selection

As stated in the beginning of this chapter, the radio frequency range for practical use is limited. Most frequencies are already assigned to some kind of radio communication services. But, it is still possible to assign a frequency already assigned to an existing radio station to another radio station when both radio stations can be geographically separated and operated without harmful interference. But in a case of assigning a dedicated frequency band for a new nationwide mobile service, an existing radio stations operating in this frequency band would have to be converted to another frequency band to make frequency band vacant to accommodate the new service. This is the most likely example of an instance that explains the necessity of spectrum redeployment.

But in some cases, the vacant frequency band created by spectrum redeployment fails to fulfill demands of the operator. The administration often has to select one or a limited number of licensee(s) from a larger number of applicants. The most basic of selection methods according to the Radio Act is the first-come-first-served basis method, which works as long as the frequency bands are not congested and can be shared by means of some kind of separation (geographical separation in the most cases).

In the early days of personal cellular phone services, the administration coordinated with operators to find a mutually beneficial assignment plan prior to their applications. This kind of coordination was criticized as not being transparent and as being a cause of frequency band congestion. The Radio Act was amended to stipulate the Minister's setting of the time period for inviting applications for new assignments from operators, and that selection of licensees be done through a deliberation process, giving birth to the method called a "Beauty Contest."

5.1 First-Come-First-Served Selection

The Radio Act was originally intended to apply to licensing radio stations when assignment of applied frequency was feasible. If the frequency was already assigned to a radio station and frequency sharing was unacceptable, frequency sharing and the same frequency assignment were no longer feasible and an applicant would have no chance of being licensed. Implementation of the spectrum management policy ushered in selection of the applicant who comes first. The situation of many applicants desiring to obtain the radio station license for the frequency in question and the administration choosing the applicant who applied first is the main distinctions of the method. In this sense, selection is like the way a patent is granted. There are requirements that must be met to be granted a license, but for the most part the license goes to the applicant who satisfies the requirements first. Because there is no substantial selection process, you might regard this as selection by time of application.

While this may sound fair, this basis of selection is not without some difficulties. On the first-come-first-served basis, applicants require a reasonably accurate prediction of the feasibility of frequency assignment. Otherwise, they may have to apply for a radio station license several times. Again, it is very important for applicants to know whether the frequency assignment is feasible.

Frequency assignment is feasible when a single frequency can be shared by many radio stations. For instance, amateur radio stations are operated on the same frequencies so that they can communicate each other, and thus, their frequencies can always be assigned.

In cases of an abundance of frequencies, frequency assignment can be readily carried out. The frequency band is sufficiently broad in comparison with necessary bandwidth and number of radio stations. In many cases, the frequency demand is high in urban areas and scarce in rural areas. If the applicant desires to obtain a license for an experimental radio station to service area having limited demand, i.e., an area in which the station can be easily separated geographically, it is likely that frequency assignment is feasible.

Consultation prior to application can also be effective to "sense" frequency feasibility. The applicant may be able to consult officials directly. However, the Radio Act stipulates the designation of effective usage of the radio spectrum, which provides for consultation on investigation of interference and other matters necessary for establishing a radio station. The Minister provides the consultation center with the necessary information on radio stations for conducting consultations. For instance, applicants visiting the center often want to obtain a radio station license for a radio relay system operating in the microwave frequency band. This band is allocated for fixed service, includes radio relay systems, many earth stations, and satellite stations in fixed satellite service, and frequencies have already been implemented because these services are able to share same frequency band and technical conditions. Interference analysis is not easy for applicants, but the center provides a service that helps

visitors check frequency assignment feasibility prior to an application. This service is both time and cost effective.

6 Beauty Contest

The Radio Act basically follows the first-come-first-served principle in licensing radio stations, and a license is issued when frequency assignment is feasible. If the first radio station is unable to share frequency with another one, other radio stations cannot be licensed because frequency assignment is no longer feasible.

However, similar to cellular phone service, if a company wishes to launch a mobile communication service, which requires occupying an exclusive frequency band for its base stations all over the country or a region, that company has to secure the right to be licensed not only for the areas where the base stations establish upon launch of the service, but also where the company plans to have stations in the future. For providing such services, the number of licensees is limited, which give rise to the need for a different kind of selection process because the first-come-first-served principle ineffective, and may result in an incompetent operator who provides a service of very poor quality occupying the most precious frequency band for a considerably long time. People give a nod to a good quality operator over a poor quality operator able to apply quickly.

A similar selection process is needed also for broadcasting stations and satellite stations providing telecommunication services. The broadcasting stations are similar to the base stations operated for cellular services, as they both hold their own coverage in the provision of services. On the other hand, in order to obtain a license for satellite stations, it is necessary that assignment of a specific orbital position be feasible alongside frequency assignment. Here, too, the number of licensees for satellite stations is limited, far fewer in fact than the number of potential applicants. Both broadcasting stations and satellite stations have a strong influence on economies and our daily lives, so the licensee selection process should be fair, and so the promotion of public welfare stays priority number one.

The licensing procedure for some broadcasting stations and satellite stations for telecommunication services starts with the ministerial offering for public application for the license. The offering is a preparatory action followed by a comparative review when the assignable frequency bandwidth does not fulfill all of an applicant's needs. In the comparative review, each application is checked for conformance to "Essential Standards" specified by ministerial ordinance. The Essential Standards stipulate comprehensively the various aspects of matters to be checked in licensing, such as the economical appropriateness of using radio communication (e.g., reasonableness of establishing a radio station in comparison with other communication means). By the reviews, applicants with a high conformity are selected as licensees.

6.1 Beauty Contest for Mobile Communication Services

For mobile communication services, applicants are invited to submit their Establishment Plans for comparative review. Establishment Plans include, for instance, milestone markers of base station deployment (e.g., the number of established base stations by prefecture at the end of each year), objectives of covered population, estimation of costs and earnings, and other information concerning "Termination Promotion Measures (described in the next subsection)." These items are specified in the Establishment Guideline submitted by the Minister before the invitation to submit the Establishment Plan. The guideline is also the criteria in the comparative review since the Essential Standards require specified base stations to conform to the Establishment Guideline. In the evaluations, plans with high conformity are selected by the review and approval is granted. In the frequency band specified in the guideline, the company whose Establishment Plan is approved by the Minister can obtain radio station license exclusively. Thus, the company can deploy base stations as originally planned.

Approval for the Establishment Plan is followed by licensing of radio stations, but the frequency is assigned at the time of approval. In fact, the word of "assignment" is often synonymous with the expressions of approval in press reports and official explanations.

More information on the licensee selection process for mobile communication services is provided in the next chapter.

6.2 Termination Promotion Measures

In 2018, mobile data traffic in Japan was increasing at an average pace of 40% yearly. The high penetration rate of mobile communication services and their large capacity motivated private companies to actively launch various new services (not limited to telecommunication services) making heavy use of mobile equipment. These services generate huge revenues and have a large subscriber base. As long as the cycle works, mobile data traffic will not be saturated and will continue to grow. Telecommunication operators have introduced advanced technologies and a variety of valuable functions, including a high transmission rate, high connectivity, low latency, and other development that are positioning mobile services as an indispensable communications tool.

As mentioned in the beginning of this chapter, radio waves have diverse characteristics according to their frequencies, and the radio frequency range for practical use is limited. In order to deliver a high transmission rate, mobile communication services have to occupy a due proportion of the frequency range. The measure of radio stations vacating a frequency band is the only way to secure necessary bandwidth. However, most easy to vacate radio stations have already vacated to higher-frequency bands. Efforts must continue to secure future bandwidth.

Termination Promotion Measures urge new licensee(s) to expense the cost of terminating the use of frequency bands by operating radio stations. The action of terminating the use of a frequency is mostly to transfer these radio stations to a higher-frequency band. This is now a key process of spectrum redeployment.

When the 700 and 900 MHz bands for mobile communication services were assigned in 2012, the bands had originally been occupied by the microwave transmission links of broadcasting companies and by wireless microphones. The new licensees, holding an approved Establishment Plan, expended costs for these using Termination Promotion Measures. Microwave transmission links are called field pickup units (FPUs) in Japan. FPUs operating in the 700 MHz band were transferred to higher-frequency bands (1.2 or 2.3 GHz bands), and wireless microphones operating in the 700 MHz band were transferred to the 1.2 GHz band or to TV white space. As for the 900 MHz band, a suitable vacant frequency band was created by changing the disposition of the assigned frequencies which were originally used by RFID. The total cost for these measures was estimated be 63.5 billion JPY for 700 MHz and 97.7 billion JPY for 900 MHz.

Termination Promotion Measures are requested through the Establishment Guideline. Both the minimum and maximum estimated costs for the measures are also provided in the guideline. Each applicant company has to describe the budget plan for measures in its Establishment Plan. The budget plan differs by applicant, but the differences are insignificant. Needless to say, if the company pay much for the termination of operating radio stations, the company can start the service earlier. Therefore, each applicant basically indicates larger amount, as much as he can, to receive a higher evaluation in comparative review. However, even if the amount exceeds a certain monetary value in light of the original purpose, this does not compensate for evaluations in other respects. In other words, the amount of the fund will not influence judgment on licensee selection.

6.3 Case Studies—A Comparative Review

At the time of this writing, one of the most recent cases of comparative review for mobile communications is a second frequency assignment for a 4G mobile telecommunication system. The submission of the Establishment Plan was invited from January to February 2018. It targeted two pairs of 20 MHz blocks in the 1.7 GHz band and two 40 MHz blocks in the 3.4 GHz band. The total number of licensees to be selected was four. Criteria for making a difference in the comparative review included the allocation status in other frequency bands (e.g., points are given when a cellular phone frequency is not assigned, and a criterion that encourages new entries.); population coverage eight years after approval (e.g., a higher rate earns higher points.); measures to ensure safety and reliability (e.g., richer content earns higher points.); available budget for Termination Promotion Measures (e.g., a larger amount earns higher points.); and so on. But, this time, there were only four applicants submitted applications (their Establishment Plans), and because these were free of conflict, a

comparative review for licensee selection was unnecessary, leaving only evaluation based on applicant eligibility.

The second most recent case is a first frequency assignment for a 4G generation mobile telecommunication system. This case targeted three 40 MHz blocks between 3480 and 3600 MHz. The Establishment Plan was invited from September to October 2014. The three applicants equaled the maximum number of licensable applicants. Two applicants indicated the same frequency block as a first choice, so a comparative review was carried out and priority would be given to the one with the best results. The criteria included population coverage four years from approval, measures to ensure safety and reliability, and others. There was no need for Termination Promotion Measures for this frequency band.

The latest case of licensee selection for mobile communication is frequency assignment for broadband wireless access (BWA). The Establishment Plan was invited from May to June 2013. It targeted only one 20 MHz block between 2625 and 2650 MHz (a 5 MHz strip from 2645 to 2650 MHz is basically a guard band that cannot be assigned unless special measures are taken to avoid interference between neighboring services). With two applicants for one block, there was a comparative review for the licensee selection. The criteria included a plan for introducing new technology for efficient use of radio waves, as well as the allocation status in other frequency bands, population coverage, and measures to ensure safety and reliability. Also at this time, there was no need for Termination Promotion Measures. As a result, the one with the higher overall score was screened out. (In this review, the Establishment Plans were compared first by population coverage, and then reviewed according to other criteria).

6.4 Consultation with Radio Regulatory Council

Every comparative review is justified by setting criteria and making decisions through a fair and transparent process. The Radio Act ensures it by consultation with the Radio Regulatory Council. The Minister consults the Council in establishing or changing an Establishment Guideline in granting approval for an Establishment Plan.

The Radio Regulatory Council is composed of five members appointed by the Minister with the consent of both the House of Representatives and the House of Councilors from persons possessing the experience and knowledge necessary to make fair judgments based on the welfare of the public. They shall be independent from telecommunications businesses, broadcasting businesses, and manufacturers and dealers of radio equipment. The consultation is a major process ensuring the transparency of important decisions, including selection of licensee and changes in rules.

Recently, Councilors have pointed out the necessity of expanding evaluation items to cover quantitative items as well as qualitative ones. Deliberation for further improvement of comparative review is awaited.

7 Spectrum Auction

Quantitative evaluation items enhance fairness and transparency of the evaluation, because a numerical difference is clear to everyone. To the contrary, qualitative evaluation items might allow a variety of different interpretations. One of the most common quantitative items is the amount of money. Many administrations carry out Spectrum Auctions in the licensee selection process.

There have been several discussions on introducing the Spectrum Auction. In Japan, the Cabinet once submitted a bill to the Diet (in March of 2012) to amend the Radio Act in order to introduce the Spectrum Auction. At the time, the Democratic Party was the ruling party in the coalition with the Social Democratic Party and the People's New Party. But the bill was not passed. At the time of this writing, this instance represents the first and last time a bill for the Spectrum Auction has been deliberated. In the Diet discussion after the next bill to amend the Radio Act was submitted by the Cabinet in March 2013, shortly after the return of the Liberal Democratic Party to power in an alliance with the New Komeito Party, a number of questions on the Spectrum Auction were raised but no provision was made to re-introduce the Spectrum Auction bill. According to the discussion, the Spectrum Auction offers the merits of transparency, quickness, and efficiency in radio wave usage in terms of intention to recover the costs of bidding, and improvement of the governmental financial status through gained revenue; the possibility of promoting new entries and competition has also been mentioned. In contrast, demerits include the risk of business stagnation due to soaring bid prices and the risk of monopolization of radio frequency bands by the persons who have strong investment power.

With regard to the risk of a business slump due to soaring bid prices, failure auction cases in other countries are the focal point of discussions. A number of interested persons were impressed that the bid prices were soaring beyond an economically reasonable level and making business problematic. This kind of risk eventually is disadvantageous for users. Although natural, it is still difficult to predict how far soaring bid prices will go. Especially in the Spectrum Auction, the winning bid fluctuates largely in each case. There is no regularity.

To prevent soaring of the bid price, setting a bidding upper limit is conceivable. However, if the upper limit is still low in comparison with the total revenue expected according to the frequency band being auctioned, bidding prices easily reach the limit. In such cases, licensee selection depends greatly on the results of a different item of evaluation, such as population coverage. Consequently, the method is no longer an auction. The method is not significantly different from Japan's Beauty Contest process, which often includes evaluation of items such as of the amount of funds for Termination Promotion Measures.

7.1 Possibility of Provoked Hike in Mobile Charges

When an upper limit is not set or is set too high (both are nearly the same, because both fail to work.), bids can soar to the point where they might have a negative effect on the revenue balance of a mobile communication operator. The operator can either pass amount on to users as a rise in mobile charges or the operator can reduce profits. Mobile communication operators currently enjoy good sales performance, but the opinion of some operators is that the amount passed on to users has to be limited. However, the decision is entirely up to operators in Japan, where the mobile charge is not controlled.

Are we worrying too much about the provocation of rise in mobile charges? When the upper limit amount is set at a higher price level to weigh more on the bidding in licensee selection, it surely will increase the possibility of increased mobile charges. In Japan, a reduction in mobile charges is now a major policy issue. According to the MIC statistics (Ministry of Internal Affairs and Communications 2018), the average yearly household telephone expenditure in 2017 was 122,207 JPY (21,957 JPY for fixed phone services and 100,250 JPY for mobile phone services), which is 4.18% of the total consumption expenditure. The expenditure for mobile phone services is gradually increasing. Under these circumstances, the government certainly will not welcome further communication-related expenditure increases even though the revenue from the Spectrum Auctions contributes to national finances.

7.2 Further Consideration

There is no best "stable methodology" for licensee selection. Administrations employing Spectrum Auction have been developing and improving various types of auctions that overcome each new defect, such as the Simultaneous Multiple Round Auction (SMRA) and Combinatorial Clock Auction (CCA). The SMRA has been widely employed and was once considered successful, but the administrations employing the SMRA have to make changes each time the auction is held. Even so, problems remained, such as no one participates in the bidding or the bidding price is incredibly low.

As an example, France once employed the Spectrum Auction, but in re-assigning the radio frequency spectrum bands of 900 MHz, 1800 MHz, and 2.1 GHz, which are currently being used for 2G, 3G, and 4G, ARCEP (Autorité de régulation des communications électroniques et des Postes) and the government decided to set a priority in service coverage rather than use financial criteria, as announced by ARCEP in January 2018. Each administration of the governments of the world continues to pursue better methodology.

In addition, regarding Japan's use of the "Beauty Contest," some companies are requesting elaboration on improvement of the selection process so as to include evaluation items from an economic perspective. The line of difference between the Spectrum Auction and the Beauty Contest is gradually blurring.

8 Conclusion

Frequency spectrum management is governed by the Radio Act in Japan. The MIC has the competence for the relevant regulations. The Minister issues the radio station license and assigns each radio frequency according to the Frequency Assignment Plan, the national frequency allocation table. When revising the plan, the Minister orders a survey on Actual Radio Spectrum Utilization. Each frequency to be assigned is either by means of designation on the radio station license or by stipulation as a part of the technical requirement in the relevant regulations for certification of conformance.

The transition of radio communication services and technological development will always pressure administrations toward Spectrum Redeployment. One of the typical examples of Spectrum Redeployment is carried out during preparations to implement a new generation of mobile communication services.

Mobile communication services require licensee selection because often the number of applicants exceeds the number of frequency bands to be assigned. In Japan, a comparative review, the so-called Beauty Contest, is employed as the licensee selection method, although many countries employ the Spectrum Auction. There has been much discussion on comparisons of the two methods. One of the merits of the Spectrum Auction, for example, is its transparency. The auction ensures transparency by making judgments based on quantitative evaluation of bidding price. The Beauty Contest also ensures transparency but by way of procedure, including through consultations with the Radio Regulatory Council. Both methods of licensee selection are starting to resemble each other as they undergo ongoing improvements.

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Development of Mobile Technology (3G, 4G, 5G)

Gaku Nakazato

1 Introduction

This chapter describes the development of mobile communications systems from the late 2000s to 2018 and the relationship between mobile communications system and frequency assignment to mobile communications operators. This time period has witnessed the explosive growth of the smartphone since its introduction in 2008, along with the corresponding increase in mobile traffic and the vigorous construction of network infrastructure that has followed. From the point of radio administration, the Ministry of Internal Affairs and Communications (hereinafter referred to as MIC) has conducted frequency assignment to respond to growing traffic demands and has improved various environments (technical requirements, frequency reallocation, etc.) representative of prerequisites for frequency assignment.

Section 2 describes the general flow of frequency assignment to mobile operators in Japan. The background, technical requirements, and frequency assignment based on the requirements are explained in the following sections. Section 3 illustrates how 3.9-generation mobile communications system was introduced. Section 4 details reallocation of the 700 MHz band and 900 MHz band. Section 5 outlines the fourth-generation mobile communications system. The fifth-generation mobile communications system is characterized in Sect. 6. Section 7 concludes the chapter.

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2 Flow of Frequency Assignments to Japan's Mobile Operators

In Japan, frequencies for mobile communications have been assigned to mobile operators in the following sequence of flow and as depicted in Fig. 1.

To ensure transparency and fairness in frequency assignment to mobile operators, processes of consultation with the council and reports from the council are adopted in Japan. One reason for this is that Japan adopts a beauty contest instead of a frequency auction, as mentioned in Sect. 6 in Chapter "Spectrum Management". Two councils are involved in the processes to secure fairness. One is the Telecommunications Council and the other is the Radio Regulatory Council. The former mainly deliberates the technical content of a new system and the expert subcommittee usually consists of members who are academic experts, operators, vendors, or representatives of research institutes and think tanks interested in the new system. The latter deliberates the content on frequency assignment.

3 Introduction of 3.9G Mobile Communications System—A 3G Upgrade

3.1 Background

Subscribers to mobile phone and Personal Handy Phone System (PHS) services in Japan numbered approximately 113.03 million (as of the end of June 2009), with third-generation mobile accounting for approximately 94% of the market, and a continuing shift away from the second generation. Since the population penetration rate of mobile phones had already exceeded 100% at that time in, for example, Luxembourg, Hong Kong, and Italy, it was assumed that mobile subscribers in Japan would continue to increase spurred by market revitalization.

Conversely, due to the sophistication and diversification of social and economic activities, the use of data communication using cellular phones was on the rise and the introduction of the 3.9G mobile communications system, an advanced version of 3G mobile communications system with higher speed, larger capacity, and higher convenience, was eagerly expected. At that time, especially widespread were downloading of contents such as music, images, games and the like and obtaining useful information from information sites by accessing the Internet from the cellular phones. In addition, the use of so-called mobile commerce, the purchase of tickets and securities transactions are examples, had expanded and already penetrated the daily lifestyle. In response to these demands, international standardization activities for 3.9G were in their final stage, and efforts aimed at commercializing 3.9G around 2010 were moving forward in Japan.

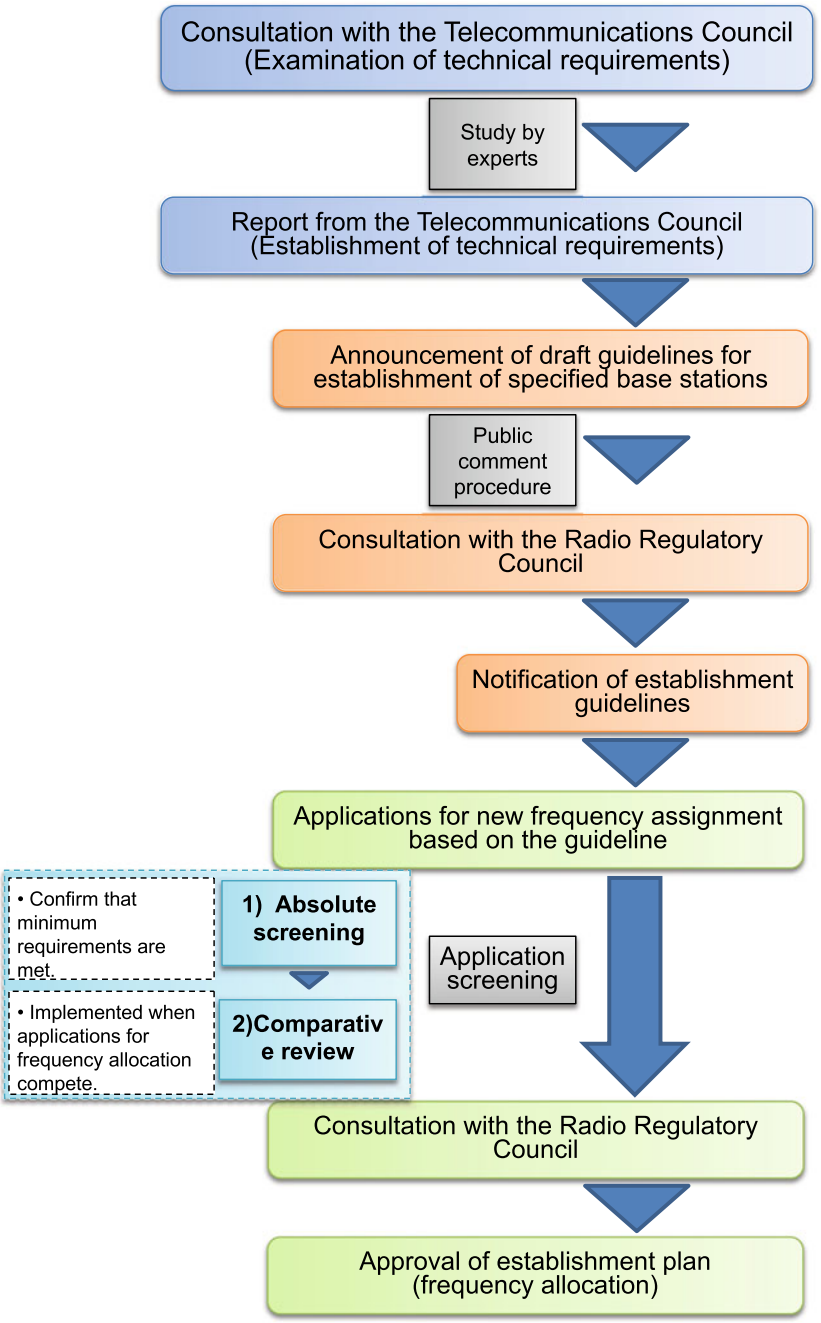

Fig. 1 Flow of frequency allocation to mobile operators. *Source* By author

Technology/standardization trend

At 3G Partnership Project (3GPP), an international standardization organization studying W-CDMA technology, standardization activities toward the end of 2004 on a system called "Long-Term Evolution" (LTE) targeted dramatic upgrading of performance even after the provision of HSDPA and HSUPA, extension technologies of W-CDMA, in expectation of increased demand for data communication and with an aim to make 3G itself a more competitive system in the future. In addition, 3GPP completed specifications designated High-Speed Packet Access (HSPA) with a downlink maximum transmission speed of approximately 14 Mbps and an uplink maximum transmission speed of approximately 5.8 Mbps around 2005. Since then, to respond to the need for further high speed, the development of HSPA Evolution, a high-speed version of HSPA, began around 2006.

The design of the Dual-Cell High-Speed Downlink Packet Access (DC-HSDPA) advanced transmission speed further by a method different from that of multiple-input multiple-output (MIMO). This technology improved maximum transmission speed by transmitting the adjacent 5 MHz carrier simultaneously in downlink communication, and its specification activity started in 2008.

In a different project, 3G Partnership Project 2 (3GPP2), which is standardizing CDMA2000 technology, was studying Ultra-Mobile Broadband (UMB) as the next-generation system to operate in IMT-2000 bands under the same environmental conditions and interference parameters as conventional 3G. Specification development of UMB was positioned as the next-generation system, "Evolved 3G System," for 3GPP2. Standardization activity for UMB was started in 2006 and development of UMB radio interface specification was completed in 2007.

3.2 Studies on Technical Requirements

To realize 3.9G, 3G's enhanced system (Enhanced IMT-2000), the expert subcommittee, working under the auspices of the Telecommunications Council, began studies on technical requirements in April 2008. In these studies, 3.5G (HSPA Evolution and DC-HSDPA) was included, as was 3.9G (LTE and UMB). The following matters were studied in detail (Telecommunications Council 2008).

(1) Targeted technology systems
Technical requirements for base stations, land mobile relay stations as well as land mobile stations for Enhanced IMT-2000.

(2) Preconditions for studies on technical requirements
Frequency bands used for cellular systems in Japan at that time (800 MHz, 1.5 GHz, 1.7 GHz, and 2 GHz) were the targets.

(3) Matters studied
In order to realize 3.9G, the studies took into consideration matters such as usage scenarios, trends in international standardization, and technical compatibility, to mention several, along with.

- Basic concept (usage environments, system functions, interference conditions, transmission/reception interval, etc.),
- Environments of sharing with existing systems, technical requirements, as well as operating requirements, and
- Technical measures for smooth future transition to 4G.

As specific contents of the basic concept, the matters listed below were discussed.

<System positioning and expected functions>

- Advanced radio access (high speed/large capacity access, low latency, high transmission quality, etc.)
- Flexible network (all IP network, seamless cooperation with other systems, communication with various terminals, etc.)
- User affinities (diversification and sophistication of mobile terminals, Quality of Service (QoS) securement, securement of safety and security, such as security and privacy, etc., and realization of a low bit unit price)

<Basic system requirements>

- Maximum transmission speed: more than 100 Mbps for the downlink and more than 50 Mbps for the uplink
- Efficient radio use (three times or more better than 3.5G for the downlink, twice or more times better than 3.5G for the uplink)
- Network: all IP network
- Transition to future system: capability of smooth future transition to 4G.
- Transmission quality: realization of lower latency than 3.5G (approximate minimum of 5 ms).

At that time, 3.5G was still at the penetration and expansion stage but when the 3.9G network, which fulfills all of the requirements outlined above, was introduced around 2010, 2G would come to an end, and it was expected that 3.9G would gradually expand upon 3G and 3.5G networks. After this, 3.9G was expected to gradually expand, and sometime toward the mid-2010s, 4G would emerge, and its area coverage was expected to expand after 2020. It was also expected that 4G would gradually expand upon 3.9G which acts as a base network. Based on these considerations, major technical requirements were defined for 3.9G, concerning 800 MHz, 1.5 GHz, 1.7 GHz, and 2 GHz frequency bands being used for the existing mobile phone systems.

3.3 Frequency Assignment

In November 2008, to allow for public consultation on licensing policy such as assigned bandwidth and comparative criteria under application screening, an open hearing was held. Opinions were received from four operators, NTT DOCOMO, KDDI, SoftBank Mobile, and eAccess. That was followed by the release in January

2009 of the draft guidelines for establishing specified base stations (MIC 2009a), which was followed by soliciting opinions on the draft.

In March 2009, MIC held consultations on the draft guidelines with the Radio Regulatory Council and received a report from the Council stating its approval of the original plan. MIC (2009b) promulgated the establishment guidelines and started accepting applications for approval of the establishment plan. The establishment guidelines included the following points:

- A maximum of four operators, whether new entrants or existing operators, would be assigned a 10 MHz or 15 MHz block in the 1.5 GHz band or the 1.7 GHz band.
- The establishment plan must show that within five years from the date of approval, on the assigned frequency band, the ability to cover over 50% of the population within 11 jurisdictions nationally with 3.9G (wireless broadband of over 100 Mbps), as well as 3.5G enhanced system (wireless broadband of over 40 Mbps).

Four operators (NTT DOCOMO, KDDI, SoftBank Mobile, and eAccess) submitted applications. In June 2009, the operators' establishment plans were reviewed by the Radio Regulatory Council and were approved by the Minister for Internal Affairs and Communications. Each operator was assigned a new bandwidth on the 1.5 GHz band (NTT DOCOMO, KDDI, and SoftBank Mobile) and 1.7 GHz band (eAccess). NTT DOCOMO became the first among the four operators to provide commercial LTE services, beginning December 24, 2010.

4 Reallocation of 700 MHz and 900 MHz Bands

4.1 Background

The frequency band between 700 and 900 MHz, casually referred to as the "platinum band," offers outstanding signal reach and the ability "to reach" around buildings and other obstacles. These characteristics make it the optimal frequency bandwidth for mobile communication services.

In February 2005, MIC devised a frequency reorganization plan for the 800 MHz band (MIC 2005a). The main three goals of the plan were:

- To improve the efficiency of frequency utilization with a wider bandwidth assignment
- To realize international roaming and prevent interference from neighboring countries in harmony with international frequency usage
- To make a pair of the 700 MHz band (FDD uplink), which was used for analog TV broadcasting at that time and 900 MHz band (FDD downlink) for mobile communications after July 2012.

With those goals in mind, MIC decided to complete the frequency reallocation of 800–900 MHz band for mobile communications by July 2012 (MIC 2005b). As

a result of the reallocation, the 800–900 MHz band being used by NTT DOCOMO and KDDI in a subdivided manner was migrated and aggregated to the 800 MHz band (a decline of total frequency bandwidth from 88 to 60 MHz).

4.2 Studies on Technical Requirements

In June 2007, the Telecommunications Council reported that the use of the 700 MHz band and 900 MHz band for mobile communications would be appropriate (Telecommunications Council 2007). From January 2010, the Council began to study the technical requirements for the introduction of mobile communication for these bands.

The Telecommunications Council's expert subcommittee began the specified study with the hearings from stakeholders as to how the frequency bands would be used. The following opinions were made known.

– Mobile operators expressed the view that "in order to use the bands as early as possible to meet the rapidly growing traffic requirements, the 700 MHz band and 900 MHz band should be used as a pair."
– Device and chip vendors expressed the view that "to be harmonized with frequency usage overseas, it was better to make uplink and downlink pair(s) in the 700 MHz band and uplink and downlink pair(s) in the 900 MHz band separately."

One opinion on the 700 MHz band was that considering the allocation in the USA as well as the study by Asia-Pacific Telecommunity (APT), the mobile pair band should be made in the 700 MHz band by reallocating the 730–770 MHz band and adjacent bands. Another opinion concerning the 900 MHz band was that considering the 3G allocation in Europe and elsewhere using the 900 MHz band such as UMTS900, the mobile pair band should be made in the 900 MHz band by reallocating the 915–950 MHz band and adjacent bands.

To verify the feasibility of the various options, several allocation models were presented and comprehensive technical studies were carried. From September 2010, the subcommittee carried out intensive studies on the minimum guard band block necessary for coexistence of particular wireless systems on the allocated band for each model and the possibility of frequency sharing between the new and old systems after frequency allocation.

In the second half of the study, to provide an internationally harmonized frequency at the maximum for mobile communications, implementation of frequency reallocation for existing systems (field pick-up unit (FPU), radio microphone, multichannel access system (MCA), and RFID) was investigated. Based on the findings of the technical studies, the basic policy for reallocation of the 700 MHz band and 900 MHz band was decided in November 2010. The policy reflected the following ideas:

– Allocation for uplink and downlink in 700 MHz and for uplink and downlink in 900 MHz is appropriate, while stressing the importance of harmony with the frequency allocation abroad

– To make the 700 MHz band available in 2015 and the 900 MHz band available in 2012, respectively, reallocation of frequencies for related radio systems is desirable as soon as possible
– To closely track future frequency demands for mobile communications, measures to bear the reallocation costs of existing systems must be taken. In this context, measures to realize prompt and smooth frequency reallocation, measures described later in this section were devised.

Mobile operators initially opposed the frequency reallocation for each band in 700/900 MHz bands; however, after securing the necessary guard bands based on interference evaluation and considering appropriate assignment plans, operators agreed to frequency reallocation.

4.3 Frequency Assignment

The Telecommunications Council completed its studies of the 900 MHz band first and delivered its report to MIC (Telecommunications Council 2011) on technical requirements using the 900 MHz band in May 2011, after which, in December 2011, MIC submitted an inquiry to the Radio Regulatory Council on the framework for the spread of 3.9G; in reply, the Council stated its approval of the framework. The "Guidelines for Establishing the Spread of 3.9 Generation Mobile Communication Systems Using 900 MHz Band" were then officially released (MIC 2011a). The basic concepts of the guidelines were:

– The frequencies applicable to being assigned are blocks of 15 MHz $\times$ 2. To offer high-speed broadband services, 15 MHz $\times$ 2 is desirable, and one operator will be offered this block.
– In order to make frequencies available to more operators, when the 700 MHz band is assigned in the near future, the operator with the 900 MHz band will have a lower priority when the 700 MHz band is examined.

Four operators (eAccess, NTT DOCOMO, KDDI, and SoftBank Mobile) ultimately applied. Their establishment plans were then examined in the following manner.

Minimum standards to be met including the following points were set:

– To be able to raise funds covering the minimum cost (120 billion yen) for frequency reallocation of existing radio stations. For MCA and RFID systems, rough estimates of (1) cost for acquisition of equipment using the new frequency after reallocation, (2) cost required for system changes including software modifications were calculated. The maximum cost (210 billion yen) and minimum cost were set.
– To achieve 50% population coverage in all jurisdictions four years from approval (by the end of FY2015), and to achieve 80% in all jurisdictions seven years from approval (by the end of FY2018), respectively.

All applicants met the minimum standards and were judged and scored based on comparative criteria. The first comparative criterion was that an applicant would be able to bear reallocation costs of up to 210 billion yen; the criterion was applied and all applicants declared 210 billion yen. The second criterion was that an applicant setting the most population coverage (95% per unit as of the end of FY2018) would receive the highest points; the criterion was applied and all applicants declared more than 95%. The third comparative criterion applied included the following matters.

– Regarding matters pertaining to exit promotion measures, as described later in this section, to have substantial plans of concrete measures for promptly concluding agreements with subject licensees, and concrete systems facilitating smooth implementation.
– To have concrete plans for promoting the use of specified base stations by providing wholesale telecommunications services or connecting telecommunications facilities to MVNOs, necessary because securing a fair competitive environment in the telecommunications business at that time was important.
– Considering the frequency assignment status and degree, the number of subscribers assigned to a bandwidth opening a specified base station and delivering telecommunications services would contribute to sound development of the telecommunications industry.

Each degree of conformity was scored, and the applicant with the highest total score was approved. The result of this process was that SoftBank Mobile's establishment plan was approved in March 2012.

It took more time to complete the 700 MHz band study than it did to complete the 900 MHz band because of the complexity of interference evaluation and assignment plan studies. The Telecommunications Council released the "Mobile Telecommunication System Technical Requirements using the 700 MHz Band" in February 2012 (Telecommunications Council 2012) and establishment guidelines were released in April 2012. The approach was the same as that of 900 MHz assignment and the basic concepts behind the guidelines were:

– Three operators would be assigned blocks of 10 MHz × 2
– Applicants should cover all costs associated with reallocation
– To make frequencies available to more operators, the operator assigned the 900 MHz band would have a lower priority.

Three operators (eAccess, NTT DOCOMO, and KDDI) ultimately applied. Their establishment plans were evaluated in the following manner.

Minimum standards to be met including the following points were set.

– To be able to raise funds for the minimum cost (60 billion yen) required for frequency reallocation of existing radio stations
– To achieve 80% population coverage in all jurisdictions by seven years from approval (by the end of FY2019).

All applicants met the minimum standards and were judged and scored on the following comparative criteria because of overlapping of the preferred frequency

(low, middle, or high) of the applicants. The first comparative criterion was that an applicant would be able to bear costs of up to 150 billion yen to cover costs, and all applicants declared 150 billion yen. The second comparative criterion applied was that an applicant setting the most population coverage (5% per unit as of the end of FY2019) would receive the highest points, and all applicants declared more than 95%. The third completive criterion applied addressed the following matters.

- Regarding matters pertaining to exit promotion measures, to have substantial plans detailing concrete measures to promptly conclude agreements with the subject licensees, and concrete systems facilitating smooth implementation.
- To have concrete plans promoting the use of specified base stations by providing wholesale telecommunications services or connecting telecommunications facilities to MVNOs.
- The amount of the assigned frequency band and the degree of subscribers to the assigned bandwidth.

Each degree of conformity was scored, and assignment of the desired frequency band was judged based on the total score. NTT DOCOMO received the highest score, while KDDI and eAccess received the same score. This resulted in NTT DOCOMO being assigned the first choice (middle band), while KDDI and eAccess were assigned their preferred second choice (eAccess was assigned the high band and KDDI the low band). The result of this process was that a total of 2×30 MHz was assigned in 2×10 MHz blocks to NTT DOCOMO, KDDI, and eAccess in June 2012. The frequency for eAccess in the 700 MHz band was assigned to SoftBank as of December 2018 as a result of succession of the status of certification following the absorption merger of Ymobile (company name changed from eAccess in July 2014) by SoftBank Mobile.

4.4 Introduction of Measures to Realize the Prompt and Smooth Frequency Reallocation (Exit Promotion Measures)

Until around 2010, the processes usually followed for frequency assignment were:

- Frequency reallocation of the existing system was carried out over a period of about 5–10 years taking into account the renewal period and other factors of the facility (all expenses required for reallocation were borne by the existing system).
- The new system would be introduced after completion of existing-system reallocation.

It is notable that the processes involved in making adjustments related to implementation of reallocation take a substantial amount of time; sometimes, the time lapse between conducting the reallocation study and introducing the new system can be as long as ten years.

However, in the case of reallocating the 700/900 MHz bands, it was necessary to perform frequency reallocation as soon as possible because a wireless broadband

environment would be built thereafter. To achieve this, measures to hasten frequency reallocation were taken.

- Rather than introducing a new system after reallocation, prompt reallocation was planned while sharing the frequency geographically with the existing system or by sharing the frequency in a time division manner.
- A user of the frequency after reallocation would bear the costs for the reallocation of the existing system.

However, the following points needed to be considered with this process.

- The costs of ensuring a smooth frequency reallocation were expected to be considerable.
- Incentives for cost burden were thought to work for those using the frequency after reallocation.
- The methods of sharing and reallocation of existing system vary depending on the start time of the service and the area deployment, and the cost of reallocation is likely to change.

Therefore, it was considered best to introduce measures utilizing the market principle of letting the person who wants to use the frequency after reallocation which makes an offer of the amount of available expenses directly. Specifically, introduction of a method was considered whereby selecting an applicant to be granted approval would be based on the amount of available expenses for reallocation and the time of the service starts up.

The introduction of measures incorporating the idea of auctioning in this manner was expected to encourage mobile operators to launch services promptly and deploy in areas early, while bearing the expenses required for frequency reallocation. This was expected to contribute to early realization of a wireless broadband environment and to create new services and strengthened international competitiveness. The mechanism to create these exit promotion measures with these ideas in mind was passed into law (MIC 2011b) via a related bill in May 2011 and reallocation of the 700/900 MHz bands followed these procedures for the first time.

5 Debut of 4G Mobile Communications System

5.1 Background

In March 2013, the number of subscribers using mobile phones and broadband wireless access systems (BWA) numbered 141,340,000, equal to 110.4% of the population at that time, and illustrating how much mobile devices had penetrated society. Some users were even using multiple devices. Under such circumstances, MIC aspired to achieving the status of Japan as the world's most advanced mobile network environment (where the maximum speed is 1 Gbps), thereby contributing to the promotion

of the Japan Revitalization Strategy (Cabinet 2013) and raising Japan to the status of the most business-friendly country in the world. As part of improving the environment for these purposes, from around 2012, the government decided to consider the introduction of fourth-generation mobile communications (4G), which realizes high-speed communication equivalent to optic fiber. The technical merit of 4G was twofold: (1) a maximum transmission speeds of 1 Gbps and (2) flexible radio wave use.

Concerning the second point, up until then, in order to realize high-speed communications, it was necessary to ensure continuous bandwidth as much as possible. However, with 4G carrier aggression technology, which bundles several carriers from discontinuous bands, high-speed telecommunication was expected to be easily realized.

5.2 Studies on Technical Requirements

ITU-R promotion of IMT-Advanced standardization studies had ongoing since the year 2000 aiming at realizing a maximum downlink speed of 1 Gbps by using a wider frequency bandwidth, assuming increased future demand for mobile data communications. These studies turned out to be more concrete than thought in response to the fact that new frequency bands for International Mobile. Telecommunications (IMT) were identified at the World Radiocommunication Conference (WRC-07) held from October to November 2007.

In January 2012, the ITU Radiocommunication Assembly (RA-12) approved the recommendation for the IMT-Advanced radio communication system (ITU-R M.2012 2012). In response, the Telecommunications Council expert subcommittee studied the technical requirements for 4G (IMT-Advanced), targeting the 3.4–3.6 GHz band specified for IMT worldwide as well as the frequency bands expected to be used for 4G in Japan. MIC received the council's report (Telecommunications Council 2013) in July 2013.

Given the technological and international trends of the IMT-Advanced, a LTE-Advanced was considered a candidate communication method to be introduced in the market in the future. The results of the study were as follows:

<Basic Concept>

4G was expected to offer a higher speed and larger capacity transmission services than 3G, 3.5G, and 3.9G. In Recommendation ITU-R M.1645, as the target transmission speed, 100 Mbps for high-speed and 1 Gbps for low-speed movement were indicated. What is more, 4G was expected to be able to respond to sophisticated and diversified services by adopting various functions in response to traffic conditions.

<Special characteristics of LTE-Advanced technology>

- Carrier Aggregation (CA):
  Transmitting/receiving (maximum 100 MHz bandwidth) while bundling several LTE carriers (discontinuous or continuous band) to increase transmission speed (maximum downlink speed of 3 Gbps)
- Expansion of MIMO:
  Expanding MIMO multiplex transmission (downlink: maximum 8, uplink: maximum 4) and multi-user MIMO expansion and application.
- Heterogeneous networks:
  Different types of base stations (for example; transmission power) coexist and are used in one area. Technologies to improve collaboration among base stations within a network and to improve cell-edge throughput, etc. were also studied.

5.3 Frequency Assignment

Based on the results of the open hearing in January 2014, MIC decided to assign frequency for 4G according to these policies,

- From the perspective of contributing to Japan's promotion of growth strategy, the third arrow of "three arrows" toward the revival of the national economy, by developing the world's most advanced mobile network ahead of the rest of the world, and to allocate bands firstly that could be assigned early
- To manage rapid increases in traffic and to introduce the time division duplex (TDD) method, allowing for changes in the ratio of uplinks and downlinks
- To achieve the 4G characteristic of a maximum speed of 1 Gbps and to assign the 40 MHz band to each of the three mobile operators (3.48–3.6 GHz).

Following those policies, in September 2014, the draft guidelines for establishing specified base stations for 4G, including the bands selected for allocation as well as the criteria to decide the allocation, were formulated. The allocation criteria were:

The minimum standards to be met included the following points.

- To achieve 50% population coverage in all jurisdictions four years from approval.
- To use adaptive multi-level modulation, carrier aggregation technology and other technologies to ensure efficient use of radio waves.
- To have plans to promote the use of specified base stations by providing wholesale telecommunications services or connecting telecommunications facilities to MVNOs.
- To have a plan to make various charges in settings according to the traffic demand of users on services to be provided.

In addition to what has already been mentioned, integrated frequency operations were carried out among the mobile operators having capital relations and groups were then formed in the mobile communication market. For this reason, since the idea of frequency assignment to each operator was slightly changed, MIC decided to conduct

a strict examination considering the grouping to ensure fairness. It was previously prohibited for one applicant who had voting rights and a holdings relationship of one-third or more with another applicant applying for assignment. The capital relationship (investment ratio and ownership structure), decision making (composition of officers), and frequency operation status also were included in the examination.

Comparative criteria (applied in the case of four or more applicants) included the following.

– whether the population coverage by specified base stations is higher than that of the other applicants four years from approval.
– whether the plans are more specific than the plans of other applicants for promoting the use of specified base stations by providing wholesale telecommunications services or connecting telecommunications facilities to other operators.

NTT DOCOMO, KDDI, and SoftBank Mobile applied for assignment of 3.48–3.6 GHz band, and their establishment plans were evaluated based on establishment guidelines. The three applications were judged to meet the minimum standards to be met and subsequently, all three applicants' establishment plans were granted approval. However, since there was overlapping of the frequency applied for by the three applicants, the applications were judged and scored based on the comparative criteria with the applicant ranking highest being assigned the requested frequency. Provided below is an example of the applied and scored individual criteria.

– population coverage of specified base stations (in increments of 5%) four years from approval is highest
– plan for the number and location of establishments of specified base stations is more specific.

The results were announced in December 2014, with each applicant assigned a 40 MHz block each. NTT DOCOMO was assigned 3.48–3.52 GHz, KDDI was assigned 3.52–3.56 GHz, and SoftBank Mobile was assigned 3.56–3.6 GHz.

5.4 Additional Assignments to Further 4G Deployment

MIC decided that the best response to the increase in mobile communication traffic (it continues to increase at a pace of about 1.3–1.4 times per year) was to increase the frequency assignment and then carry out the additional frequency assignment for 4G. In December 2017, MIC submitted an inquiry to the Radio Regulatory Council on draft guidelines for establishing specified base stations for further deployment of 4G, and received a report (Radio Regulatory Council 2017) from the Council stating that the draft was appropriate.

This report stated that the following four bands were prepared and a new entrant would receive extra points when comparative examination criteria are applied.

1.7 GHz band (40 MHz (20 MHz × 2), FDD): 2 blocks

3.4 GHz band (40 MHz, TDD): 2 blocks.

In addition, because the 1.7 GHz band is used for fixed stations for public services and the 3.4 GHz band for the fixed and mobile base stations of broadcasting operators, respectively, the guidelines included implementation by termination promotion measures regarding reallocation of each band.

Four applications were filed in March 2018. Their establishment plans were then evaluated in the following manner.

The minimum standards to be met including the following points were set.

- To achieve population coverage criteria (80% in all jurisdictions eight years from approval for 1.7 GHz band and 50% in all jurisdictions five years from approval for the 3.4 GHz band).
- To be able to raise funds for the minimum cost (195 billion yen for 1.7 GHz band and 11 billion yen for the 3.4 GHz band) required for frequency reallocation of existing radio stations.
- To have plans to promote the use of specified base stations by providing wholesale telecommunications services or connecting telecommunications facilities to MVNOs.
- Not to transfer business to existing operators after frequency assignment.

All applicants met the minimum standards and there was no overlapping of the first desired band. Therefore, the four operators were assigned the desired band. Assignment details are as follows.

1.7 GHz: KDDI: 1710–1730 MHz for FDD uplink, 1805–1825 MHz for FDD downlink
1.7 GHz: Rakuten Mobile Network: 1730–1750 MHz for FDD uplink, 1825–1845 MHz for FDD downlink
3.4 GHz: SoftBank: 3400–3440 MHz for TDD
3.4 GHz: NTT DOCOMO: 3440–3480 MHz for TDD.

The results meant that a fourth Japanese mobile network operator was established in the market. The assignment to a new operator is the first in 13 years, since assignment to eAccess in 2005.

6 Introduction of 5G Mobile Communications System

6.1 Background

Efforts aimed at realizing the 5G mobile communications system started to gain momentum in Japan and abroad around 2013. After Tokyo was selected to host the 2020 Summer Olympic and Paralympic Games in September 2013, it was decided that Japan would aim to be a pioneer in mobile communications by realizing 5G in time for the games. Support activities for Japan's 5G promotion organization,

referred to as the 5G Mobile Communication Promotion Forum (5GMF), a research and development program on 5G-related technologies and promoter of international cooperation, were started to 5G three pillars of support.

As the next-generation mobile communications system, 5G not only offers ultra-high speed developed as an outgrowth of 3G and 4G technology but also to new with functions such as massive connectivity and ultra-reliability and low latency. Massive connectivity refers to the massive number of devices that can communicate simultaneously over the network and ultra-reliable and low latency refer to the almost zero delay during radio space through radio communication sessions.

Beyond the tools that people used to communicate with each other on a daily basis, networks have evolved to connect with the inanimate things around us to permit new forms of information exchange. Here, 5G is expected to be the vanguard ICT base for the Internet of Things (IoT) era.

Around the same time, Europe, China, and Korea started up their own 5G research programs. International discussions also became animated when ITU held a 5G-related workshop in February 2014 and discussions to make ITU-R Recommendations started.

6.2 Studies on Technical Requirements

In September 2015, ITU released "Recommendation ITU-R M.2083-0" (ITU-R 2015), which stated that 5G requirements would include transmission speeds of 10 Gbps, 100 times faster than LTE and 10 times faster than 4G, massive connectivity of 1 million devices per square kilometer, 100 times more than LTE and 10 times than 4G, and ultra-low latency of 1 ms, one-tenth that of 4G. These requirements would make 5G a valuable tool for automobile, production plants, and agricultural applications, to name a few. Since 5G is a next-generation mobile communications system that exceeds the usage form of conventional smartphones and mobile phones, basic concept, service image, network configuration, and so on were clarified before the studies on technical requirements for 5G.

Basic Concept of 5G

- Technical Perspective: Adopting new radio technologies (5G NR), along with existing frequency bands, using a variety of frequency bands, for example, a high-frequency band with millimeter-wave propagation and building further on a heterogeneous network composed of multiple wireless technologies.
- Business Perspective: It was pointed out that in order to establish 5G as a business tool, a different approach would be required from the mobile industry's traditional operation (Telecommunications Council 2017).

In the 5G era, it is assumed that operators will cooperate with partner companies from vertical sectors and provide services based on the "B2B2X" model, and what kind of business model could be constructed with what kind of partner was regarded as the key for success. Thus, building an ecosystem beyond industry to create new businesses is indispensable.

In the era of IoT, 5G will be the ICT infrastructure, and the special characteristics of 5G will drive new services and create new opportunities in various fields. With realization of 5G, the IoT environment in which all manner of things around us are connected will be firmly established. For example, IoT is expected to play an important role in offsetting some of the negative effects of the population decline; it is expected to reinvigorate local economies when 5G is introduced to fields such as agriculture, tourism, transportation, and construction, and 5G is expected help negate some of the negative output impact of a declining workforce by raising overall productivity levels of labor.

What is more, beyond 5G standalone services, the possibility of improving 4G services through application of 5G technology deserves further study. In July 2018, the Telecommunications Council released a report (Telecommunications Council 2018) on the technical requirements for the 5G mobile communications system (5G NR).

6.3 Frequency Assignment

In October 2018, to allow for public consultation on licensing policy, an open hearing was held. Opinions were received from four operators, NTT DOCOMO, KDDI, SoftBank, and Rakuten Mobile Network. That was followed by the release in November 2018 of the draft guidelines for establishing specified base stations for the introduction of the fifth-generation mobile communications system, which was followed by soliciting opinions on the draft guidelines.

In December 2018 establishment guidelines were officially released (MIC 2018). They include:

– Availability of 10 slots.

  3.7 GHz band: 5 slots, each with a bandwidth of 100 MHz
  4.5 GHz band: 1 slot with a bandwidth of 100 MHz
  28 GHz band: 4 slots, each with a bandwidth of 400 MHz.

– Instead of the conventional population coverage ratio, new evaluation indices such as the possibility of nationwide deployment, early service in rural areas, and a variety of services are set.
– Wide areas with real needs, irrespective of whether an urban or a rural area, would be covered early.
– To offer a wide range of areas business possibilities irrespective of whether are urban or rural areas, the whole nation has been divided into 10-km^2 meshed territories instead of 500-m^2 meshed territories adopted thus far; there are about 4500 target meshed territories across the country).

The minimum standards to be met including the following points were set to promote early 5G deployment not only in urban areas but also in rural areas.

– To achieve 50% or more for 5G infrastructure development ratio in each jurisdiction as well as nationwide five years from approval.
– To start operation of 5G advanced base stations in all prefectures two years from approval.
– To have plans to promote the use of specified base stations by providing wholesale telecommunications services or connecting telecommunications facilities to MVNOs.
– No multiple applications from companies in the same business group.

MIC will conduct a comparative examination on applications of all applicants who satisfy the minimum standards. The following items are included in the comparative criteria when there is desired-band overlap, because it is assumed that the difference between applicants will become apparent for such criteria:

– Whether the number of advanced base stations established is higher than those of other applicants five years from approval.
– Plans concerning the number and location of established specified base stations that enable communication indoors including public spaces such as underground malls and subway stations, etc., are more substantial than other applicants.
– To have more specific plans than other applicants in promoting use of specified base stations by providing wholesale telecommunications services or connecting telecommunications facilities to MVNOs.
– Plans on advanced utilization with the features of 5G and plans for efforts to expand the utilization needs for 5G are more specific than the plans of other applicants.

Hereafter, after acceptance of application for the establishment plan in January 2019, frequency will be assigned in April 2019.

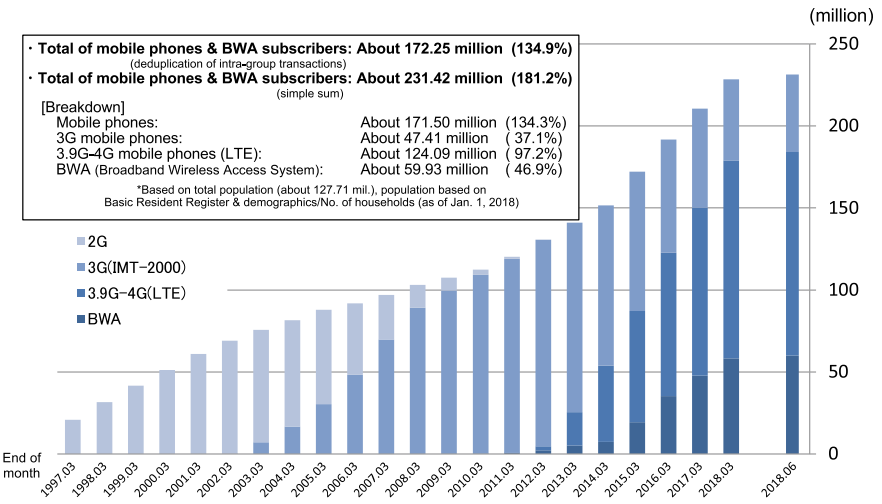

Fig. 2 Number of subscribers (rate of diffusion in population*) as of June 30, 2018. *Source* By Author [Quarterly Data on Telecommunications Service Contract Numbers and Market Share Published]

7 Conclusion

This chapter has provided an overview of mobile communications systems over the past ten years, mainly from the viewpoint of radio policies. Mobile communication systems have evolved by generation almost every decade, incorporating new technologies in each new generation. In this decade, the scene has changed from the maturity period of the 3G to the 4G introduction period, to the maturity of 4G, to the time to look toward 5G, the next generation. During this period, the number of subscribers has more than doubled, as shown in Fig. 2.

Remarkable progress and development have occurred both in devices, typically smartphones, and applications, such as SNS and video streaming. Radio policies have also made substantial jumps in progress both in response to these demands and partially anticipating these changes during this short period of time. Looking back at the development of mobile communications systems up until now, development of the next-generation system and the applications did not always follow directly what was anticipated before start-up. Radio policies need to be revised from time to time and continue moving forward in the 5G era to meet the challenge of unforeseen radio usage.

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Effective Use of Radio Waves

Yasuo Shinozawa

1 Introduction

The Radio Act (Act No. 131 of May 2, 1950) states in Article 1 that the purpose of this Act is to promote the public welfare by ensuring the fair and efficient usage of radio waves. This chapter examines the effective use of radio waves, which means using our limited and scarce radio spectrum resources effectively. The view that will be put forth in this chapter is that this effective use is essential in order to fulfill the Radio Act's purpose—namely "the fair and efficient usage of radio waves."

Efforts and initiatives to ensure the effective use of radio frequencies are part of and indivisible from the history of all wireless systems that have made use of radio waves. Therefore, such efforts and initiatives should be discussed from a variety of perspectives. Of the many different wireless systems, however, this chapter will focus on broadcasting system, in which people around the world are familiar with their daily lives. But broadcasting system is also the subject of constant and varied efforts to ensure the effective use of radio waves. These include advances in broadcasting formats—beginning with the switchover from analog formats to digital formats, frequency sharing, and the resulting creation of new industries.

Note that Chapter "Development of Mobile Technology (3G, 4G, 5G)" covers the systems related to the allocation and usage of radio frequencies, such as the establishment of frequency allocation plans, frequency usage plans, and technical standards as well as the licensing of radio stations. It also covers the relationship between the Minister for Internal Affairs and Communications, who is the cabinet minister in charge of radio usage, and the Minister's Advisory Committees, such as the Radio Regulatory Council and the Information and Communications Council.

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2 The Switchover to Digital Broadcasting Formats

Countries around the world began transitioning to digital broadcasting formats in the 1990s. Digital broadcasting formats offered viewers greater selection through the diversification of programming and services. Digital formats would also drive advanced broadcast services through connectivity and convergence with info-communications and computers. Moving to digital quickly was an important issue for Japan's broadcast policy as well. A key part of this was transitioning to digital in a form that was consistent across all three media—terrestrial broadcasting, satellite broadcasting, and cable TV. Digital broadcasts in Japan began in 1996 with communication satellite (CS) digital broadcasts, which were followed by broadcasting satellite (BS) digital broadcasts in 2000 and terrestrial digital broadcasts in 2003 (see Fig. 1).

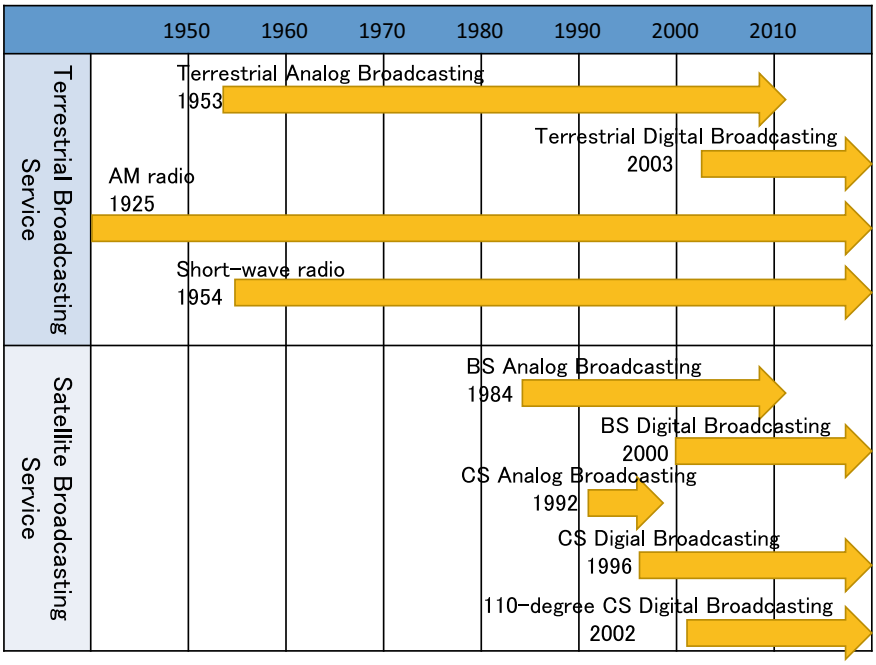

Fig. 1 Starting years for leading digital broadcast services. *Source* Ministry of Internal Affairs and Communications

2.1 Launch of BS Digital Broadcasts

The Radio Regulatory Council, in a May 1997 reply to an inquiry regarding transitioning to digital satellite broadcasts, formulated a policy to address broadcasts from the satellite to replace the BS-4 satellite (MIC, Radio Regulatory Council 1997). The policy indicated, among other matters, that high-definition television (HDTV) broadcasts were to be the standard broadcast from BS-4's replacement and those BS digital broadcasts would contain the same content as BS analog broadcasts. For many years, there had been debate about whether the BS-4 replacement should continue to use the Multiple Sub-Nyquist Sampling Encoding (MUSE) format, which was used for high-definition analog broadcasts at the time or whether to convert to digital broadcasts. At the time, some one million TV receivers capable of receiving high-definition MUSE broadcasts had already been sold. Broadcasters, therefore, faced the serious challenge of how to protect these viewers while migrating to digital broadcasts.

Conversely, two developments had accelerated the digital movement. The first was the standardization of video compression by the Motion Picture Experts Group (MPEG) and the development of MPEG-compatible devices. The second was a report by the Study Group on Digital Satellite Broadcast Technology stating that: "It will be technically feasible to broadcast to two HDTV channels per transponder by around 2000" (Study Group on Digital Satellite Broadcast Technology 1996).

System arrangements were made in 1998 in response to the report, and the broadcasters listed in Table 1 started BS digital broadcasts in December 2000. This made

Table 1 BS digital broadcasters (at the time BS digital broadcasts were launched)

Category		Broadcasters
Consignment broadcasters		Broadcasting Satellite System Corporation (BSAT)
Consigning broadcasters	Simulcasts	NHK, Satellite Digital Audio Broadcasting
	HDTV broadcasts	BS Asahi, Japan Satellite Broadcasting, BS Nippon Corporation, BS Japan, BS Fuji, BS-i
	Standard TV broadcasts only	BSJ Radio, Music Bird, JFN
	Data broadcasts	Nippon BS Broadcasting Corporation, MediaServe, Megaport Broadcasting, Weathernews, Japan Media Arc, Digital Cast International, Japan Data Broadcasting, Hi-Vision Promotion Association

Source Ministry of Internal Affairs and Communications

multi-channel broadcasts and efficient and flexible transmission of video and audio possible as well as contributing greatly to effective radio waves used.

Working toward the target of reaching 10 million household subscribers within 1000 days of commencing digital broadcasts, the public and private sectors together took various steps to promote adoption of digital broadcasts. These steps included holding demonstrations of the technology at the Kyushu-Okinawa G8 Summit, high school baseball tournaments, the Sydney Olympics, and other large events, as well as at post offices and other public facilities, promoting technology development, and inaugurating the BS Digital Broadcasting Promotion Liaison Conference.

Japan has a long history of satellite broadcasting, and the country has made tremendous contributions on the technical side to satellite broadcasting around the world. For example, according to NHK (2016), NHK's satellite broadcasting R&D made it possible to receive TV broadcasts in every home in Japan, including those in mountainous regions and on outlying islands. Furthermore, NHK's R&D built the foundation of satellite broadcast services now found worldwide. And in 1989, NHK started the world's first regular HDTV broadcasting trials via satellite. Each of these achievements was recognized with an IEEE Milestones in Electrical Engineering and Computing.

Japan's undulating topography necessitates measures to address areas with poor reception. Satellite broadcasts are a very effective way to deal with blind spots in terrestrial broadcast coverage. Japan's first dedicated broadcast satellite was launched in 1984 with the mission of broadcasting to poor reception areas in mountainous regions and on remote islands. Since then, the country has worked over many years to improve satellite broadcasting.

2.2 Transition to Terrestrial Digital Television Broadcasts

The transition to terrestrial digital television broadcasts was a pressing concern, both to boost dramatically the functionality and role of broadcasting and to resolve the unavoidable issue of radio waves congestion. Indeed, it was a global trend, with many countries and regions grappling with how to resolve radio waves congestion because of surging demand for radio frequencies caused by the growth of mobile phones and many other wireless systems.

In the mid-1990s, Japan made switching to terrestrial digital broadcasts part of its overall policy strategy to advance information and communications—a strategy that also involved a plan to construct optical fiber networks throughout the country. The Telecommunications Council, in a June 1997 reply to an inquiry, stated that: "Terrestrial digital broadcasts should be introduced over a period from 2000 to 2005." Despite this recommendation, deliberations continued from multiple perspectives. Some of the concerns voiced included:

- Are benefits from transitioning to digital broadcasts worth the costs, in terms of the expenses and labor to convert to digital?

- Is it possible to secure sufficient radio waves resources to migrate massive networks that stretch across the entire country to digital formats while also continuing to provide analog broadcasts?

A report by the Advisory Committee on Terrestrial Digital Broadcasting, submitted in October 1998, indicated that the benefits of transitioning to terrestrial digital broadcasts included social benefits such as more efficient use of radio frequencies and economic knock-on effects as well as benefits for viewers, broadcasters, and other related parties (MIC 1998). The benefits mentioned are summarized below.

For viewers:

- Receive high-quality image and audio services
- Receive a greater diversity of channels
- Potential for advances in TV viewing
- Enriched services for older people and the disabled
- Potential for receiving stable services while mobile

For broadcasters:

- Greater business opportunities through the provision of more diverse broadcast services
- More efficient and more diverse program production
- Enable energy conservation
- Help turn broadcast programs into multiuse content
- Integrate with audiences

For device manufacturers and broadcast program producers:

- Expand the market for digital receivers
- Enlarge demand for LSIs, LCDs, plasma displays, and other new devices
- Increase demand for broadcast program production
- Create more opportunities for broadcast programs to enter international markets.

In light of this report and the benefits it described, the government decided to make arrangements so terrestrial digital broadcasts could start in the three large urban areas of Kanto, Chukyo, and Kinki, by a target date of the end of 2003, and the rest of the country by the end of 2006. The arrangements were guided by the basic approach outlined below (Advisory Committee on Terrestrial Digital Broadcasting 1998).

1. Complete the transition from analog broadcasts to digital broadcasts as soon as possible. Make considerations for broadcasters so they can carry out the transition inexpensively.
2. Administrative authorities and broadcasters should endeavor to clarify, to the degree possible, a rough implementation schedule and the timing of analog broadcast terminations for each separate terrestrial digital broadcast region.
3. Opportunities for new market entrants should only be provided once analog broadcasts have ended, as a rule. The reasoning is twofold: to ensure the transition goes smoothly using minor frequency adjustments with current analog broadcasts and to account for the costs borne by existing broadcasters to build digital broadcasting networks while continuing analog broadcasts in parallel.

4. Moving the three broadcasting systems—satellite broadcasts, cable TV, and terrestrial broadcasts—to digital will enable each to better fulfill their respective roles. Terrestrial broadcasts, in particular, will be able to further develop their role as the primary broadcasting media already widely disseminated among citizens.
5. Administrative authorities, broadcasters, device manufacturers, and others should work together to institute a smooth transition methodology that is not unnecessarily confusing for viewers.

To carry out these arrangements, the Ministry of Posts and Telecommunications (hereinafter referred to as MPT)—together with the Tokyo Pilot Project Implementation Committee, which consisted of broadcasters, manufacturers, communication carriers, and others—ran a two-year terrestrial digital broadcast pilot project starting in November 1998. The Ministry also promoted the development of new technologies and services that would utilize terrestrial digital broadcasts.

In November 1999, two new Acts went into force: The Act Partially Amending the Broadcast Act and the Act on Temporary Measures concerning Promotion of Development of Advanced Television Broadcasting Facilities. The former contained several amendments to provisions concerning the definition of television broadcasts and other terms. The new definitions assisted the dissemination of advanced and diverse broadcasts combining text, graphics, and other forms of data with video and/or audio—a key advantage of digital broadcasts. The latter act added the services of communication and broadcast organizations to services eligible for loan guarantees. The goal was to aid the construction of advanced television broadcasting facilities for terrestrial digital television broadcasts and, in this manner, push the early dissemination of terrestrial digital television broadcasts.

In Fiscal Year (FY) 1999, additional assistance measures were created to help offset the investments by broadcasters and program producers in facilities and equipment needed to move to terrestrial digital broadcasts. The assistance measures made use of the tax system along with financing from the Development Bank of Japan and other institutions. In November 1999, the MPT amended ministerial ordinances and a number of other regulations pertaining to the broadcast method to be used for terrestrial digital television broadcasts. The broadcast method had been verified through large-scale field proving tests based on a tentative broadcast method put together in September 1998. The amendments followed a reply from the Radio Regulatory Council in 1999 regarding an inquiry on proposed technical standards for the broadcast method.

Advantages of the terrestrial digital television broadcast method (ISDB-T) are:

- ISDB-T's 6 MHz channel bandwidth permits the broadcast of one HDTV channel or multiple SDTV channels on one channel
- Good mobile phone and mobile reception is possible with the use of either a modulation method suited for mobile phone and mobile reception (OFDM method) or powerful error-correction functions
- Permits flexible use of frequency bands, as broadcasters can combine as needed various operational configurations, such as simultaneously transmitting broadcasts for fixed-position reception and mobile reception

- Permits single frequency networks (SFNs), which help make effective use of radio frequencies
- Ensures consistency by using compression technologies and multiplexing technologies (MPEG-2) already in use by other digital broadcasting media in the country.

With the switchover to digital broadcasts, it became possible to watch a higher definition program or multiple standard-definition programs in the same frequency bandwidth that previously could only support one analog channel of standard-definition television.

A disadvantage with analog broadcasts was the inability of adjacent stations uses the same channel or adjacent channels because of frequency interference. For example, if one station used Channel 2, the adjacent station obviously could not use Channel 2 in the same region, and it could not use the neighboring Channel 1 or Channel 3 either. Digital broadcasts, thus, dramatically improved frequency usage efficiency. For example, by using SFNs shown in Fig. 2, the same channel could be used repeatedly, i.e., adjacent stations can use the same frequency channel without causing interference. Japan suffers from many poor reception areas because of its undulating topography. These poor reception problems were solved and broadcast networks covering the entire country were constructed by taking full advantage of SFNs. More than 12,000 relay stations were successfully set up around the country

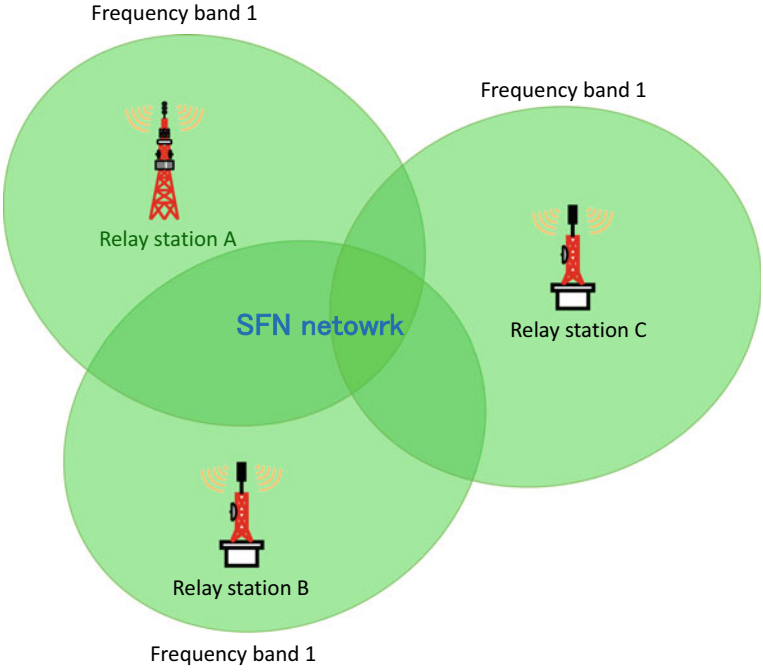

Fig. 2 Single frequency networks. *Source* Ministry of Internal Affairs and Communications

using just 40 frequency channels (between 470 and 710 MHz) for terrestrial digital broadcasting. This very dense use of broadcast frequencies was a groundbreaking precedent, almost unheard of elsewhere in the world.

2.3 The Analog Frequency Conversion

Switching terrestrial television broadcasts from analog to digital required some existing analog broadcast frequencies to be reassigned to other analog broadcast frequencies—a so-called *analog–analog reassignment*. This move was needed to free up frequencies for use by digital television broadcasting stations. The analog frequency conversion was implemented between 2002 and 2011 to carry out the frequency reassignment.

It was known from the outset that the analog–analog reassignment would be enormously expensive. Numerous deliberations and examinations looked at how to divvy up the expense. The MPT announced a draft plan on the use of frequencies for terrestrial digital broadcasts in December 1998 and released an estimate of the number of affected households and the cost of the measures in January 1999. Broadcasters, however, firmly opposed the draft plan, which would have impacted a very large number of households, as being unsuitable even as a starting point for discussions. This resistance shelved, for the time being, the establishment of a national channel plan.

In the National Diet, meanwhile, many questions arose concerning analog–analog reassignment measures. The National Diet passed a number of additional resolutions concerning the bill for the Act Partially Amending the Broadcast Act (Cabinet Bill No. 92). These included: due consideration shall be made to ensure the conversion of terrestrial broadcasts to digital formats will not lead to the formation of either geographic or economic digital divides, and endeavors shall be made to improve access to information for members of the public—such as older people and people with visual and hearing disabilities—who are at a disadvantage when accessing information. Due consideration shall be made, in cases where the viewing of existing analog broadcasts is obstructed or hindered during the transition period to digital broadcasts, so that costs incurred in remedying such obstructions or hindrances are not simply passed on to viewers. Furthermore, examinations shall be made of measures to lower the costs to viewers who must update or change equipment in order to receive digital broadcasts. Measures shall be put in place to support investments in facilities by broadcasters required to convert terrestrial broadcasts to digital formats (The House of Representatives, Japan 1999; House of Councilors, The National Diet of Japan 1999).

In response to these developments, NHK, commercial broadcasters, and the MPT set up the Joint Study Committee on Digital Terrestrial Broadcasting in September 1999. The Joint Study Committee drafted a new national channel plan for terrestrial digital television broadcasts in April 2000. It estimated that the analog–analog reassignment would affect 2.46 million households and cost around 85.2 billion yen.

It also concluded that "broadcasters were in complete agreement that the central government should bear the costs" of the analog–analog reassignment (MIC 2000).

Some argued using public funds to cover broadcasting station expenses was inappropriate. Ultimately, however, public funds were used to cover analog–analog reassignment expenses in areas outside of Tokyo and other large metropolitan areas, on the condition that the vacated frequencies after analog broadcast switch-off would be reused for non-broadcasting purposes. Broadcasters were successful in their argument that analog–analog reassignment was a frequency adjustment project by the government in advance of digital broadcasts. The use of public funds was also justified on the reasoning that the digital divide between urban and rural areas should be closed as soon as possible.

The Joint Study Committee wrapped up its assignment in June 2001. In its place, the Joint Council to Promote Terrestrial Digital Broadcasting was set up in July 2001 to implement the analog–analog reassignment and promote digital broadcasts. The Joint Council led the implementation of the Analog Broadcast Frequency Reassignment Plan. To implement the plan, the Joint Council organized regional councils across the country. On the broadcasting station side, they assisted with frequency conversion construction work, and on the viewer side (including apartments and other facilities with shared TV receivers), they set up receiving equipment.

According to a release by the Ministry of Internal Affairs and Communications (hereinafter referred to as MIC 2011), frequency conversion and related construction work on the transmitting side took place at 1166 analog broadcasting stations. Operations to ensure reception, such as replacing antennas or adjusting antenna directions and reprogramming channels on TV receivers, took place at around 4.71 million households. Because of the successful implementation of these measures, analog broadcasts were switched off in 44 prefectures in July 2011. Analog broadcasts in Iwate, Miyagi, and Fukushima prefectures, which were severely damaged in the 2011 Great East Japan earthquake, were switched off in March 2012. The measures ensured households could continue to watch analog broadcasts, even as 11,300 digital relay stations were built out across the country by December 31, 2010.

2.4 UHF (700 MHz Band) Frequency Reallocations

On the question of 700 MHz band frequencies that would be vacated with the full transition to terrestrial digital broadcasts, the Information and Communications Council gave a reply on the mid-to-long-term outlook on radio spectrum usage and the role administration should take in October 2003 (MIC 2003b). The Council recommended that: frequencies in the UHF band (700 MHz band) should be allocated to mobile communication systems, for which demand will surge in the coming years, because this frequency band is well suited to the mobile field.

For its part, the MIC worked out the Frequency Reallocation Policy (MIC 2003a) in October 2003. The policy formed the Ministry's basic position on the reallocation of vacated frequencies and signaled the Ministry's intention to secure frequencies

for mobile phone use. The policy was based on forecasts that by around 2008, the total frequency bandwidth needed by mobile phones would balloon from 330 kHz to 34 MHz. The policy named bandwidths found in the 700 MHz and the 900 MHz bands, as well as the 2.5 GHz band, as potential new frequency bands for mobile phone allocation—in addition to the VHF band, the 1.7 GHz band, and the 2.0 GHz band.

The Ministry accepted proposals over March and April 2006 of systems either being planned or envisioned for use on the VHF/UHF bands. In response, 100 companies submitted 149 proposals of 33 specific systems. The proposals were broadly categorized into private communication systems, broadcasting-related systems, intelligent transport systems, and telecommunication systems. Twenty-two of the proposed systems were private communication systems. These included systems used by policing, firefighting, and disaster relief organizations to execute their duties as well as many other kinds of systems such as ordinary leisure applications. The MIC commissioned the Study Group on ICT for Realizing a Safe and Secure Society, which released a final report in March 2007 (MIC 2007b). In the interest of prioritizing mobile communications and prioritizing the implementation of radio spectrum applications necessary for ensuring safety and security—a high public good, the Study Group decided that examinations would focus on broadband mobile communication systems for disaster response and relief operations expected to be field-ready by FY 2011.

Broadcasting-related systems were categorized into various methods of digital broadcasting, excluding television broadcasts. The Study Group concluded that the necessary frequency bandwidths for such services should be based on the amount and the necessity of information they provided to viewers. Telecommunication systems were categorized into mobile phone systems and other mobile communication systems. Because the 700 MHz band had been earmarked for mobile phones and other mobile services, and because of the skyrocketing growth of mobile phone systems, the Study Group decided it was necessary to secure as much frequency bandwidth as possible for mobile communication systems in the 700 MHz band. Intelligent transport systems were categorized as crucial systems for vehicle-to-vehicle communications to prevent collisions between vehicles at intersections.

The Information and Communications Council's Subcommittee on Information and Communications Technology published a report by the Committee on Effective Radio Spectrum Usage Measures in June 2007 (MIC 2007a). The report stated: "Based on the proposals submitted in regard to future radio spectrum usage needs, the frequency bands that will be vacated with the transition to terrestrial digital television broadcasts—namely, 90–108 MHz and 170–222 MHz in the VHF band and 710–770 MHz in the UHF band—should be allocated for use for the following services:

- broadcasting, meaning multimedia and other forms of broadcasting for mobile applications;
- private communications, which will enable broadband communications that ensure the safety and security of society;

- telecommunications, meaning mobile phones and related services that will require additional frequencies due to rapid increases in demand; and
- intelligent transport systems, which are necessary to ensure better road traffic safety for the public."

Based on this report, frequencies in the 700 MHz band were reallocated to communication systems that assist driving safety and to mobile phones. To free up as much frequency bandwidth as possible in the 700 MHz band for reallocation, applications that had been using frequencies between 770 and 806 MHz—field pickup units (FPUs) for wireless relay transmissions of television broadcasts and wireless radio microphones—were also moved. This was in addition to the frequencies between 710 and 770 MHz that had formerly been used by terrestrial television broadcasts. It was decided to move FPUs to the 1.2 and 2.3 GHz bands by March 2017, and wireless radio microphones to TV white spaces and the 1.2 GHz band by May 2018 (see Fig. 3).

After the frequency reallocations, mobile phones began emitting radio signals at frequencies in the 700 MHz band that had previously been used for terrestrial television broadcasts. These mobile phone signals have caused TV reception interference at homes and buildings near 700 MHz band mobile phone base stations. In some cases, the mobile phone signals disrupt antenna amplifiers—used in homes and buildings to amplify terrestrial digital broadcasts for better reception—causing block noise, blank screens, and frozen images to appear on TVs. To eliminate this interference, mobile carriers formed the Association of 700 MHz Frequency Promotion in December 2012. The Association continues at present to deal with TV receivers suffering from interference problems in homes and buildings near 700 MHz band mobile phone base stations.

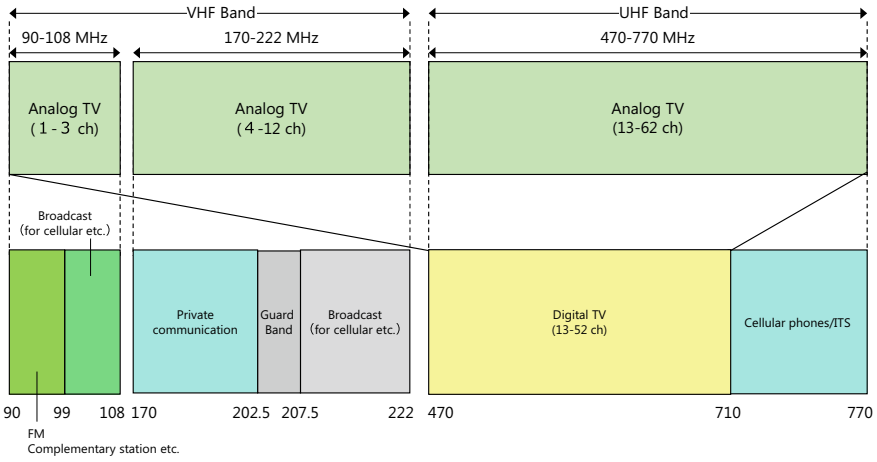

Fig. 3 Outline of 700 MHz band frequency reallocations. *Source* Ministry of Internal Affairs and Communications

2.5 VHF Frequency Reallocations

The full switchover to terrestrial digital broadcasts would vacate frequencies in the VHF band (90–108 MHz and 170–222 MHz) along with frequencies in the 700 MHz band. The Information and Communications Council issued a reply to an inquiry about the future use of these frequencies. The Council advised that: "a policy should be formulated regarding the allocation of frequencies in the VHF band to serve new frequency demands after determining the specifics of new frequency demands, based on technological developments and on future needs for the use of digital voice broadcasts and mobile communications" (Ministry of Internal Affairs and Communications 2003b). The Ministry then accepted proposals of systems either being planned or envisioned for use in these frequency bands. As a result of the proposals and based on the state of international frequency allocations and needs, the Ministry allocated the V-Low band (90–108 MHz) to broadcasting and the V-High band (170–222 MHz) to private communications (170–202.5 MHz) and broadcasting (207.5–222 MHz).

The Information and Communications Council's Subcommittee on Information and Communications Technology submitted a report by the Committee on Effective Radio Spectrum Usage Measures in June 2007. The report stated that it is appropriate to use the 90–108 MHz and the 207.5–222 MHz frequency bands for multimedia and other broadcasts (but excluding television broadcasts) for mobile applications (Ministry of Internal Affairs and Communications 2007a). Furthermore, the Advisory Committee on Approaches to Multimedia Broadcast Services for Mobile Devices compiled a report in July 2008, which stated that the V-High band (207.5–222 MHz) should be allocated for national broadcasts, and the V-Low band (90–108 MHz) should be allocated for regional block broadcasts (MIC 2008).

The MIC accepted applications of plans to establish multimedia broadcasts in the V-High band. Applications were judged based on the Guidelines for Establishing Designated Base Stations to Use Frequencies at or above 207.5 MHz and at or below 222 MHz (Bulletin No. 173 of 2010) (MIC 2010b). Applications were received from two companies: Multimedia Broadcasting Inc. (mmbi) and MediaFLO Japan Planning Inc. The Radio Regulatory Council conducted its first-ever comparative review of the two applications. The Council reviewed the examination items given in the establishment guidelines—which included the feasibility of the service, the availability of receiving devices, and the competence and framework to execute the submitted plan. As a result of its review, the Council submitted a report and advised in September 2010 that mmbi's service plan was more appropriate, primarily because of significant differences in the pricing structure for consignment broadcast fees (MIC, Radio Regulatory Council 2010). Mmbi did launch a for-fee broadcast service named NOTTV in April 2012. NOTTV, however, failed to capture significant viewer numbers and the service went off the air at the end of June 2016. In November 2017, the Ministry conducted a survey and accepted proposals for the use of the unused V-High band. Eight proposals were submitted, although no companies expressed a

wish to enter the market. The Ministry is continuing, as of September 2018, to weigh measures toward making effective use of the V-High band.

In the V-Low band, the 90–95 MHz band is used for a complemental AM simulcast in FM band—a so-called Wide FM, and the 99–108 MHz band is used for regional block multimedia broadcasts to transmit local community information as well as disaster response and safety information. The allocations were based on the needs of broadcasters expressing a wish to enter the market. Wide FM relay stations are relay stations using FM signals as means to remedy various issues with AM radio broadcasts, such as poor reception in urban areas, interference from signals from other countries, poor reception due to geographical or geological issues, and to assist disaster responses. Forty-one stations were operating as of April 2018 and more continue to be built.

The MIC accepted applications of plans to establish multimedia broadcasts in the 99–108 MHz band. Applications were judged based on the Guidelines for Establishing Designated Base Stations to Use Frequencies above 99 MHz and at or below 108 MHz (Bulletin No. 455 of 2013) (MIC 2013b). An application was received from VIP Co., Ltd., a company established primarily by Tokyo FM Broadcasting, for all seven national broadcast regions. The Radio Regulatory Council submitted a report and advised in July 2014 that certification of the plan was appropriate (MIC, Radio Regulatory Council 2014), leading to certification of VIP's multimedia broadcast establishment plan. VIP launched services in Tokyo, Osaka, and Fukuoka in March 2016 and now provides services in six areas.

2.6 White Spaces

Striving to use radio waves effectively is becoming all the more important, given the skyrocketing demand for radio frequencies. The demand is being driven by the appearance of new services and systems that use radio signals, compounded by the advancement and expansion of existing radio signal-based services and systems. Given the urgency of the situation, the MIC set up the Examination Team for New Radio Usage Vision in 2009. The Examination Team began discussions about introducing white spaces, which can be used flexibly for wireless systems, such as wireless radio microphones or local-area broadcasts while protecting against interference other broadcasts. White spaces refer to frequencies allocated for broadcasting use, for example, that can be used for other purposes under certain geographic or technical conditions.

The Examination Team's report, which came out in July 2010, recommended the creation of white spaces, in which radio signals can be used locally, in the UHF band (470–770 MHz) within frequency bands allocated for terrestrial TV broadcasts (MIC 2010a). The Ministry set up white spaces in several areas and carried out field experiments.

The Radio Regulatory Council examined a draft arranging a system for local-area broadcast systems using white spaces, based on the field experiment results and issued

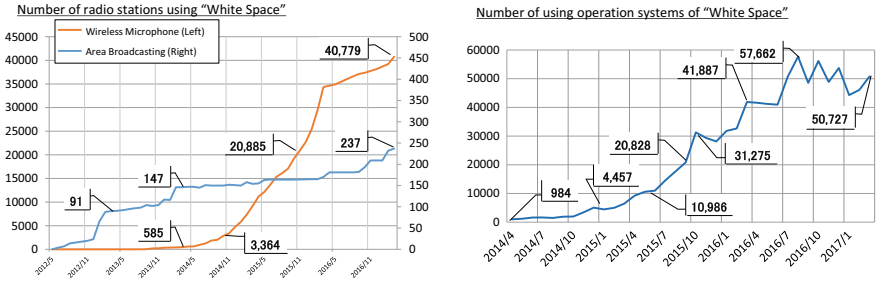

Fig. 4 Usage of white spaces. *Source* Ministry of Internal Affairs and Communications

a reply in March 2012 (MIC, Radio Regulatory Council 2012). Consequently, in April of that year, local-area broadcasts were instituted. These local-area broadcasts are comparatively low-power broadcast services intended for receivers such as mobile phone handsets in a limited area. Services using white spaces are provided in all parts of the country. Furthermore, as a measure to alleviate frequency congestion due to mobile phone growth, the Ministry decided to end the use of the 800 MHz band by wireless radio microphones by March 2019 and use TV white space bands as an alternative. The switchover has been largely completed as of August 31, 2018.

The use of white spaces in Japan has proceeded under the system arrangement described above. As illustrated in Fig. 4, 41,866 designated radio microphone stations and 232 local-area broadcasting stations had been licensed as of the end of 2017. Furthermore, 57,730 operations per month had been made at systems using white spaces to adjust white space usage. In this way, frequencies allocated to broadcasting are used more effectively by using them not just for broadcasting applications but also as white spaces in particular localities where the frequencies are not used for broadcasting applications. This helps get the maximum utility from frequency resources. Nevertheless, a large issue that remains is the difficulty to sufficiently meet radio waves demands at very large events, such as the upcoming Tokyo 2020 Olympic and Paralympic Games.

3 Advances in Satellite Broadcasting

Japan will begin new 4K and 8K satellite broadcasts in December 2018, including the world's first 8K broadcasts. To implement these new services, various efforts were made to make effective use of radio waves.

3.1 *Ultra-High-Definition Television Broadcast Systems*

In the broadcasting and communications fields, international video format standards have been established for ultra-high-definition television (UHDTV) broadcasts that support 4K and 8K video. These have been the result of R&D and standardization of video and other technologies, such as new video encoding methods, that deliver image quality that greatly exceeds current high-definition television (HDTV) broadcasts.

The Study Group on Upgrading of Broadcasting Services, in May 2013, laid out a roadmap toward launching 4K/8K BS broadcasts in 2020. The roadmap was arrived at after examining targets for joint public–private initiatives for the widespread adoption of advanced broadcast services and joint broadcasting and communication services that utilize our world-leading IT infrastructure (MIC 2013a). The Ministry organized Follow-up Meetings on the 4K/8K roadmap starting in February 2014. The meetings looked at the state of initiatives in other countries on advanced broadcast services, the market penetration of 4K-enabled devices, and the readiness state of broadcasters. Based on these considerations, as well as the growing momentum leading up to the opening of the Tokyo 2020 Olympic and Paralympic Games, the meetings compiled a roadmap (see Fig. 5) in July 2015 that set 2018 as the launch date for 4K and 8K broadcasts from the BS satellite and the 110° CS satellite (MIC 2015). Based on this roadmap, it was determined to launch 4K/8K satellite broadcasts in December 2018. Several countries and regions have already launched 4K satellite broadcasts, but the 8K satellite broadcasts will be a world-first service.

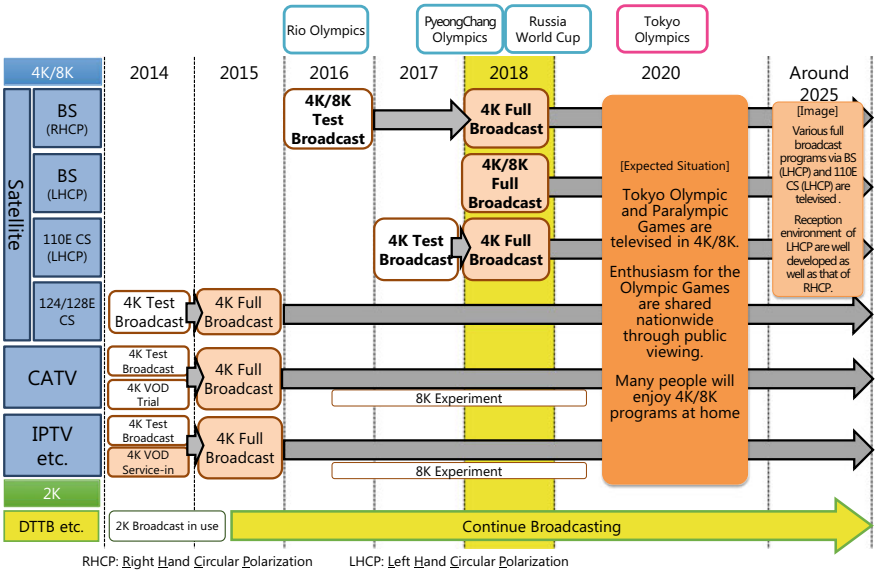

Fig. 5 Roadmap to 4K/8K. *Source* MIC (2015), Second Interim Report of the Follow-up Meetings on the 4K/8K Roadmap

Table 2 Requirements of satellite digital broadcasts for 4K/8K broadcasting

	Broad-band transmission (34.5 MHz width)	Narrow-band transmission (27 MHz width)
Quality of broadcast	(Image quality) • To keep high image quality as much as possible, considering UHDTV (4K/8K format) service is needed	(Image quality) • To keep high image quality as much as possible, considering UHDTV (4K format) service is needed
	(Sound quality) • To keep high sound quality as much as possible, considering high quality of sound and presence for UHDTV service is needed	(Sound quality) • To keep high sound quality as much as possible, considering UHDTV service and current service
Technology system	(Video input format and encoding method) • To be a video input format and an encoding method with high efficiency/high image quality considering UHDTV service, etc. (Sound input format and encoding method) • To be an encoding method with high efficiency/high sound quality, a system adjusting International standards, etc. (Transmission method) • To be a modulation system securing high transmission capacity as variable services including UHDTV service can be transmitted • To consider receiving antenna characteristics (including small antenna with 45 cm opening diameter) (Multiplex system) • To be a multiplex system adjusted to UHDTV service • To consider cooperation with communication service	

Source MIC, Radio Regulatory (2014), Reply from the Radio Regulatory Council (2014)

The Radio Regulatory Council issued a reply in June 2014 on the technical requirements pertaining to UHDTV broadcast systems (MIC, Radio Regulatory Council 2014). As shown in Table 2, the reply arranged the technical standards to satisfy the requirements on satellite digital broadcasts for 4K/8K broadcasting.

The 4K and 8K video formats were introduced and HEVC was adopted as the video encoding method for UHDTV broadcasts. Furthermore, the 16-APSK modulation scheme was introduced and symbol rates were increased to raise the transmission capacity of satellites. These moves boosted the transmission capacity per satellite transponder from the previous maximum of about 52 Mbps to a maximum of about 100 Mbps. This enabled one transponder to transmit one program in 8K or three programs in 4K. Other advances incorporated for UHDTV broadcasts include 22.2 surround sound and an encryption algorithm to allow for conditional access systems (CAS).

3.2 *Frequency Reallocations Among BS Right-Handed Circularly Polarized Wave*

BS digital broadcasts by 2018 had used all satellite broadcast frequencies allocated to Japan. Consequently, Japan could not obtain more frequencies for new 4K/8K satellite broadcasts. Therefore, after coordinating frequencies with other countries, it was decided to use, for the first time, left-hand circularly polarized wave at satellite broadcast frequencies in the 11 GHz band for 4K/8K satellite broadcasts, in addition to the right-hand circularly polarized wave already in use. The complication was that existing parabola receiving antennas cannot receive left-hand circularly polarized wave. To speed up the adoption of 4K/8K broadcasts, a roadmap was created to reallocate frequencies now used by right-hand circularly polarized wave and transmit some 4K broadcasts with right-hand circularly polarized wave on the vacated frequencies.

The roadmap called for securing frequencies by (i) reducing a band used by some existing 2K broadcasts and (ii) rearranging frequency allocations using the resulting opening in the frequency spectrum (see Fig. 6). The frequency reallocation meant Channel 7 could be used for 4K broadcasts, along with Channel 17, which had previously been used for test broadcasts. In total, six 4K programs are now provided using right-hand circularly polarized wave.

The band reallocation would impact viewers (such as requiring reprogramming of receivers and failures with preset recording schedules). To minimize these impacts,

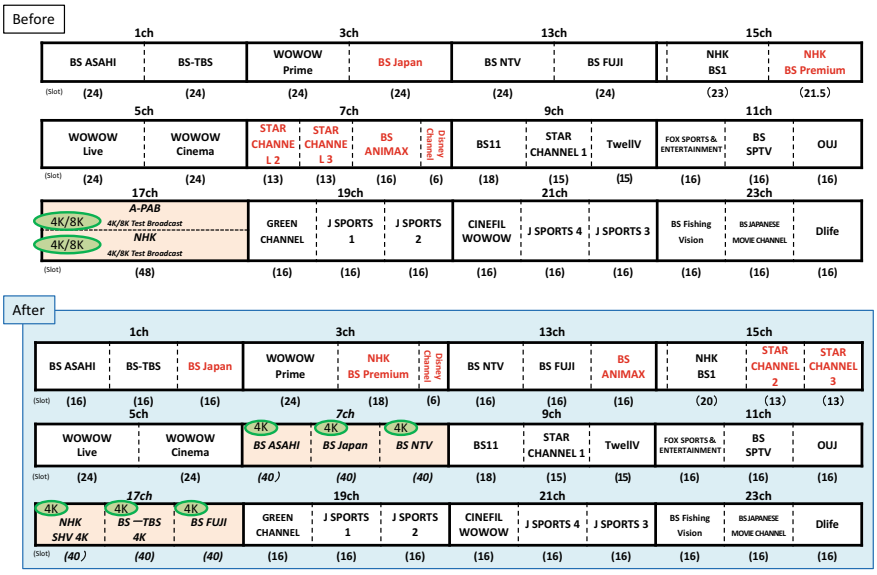

Fig. 6 Channel allocation changes due to the reallocation of right-handed bands. *Source* MIC (2015), Second Interim Report of the Follow-up Meetings on the 4K/8K Roadmap

the private and public sectors worked together in setting up a joint test center to test a wide range of receivers in advance and in informing viewers. Thanks to this collaboration, most problems were avoided.

4 Efforts for the Further Advancement of Terrestrial Broadcasts

As of 2018, 15 years have passed since the switchover to terrestrial digital television broadcasts began in 2003. Over this time, an incredible variety of services, such as communication and broadcasting convergence services, with 4K and other higher resolution content, has been launched on such platforms as IP broadcasts, online video delivery, and satellite broadcasts. In addition, there are mounting expectations for further effective use of radio waves, as demand ratchets up at a dramatic rate. Given this, the Implementation Plan for Regulatory Reform (passed by the Cabinet on June 15, 2018) stated: "The Ministry of Internal Affairs and Communications shall survey the state of radio spectrum use and study and examine effective radio spectrum use measures in order to further the effective use of frequencies used for broadcasting."

The Study Group on Issues Surrounding Broadcasting put together a report in September 2018 urging that "technical studies be conducted on furthering the effective use of broadcast frequencies, such as expanding the use of white spaces and advancing broadcast services, including terrestrial 4K broadcasts and advanced communication and broadcasting convergence services, with an eye on a future vision of broadcasting" (Study Group on Issues Surrounding Broadcasting 2018).

5 Conclusion

This chapter has focused on broadcasting and has given examples of Japan's initiatives to achieve effective use of radio waves. The social landscape around the service of broadcasting has changed dramatically, with the expansion of broadband networks and changes in the service market. Nevertheless, given that broadcasting is positioned as universal service and as a trusted media, exemplified by disaster reporting and current affairs reporting, we must constantly seek ways to achieve more effective use of broadcast frequencies.

A key perspective is to strive for the effective use of the entire radio spectrum, not just that of broadcast frequencies. It is hoped these efforts continue while monitoring the social needs and the developments in technology and services for radio waves, including broadcast frequencies and other frequency bands.

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Personal Data, Privacy and Security

Japan's Cybersecurity Policy

Wataru Aikawa

Abstract This chapter provides an overview of Japan's cybersecurity policy. After Sect. 1, which introduces the definition of cybersecurity, Sect. 2 touches on the current state of cybersecurity, tracing the changing means and objectives of cyberattacks and the corresponding approaches to cybersecurity. Section 3 considers the particular characteristics of Japan's cybersecurity policy. In this section, the characteristics of Japan's cybersecurity policy are discussed, focusing on the government role in the area. In Sect. 4, specific policy measures taken by the Ministry of Internal Affairs and Communications, one of the main government agencies responsible for cybersecurity policy, are introduced, in light of Sect. 3.

1 Introduction

This chapter provides an overview of Japan's cybersecurity policy. Let us start with the definition of "cybersecurity". Although numerous organizations, institutions, and experts advocate for and use a variety of definitions for cybersecurity, to begin with, the discussion in this chapter relies on Japan's Basic Act on Cybersecurity (Japan's Basic Act on Cybersecurity, Act No. 104 2014). The law defines "cybersecurity" as: "For the purposes of this Act, the term 'cybersecurity' means the necessary measures that are needed to be taken to safely manage information, such as prevention against the leak, disappearance, or damage of information which is stored, sent, in transmission, or received by electronic, magnetic, or other means unrecognizable by natural perceptive functions (hereinafter referred to as "electronic or magnetic means"); and to guarantee the safety and reliability of information systems and information and telecommunication networks [including necessary preventive measures against malicious activities toward electronic computers through information network or storage media for information created by electronic or magnetic means (hereinafter referred

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to as "electronic or magnetic storage media")], and that those states are appropriately maintained".

As a similar term, Japan Industrial Standards Commission JIS Q 27001:2014 defines "information security" as "the preservation of the confidentiality, integrity, and availability of information". *Confidentiality* is specified as "the property that information is not made available or disclosed to unauthorized individuals, entities, or processes"; *integrity* is specified as "the property of safeguarding the accuracy and completeness of assets"; and *availability* is characterized as "the property of being accessible and usable on demand by an authorized entity" (JIS, JIS Q 27001:2014, 2014).

The preservation of these three properties is well-known as the *CIA triad* and this seems to correspond roughly to prevention against the "leak, disappearance, or damage of information" stipulated in Japan's Basic Act on Cybersecurity. On this premise, we can see that Japan's Basic Act on Cybersecurity conceives the scope of cybersecurity to consist of two aspects: (1) secure management to preserve the CIA triad of information itself (i.e., prevention against the disclosure, disappearance, or damage of information) and (2) the guarantee of the reliability and security of the information systems and information and communication networks on which the information is processed or circulated. The Act illustrates an example of a measure to yield such guarantees as follows: "including necessary preventive measures against malicious activities toward electronic computers through information network or storage media for information created by electronic or magnetic means" (Japan's Basic Act on Cybersecurity 2014). It is fair to say that the Act's drafters had countering cyberattacks in mind.

Section 2 touches on the current state of cybersecurity, tracing the changing means and objectives of cyberattacks and the corresponding approaches to cybersecurity. Section 3 considers the particular characteristics of Japan's cybersecurity policy. In this section, the characteristics of Japan's cybersecurity policy are discussed, focusing on the government role in the area. In Sect. 4, specific policy measures taken by the Ministry of Internal Affairs and Communications (hereinafter referred to as MIC), one of the main government agencies responsible for cybersecurity policy, are introduced, in light of Sect. 3.

2 The Current State of Cybersecurity

In the context of Japan's "cybersecurity policy", the relevant people seem to regard "cybersecurity" as described above. Given this definition, there is no debate that cybersecurity has increased in importance and transformed in nature as the Internet and information and communications technology (hereinafter referred to as ICT) have advanced and become essential platforms for social and economic activities.

For example, the objectives of cyberattacks have transformed over time. According to Kamata (2017), Japan started to see clearly the existence of cyberattacks at the beginning of the 2000s. A series of cyberattacks against national government and public corporations were conducted in January and February 2000, and these attacks exploited vulnerabilities in these institutions' websites and defacing the web pages. The defacements were meant to be overtly obvious as if the attacks at this time had been mostly committed as pranks or for kicks. The attackers' objectives, for this reason, would be largely to show off their abilities, to make an example of others, and to pester others.

In comparison with the situation at the advent of cyberattacks around 2000, targeted attacks against institutions believed to possess valuable and highly confidential data, such as personal information or information related to trade secrets, are often seen recently. Another trend has been economic organized crime in a systematic and malicious way whose objective would rather economic interest. These include the illegal purchase of goods from online shopping sites with login credentials stolen using list-based attacks or the use of ransomware to demand payments of money or other assets.

One of the instances of recent serious cyberattacks was the targeted attack on the Japan Pension Service. In May 2015, a computer used by a Japan Pension Service employee was infected with malware by means of a spoofing email attack. The attacker or attackers made off with some 1.25 million records on pension subscribers. The Pension Service's investigation concluded that the damage had been magnified due to an inadequate initial response after the discovery of incident (Japan Pension Service 2015). What should be specially mentioned is that the attackers cleverly breached the Pension Service's systems. The email's subject line was designed to look like a business email and an actual employee's surname was used as the sender name. The incident served as a reminder of the need to bolster security at public organizations such as local governments, independent administrative agencies, public corporations, and authorized corporations.

From the point of economic cybercrime, cyber attackers started to make use of ransomware, malicious software that locks computer systems or in worse cases encrypts users' data and files and that demands payment from victims who want to decrypt. Another well-known example of recent cyberattacks was caused by the *WannaCry* ransomware. In May 2017 the ransomware was found to have caused damage in a wide range of institutions, including government bodies, private corporations, and hospitals in Japan as well as in many other countries.

More recently, state actors have been accused of being behind cyberattacks in some cases. Thus, the nature of cyberattacks has broadened immensely, from individuals committing offenses for thrills to carefully orchestrated attacks for specific objectives.

The means of attacks have also transformed over time. Many attacks in the past, including attacks that take advantage of simple website vulnerabilities, were discovered and patched quickly. Over time, however, methods and channels of cyberattacks

have greatly diversified. First, recent attacks cleverly exploit the victim's mental process as happened in the case of the Japan Pension Service or remain inconspicuous, so that the victims cannot notice the attacks themselves immediately.

Moreover, ICT has been prevailed throughout society and technology has been used in a variety of situations and opportunities. One typical example is an IoT device that is installed and used not only by ICT professionals but also by layperson. The National Institute of Information and Communications Technology (hereinafter referred to as NICT) operates Network Incident analysis Center for Tactical Emergency Response (hereinafter referred to as NICTER), a mechanism for observing global cyberattack activities using a darknet observation network made up of 300,000 unused IP addresses. NICTER has a means of estimating the latitude and longitude of addresses from which packets are sent into the darknet observation network. The senders are then displayed visually on a global map. According to the NICT (2018), the NICTER darknet observation network measured 150.4 billion packets of cyberattack-related communications in 2017. On top of this, more than half were directed at IoT devices. NICT also found changes in the scanning activities of attackers. Compared with 2016, the percentage of scans of TCP/23, the port used by Telnet, fell from 53 to 38.5%. Conversely, the scans of other ports climbed from 24 to 35.8%. The measurements suggest a move from attacks exploiting unset passwords and IDs on many IoT devices that rely on Telnet to more sophisticated attacks exploiting vulnerabilities of specific IoT devices.

We can imagine from the attackers' side that the prevalence of ICT in all aspects of society, including the increased use of IoT devices, creates more opportunities for cyberattacks. As Kamata (2017) pointed out, to take security measures at multilayer levels (often called as defense-in-depth measures) for cybersecurity is crucial in order to limit the ultimate damage even when initial defenses are penetrated.

3 Japan's Cybersecurity Policy

3.1 Characteristics of Japan's Cybersecurity Policy

Partly in light of the recent trend of cybersecurity, the cabinet endorsed the new Cybersecurity Strategy in July 2018. The Cybersecurity Strategy, the expected implementers of which are the national government, local governments, and critical infrastructure operators, embodies the relevant player's basic actions and underlying principles on cybersecurity.

The new Cybersecurity Strategy stresses three keywords as basic perspectives on public and private efforts for Japan's cybersecurity: (i) mission assurance of service providers, (ii) risk management, and (iii) participation, coordination, and collaboration (Cyber Strategy Headquarters 2018).

The Cybersecurity Strategy defines *mission assurance* as: "characterizing as 'missions' the operations and services that each organization—typically companies, key

infrastructure operators, and government bodies—should execute and securing the necessary capabilities and resources to assure the execution of such missions" (2018). The chief aim of mission assurance is "people in positions of responsibility proactively undertaking cybersecurity assurance" (2018). Similarly, the document defines *risk management* as "taking measures to lower risks to a tolerable level by identifying, analyzing, and evaluating risks associated with the missions the organization undertakes" as well as "a series of activities to command and control the organization for the appropriate allocation of the organization's limited resources and the coping of risks" (2018).

Participation, coordination, and collaboration are defined as: "fundamental initiatives taken in normal times by individuals or organizations to prevent potential damage or escalation of damage from threats in cyberspace" (2018). Given these three main pillars of the strategy, the basic direction of Japan's cybersecurity policy would be as follows: the government's responsibility is to arrange conditions such that each public or private entity can undertake risk management commensurate with its own expected missions while also proactively coordinating and collaborating with other parties during normal times to ensure cybersecurity.

Logically, each of cybersecurity policies can be classified into one or both of these two categories: (1) the suppression of security breaches and (2) the improvement of the responsiveness of entities subject to security breaches. Regarding the former, laws and regulations are typical forms of inhibiting potential offenders from putting cyberattacks into practice. A well-known law is the Act on Prohibition of Unauthorized Computer Access (Act No. 128 of 1999). According to the Unauthorized Computer Access Act Study Group (2012), the Act imposes criminal penalties for acts that exploit unauthorized logins using another person's ID or password, known as spoofing, or that exploit security holes, or acts of phishing, to gain access to a computer. The Penal Code (Act No. 45 of 1907) also stipulates some illegal cyberattack-related acts. Denial-of-services (DoS) attacks and distributed-denial-of-service (DDoS) attacks, both of which impair the availability of computer system, send traffics with such malicious intention that the targeted computer systems become overloaded and cannot afford to execute processing properly. DoS or DDoS attacks themselves might not be classed as unauthorized access acts as stipulated by the law. In the event of successful DoS or DDoS attacks, however, as Natsui (2012) has pointed out, the crime of obstruction of business by damaging a computer under Article 234-2 of the Penal Code could be applied.

Aside from these laws, acts possibly breaching the CIA triad mentioned earlier can be dealt with under a variety of industry or business laws, provided that the acts themselves can be categorized as violations of the protected interests under the provisions of the specific laws. Taking telecommunications for instance, as Okamura stated, the Wire Telecommunications Act (Act No. 96 of 1953), the Radio Act (Act No. 131 of 1950), the Public Telecommunications Act (Act No. 97 of 1953), and its successor, the Telecommunications Business Act (Act No. 86 of 1984) provide penalties for acts infringing the secrecy of communications (Okamura 2011). Prior to the advent of notions of "information security" or "cybersecurity", these laws already

contained provisions on the secrecy of communications, which in part contribute to ensuring confidentiality.

A considerable amount of cyberattacks in Japan, however, are launched from the other countries. Thus, these attacks would be beyond the jurisdiction of Japan's administrative and judicial branches. Moreover, recently state actors are suspected to be behind some cyberattacks launched from abroad. It is unlikely that Japan's laws or administrative measures will have any deterrent effect on the actions of such aggressors.

Given this argument, it is also absolutely vital to improve the responsiveness of entities subject to security breaches. The first and unequivocal step in this term is the establishment and implementation of some form of legal standards or rules. For example, Article 41(1) of the Telecommunications Business Act mandates that telecommunications operators must comply with technical standards specified in the ordinance. Along with the law, the Article 6 of the Regulations for Telecommunications Facilities for Telecommunications Business (Ministry of Internal Affairs and Communications Ordinance No. 30 of 1985) legally obliges telecommunications operators to implement defensive measures for telecommunication facilities used in their telecommunications business, in the interest of assuring the availability of the facilities and the security of information and communication systems and networks.

The problem is that service costs proportionately rise in general as more and more security requirements are imposed. Moreover, cybersecurity assurance has long been driven by independent and voluntary efforts by business sectors in such a sense that a wide range of cybersecurity-related products and services have been marketed and customers at will determine what services they use in light of their business and financial condition. For this reason, to create uniform security obligations or mandatory standards, typically by laws, is not necessarily the best choice, as they may in many cases impose excess burdens on private companies and restrict their freedom of business.

Therefore, in parallel with laws, the government recommends less rigid standards in the form of guidelines or standards. In fact, government, industry groups, and other organizations have established and released numerous standards or guidelines on cybersecurity. Private companies then determine and adopt the security levels suitable for their own circumstances while referring to these guidelines or standards as needed. One of the best-known examples of such international standards is ISO/IEC 27001, ISO (2013), an international standard for management systems to ensure information security. To get a certification of this standard, a highly motivated company establishes such a management system that it can effectively manage and reduce the risk of its information and ensure its own information security typically represented by the preservation of CIA triad. In some cases where, for example, companies deal with personal information, the certification for ISO/IEC 27001 is a necessary condition for deals. Therefore, these voluntary standard and guideline have been prevailed through ordinary market mechanism.

As stated before, under Japan's Basic Act on Cybersecurity, cybersecurity is regarded as the (1) secure management to preserve the CIA triad of information

itself (i.e., prevention against the disclosure, disappearance, or damage of information) and (2) the guarantee of the reliability and security of the information systems and information and communication networks on which the information is processed or circulated. As a tendency, the former has been promoted by each company's individual effort, in part through the application of the voluntary standard and guideline described above. For this reason, Japan's cybersecurity policy has been expected to promote the latter part, the reliability, and the security of systems and networks, which would be beyond each company's own interest, as I state later in Sect. 4.

As mentioned above, the government is expected to play bigger role than just establishing and applying laws. Government is expected to use budgetary measures to promote R&D and personnel development, coordinate with other countries, build information-sharing frameworks between the public and private sectors, and take other comprehensive and multifaceted measures to support, in an effective way, the cybersecurity measures private companies implement. This may not be unique to Japan, but a strong component of our cybersecurity policy is a policy mix that integrates multiple tools in a coordinated fashion, chiefly to ensure the security of information systems and communication networks.

3.2 Promotion Framework Behind Japan's Cybersecurity Policy

For many years, Japan's cybersecurity policy tended to be ad hoc, with individual responses by field or industry, instead of having united government-wide efforts. But as the demand for security measures throughout society has risen, government-wide efforts have greatly expanded and become more robust over the past twenty years. These government-wide efforts fall into two main categories: (1) organizational frameworks and (2) basic strategies to promote cybersecurity measures.

The turning point with respect to the first, organizational frameworks came with the series of defacements to government body websites in January 2000 mentioned earlier. In response, government-wide frameworks on cybersecurity assurance were gradually enhanced. The first move was to create the Information Security Measures Promotion Council, chaired by the Deputy Chief Cabinet Secretary, under the Advanced Information and Telecommunication Society Promotion Headquarters. Following this, the Cyber Security Strategy Headquarters was created within the Cabinet in January 2015—based on the November 2014 Basic Act on Cybersecurity—as the command post for the government's overall cybersecurity policy. The National Center of Incident Readiness and Strategy for Cybersecurity (hereinafter referred to as "NISC"), in turn, serves as the secretariat for the Strategy Headquarters. Under these arrangements, related ministries and agencies implement cybersecurity policies within a coordinated cross-governmental cybersecurity promotion framework.

Regarding the second category, basic strategies to promote cybersecurity measures, the Cabinet has endorsed a Cybersecurity Strategy once every three years since 2013. Each of these strategy documents set out the government's overall mid-to-long-term efforts on cybersecurity. These efforts are pursued in line with an annual plan, which summarizes specific policy items for the year to ensure the forward progress of the overall strategy. In addition, uniform standards for government bodies' information security was established and have been updated. Action plans are also drawn up and revised to enhance security at 14 critical infrastructure operators (as of January 2019). Under the framework of Cybersecurity Strategy, then, the government takes steps to ensure the security of government bodies and critical infrastructure operators.

4 Specific Cybersecurity Policy Measures

Cyberattacks, by definition, are invariably attacks via communication networks controlled and operated by telecommunications carriers. Consequently, telecommunications carriers have a significant and necessary role to play in preventing and curbing cyberattacks. This fact makes the telecommunications authority, the MIC, a part of the administrative branch central to the government's overall cybersecurity policy, as the Ministry has jurisdiction over the communications industry. In this section, typical examples of recent cybersecurity policy measures planned and implemented by the MIC will be provided.

4.1 Anti-cyber-Attack Measures on Communication Networks and Their Legal Arrangements

Cyberattacks are launched via communication networks. Therefore, the most direct measure to counter cyberattacks is for telecommunications operators to block attack traffics on their communication networks or to alert users about attacks and the threat of attacks.

The legal issue is that such anti-cyber-attack measures may conflict with the secrecy of communications, which is stipulated in Article 4(1) of the Telecommunications Business Act (Act No. 86 of 1984), the law that regulates telecom operators. Specifically, Article 4(1) states: "The secrecy of communications being handled by a telecommunications carrier shall not be violated". Under the Ministry of Internal Affairs and Communications' interpretation of this provision, *knowledge*, *use without permission*, or *disclosure* of any components composing communications constitutes a violation of this provision. Furthermore, according to a Ministry study group report (2014): "The scope of secrecy of communications includes the content of individual communication events. It also encompasses all matters that could be used to reasonably infer the semantic content of individual communication events.

These matters include the content of the communication event as well as the name of the communication parties or their location, address, phone number, or other sign or code that can identify a communication party. Furthermore, mechanically or automatically detecting communications that fulfill certain conditions and using the communication event against the will of the communication parties can be interpreted as *knowledge* or *use without permission* even if the information is processed by a mechanical or automated mechanism".

According to its interpretation, there are two exceptions: (1) If the communication parties have given their consent to the acts, these acts do not conflict with the secrecy of communications and (2) violations of the secrecy of communications are tolerated as exceptions when there is a justifiable cause, including justifiable actions, justifiable self-defense, and emergency evacuations, for violating the secrecy of communications. Whether an exception applies to a given violation is determined on a case-by-case basis.

For example, the MIC, in cooperation with the Internet service providers and other entities, ran the Advanced Cyber Threats Responsive Initiative (hereinafter referred to as ACTIVE) project from 2013 to 2018. According to ICT-ISAC Japan, this joint public–private project ran field experiments to protect users from unknowingly accessing malware-laden websites. One aspect of the project was designed to prevent malware infections. Lists of websites distributing malware were created and alerts were sent to users attempting to access one of the listed sites. Warnings were also sent to the administrators of the malware-laden websites to take appropriate action. Generally speaking, however, prior general consent based on user agreements and similar contracts is not interpreted as effective consent when it comes to the applicability of the secrecy of communications. This posed a problem to the ACTIVE project with respect to the expansion of users participating in the project and moving ahead with malware prevention, for to get individual consents from users repeatedly by, for example, opt-in step would apparently increase operational cost.

According to a Ministry study group report on this point (2014), there are two reasons why prior general consent alone based on user agreements and similar contracts is not generally accepted as effective consent. The first is that it is the nature of user agreements that they stipulate matters for which the parties' consent can be presumed, and stipulations that waive the party's interest in the secrecy of communications contravene this nature of user agreements. The second reason is that the scope or target of prior general consent is unclear, as it is based on predictions of future events.

The ACTIVE project made the following arrangements responding to these two reasons with regard to alerting users before they access a malware site. For the first reason, the study group's report (2014) stated that to ensure safe Internet access is the sole intent of, first, mechanically or automatically detecting the only absolute minimum required data recognized as a subject of secrecy of communications (i.e., the IP address or URL of the access destination) and, then, displaying an alert screen regarding an access to a suspicious website. Therefore, the report (2014) concluded that this usage does not contravene the nature of user agreements because it is possible to presume that an ordinary user of Internet access services would consent to the use of such data for this limited purpose. As for the second reason, the report (2014)

mentioned that even with general consent by means of a user agreement, if the agreement stipulates that the user has the right to change consent details (i.e., change settings) at any time after consenting to the agreement and a reasonable effort has been made to inform the user about this right, along with an explanation given to the user on the alert screen and elsewhere, the user can avoid harm due to unforeseen disadvantages in the future because the user has the right to change consent details at any time.

In this way, the project arranged matters so that blanket consent by means of a user agreement can be interpreted as effective consent for the display of alert screens by the method described above, under three conditions: (1) The agreement stipulates that the user has the right to change consent details at any time after consenting to the agreement and that other conditions of provision remain the same regardless of whether the user changes consent details pertaining to alerts about accessing malware-laden websites; (2) A reasonable effort will be made to inform the user about the provisions of the agreement and about the right to change consent details ex post facto; and (3) In addition to explanations about this alert measure on the alert screen and elsewhere, a user not wishing to participate in this measure may change consent details at any time and the method of changing consent details is explained.

This interpretation was later included in the Guideline for Properly Dealing with Telecommunications Business Cyberattacks and Secrecy of Communications. This Guideline was established by four telecom operator associations (the Japan Internet Providers Association, the Telecommunications Carriers Association, the Telecom Services Association, and the Japan Cable and Telecommunications Association) as well as the Telecom Information Sharing and Analysis Center Japan (which was later expanded and made independent as ICT-ISAC). The guideline is a reference for telecom operators about the provisions of the Telecommunications Business Act and other related laws and ordinances. It describes how to legally implement such measures as detecting and blocking DDoS and other cyberattacks, the spread of malware infections, mass emailing of spam, and corrupted packets.

Cyberattacks, however, are becoming increasingly sophisticated and complex. Consequently, telecommunications operators—who are most likely to be at the center of responding to cyberattacks—may need to take new measures and initiatives, even as they account for the secrecy of communications that they must comply with. This has made further legal arrangements necessary. Noting this, the Ministry of Internal Affairs and Communications launched the Study Group on Proper Responses to Cyberattacks on Telecommunication Businesses in November 2013. The Study Group issued its first report, which discusses the legal issues on ACTIVE project stated above, in April 2014 (MIC 2014). The Study Group reconvened in June 2015 and examined issues that had arisen since its first report, releasing a second report in September 2015. Legal arrangements have been made for various anti-cyber-attack measures since the ACTIVE project's measures. The results have been incorporated in the previously mentioned guideline, which I encourage to read.

4.2 Policy Measures Against Botnets

Policy measures against botnets have been one of the most discussed cybersecurity policy issues recently in Japan. The interest follows the massive 2016 DDoS attack caused by the Mirai malware. This malware, if successfully infected, enables cyber attackers to manipulate remotely numerous devices connected to the Internet as "botnets". The botnets launched relentless DDoS attacks to some businesses. For example, botnets controlled by the Mirai malware directed two huge DDoS attack waves at the DNS servers of Dyn in the USA in October 2016. This caused large disruptions in the availability of services of companies that subscribed to Dyn's DNS services. The Mirai malware had infected a large number of IoT devices prior to the attack. During the attack, over 100,000 infected IoT devices repeatedly sent millions of requests to Dyn's systems. The attack traffic was reported to have reached 1.2 Tbps at its peak. The attack affected many major Internet services and news sites that used Dyn's DNS services.

The Mirai attack had a massive impact globally. The US President in May 2017 issued the Presidential Executive Order on Strengthening the Cybersecurity of Federal Networks and Critical Infrastructure (The White House 2017), which called for "resilience against botnets and other automated, distributed threats". In response to the executive order, the Department of Commerce and the Department of Homeland Security in May 2018 submitted a report (US Department of Commerce and Department of Homeland Security 2018) to the President containing six principal themes (characteristics of distributed attacks and issues with initiatives to counter them) and five complementary goals. In the wake of this report, the US public and private sectors are expected to engage in further measures against botnets.

According to the MIC's 2019 Progress Report on Comprehensive IoT Security Measures (MIC 2019), the Ministry tabled in March 2018 in the National Diet the Bill to Partially Amend the Telecommunications Business Act and the Act on the National Institute of Information and Communications Technology. The bill contains provisions to add a five-year limited measure to NICT's purview to investigate unsecured IoT devices lacking passwords or other security functions as a part of anti-botnet measures. The bill was passed and made into law in May 2018. Under the new Act, the NICT investigates unsecured IoT devices without password settings or other security measures and supply information, such as IP addresses, about the devices to Internet service providers. Telecommunications operators identify users based on the information and issue notices to users to set or update the password settings on their IoT devices. This operation, named as National Operation Toward IoT Clean Environment (which is abbreviated as "NOTICE") started in February 2019 (MIC 2019).

The same report also stated that in parallel with the NICT studies, the IP Network Facilities Committee, under the MIC' Information and Communications Council, considered to add a minimum level of security measures to the technical standards on IP network devices, including IoT devices. The goal of this addition would be to prevent large numbers of IoT devices from being infected with malware, which may

cause DDoS attacks, and thus ensure the security and reliability of ICT networks. The MIC established the minimum level of security requirements for IoT and other devices, including access control functions, functions that encourage the setting of secure ID/password combinations for access controls, and firmware update functions (MIC 2019).

4.3 Human Resource Development

Humans are behind cyberattacks and, as mentioned earlier, attackers actively strive to improve and diversify their attack methods while taking advantage of all the benefits of technological innovation. This is why the development of human resources to respond to cyberattacks is such a critical part of cybersecurity measures. As a study by the Ministry of Economy, Trade and Industry's Information Technology Promotion Department (2016) estimated the shortfall in information security professionals in Japan will climb from 132,000 people in 2016 to 193,000 people in 2020, human resource development is an urgent task to ensure cybersecurity.

From the standpoint of organizational human resource development, we need to consider three levels, including (1) the executive levels, (2) the strategic management levels, and (3) the implementation and engineering levels in implementing capacity building, for these three levels play different roles to enhance organizational cybersecurity as a whole. The Cyber Security Strategy Headquarters on May 31, 2018 endorsed the Policy on Initiatives to Develop Cyber Security Personnel: Promotion of Joint Industry–University–Government Collaborations on Business Continuity and Value Creation (Cybersecurity Strategy Headquarter 2018). This policy paper sets out definitions and recommendations for these three organizational levels.

According to the policy paper, in regards to the executive level, there must first be recognition of the importance of promoting cybersecurity measures as part of overall risk management for business continuity and new value creation. As for future policy directions following this recognition, the government must strive to promote understanding and transform mindsets at the executive level and work to establish platforms suited for each industry and business category. In tandem with this, the government must encourage cybersecurity investments (Cybersecurity Strategy Headquarter 2018).

As for the second strategic management level, the policy paper defined it as the level that plays the central role in risk management as it pertains to business continuity and value creation while recognizing the risks of cybersecurity in management and business strategy. Furthermore, the strategic management level is responsible for planning and reporting on measures based on policies from the executive level" as well as "undertaking the lion's share of responses in the event of actual incidents.

The policy paper describes the third implementation and engineering level as the level that ascertains risks and standardizes, constructs, and implements security measures based on policies from the strategic management level. Furthermore, in the event of an incident, this level identifies the scope of the incident's impact, contacts

and coordinates with other officials under the instructions of the strategic management level, and implements technical responses. In addition to recommending the development of personnel for these three organizational levels, the policy emphasizes the importance of personnel and awareness campaigns directed at (4) young workers and (5) small and medium enterprises.

The MIC has put resources into developing personnel for the third implementation and engineering level and the fourth young worker level. To this end, the National Cyber Training Center was opened in April 2017, where the NICT trains security personnel in practical response skills. The National Cyber Training Center runs three programs. Cyber Defense Exercises with Recurrence (hereinafter referred to as CYDER), Cyber Colosseo, and SecHack 365. CYDER programs are intended for personnel from central government bodies, local governments, independent administrative bodies, and key infrastructure operators. Cyber Colosseo consists of practical defense exercises for security officials from event organizations leading up to the 2020 Tokyo Olympic and Paralympic Games. And SecHack 365, meaning a security hackathon for 365 days, is intended to nurture young security innovators. The MIC provides budgetary support for the programs. Other public organizations are also involved in cybersecurity personnel development projects for other levels. Efforts in this area are expected to continue.

4.4 International Cooperation

As cyberspace is global, it is self-evident that cooperation among countries is essential to combating cyberattacks and bolstering cybersecurity. Especially, in response to cybercrime that spans multiple countries, structures have been needed to harmonize laws and policy measures that are extended under each country's territorial sovereignty.

The Convention on Cybercrime is one such international structure. Since it came into force in Europe in 2004, more countries have signed onto the treaty, with Japan enforcing the treaty in 2012. The Convention on Cybercrime is expected to help construct basic cooperation frameworks between countries on addressing cybercrime and promote the unification of normative standards. But as Torasawa (2015) pointed out, although the convention has provisions for criminal acts against information systems, protection of computer records, investigation procedures for cybercrimes, the establishment of jurisdiction, and the necessary domestic measures for the extradition of criminals, it does not resolve issues stemming from the principle of territorial jurisdiction, and countries' abilities to respond to cross-border cybercrime remain limited. Furthermore, it is still necessary to share values in a separate form with countries that have not signed the convention.

Discussions concerning international rules and standards on cyberspace and not limited to just cybercrime are ongoing at many venues. These include the G7 and other high-level meetings of cabinet ministers and meetings of the UN and other international organizations that work at a practical level as well as multilateral and

bilateral negotiations on cybersecurity and other matters. At present, no clear consensus exists concerning the application of international law to cyberspace, the formation of international standards for cyberspace, or Internet governance. Countries appear to be moving into one of two camps. One camp, like Japan, seeks the free circulation of information, openness, and cooperation between diverse ranges of entities. The other camp favors stronger regulation of cyberspace and national control over cyberspace.

For example, China enacted the Cyber Security Law in June 2017 and put various regulations into force based on this law. Russia as well announced in December 2016 the Doctrine of Information Security, which struck a direction for the country's cybersecurity policy that aims to guarantee the security of the Russian Federation in cyberspace. At the same time, the European Union (hereinafter referred to as EU) adopted in July 2016 the Directive on Security of Network and Information Systems (hereinafter referred to as the NIS Directive) to ensure the security of networks and information systems throughout the EU. EU member states are required to take enshrine the NIS Directive in their domestic law by May 2018. The EU is also stepping up its policy measures on cybersecurity, exemplified by the announcement in September 2017 of a cybersecurity package that includes a cybersecurity bill containing expanded powers for European Network and Information Security Agency and the introduction of an authentication framework. In May 2018, the General Data Protection Regulation came into force, and the EU worked out a direction for personal data localization. In the USA, President Trump in May 2017 signed the Presidential Executive Order on Strengthening the Cybersecurity of Federal Networks and Critical Infrastructure, as mentioned above. The executive order requires relevant US government organizations to report on their measures to beef up cybersecurity.

Given this international trend, Japan has decided to participate actively in discussions, through many channels, on the realization of a free, fair, and secure cyberspace, in line with Japan's Cybersecurity Strategy.

In terms of bilateral discussions, beginning with the UK and India in 2012, Japan has had talks about cybersecurity with the USA, the EU, China, South Korea, Israel, France, Estonia, Australia, Russia, Germany, and Ukraine. Japan continues to have cross-governmental policy discussions about cyberspace at a pace of about once a year with each country. For example, according to the MIC (2017, 2018) Japan has discussed and advanced cooperation in the cyber field with the USA at the Japan–USA Policy Cooperation Dialogue on the Internet Economy and other venues. Japan is also engaged with building trust with other countries through sharing cybersecurity strategies, by appealing related policy measure developments and sharing information on threat recognition and other topics with like-minded countries and promotes concrete collaborations, such as cyber exercises. Japan also has constructed a communication framework with relevant organizations in other countries in the event of major information security incidents.

5 Conclusion

I have provided an outline of Japan's current state of cybersecurity and cybersecurity policy in this article. Under Japan's cybersecurity policy over the past 20 years, government functions have been enhanced and, under central government leadership, Japan has achieved more rigorous cybersecurity measures that had previously been pursued independently by different ministries and agencies as well as by industries.

Japan's cybersecurity policy is founded on the principles of mission assurance, risk management, and participation/coordination/collaboration. Based on the principles above, as seen in this article, at the heart of the cybersecurity policy is the concept that the government supports each entity's self-protection about its own information security by ensuring the security of information systems and communications networks. In light of this, cybersecurity policy requires the combination and provision of multiple policy means, which makes these policy areas unique.

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Consumer Protection

Yoshikazu Okamoto

1 Introduction

Two events can be said to mark the dawn of consumer affairs administration in Japan's telecommunications sector, which refers to the administration that protects the interests of ordinary consumers in the telecommunications business. The first signal arrived in the early 1990s with the Ministry of Posts and Telecommunications' (hereinafter referred to as MPT) establishment of the Guideline on the Protection of Personal Information in the Telecommunications Business in 1991 (MPT 1991). The second was the reorganization within the MPT, which was intended to establish an office that would carry out consumer protection in the telecommunications sector in a consistent and comprehensive manner in 1994.

The reorganization was likely caused by a fostering of awareness within the MPT that it could not afford to overlook consumer affairs administration. In fact, at the same time, wide-ranging initiatives were launched with the intention of protecting consumers across Japan. One of these was the Telecommunications Service Monitor System, in which consumers across the country were invited to be telecommunication service monitors. In this way, the system surveyed consumer opinions and demands about telecommunications services and incorporated these into administrative policies (MPT 1995, p. 251).

Going back to the first event above, in the process of establishing the Act on the Protection of Personal Information Pertaining to Electronic Data Processing Held by Administrative Organs starting in the early 1990s, the government studied how to handle personal information at administrative organizations. It was also recommended at that time to examine the handling of personal information in the private

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sector (Uga and Hasebe 2012, p. 99). From the viewpoint of consumer affairs administration, personal information in the private sector was addressed first, as a so-called separate exception. In fact, we would have to wait until the 2005 enforcement of the Act on the Protection of Personal Information (Personal Information Protection Commission 2005), which was a general law that applied across all business sectors, for a legal system in Japan that pertained to personal information protection in the private sector.

Until the spotlight started to fall on consumer affairs administration in the telecom sector, telecommunications administration was primarily occupied with the supply side of the telecom market. A public corporation maintained a postwar monopoly on the telecom market until the 1985 privatization of the Nippon Telegraph and Telephone Public Corporation and the subsequent arrangement of a competitive market environment with the enforcement of the Telecommunications Business Act (Ministry of Internal Affairs and Communications hereinafter referred to as MIC 1985). With this series of developments, telecommunications administration post-1985 was mostly concerned with how to promote the market entry of new carriers and how to ensure an equal footing for competition. In tandem with the introduction of competition principles, telecom operators began providing more diverse services, which gave consumers more options. And having more options caused consumer needs to become more sophisticated and diverse. The administration, in turn, had to quickly and appropriately deal with this transformation, and as an unintentional consequence of the introduction of competition principles, administrative techniques directly focused on the demand side materialized.

The above is a very brief summary of the dawning of consumer affairs administration in Japan's telecom sector. In the next section, I will describe the two main components that will be discussed for which laws and systems have been enacted and continue to be operated to the present day. They are measures to handle the circulation of illegal and harmful information on the Internet and the protection of personal information handled by telecom operators.

2 Measures Against Illegal and Harmful Information

Illegal information is defined as information that when disseminated either contravene laws or ordinances or violates the rights of specific individuals or companies. Harmful information is defined as information that when disseminated is deemed to damage public order and morals or to impair the sound development of young people. Circulating illegal or harmful information over the Internet, however, faces few economic, physical, or psychological constraints. As a natural consequence of the ease of distributing information then, measures were felt necessary to cope with such information from the very dawn of the Internet. At the same time, there was scholarly debate that admitted illegal or harmful information, although illegal or harmful, had

a dimension as an act of expression. Consequently, a question was how to systemize the legal liability of telecom operators due to some act by a telecom operator, or the omission of some act, in response to such expressions, as the telecom operator is, after all, just an intermediary in other people's communications.

To jump ahead to the conclusion, an approach was adopted that aimed to rectify the situation through guarantees of independent and voluntary monitoring by telecom operators. The approach was dependent on so-called bottom-up actions by telecom operators. This was believed to be appropriate from the view that telecom operators are a key entity in assuring freedom of expression and similar matters and from the Internet's qualities of autonomy, decentralization, and collaboration.

2.1 Current Arrangement of Policy Measures

Illegal or harmful information circulated or distributed over the Internet is divided into two types of illegal information and two types of harmful information. Illegal information can be: (1) information that when distributed violates the rights of a specific individual or company under the Civil Code, Penal Code, laws related to intellectual property, and other laws and ordinances, such as defamation, privacy violations, and violations of the Copyright Act; or (2) information that does not violate the rights of a specific individual or company when distributed but does contravene laws or ordinances, such as child pornography. Harmful information can be: (3) information that does not contravene any specific law or ordinance when distributed but is contrary to public order or morality such as postings that incite others to commit suicide; or (4) information that does not contravene any specific law or ordinance when distributed but is likely to impair the sound development of young people, such as adult Web sites.

The measures to counter or control illegal and harmful information vary depending on the type: Illegal information of type (1) is dealt with by means of the Act on the Limitation of Liability for Damages of Specified Telecommunications Service Providers and the Right to Demand Disclosure of Identification Information of the Senders (hereinafter referred to as the Act until section "Act on the Development of Safe and Secure Internet Use for Young People") and its related guidelines; and type (2) by means of the Guidelines on Measures for Illegal Information on the Internet. Harmful information of type (3) is dealt with by means of the Model Contract Articles for Illegal and Harmful Information (Telecom Services Association 2006); and type (4) by means of the Act on Development of an Environment that Provides Safe and Secure Internet Use for Young People.

Data on illegal and harmful information has been published in the annual White Paper since 1998 (MPT 1998, p. 324). Since then a single package of measures against illegal and harmful information has been in operation. These measures are described below for each type of illegal and harmful information (Fig. 1).

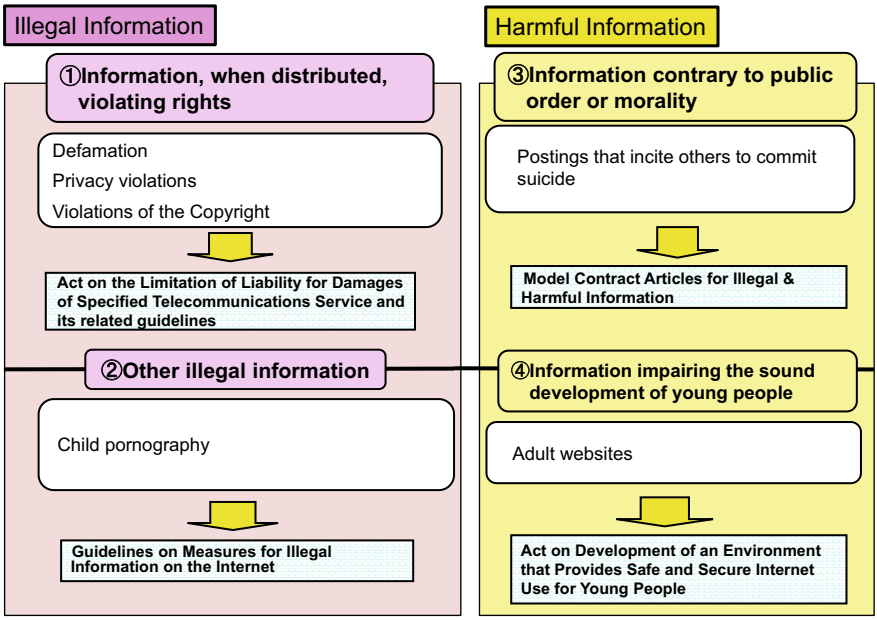

Fig. 1 Types of illegal and harmful information on the internet and their respective measures. *Source* Ministry of Internal Affairs and Communications

2.2 The Act on the Limitation of Liability for Damages of Specified Telecommunications Service Providers and the Right to Demand Disclosure of Identification Information of the Senders and Its Related Guidelines

The Act came into force in May 2002 to counter the rise in the distribution and circulation of information that violated the rights of others on webpages, forums, and other places on the Internet. The two key provisions of the Act are:

Provision 1

the limitation and clarification of liability for damages of ISPs and server managers and administrators (jointly referred to as ISPs) in the case that information distributed by means of ISP servers violates the rights of others and in the case that the information does not violate the rights of others; and

Provision 2

the right of entities whose rights are violated to demand ISPs to disclose information on the sender of the violating information.

At the time, the Act was being formulated, in parallel with the rapid growth of the Internet, there was a noticeable surge in negative events, especially those

involving abuse, defamation, and privacy violations, regarding telecommunications being sent or distributed to large numbers of the general public on the Internet via chat rooms, streaming services, email newsletters, webpages, forums, and other places. Furthermore, because of the nature of Internet services—namely the few economic, physical, or psychological constraints to distributing or sending information—there was a low barrier to sending information that violated the rights of others. As a result, violations of rights protected by law were escalating immediately and without bound. And when the information was sent or distributed anonymously, entities who suffered harm had little recourse to recover civil damages (MIC 2018, pp. 2–3).

The problem from the ISP side is the frequent instances where it is difficult to judge or determine whether the distribution of a given piece of information truly constitutes a rights violation. This is in spite of the occasions when they can take measures, such as deleting information from the servers they manage, where the distribution of the information is almost certainly a rights violation. An additional problem is the lack of clarity on the liability they face when they take steps and when they do not take steps. Consequently, it is often difficult for ISPs to decide quickly and accurately whether to take measures on their own initiative.

Provision 1 above, then, is designed to clarify the liability of ISPs when they take steps, such as deleting information, and when they do not. More specifically, in a case where the ISP did not take steps, such as deleting the information in question, and the distribution of the information in question did, in fact, violate the rights of others, then the ISP is exempt from liability, in relation to them whose rights were violated, for not deleting the information in question from the servers it manages. Two preconditions, however, apply for this liability to exist. First, it must have been technically possible for the ISP to take measures to stop the distribution, such as deleting the information, and, second, the ISP must have been aware, or there must be sufficient grounds to show the ISP could have been aware, that the distribution of the information was in violation of the rights of a specific individual or company.

In the opposite case where the ISP did take steps, such as deleting the information in question, but the distribution of the information in question did not, in fact, violate the rights of others, then the ISP is exempt from liability, in relation to the sender, for deleting the information in question from the servers it manages. The two preconditions for this exemption to exist are, first, the measures the ISP took were within the limit necessary to stop the distribution, such as deleting the information, and, second, the ISP had sufficient grounds to believe the distribution of the information unreasonably violated the rights of a specific individual or company, or the sender of the information, after receiving an inquiry from the ISP concerning whether the sender consents to the deletion or other measures, did not indicate any disagreement with the ISP's decision within seven days of the inquiry.

Prior to the Act, ISPs may have held information that could help identify the sender of information that violated rights, but they could not disclose the information, save for criminal proceedings or a court-issued warrant, in the interest of protecting the secrecy of communications and the privacy of the sender. (The secrecy of communications is protected in the Constitution of Japan in Article 21(2) as a fundamental right, since communications are essential for people to lead their lives, to assure the

freedom of individuals' private lives as well as to assure freedom of expression and to assure the peace of individuals' lives. Accordingly, Article 4 of the Telecommunications Business Act (MIC 1985) also stipulates that telecom operators must protect the secrecy of communications or face penalties.) Given this situation, key provision 2 above creates the right for parties whose rights have been violated to demand that ISPs disclose sender information to them, in order that citizens can use the Internet with reassurance.

The provision balances this right with the exercise of the sender's rights with the following stipulations: (1) when an ISP receives a demand to disclose a sender's information, the ISP must ask for the sender's opinion first, so that information is not disclosed by accident or error because once such information is disclosed, its secrecy cannot be reinstated; (2) the party that receives the sender's information must not use that information without due cause; and (3) the ISP does not bear liability should a party making an extra-judicial request for disclosure of sender information suffer damages as a result of the ISP's noncompliance with the extra-judicial request for disclosure, unless that noncompliance was done in bad faith or out of gross negligence (MIC 2018, pp. 27–44).

With the opportunity provided by the establishment of the Act, a council was formed, which included ISP organizations, copyright groups, and many other related entities, and created a series of guidelines: Guidelines on Defamation and Privacy, Guidelines on Copyright Infringement, Guidelines on Trademark Infringement, and Guidelines on Sender Information Disclosures. These guidelines attempted to illustrate the conditions on ISP exemptions provided for in the Act: namely, when there are sufficient grounds to show that the ISP could have known the distribution of the information in question violated the rights of others; when there are sufficient grounds to believe the distribution of information unfairly violates the rights of others; and when the conditions for disclosing sender information are met (MIC 2018, p. 9).

The Guidelines on Copyright Infringement gives an account of the council's rationale for establishing the guidelines mentioned above. Courts will ultimately be the ones to decide whether ISPs are exempt from liability through litigation at the end of the day. Given this fact, the council believed that the first court rulings would find cause to trust the guidelines' content and how they were prepared, and thus courts would hold that "sufficient grounds" applied in cases where the copyright holders and ISPs act appropriately in accordance with the guidelines that have this high degree of trustworthiness. The administrative side, for its part, preferred that copyright holders and ISPs together prepare practical guidelines rather than the administration. The reason for this is that copyright holders and ISPs are key players in assuring freedom of expression and similar matters. The administrative side, therefore, has taken the stance of supporting attempts to correct the circulation of illegal and harmful information through the assurance of voluntary monitoring by ISPs.

There have been two major amendments to the Act since it came into force. The first came as a result of the Act for Partial Revision of the Public Offices Election Act in May 2013, which removed the ban on election campaigning on the Internet. With this removal of the ban on election campaigning using the Internet and similar

means, the Act was amended to add a special clause on the circulation of information defaming candidates for public office during an election campaign. The special clause grants an exemption from liability for ISPs that, first, receive a notice from a candidate for public office to take measures to stop the circulation of information involving documents or images used for election campaigning which defame the candidate for public office and that, second, delete the information after an inquiry to the sender of the information concerning whether the sender consents to the deletion and the sender does not indicate any disagreement within two days of the inquiry. This is shorter than the normal seven-day waiting period. The reason for shortening the waiting period to two days is that for some candidates for public office, the time from the election announcement date to the election date is less than seven days. The addition of this special clause has encouraged ISPs to take appropriate action at their own discretion and not to hesitate excessively when it comes to taking measures to stop the distribution of information that defames candidates for public office (MIC 2018, pp. 47–57).

The second amendment came with the execution of the Act on Prevention of Damage by Provision of Private Sexual Image Recordings (so-called the Revenge Porn Prevention Act) in December 2014. The Revenge Porn Prevention Act stipulates penalties for acts that infringe on the peace of private lives by providing private sexual image recordings (electromagnetic recordings of images depicting people engaging in sexual acts). The Revenge Porn Prevention Act also enumerates special cases of the Act. The Revenge Porn Prevention Act defines certain sexual image recordings as private sexual image recordings in which the sexual reputations and sexual privacy of the individuals should be protected. The Revenge Porn Prevention Act was, in turn, amended to add a special clause on the circulation of information pertaining to such private sexual image recordings. The special clause grants an exemption from liability for ISPs that, first, receive a notice from a person appearing in a private sexual image recording to take measures to stop the circulation of information connected with the private sexual image recording that defame the person in question and that, second, delete the information after an inquiry to the sender of the information concerning whether the sender consents to the deletion and the sender does not indicate any disagreement within two days of the inquiry. This is shorter than the normal seven-day waiting period. The reason for shortening the waiting period to two days is that the public release of private sexual image recordings causes grave harm to the individuals involved and, because information of this nature spreads quickly, restoring the harm done is very difficult unless the information is deleted promptly. The addition of this special clause has encouraged ISPs to take appropriate action at their own discretion and not to hesitate excessively when it comes to taking measures to stop the distribution of information that defames or infringes on the peace of the private life of people appearing in a private sexual image recording (MIC 2018, pp. 58–68).

2.3 Guidelines on Measures for Illegal Information on the Internet

The public exhibition of child pornography on the Internet, illegal dating sites, and the circulation of information enticing people to abuse controlled substances and other information that contravene laws and ordinances has become an issue for society. At the same time, it has become difficult for ISPs to make decisions about whether the circulation of a specific piece of information violates laws or ordinances, in terms of both legal interpretations and fact-finding. Furthermore, more types of distributed information have been added as illegal in the reflection of social conditions, and there is greater variation in the manner by which such information is circulated. This reality has made it hard for ISPs to step up their voluntary monitoring.

Consequently, some carrier organizations, with ISPs and other Internet companies as members, created the Guidelines on Measures for Illegal Information on the Internet in November 2006. The Guidelines provide examples of illegal information in circulation that violate obscenity-related laws and regulations, drug-related laws and regulations, billing fraud-related laws and regulations, money lending-related laws and regulations, and so on. They also provide criteria for determining violations of each of these laws and regulations. Furthermore, the Guidelines are kept up to date with changes in social conditions. ISPs can take voluntary actions (measures to stop the distribution of illegal information) because the Guidelines aid them in judging when to take measures to stop the distribution of illegal information. And like other guidelines related to the Act, the Guidelines were created at the impetus of private businesses to govern their own voluntary actions. This is important because any sort of guidelines from the government would constitute an obstruction of the expressions and actions of private businesses. In this light, the Guidelines are seen as mutually complementing the government's policy to deal substantively with the circulation of illegal information on the Internet.

2.4 Model Contract Articles for Illegal and Harmful Information

Some carrier organizations, with ISPs and other Internet companies as members, created the Model Contract Articles for Illegal and Harmful Information in November 2006 (Telecom Services Association 2006). The aim of the Model Contract is to have ISPs adopt clauses from the model into their own contracts and agreements as needed to suit the services they provide. The Model Contract lists matters to be banned on services, such as acts that incite or encourage suicide. The Model Contract is updated to keep up with social conditions. For example, it clarifies that "acts that promote unjust discrimination against other people," one of the prohibitions in the Model Contract, include hate speech that contains unjust discriminatory words and conduct directed at people born outside of Japan.

Similar to the guidelines related to the Act and the Guidelines on Measures for Illegal Information on the Internet, the Model Contract was created at the impetus of private businesses as a model for their own voluntary actions. This is important because any sort of guidelines from the government would constitute an obstruction of the expressions and actions of private businesses. In this light, the Model Contract is seen as mutually complementing the government's policy to deal substantively with the circulation of illegal and harmful information on the Internet.

2.5 Act on the Development of Safe and Secure Internet Use for Young People

The official title of the Act on the Development of Safe and Secure Internet Use for Young People, which came into force in April 2009, is the Act on Development of an Environment that Provides Safe and Secure Internet Use for Young People. The basic principle of the Act is to promote three major objectives. The first is the acquisition by young people under 18 years old of appropriate Internet usage skills. The second is the development of the capacity of young people to select age-appropriate information. The third objective is filtering so that young people have as few opportunities as possible while using the Internet to view information harmful to their development. (Filtering means a type of software that rates Internet webpages and other content on certain criteria and then selectively hides webpages and other Internet content containing illegal or harmful information (MIC 2016, p. 435). Providers of filtering services sort individual sites and applications into categories (such as illegal, gambling) and then block access to sites and apps in accordance with the user's preferences.)

The Act deserves special mention because it places obligations on carriers to provide filtering. For example, providers of mobile-phone Internet access services (mobile ISPs) are legally obligated to provide filtering services when the user is a young person. (Except in cases where the legal guardian has given notice requesting that filtering will not be used.) Ordinary ISPs are also legally obligated to provide filtering software or filtering services when requested by users. (Except in cases where the ISP has less than 50,000 subscribers, as the impact is assumed to be minimal.) Furthermore, the Act mandates that manufacturers of devices with Internet connectivity take measures to simplify the use of filtering by embedding filtering software or other methods at the time of sale (Except for devices like car navigation units that are unlikely to be viewed by young people under the supervision of 18-years-old people.)

The Act was amended to address the increasing Internet connectivity via smartphones, applications, and similar methods. The amendment, which went into force in February 2018, adds new regulations on franchised dealers, as well as mobile ISPs, to verify whether subscribers or users of mobile devices are young people under the age of 18 and to explain filtering to young people and take measures to enable filtering on mobile devices. In this way, the amendment institutionalizes filtering to make Internet use more suitable for young people.

3 Protection of Personal Information by Telecom Operators

3.1 Execution of the Act on the Protection of Personal Information and Its Significant Revision After a Decade

As I described in Sect. 1, the creation of a legal framework on the treatment of protection of personal information by the private sector began with the execution of the Act on the Protection of Personal Information (hereinafter referred to as the Act until Sect. 4) in 2005. The Guideline on the Protection of Personal Information in the Telecommunications Business, which was in effect before the Act, was updated to reflect the Act. As telecom operators were essentially no different from any other business operators handling personal information subject to the regulations of the Act, the Guideline emulated the Act's provisions and their intentions. The one difference, as will be described below, to remember is the Guideline included provisions based on the secrecy of communications, which is inherent to the telecommunications business, in addition to the provisions of the Act. The reason, of course, is that there are specific regulations on telecom operators regarding the secrecy of communications.

The backdrop for the push to enact the Act was the dissemination of information and communications technology (ICT) on a global scale in the 2000s. ICT came with both positive and negative facets. On the positive side, ICT facilitated the construction of e-government and e-municipalities in the public sector. And in the private sector, ICT fueled the rapid growth of e-commerce and led to the development of new products and services based on massive amounts of customer data, such as customer relationship management (CRM) and data mining. On the negative side, however, there was rising concern among citizens about the improper or illegitimate handling of personal information connected to the personhood of individuals, leading to violations of individuals' privacy and other rights and interests.

As a side note, the OECD adopted the so-called Eight OECD Privacy Principles in 1980, and nearly all OECD members followed suit by establishing laws on protecting personal information in the private sector. This was another consideration that led to the Act (Sonobe and Fujiwara 2018, pp. 9–14).

For about a decade after coming into force in 2005, none of the provisions of the Act were amended. But advances in ICT had drastically changed the landscape in ways that had not been considered when the Act was drawn up. Big data analysis was a particular concern, as it became possible to obtain and use the information on the behavior and status of individuals, information that was especially valuable to companies. Companies could easily turn such behavior and status information on individuals into personal information by referencing other personal information—i.e., information on a living person that can be used to identify a specific individual by means of a name, date of birth, or other descriptions contained in the information (and including information that can be easily associated with other information in order to identify a specific individual). The handling of this kind of information brought with it all kinds of issues. Another need that had surfaced was a supervising body to

carry out the administrative measures of the Act in a consistent and uniform manner, rather than having the Cabinet minister in charge of each ministry and agency be the main administrative entity for each industry field.

Specific issues had cropped up with the use of behavior and status information on individuals. One was the hesitation by companies to utilize big data because of various gray zones that made it difficult to judge what information was personal information. Another was reminders from consumers to take privacy protection into account concerning behavior and status information on individuals, while at the same time companies were pressing for the establishment of conditions so they could use this information legitimately. Part of the background to this last point was an attempt by a major railway company to analyze big data using the travel histories and purchase histories stored on its users' IC cards and the huge backlash from users that followed.

To add to this, another consideration deemed necessary was instituting internationally harmonized laws, given the globalization of company activities and the massive flows of personal information across borders. Given all these factors, the government decided to revise the Act a decade after its enactment. But during the drafting process, an employee at a contractor to a large correspondence education company stole data on some 28.95 million people and sold the data to a list broker. This caused a public outcry and brought attention to the improper sale of personal information to list brokers (Sonobe and Fujiwara 2018, p. 43). In light of this incident, the government decided to introduce regulations in the interest of taking measures against the theft of registries and similar data and to police list brokers.

3.2 Amended Act on the Protection of Personal Information

The amended Act went into force in May 2017. The key amended points are as given below.

- Establishment of the Personal Information Protection Commission

The amendment created the Personal Information Protection Commission, an independent and centralized organization in charge of privacy administration. The creation of the Commission centralized the supervisory powers over businesses that handle personal information away from the Cabinet ministers (ministries) in charge of each industry field. It was a move motivated in part by criticism of duplicate supervision by different ministries and a lack of clarity of which ministry was the competent authority. The creation of a single-point authority was intended to make private business activities more efficient and further visibility for citizens. It was also intended to unify and simplify privacy administration by doing away with the previous legal operations and administrative measures that operated in their own siloes.

- Clarification of the definition of personal information

The amendment introduced the concept of individual identification codes to the definition of personal information. The addition was deemed necessary to clarify extensions to the scope of protection afforded by personal information and to eliminate gray zones that were contributing to the use and application of personal information (Individual identification codes are defined as letters, numbers, symbols, or other codes created through the conversion of some or all of the physical characteristics of a specific individual for use in or by computers that can be used to identify the specific individual and that have been removed from personal information.) Although, in practice, individual identification codes had been previously treated as personal information, the amendment clarified that such codes are now under the scope of legal protection. The reasoning behind the individual identification code concept was the assumption that, by using individual identification codes as a sort of information hub, it would be possible to associate information with individuals, which would lead to the identification of a specific individual.

The amendment also introduced the concept of special care required personal information. Special care required personal information requiring special attention is defined as personal information such as a person's race, beliefs, or medical history, that could lead to unfair discrimination or prejudice against the person. Businesses that collect this type of personal information are obligated, in principle, to obtain the person's consent. A notification or announcement is sufficient for the collection of ordinary personal information, but stricter regulations are imposed on the collection of this special type of personal information. The founding of the concept of special care required personal information, in addition to ordinary personal information, dovetails with the EU's regulations on data protection.

- Arrangements to secure the usage of personal information

The amendment instituted provisions on the use of anonymously processed personal information. Anonymously processed personal information is defined as personal information that has been processed in such a way that no specific individual can be identified. The provision was instituted as a result of the IC card data analysis incident involving a major railway company mentioned above. The new provision is expected to pave the way for big data analysis contributing to a higher quality of life for all citizens. Examples include the use of loyalty card purchase histories or transport IC card travel histories among multiple businesses across different fields leading to breakthroughs generating new services or innovations; advancements in the drug discovery and clinical fields through the use of medical data held by medical institutions; and the use of probe data to provide more accurate traffic congestion predictions and weather forecasts (Uryu 2015, p 39).

- Measures on list brokers

The amendment makes it obligatory to verify and keep records pertaining to the third-party provision of personal data. Personal data is defined as personal information constituting a database of personal information held by a business. Specifically, when a business accepts the provision of personal data from a third party, the business is

obligated to verify the name of the provider and the circumstances under which the personal data was collected, to create a record of the provision and the details above, and to retain the record for a specified length of time. Furthermore, when businesses provide personal data to third parties, they are obligated to create and retain records of the date of provision, the name of the receiver of the data, and other details.

The amendment also makes the act of providing a personal information database or other data to a third party for unfair gain or using a personal information database or other data for fraudulent purposes a crime. This addition makes such acts subject to direct punishment through prosecution, without going through the administrative measures of the Personal Information Protection Commission.

- Other points

Prior to the amendment, the Act provided an exception from regulations for businesses that handle fewer than 5000 personal information records, out of consideration of the burden complying with regulations would have on SMEs. The amendment, however, removed this numerical exception because, with the advances in ICT today, the mishandling of even a few personal information records may lead to grave violations of the rights and interests of the individuals involved.

The Act has had an opt-out clause instituted since it first came into force. The opt-out clause allows businesses to provide personal data to third parties without the consent of the person, provided that the business ensures, in some form, that the provision to third parties of an individual's personal data that identifies the person can be stopped in accordance with the individual's request to do so. The amendment now mandates businesses that make use of the opt-out clause to notify certain prescribed details to the Personal Information Protection Commission and the Commission is required to publish the details.

The amendment also adds provisions restricting the provision of personal data to third parties in other countries, provisions stating that the Act applies outside of Japan, and provisions on the provision of information to regulators in other countries by the Personal Information Protection Commission. These additions were intended to impose some regulations on the international circulation of personal data. This is closely connected to the adequacy decision in the EU's GDPR, which is discussed below.

3.3 Connections to Regulations in Other Countries

The EU's Data Protection Directive contained adequacy decision clause. This clause permitted the transfer of personal data within the EU region to countries outside the region provided that the country outside the region had a level of protection for personal data equivalent to that within the EU. This clause was carried over when the directive was turned into a regulation with the GDPR.

When Japan's Act was amended, an equivalent clause was added. The intention was to design a system that, for example, would enable mutual adequacy arrangement with the EU instead of Japan being subject to unilateral adequacy decision from the EU.

Specifically, the clause permits the transfer of personal data to third parties outside of Japan when any of three conditions are met: (1) the person in question consents to the provision of the person's personal data to a third party outside of Japan; (2) the third party outside of Japan has instituted a system conforming to the standards stipulated by rules of the Personal Information Protection Commission; or (3) the third party outside of Japan is located in a country that the Personal Information Protection Commission has certified. The third condition is the provision related to mutual adequacy arrangement with the EU's GDPR. In other words, if a country the Personal Information Protection Commission certifies as having the same level of protection as Japan's Act corresponds to an EU country, a business can transfer personal data to a third party in that country. The actual negotiations have taken over three years, but mutual adequacy arrangement with the EU was completed in January 2019.

The second condition applies to relations with the USA. The condition on transfers of personal data is whether the third party in the USA has instituted a system of personal information protection conforming to the standards stipulated by rules of the Personal Information Protection Commission. This condition has been worked out by regarding observance of the APEC Cross-Border Privacy Rules (CBPR) system as having instituted a conforming framework.

3.4 Regulations on Telecom Operators

Telecom operators are also business operators that handle personal information subject to the regulations of the Act. This is why the Guideline on the Protection of Personal Information in the Telecommunications Business, which telecom operators refer to, borrowed from the amended Act. On the other hand, regulations specific to telecom operators involve them in protecting the secrecy of communications. This is why the Guideline added regulations grounded on the secrecy of communications specific to telecom operators, in addition to the provisions of the Act.

The secrecy of communications, at its most fundamental level, is the supporting concept that provides the incentive for users to rely on the Internet and other information and communication networks. It is the fact that ISPs and other telecom operators abide by the secrecy of communications that allows users to use the Internet and other information and communication networks safely and securely. If the secrecy of communications was infringed on, it would cause a withering of communication acts as well as freedom of expression and would even pose a threat to democracy. This is why the concept occupies such a prominent position in Japan as a fundamental right enshrined in the Constitution. While the secrecy of communications is not widely designated by law in other countries, it is not a unique concept or legal structure to

Japan. Each country's particular legal system guarantees the secrecy of communications in one form or another. For example, it is encompassed and guaranteed by the privacy concept in EU countries and by the freedom of expression concept in the USA.

Returning to telecom operators in this country, they are required to take special handling precautions with information connected to the secrecy of communications, such as call histories or location information. To ensure this, additional regulations are imposed on telecom operators. For example, telecom operators can record call histories only as needed to complete billing and other internal business processes and cannot provide call histories to any other party, apart from abiding by a judicial warrant. And handling location information is restricted to cases where consent has been obtained from the user or cases where handling is legitimate for completing internal business processes.

As described above, with the amendment to the Act, mutual adequacy arrangement with the EU's GDPR has been established. There is, however, a movement in the EU to establish an ePrivacy regulation in addition to the GDPR. If this comes about, in the future Japan may need to establish an adequate level of protection or mutual certification again with the ePrivacy regulation. This type of issue could conceivably involve platform operators that provide identical telecommunications services within the EU and in Japan and, as a result, would be transferring personal data or data relating to secrecy of communications between Japan and the EU. Attention should be paid to this matter moving forward.

4 Conclusion

In this chapter, two of the main components of consumer protection policy were outlined in the telecommunications business to date—namely measures to curb the circulation of illegal and harmful information on the Internet and the protection of personal information by telecom operators.

Aside from these two components, the government has adopted necessary comprehensive measures from time to cope with social conditions or technological innovations, such as anti-spam measures or the prevention of fraud using mobile phones, but these have been omitted for space considerations. The government will continue to have to closely monitor changes in the telecommunications business landscape and administer consumer affairs in the telecommunications business as appropriate and necessary.

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Personal Data Protection

Teppei Koguchi

1 Introduction

The purpose of this chapter is to examine the policies on protection of personal data in Japan. In recent years, increasing attention has been placed on personal data, both in Japan and worldwide. Also, various systems for protecting personal data are being examined. This chapter presents the latest situation in Japan.

In the first place, why are policies for protecting personal data necessary? Personal data is increasingly becoming something that adds value to economic activities. In past economic activities, personal data was at best useful, including information such as shipping addresses or regular customers. However, with the advancement of the information age with its powerful data analyzing technology, personal data has become a value-added resource. In particular, the spread and development of the Internet have helped to further increase the value of personal data. Information on regular customers has commonly been used to understand their buying trends. Currently, it is used for recommendations, which is a clear value-added use. Recommendations include information about what the customers have bought, as well as personal data, such as age and gender.

Recommendations are not the only value added by personal data. Other forms of added value can be considered, such as transportation, medical care, and advertising. In addition, artificial intelligence (AI) is also being considered as a technology to promote the value of personal data. AI is expected to use personal data to bring additional value to every field.

When personal data becomes something of added value, companies want to utilize it. On the other hand, personal data is inherently generated from individuals. In the strict sense, individuals generate information such as gender, age, and purchasing history, but companies often provide systems for automatically accumulating such

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data. Therefore, there is a debate in Japan with regards to the idea that personal data is something generated by individuals. However, it would be natural to think that personal data belongs primarily to the individual. If so, rules must be determined so that personal data, which is a highly sought after commodity, is not used inappropriately. Therefore, policies to protect personal data must be formed and implemented.

In particular, personal data is directly linked to the privacy of an individual. Unlike economic loss, privacy is quite difficult to recover once violated. The right to be forgotten as recognized by the EU is valid, but still not perfect. Until now, various measures have been taken regarding privacy violations, but further attention should be paid to this issue in the future.

The most basic policy in Japan regarding the protection of personal data is the establishment of the Personal Information Protection Act. However, the Personal Information Protection Act was outlined in the previous chapter. Therefore, this chapter focuses on policies that are more flexible and aggressive than this law and which have been examined in recent years.

The structure of this chapter is as follows. The next section, before examining specific policies, further considers methods of understanding personal data. Section 3 followed the discussions of governmental study groups on improving data distribution. Section 4 examined the mechanism called "Information Bank," which is possible a system unique to Japan, from the perspective of personal data as economic goods. Also, Sect. 5 presented examples of empirical studies conducted in relation to the protection and utilization of personal data in Japan. Section 6 is a summary of this chapter.

Up to this point, the term personal data is used naturally in this chapter. However, in practice, there are several definitions of personal data, and what comes to mind may differ from person to person. So, let us define personal data in this chapter.

In Japan, the term "personal information" can be interchanged with personal data. However, the term "personal information" often refers to the personal information defined in the Act on Personal Information Protection (Japanese Law Translation 2003). The Act defines personal information as follows:

> The term "personal information" as used in this Act shall mean information about a living individual which can identify the specific individual by name, date of birth or other description contained in such information (including such information as will allow easy reference to other information and will thereby enable the identification of the specific individual).

On the other hand, how can we define personal data? For example, the IT Fusion Forum Personal Data Working Group, established by the Ministry of Economy, Trade, and Industry, pointed out the following: Personal data refers to the concept of "personal information" that was used in the "Information Grand Navigation Project," which was promoted by the Ministry of Economy, Trade, and Industry in 2005, and it includes information not limited to the "personal information" stipulated in the Personal Information Protection Act, but also information that cannot be used for personal identification of individuals, such as location information and purchase history. In the "Research Group on the Use and Distribution of Personal Data" held at the Ministry of Internal Affairs and Communications in 2012, "information related to

individuals" regardless to its personal identification nature was defined as "personal data" (IT Fusion Forum Personal Data Working Group 2013, p. 1). Therefore, this chapter defines personal data as "personal information + information related to individuals that do not have personal identification nature."

2 Personal Data as Economic Goods

The previous section explained that personal data changed from "something useful" to "something that brings added value." However, this statement is insufficient for observing the current method of handling personal data. Currently, personal data is changing from "something that brings added value" to "a stand-alone economic product."

For example, imagine using an online shopping site. In order to use the service, we create an account by registering an address or credit card number. In addition, the service accumulates the site browsing history and purchasing history. These are all personal data. The site uses these personal data for marketing, etc. within the scope of the terms of use.

In order to use this online shopping site, we have to agree to the terms of use. In other words, use of the service comes with accepting the use of personal data. In this way, our personal data, which is "something that brings added value" to companies (in this case, the online shopping site), is inseparable from our use of services.

However, recently, personal data is being traded as personal data, instead of being traded together with a service. In Japan, companies that serve as intermediaries for such transactions are emerging, and the data exchange market is beginning to form. The information bank is a mechanism unique to Japan for managing personal data as a stand-alone economic product.

In this case, policies to protect personal data also need to be developed on the assumption that personal data is economic goods. It is not enough to have the image of companies collecting information based on their terms of use.

As personal data is now considered economic goods, it is necessary to keep in mind that personal data will be traded and utilized.

Systems for protecting personal data are often discussed from a legal viewpoint, and important issues have been presented. On the other hand, there are comparatively few studies into problems that can arise from the viewpoint of economics when personal data is actually utilized under a well-established system.

In particular, this chapter examines the integrity of an individual's information and the rationality of an individual, which are often assumed or considered in economics. As we will see later, the distribution environment of personal data is currently under examination for improvement. Apparently, integrity in relation to the goods being traded and rationality in relation to the trade are required by individuals. However, currently, the integrity and rationality of information security are insufficient for the trading personal data; therefore, this chapter shows future issues in the use of personal data.

At first glance, the only purpose of the policies presented and examined in the next section may seem to pertain to the distribution of personal data. However, we examine what protection perspective will be incorporated in the future distribution environment of personal data from the perspective of personal data as economic goods and from the perspective of economics.

3 Development of Data Distribution Environment

The development of an environment for the distribution and utilization of data was discussed in the "Working Group on Data Utilization in the era of AI and IoT" at the "Review Conference on the Development of Data Distribution Environment." The content of the "Interim Report" released in March 2017 is important.

The "Interim Report" examined issues regarding the distribution and utilization of data from the perspective of the public and consumers, from the perspective of businesses, and in terms of security. Of these, the perspective of the public and consumers is significant in this chapter, which explores the ideas surrounding this perspective.

The following issues were cited from the perspective of the public and consumers (Working Group on Data Utilization in the era of AI and IoT 2017. pp. 5–6):

- Anxiety due to the inability to manage/control one's own data
- Dissatisfaction and sense of unfairness due to the inability to actually derive or enjoy a financial gain from the use of their personal data by third parties
- Technical issues such as data compatibility.

The third issue pertains to the "Realization of Safe, Secure and Highly Personalized Service (Working Group on Data Utilization in the era of AI and IoT 2017, p. 6)" and is directly related to the content and quality of the service. However, the first and second issues directly related to individuals' feelings and perceptions, as implied by the words anxiety, dissatisfaction, and the sense of unfairness. These issues are certainly related to information symmetry and individual rationality, which is explored in this paper. If we rethink these issues more concretely in terms of information symmetry and individual rationality, one could argue that presently, there is insufficient information for individuals regarding the use of personal data for them to manage and control their data. In addition, they are ill-informed on how to actually derive a financial gain from the use of their data by third parties. Alternatively, even if they have enough information, individuals do not possess the rationality to properly process the information and make appropriate decisions.

Furthermore, managing and controlling your own data and benefitting from it must be something that occurs when you attempt to provide your personal data to others or when you receive some compensation for the provision of the data. Therefore, one could argue that the issues related to information symmetry occur at the time of personal data trade between individual and other entities.

In this Interim Report, the following three systems of personal data distribution were presented: personal data store (PDS), information bank, and data marketplace:

- PDS

A personal data store (PDS) is defined as "a system that enables individuals to store and manage their own data at their own discretion, and a system with a function enabling control (including the transfer of control) over the provision of personal data to third parties (Working Group on Data Utilization in the era of AI and IoT 2017, p. 9)." Furthermore, PDS is divided into two types based on how data is stored (centralized or distributed).

- Information Bank

An information bank is defined as "an enterprise that manages an individuals' data using systems such as a PDS, based on a contract with the individuals regarding the use of their data. It provides data to third parties (other companies) on behalf of individuals after assessing the validity based on the individuals' instructions or pre-specified conditions. Individuals are directly or indirectly compensated for the distribution and use of their data by the companies who receive their data (Working Group on Data Utilization in the era of AI and IoT 2017, p. 9)." It is the same as a PDS in that individuals determine policies on the management of their data, but it leaves the use of the data to third parties and differs in that individuals are compensated for the use of their data.

- Data Marketplace

A data marketplace is defined as "a system (market) that enables transactions by acting as an intermediary between a data holder and those who wish to use the data (Working Group on Data Utilization in the era of AI and IoT 2017, p. 10)." Unlike PDS and information banks, as a data marketplace is ultimately a marketplace, government regulation may be required to some extent, but it is not necessarily a platform that is "maintained." Private companies have already realized initiatives for data marketplaces. Every-sense Inc. provides a service as an intermediary between individuals, whose personal data is acquired from applications and sensor devices, and buyers who would like to obtain the data.

To what extent can systems such as PDS, information banks, and data marketplaces be expected to reduce information asymmetry in personal data trade? As systems, PDS, information banks, and data marketplaces, they create a system using which individuals can store and manage their personal data and provide it to other entities at their own discretion. These three systems were equally featured in the Interim Report, but recently, there has been a movement trying to promote information banks. Therefore, this chapter will discuss information banks.

In information banks, individuals specify the conditions pertaining to how their data is handled, but the use of the data is left to third parties, and the individuals are compensated for it. Once the conditions are set, one can receive monetary compensation for the use of their data by third parties without having to manage and control

it in real time. The fact that "one can aggregate their data, including the part managed by third parties, or have it aggregated by a designated party and individually manage and control the provision of their personal data to third parties (other companies) at their own discretion (Review Conference on the Development of Data Distribution Environment. 2017 Working Group on Data Utilization in the era of AI and IoT, p. 11)" was cited in the Interim Report as a merit of promoting information banks.

Now that there are many online services, if there is a need to provide personal data to a company, one has to fully understand the terms of use of each service and make individual decisions appropriately. In many cases, the terms of use consist of a lengthy and complicated text. Many studies and surveys [e.g., Kohavi (2001)] revealed that service users do not sufficiently read the terms of use. Individuals are known to determine that the conditions of data provision by information banks are more convenient than reading through various terms of use, as has been the case so far. This, coupled with the option of letting the information banks determine the validity of information on behalf of the individuals, may contribute to the reduction of information asymmetry in personal data trade by individuals, and in terms of dealing with the limits of individual rationality.

A further merit of promoting information banks is the transparency of the financial gain from using personal data. As mentioned in the previous section, when an individual provides personal data to a company and then uses the services of the company, the value added due to the use of the personal data naturally exists. However, the type of data may make the intrinsic service more convenient. For example, when using an online shopping service, the provision of personal data for account registration can be argued to constitute an intrinsic part of the service, as the service cannot be utilized without said information. On the other hand, if the purchase and browsing history are used to show recommended products, showing product recommendations can be argued to attach value to the intrinsic service. Furthermore, most people are probably unaware of the percentage of recommendations that come from the stored history (provided).

Therefore, it was difficult to understand the portion of total profit generated from the service the added value from one's personal data constituted, and what the extent of the added value was. On the other hand, individuals receive compensation from information banks (or companies) for providing personal data at their own discretion. This respect contributes to the reduction of information asymmetry in personal data trade.

With regard to information banks, the Ministry of Internal Affairs and Communications and the Ministry of Economy, Trade, and Industry released "Guidelines of Certification Schemes Concerning Functions of Information Trust ver. 1.0" on June 26, 2018. Following that, the November 2018 "Review Conference on Certification Schemes Concerning Functions of Information Trust" held discussions aimed at the development of "Guidelines of Certification Schemes Concerning Functions of Information Trust ver. 2.0".

Furthermore, working groups have been established with regard to the distribution and use of personal data, including information banks, under the Strategic

Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (IT Strategic Headquarters), and discussions are underway. No conclusions have been made at the time of writing this paper, but according to the released conference materials, the following were listed as questions for consideration regarding the development of a safe environment for the use of personal data:

- What measures are necessary to reduce the "negative feelings toward the use of one's personal data by third parties," which is a major part of an individual's concern over the use of their personal data?
- Is it not necessary to clarify the concept of "data use centered on individuals"?
- Should we not consider the scope of the controllability of personal data and how consent should be obtained and supervised?
- With regard to the possibility of granting consent without sufficient understanding (social plugins, third-party cookies, etc.), is there a need for measures toward the safe use of personal data?
- With regard to sensitive personal information in medical fields and data pertaining to the assessment of individuals, will we not get closer to a balance between data protection and use through clarifying conditions pertaining to the use of personal data such as setting a limit to the scope of use based on consent?

(Source: The Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (IT Strategic Headquarters), 2019).

Regarding personal data trade, the promotion of systems including information banks can be argued to reduce information asymmetry to some extent and will tackle the limitation of individual rationality. However, some issues remain, which will be discussed in the next section.

4 Issues with the Protection of Data as an Economic Good

As shown above, it is possible to see structures such as information banks, being sites for trading personal data between individuals and businesses (or directly with the information bank), as the first phase of use and application of personal data. In practice, businesses pass personal information onto other agents after taking measures such as anonymizing (legal) information, so the trade of personal data (other than individuals' information) does not only happen in information banks. At any rate, however, the first phase will be formed by individuals (through structures such as information banks) trading personal data with businesses. Accordingly, structures like information banks could also be said to form a market.

If we think of a personal data market, the "goods" traded in the market would be, as the name implies, personal data. Therefore, in such a market, an arrangement would form whereby the business would be the consumer (the buyer) and the individual would be the supplier (the seller). This is the model for the data trade market, and an information bank would be the buyer.

Generally, individuals are consumers and businesses are suppliers; however, here the opposite is true; this characteristic is peculiar to personal data.

Normally, in the market, the consumer compares the benefits that can be obtained from goods against their cost and consumes if the benefit of goods outweighs the cost. On the other hand, the supplier compares the (marginal) cost of producing that good against its price and produces if the price of goods outweighs the cost. Accordingly, in making decisions related to consumption and production, the benefit to the consumer and the cost to the supplier are important factors alongside price.

Regarding this point, let us consider the trading of personal data by individuals. As mentioned above, in the trading of personal data, the individual is the supplier. Accordingly, individuals decide whether to supply their data by comparing the "production cost" and "market price" of personal data as suppliers.

Here, in an information bank system, the market price of personal data that faces the individual would be a benefit they receive from the information bank. The market price of personal data can be imagined as the price of a register of names on the black market or the prices charged by businesses when dealing with third parties. As stated above, we see that the individual is the first supplier of personal data, and the business or information bank buys that data. Moreover, in the data trading market, we must examine the market price itself. A system like an information bank might benefit the individual by providing information about the market price that would influence decisions regarding the supply.

What would be the production cost of personal data? It is odd to represent the production cost of personal data, but this indicates one of the characteristics of personal data as a product. With normal goods, production costs arise because production requires raw materials, production facilities, etc.

However, there is no production cost for names or dates of birth. Strictly speaking, costs may arise because of things like naming ceremonies, but from the perspective of the person concerned, it can still be considered to have no cost. Regarding location information according to GPS or records of purchases from internet shopping, although costs may arise due to requirements for systems to collect and store that information, the individual who produces this information is not necessarily in motion, nor are they consciously making a purchase history. Then, in daily life and economic activity, this information can be passively accumulated which incurs no cost to the individual.

However, one important point is that costs arise in the supply of personal data that is different for normal goods, and one model for constructing that cost is privacy. When offering our personal data to a company in order to use a service, we may be concerned about abuse of that data, infringement of privacy, or use of the data. These psychological costs are loaded on individuals who produce and supply personal data.

Of course, if individuals completely understood the terms of service, this kind of concern might not arise. However, from existing research, we can assume that the terms of service have not been understood. Moreover, if someone tries to understand the terms of service, then a separate cost arises in the time taken to read the terms of service. Accordingly, when trading personal data, the individual compares the prices

and benefits specified by the information bank, data trading market, etc., against the cost of concern about their own privacy, to decide whether to supply personal data.

The matter of the economic good of personal data that this document aims to identify is how an individual can fully understand the costs of their own privacy when trading personal data? As mentioned above, systems such as information banks or data trading markets can compensate for incomplete beneficial information obtained from trading personal data. This could potentially alleviate the limitations on an individuals' rationality. However, an individual may simultaneously have incomplete "cost-side" information and be rationally impaired. If that were the case, this would prevent desirable trades with institutions such as information banks and data trading markets alone.

Regarding worries about privacy, prior research has shown that people have actually not been able to exercise rational judgment concerning their own privacy; this is called the "privacy paradox" (Acquisti et al. 2016). Analysis of this privacy paradox has suggested that consumers do not seem to care as much about privacy as they say they do, and if the privacy paradox actually exists, the issues of incomplete "cost-side" information and limited rationality in personal data trading must be resolved. The following section gives examples of experimental studies carried out in Japan regarding this point.

5 Examples of Experimental Studies in Japan

Although in our day to day life there may be very few opportunities to consider the financial cost of worries or concerns about privacy, one example of a situation in which we do think about privacy concerns financial compensation for data breaches. Table 1 shows that, excluding finance-related customer information, other information such as member details can fetch a market price of up to 500 or 1000 yen.

Compensation for data breaches can be thought of as a valuation of privacy, due to the corresponding privacy violations due to leaks. However, the injured parties of a data breach just accept the compensation offered by the company, and it is unclear whether they feel compensated for the damages. Moreover, if each individual was able to determine an appropriate amount for the value of their personal information, the compensation is expected to differ in proportionate to the quality and quantity of leaked information. A standard market price would be inappropriate for such cases.

So, can individuals set an appropriate price for their own information? How would we evaluate compensation paid thus far based on an individual's valuation? Based on this kind of critical perspective, the author implemented an estimation of the intended compensation amount for information leaked thus far (Koguchi et al. 2015). In the analysis, Willingness to Pay and Willingness to Accept were estimated based on three cases. The outline of, and survey questions for, each case are as follows:

- Basic Case: name, email address, and home address are leaked via the Internet.

- YouTube + Basic Case: the past three years' worth of YouTube history is leaked as well as personal data from the Basic Case.
- Adult Movie + Basic Case: the past three years' worth of adult movies viewed is leaked as well as personal data from the Basic Case.

A question can be raised. Let us consider the situation where your Internet provider has leaked [one of the above cases]. Hypothetically, what level of compensation would be satisfactory to you as an apology for the leak?

Estimation was carried out using the Contingent Valuation Method. Estimation results are as follows (Table 2).

These results are extremely interesting. The reason for this is that when you consider the possibility of damage due to leaked information or violation of privacy due to leaks, the greater the variety of leaked information and the more sensitive the leaked information is, the greater we would expect the intended compensation amount to be. Naturally, these results are always estimated prices, and these prices are affected by the sample quality and estimation method. Accordingly, although

Table 1 Incidences of personel information leakage

Date	Leaked information	Scale	Amount for compensation
1998	Waseda University; Lecture attendance revealed to the police	1400 cases	JPY5000
1999	Uji City: Basic Resident Register data	Around 220,000 people	JPY15,000
2000	TBC Group; Information on potential beauty treatment customers	Around 6.6 mn people	JPY35,000 (court judgment)
Jun-03	Lawson; Card member information	Around 1.15 mn members	JPY5,000 shopping voucher
Nov-03	Famima club; Member information	Around 180,000 members	JPY1000 QUO card
Jan-04	Yahoo! BB; Subscriber information	Around 5.9 mn subscribers	JPY500 cash voucher
Apr-09	Mitsubishi UFJ Securities; Customer information	Around 50,000 people	JPY10,000 shopping voucher
Jul-14	Benesse; Customer information	28.95mn people	Electronic money, book card or donation, equivalent to JPY500
Sep-14	DoCoMo; Customer information	One company, 1053 individuals	(To be decided)
Sep-14	JAL	As many as 750,000 cases	(To be decided)

Source Created by the author based on the homepage of the Mizuho Chuo law firm (a professional legal corporation)

Table 2 Estimation results

	Survey period	Sample size	Basic case	YouTube + Basic case	Adult movie + Basic case
Koguchi et al. (2015)	April 2015	1264	JPY15,739	JPY14,636	N/a
Koguchi (2018)	March 2018	1699	Average: JPY94,319 Median: JPY12,500	Average: JPY100,430 Median: JPY12,500	Average: JPY122,862 Median: JPY12,500

there is a need for continued analysis through a variety of approaches, the following suggestions could be made.

First of all, the intended compensation amount requested by individuals for leaks of information such as name, email address, and postal address (which are supposed to be included in the member information) is in the tens of thousands of yen, so the usual 500 yen is highly inappropriate. Secondly, intended compensation amounts requested by individuals are not necessarily proportionate to the quality or quantity of leaked information.

Taking into account the goals of this chapter, two particular points should be considered. Although we were looking at the perception of value from a specific point of view, namely compensation value for leaks, if the perceived economic value for one's own information is not proportionate to the quality or quantity of the information, it is possible that trading will develop without people having adequate understanding of the costs regarding their own privacy. This is especially so when trading personal data in information banks or data trading markets in the future. Regarding this point, analytical results have been obtained that suggest the intended compensation for leaks of personal information is affected not just by the quality or quantity of leaked information, but on the person's mood at the time of the leak. See Koguchi et al. (2016), Jitsuzumi et al. (2018), etc., for details.

Of course, since the costs regarding one's own privacy are, at the end of the day, psychological, it might not even be a problem for the intended compensation amount to not necessarily be affected by the quantity or quality of information, considering that it is subjective after all. However, since the use and application value of personal data can be thought of as fundamentally proportionate to quality and quantity, if trading began without a resolution of this situation, specific information would not be traded due to the low cost-effectiveness for businesses. Specifically, uses and applications may not improve. Thus, as well as system maintenance, there should be a need for some kind of measure to address an individuals' understanding of the costs in supplying personal data.

6 Conclusion

The present chapter studied political measures concerning the protection of personal data in Japan, particularly information banks. For the purposes of this study, personal data was viewed as an economic resource, studying issues with the implementation of information banks or data trading markets. In particular, we inquired into the completeness of information for the individual and an individual's rationality.

Policies such as information banks have been devised with the goal of compatibility between distribution and protection of personal data. However, the results of this study show that we do not necessarily have adequate guarantees of completeness of information or rationality regarding the costs of trading our personal data and privacy. In fact, the "Interim Guidelines" suggest popularizing, raising awareness, and educating citizens about the management of their own data. Specific measures and system maintenance must be developed quickly regarding this point.

The present chapter only ever points out the possibilities of problems existing in the design of current systems, and further clarification of the details of these problems, as well as offering specific solutions, is necessary for future studies. In addition, both jurisprudential and economic points of view are necessary regarding the study of political measures for the protection of personal data.

From Sect. 2 onwards, this chapter is a reorganized and amended version of the English translation of Koguchi (2018).

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Cutting-Edge ICT

Big Data, IoT, AI, and Smart Cities

Takanori Mashiko

1 Introduction

No conversation about today's advances in Information and Communication Technology (ICT) is complete without mention of big data, the Internet of Things (IoT), and Artificial Intelligence (AI). The combination and use of these three technologies produce new value by enabling ICT products to operate with an awareness of their environment and conditions. Furthermore, this tech trio lets mass-produced ICT products, which are generally manufactured through duplication and offer advantages similar to those of order-made products.

Of the three, AI has the longest history. According to Matsuo (2015) and Kanda (2016), who have charted the history of AI in their respective books, the first AI wave started in the mid-1950s and lasted into the 1960s. It was precipitated by Alan Turing's article "Computing Machinery and Intelligence" (Turing 1950) shortly after World War II that advocated for the concept of "Artificial Intelligence." AI research at the time made it possible to use computing machines for inferences and searches. For example, early AI could solve mazes and puzzles with clearly defined rules and goals. This AI wave fizzled, however, as the limits of early AI were exposed—namely, it was not useful in solving real-world problems where the rules and goals are ambiguous at best.

The second AI wave occurred in the 1980s with the advent of "Expert System." "Expert system" attempted to solve real, complex problems by placing the knowledge of experts on computers. The systems consisted of an inference component, a knowledge base, and an interactive interface with the user. They had limited success in such applications as predictive input method editor and automated voice-response systems used in call centers and elsewhere. The fundamental problem, however, was

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the need to systematize the knowledge of experts so that computers could understand all the necessary information. It proved impossible to put the knowledge expert's use unconsciously into knowledge bases, making expert systems impractical for solving real-world problems. So, again, this AI wave faded as its limitations became clear.

The third AI wave started in the early 2010s and continues to this day. "Deep Learning" provided the initial spark for this wave. "Deep Learning" uses multiple layers of neural network models that mathematically emulate the workings of the brain. Unlike in past iterations of AI where humans showed the AI system what features to find, "Deep Learning" can automatically identify and use features from large data sets. Deep learning can even distinguish features humans do not or cannot perceive. For example, deep learning systems can distinguish images in certain applications with greater accuracy than the average human. Applications of deep learning are now underway in image diagnostics for medical exams. Researchers were studying the use of AI to recognize images and distinguish what was captured in images well before the third AI wave. But the detection accuracy of conventional AI was poor and practical applications were a long way off. Google, however, made use of deep learning in 2012 and demonstrated that it could recognize cats with a practical level of precision. And as computer GPUs increased in speed, making deep learning far more accessible to more people, many industries and researchers were drawn to the potential of practical deep-learning-based AI applications in many different fields. The automotive industry, for one, is pushing ahead with AI research into autonomous driving and many other applications.

Deep learning is a function that trains neural networks on large data sets (pairs of inputs and outputs). This is why today's AI has such a close connection with big data technology, which accumulates large amounts of data, and the IoT, which collects data from all kinds of networked sensors. Applications of big data, IoT, and AI are mutually and intimately connected. For example, it would be next to impossible to collect big data without the IoT, and it would be hard to utilize big data without AI. Japan's basic policy approach is to promote all three technologies together to return their benefits to society in the form of smarter cities, for example.

2 Related Policy Structures

There are two main policy structures that relate to big data, the IoT, AI, and smart cities. One is the structure for science and technology policy, which focuses on approaches to the technologies themselves. The other is the structure for information and communications policy, which is focused on the approaches to the distribution and application of data and information with these technologies.

The core of Japan's science and technology policy structure is the Science and Technology Basic Plan (Cabinet Office 2016), which is updated every five years, and the annual Comprehensive Strategy on Science, Technology and Innovation (Cabinet Office 2018a). Essentially, related government ministries and independent national R&D institutes carry out R&D and other projects in line with these two documents. In

addition, an AI technology strategy has been drawn up as a related government strategy, and the Information and Communications Council has compiled the Strategy to Realize a Next-Generation AI Society (Ministry of Internal Affairs and Communications, Information and Communications Council 2017c) and the Next-Generation AI x ICT Datability Strategy (Ministry of Internal Affairs and Communications, Information and Communications Council 2017b).

Japan's information and communications policy rests on the Declaration to Be the World's Most Advanced Digital Nation: Basic Plan for the Advancement of Public and Private Sector Data Utilization (Prime Minister's Office of Japan 2018), which was established in accord with the Basic Act on the Formation of an Advanced Information and Telecommunications Network Society (Cabinet Office 2001). Further to this, the Information and Communications Council has compiled the IoT Comprehensive Strategy and the TECH Strategy to Grab the Future (Ministry of Internal Affairs and Communications, Information and Communications Council 2017a).

Policies in many fields, starting with science and technology policy and information and communications policy, have many overlapping areas. For this reason, each policy was established along with a respective "command post"—the Council for Science, Technology and Innovation and the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (IT Strategic Headquarters)—to account for these overlapping areas.

2.1 Science and Technology Basic Plan

The Basic Act on Science and Technology, established in 1995, is the foundation of Japan's science and technology policy. Working from this Act, the government establishes the Science and Technology Basic Plan and proceeds with systematic and unified science and technology policy from a long-term perspective.

The Council for Science, Technology and Innovation is responsible for establishing and implementing the Science and Technology Basic Plan. In January 2016, the Cabinet endorsed the current 5th Science and Technology Basic Plan for FY 2016 through to FY 2020. The government carries out R&D and other projects in accordance with the Basic Plan.

The 5th Science and Technology Basic Plan (Cabinet Office 2016) has a basic policy that stresses the ability to be visionary and strategic, in terms of predicting what will come and acting strategically, and the ability to mobilize diversity and flexibility, in terms of responding appropriately to any changes that may occur. From this basic policy, the Basic Plan formulates four elements of the target national profile and four pillars of science and technology policy.

Four elements of the target national profile

(i) Sustainable growth and self-sustaining regional development
(ii) Ensure safety and security for the nation and our citizens and a high-quality, prosperous way of life

(iii) Address global challenges and contribute to global development
(iv) Sustainable creation of intellectual assets.

Four pillars of science and technology policy

(i) Acting to create new value for the development of future industry and social transformation
(ii) Addressing economic and social challenges
(iii) Reinforcing the fundamentals of science, technology, and innovation
(iv) Establishing a virtuous cycle of trained personnel, knowledge, and capital for innovation.

Of the four pillars, the one with the most relevance to big data, the IoT, AI, and smart cities is the first. The key part of this pillar is the following. "To enable Japan to instigate major change and to remain a world leader in an era of dramatic change, we will strengthen R&D measures that generate discontinuous innovation and will boost efforts to devise a series of initiatives, known as Society 5.0, geared toward realizing the world's first Super Smart Society that creates new value and services in rapid succession." (The 5th Science and Technology Basic Plan, Cabinet Office 2016, p. 6)

The super smart society mentioned above is characterized as a: "society that is capable of providing the necessary goods and services to the people who need them at the required time and in just the right amount; a society that is able to respond precisely to a wide variety of social needs; a society in which all kinds of people can readily obtain high-quality services, overcome differences of age, gender, region, and language, and live vigorous and comfortable lives."(The 5th Science and Technology Basic Plan, Cabinet Office 2016, p. 11)

And Society 5.0 is explained as: "Through an initiative merging the physical space (real world) and cyberspace by leveraging ICT to its fullest, we are proposing an ideal form of our future society: a Super Smart Society that will bring prosperity to people. We will promote the series of initiatives geared toward realizing this ideal society as Society 5.0."(The 5th Science and Technology Basic Plan, Cabinet Office 2016, p. 11). In other words, Society 5.0 is a new society following the succession of hunter/gatherer societies, agrarian societies, industrial societies, and information societies.

ICT, as public infrastructure, is crucial to the realization of Society 5.0. This necessitates the following:

– Effort to further advance and diversify the requirements—such as transmission speeds and latency—for networks connecting cyberspace with physical space in order to realize advanced services; and efforts to develop and standardize technologies for information and communication networks, which are the key components of public infrastructure underpinning such services; and
– efforts to develop and standardize infrastructure technology and platforms for data collection, distribution, and analysis in order to promote ICT applications in multiple fields and expand the types of businesses that make use of data.

The Ministry of Internal Affairs and Communications (hereinafter referred to as MIC) has, in response, decided to focus on the following two technology fields:

– network technology field

  - optical network technology for lower power consumption and faster speeds
  - infrastructure technology for flexible control of networks.

– technology fields underpinning data utilization, distribution, and analysis

  - data collection and intention analysis technology for the linguistics field
  - advancements in interactive platforms
  - wireless application technologies for the creation of wireless factories
  - technology promoting the application of space data.

2.2 Comprehensive Strategy on Science, Technology and Innovation

The Council for Science, Technology and Innovation established the Comprehensive Strategy on Science, Technology and Innovation (Cabinet Office 2018a) in June 2018 for the third year of the current 5th Science and Technology Basic Plan (Cabinet Office 2016). The Strategy was formulated on the following basic principles:

– flexibly apply "total optimization" to the country's systems and practices, while reforming and strengthening the three basic pillars of knowledge, institutions, and finances through policy integration, and
– become the most innovation-friendly country in the world and be the first in the world to propose solution models for the issues faced by other nations.

The Strategy calls for enhanced efforts in many different technologies. In AI technology, for example, it calls for the promotion of the following initiatives:

– personnel development at all levels at an order of magnitude larger in scale;
– strategic R&D that moves beyond mere self-sufficiency (such as agriculture; health, medical care, and nursing; construction; disaster response and mitigation); and
– establishment of principles for a human-centered AI society.

The MIC, to promote the initiatives above, is moving ahead with the following efforts:

– conduct R&D into multilingual speech translation;
– develop AI personnel through regional ICT clubs and other measures; and
– advance international discussions by creating a draft of principles on the use and application of AI.

2.3 *Artificial Intelligence Technology Strategy*

The Artificial Intelligence Technology Strategy Council was set up in April 2016. The Council finalized the Artificial Intelligence Technology Strategy (Artificial Intelligence Technology Strategy Council 2017) in March 2017, which contains the following provisions:

- accelerate integrated efforts, ranging from R&D to implementation in society, based on Japan's strength in AI industrial applications, by coordinating the ministries concerned with AI development (the MIC, the Ministry of Education, Culture, Sports, Science and Technology, and the Ministry of Economy, Trade and Industry);
- coordinate projects by the government ministries with jurisdiction over output industries, such as the Ministry of Health, Labor and Welfare, the Ministry of Land, Infrastructure, Transport and Tourism, and the Ministry of Agriculture, Forestry and Fisheries, and including the Cabinet Office's Strategic Innovation Promotion Program (SIP); and promote private-sector R&D investments in AI technology;
- establish an industrialization roadmap in each priority field—productivity; health, medicine, and nursing; and spatial mobility; and
- in order to realize the industrialization roadmaps, government bodies engage in (1) R&D, (2) personnel development, (3) arranging conditions for data and tools, (4) assistance to business ventures, and (5) promotion of AI technology literacy.

The Council also created the Artificial Intelligence Strategy Action Plan (Cabinet Office 2018b) in June 2018. For each individual AI strategy initiative presented in the Comprehensive Strategy on Science, Technology and Innovation, the plan articulates concrete measures for the respective government ministry in charge and defines targets and target achievement deadlines. And to push the plan forward with material and substantive energy, the Artificial Intelligence Strategy Implementation Committee (AI Expert Committee) was formed.

2.4 *Declaration to Be the World's Most Advanced Digital Nation: Basic Plan for the Advancement of Public and Private Sector Data Utilization*

The Cabinet endorsed the Declaration to Be the World's Most Advanced IT Nation: Basic Plan for the Advancement of Public and Private Sector Data Utilization in 2017 (Prime Minister's Office of Japan 2017). The declaration was revised and amended as the Declaration to Be the World's Most Advanced Digital Nation: Basic Plan for the Advancement of Public and Private Sector Data Utilization in 2018 (Prime Minister's Office of Japan 2018).

The Basic Plan for the Advancement of Public and Private Sector Data Utilization specifies eight priority fields: e-government; health, medicine, and nursing; tourism; finance; agriculture, forestry, and fishing; manufacturing; infrastructure, disaster response, and disaster mitigation; and mobility. The Basic Plan also sets the promotion of priority measures to be taken in each field with 2020 as the initial period, while eying the future coordination of data sets across these fields.

2.5 Strategy to Realize a Next-Generation AI Society

The Technology Strategy Committee, under the Information and Communications Council's Subcommittee on Information and Communications Technology, issued a reply on New Approaches to Information and Communications Technology Strategy (Inquiry No. 22 dated December 28, 2014) (Ministry of Internal Affairs and Communications 2014b). Based on this reply, the Strategy to Realize a Next-Generation AI Society (Third Interim Report dated July 20, 2017) (Ministry of Internal Affairs and Communications, Information and Communications Council 2017c) was compiled.

The Strategy is aimed at achieving the implementation in society of natural language processing technology and neural information and communications technology, as test cases of next-generation AI technologies. The Strategy charts a vision of a society in which these technologies are implemented, with examples of their application in many fields, including medicine, education, and disaster response. At the same time, it also points out various issues with the social implementation of these technologies, such as issues around service applications (data) and issues with the platforms supporting service applications.

The Strategy lists the following initiatives as specific measures to promote the social implementation of natural language processing technology:

- R&D and standardization of next-generation interactive platform technologies;
- implementation of advanced, next-generation interactive technologies; and
- establishment of new training data looking ahead to applications and services that address societal needs.

And as specific measures to promote the social implementation of neural information and communications technology, it lists the following initiatives:

- establishment of promotion frameworks to accelerate the social implementation of neural information and communications technology;
- acceleration of the collection, sharing, and application of neural data; and
- promotion of R&D into the social implementation of neural information and communications technology.

2.6 Next-Generation AI × ICT Datability Strategy

The Next-Generation AI × ICT Datability Strategy (Third Interim Report dated July 20, 2017) (Ministry of Internal Affairs and Communications, Information and Communications Council 2017b) was compiled after the Technology Strategy Committee, under the Information and Communications Council's Subcommittee on Information and Communications Technology, issued a reply on New Approaches to Information and Communications Technology Strategy (Inquiry No. 22 dated December 28, 2014) (Ministry of Internal Affairs and Communications 2014b). The Next-Generation AI x ICT Datability Strategy serves two purposes: to collect valuable and strategic data from such key fields as linguistics, neural information, and spatial information, as well as various workplace data from user companies, that will be the driving force behind the social implementation of next-generation AI, and to promote the arrangement of conditions (ICT datability) to link data sets from different fields and make them available for use by AI securely and conveniently for value creation.

The Next-Generation AI x ICT Datability Strategy puts forth the following three specific measures:

- measures to collect valuable and strategic data from key fields;
- measures to link data sets from different fields and make them available for use by AI securely and conveniently; and
- construction of new platforms to support a wide variety of AI services.

2.7 IoT Comprehensive Strategy

The IoT Comprehensive Strategy (Ministry of Internal Affairs and Communications, Information and Communications Council 2017a) (Third Interim Report dated January 27, 2017 and updated in the Fourth Interim Report dated July 20, 2017) was compiled in the wake of the IoT Strategy Committee, under the Information and Communications Council's Information and Communications Policy Section, issuing a reply on New Approaches to Information and Communications Policy for the IoT/Big Data Era (Ministry of Internal Affairs and Communications 2015) (Inquiry No. 23 dated September 25, 2015).

Just as ICT systems consist of multiple layers, the IoT also has a layered architecture. For this reason, the IoT Comprehensive Strategy specifies, in as much detail as possible, targets for measures to promote the IoT, the implementing entity of measures, schedules, and other matters for each of the network, platform, service (data distribution), and device layers. The Strategy also describes various steps to be taken toward realizing a data-driven society, as the fourth industrial revolution moves forward.

The IoT Comprehensive Strategy calls for engagement in the following measures, common to all layers that will contribute to the general dissemination of the IoT:

- promotion of the growth of regional IoT;
- promotion of AI networks; and
- advancement of international policy dialog and international standardization.

The Strategy also advocates for the pursuit of the following layer-specific measures.

– Service (data distribution) layer

The following measures are to be tackled because data collected with IoT applications must be put to use to raise the convenience of real-world services and because it is necessary to clarify issues on the rule and system side and actively work to resolve the issues.

- Clarification of the rules needed for the promotion of data use and application
- Arrange rules on data transaction markets
- Arrange conditions for coordination between data sets from different fields.

– Platform layer

The following measures are to be tackled because IoT systems will be adopted widely and the platform layer will take on a key role in coordinating data sets and because strength in platforms will be a key policy issue connecting directly with international competitiveness.

- Construction of certification and coordination platforms
- Application of personal data and the assurance of information controllability by individuals (privacy by design)
- Addressing systemic risks (security by design).

– Network layer

The following measures are to be tackled because networks will be needed that can withstand the exponential increases in data traffic caused by IoT growth and because flexible resource allocation, including edge computing, will be needed as data processing by cloud services becomes the general rule.

- Practical implementations of SDN (software-defined networking) and NFV (network function virtualization)
- Implementation of 5G
- Training of ICT personnel.

– Device layer

The following measures are to be tackled because different functions from those in the past will be required of the device layer with the widespread adoption of IoT systems. These functions will need to be promoted, such as devices that are smaller and last longer, addition of functions through software updates, and AI control of devices.

- Safe and secure autonomous mobility systems
- Efficient control and operation of a wide variety of IoT devices
- Promotion of R&D into next-generation AI technology and efforts toward the social implementation of next-generation AI technology.

2.8 TECH Strategy to Grab the Future

The TECH Strategy to Grab the Future (Fifth Interim Report dated August 23, 2018) (Ministry of Internal Affairs and Communications, Information and Communications Council 2018) was compiled in response to New Approaches to Information and Communications Policy for the IoT/Big Data Era (Ministry of Internal Affairs and Communications 2015) (Inquiry No. 23 dated September 25, 2015), put out by the Study Group on Future Creation for the New IoT Age, under the Information and Communications Council's Information and Communications Policy Section. The TECH Strategy to Grab the Future presents a view of Japan's future society in around 2030–2040. It explores information and communications policy that the country should take toward, first, the social implementation of innovation in IoT, AI, robotics, and other technologies, and, second, the realization of a society in which everyone can benefit from abundant lives and fully manifest their capabilities beyond their age and degree of physical ability.

Among its recommendations, the TECH Strategy to Grab the Future presents a three-part vision of the future shape of society to be realized in the 2030s as follows:

- an inclusive society, in which everyone benefits from abundant lives while leading diverse lifestyles and holding diverse values;
- a connected society, in which new bonds are created and tight communities are maintained even as the population declines; and
- a transformative society, which adapts to technological innovation and market transformations and grows through flexible and adaptive approaches.

The Strategy then works back from this future shape of society to spell out a concrete policy package.

The concrete policy package states the government should tackle wireless growth strategies, the creation of technological innovations that take on social change, and cross-cutting infrastructure projects, centered on the IoT Security Comprehensive Measures, which will sustain trust in the IoT. The concrete policy package also states the government should tackle the following projects as IoT-application-focused projects.

– For an inclusive society

The TECH Strategy to Grab the Future spells out two movements for an inclusive society: (1) the realization of a society that no longer requires terms like older people, disabled people, and diversity, and (2) the creation of new regional communities in which everyone supports each other and everyone can really sense the world's

highest level of abundance. It then recommends the government tackle the following projects for the creation of new bonds across generations without producing digital divides while cultivating personnel who can handle changes in social structures and employment conditions.

- The Regional ICT Club Projects, where people across generations learn programming and other ICT skills together
- The Creation Project for Energetic People with Challenges, which allows older people and people with disabilities to lead abundant lives.

– For a connected society

The TECH Strategy to Grab the Future describes three movements for a connected society: (1) the realization of the world's most advanced digital government where paper forms are no longer needed; (2) the formation of internationally competitive smart cities in each prefecture; and (3) take the global lead in remotely accessible and automated public services. It recommends the government tackle the following projects in order to actively promote the formation of next-generation smart cities and the remote access and automation of services while accelerating the revision of systems and practices no longer suitable for the times.

- The Network and Smart City Project for the design of compact, data application models of networks and smart cities
- The Remote Access and Automation Project for the reliable assurance of services directly connected to daily life.

– For a transformative society

The TECH Strategy to Grab the Future defines three movements for a transformative society: (1) achieve a more than 1.5-times increase in current levels of labor productivity per hour; (2) achieve the implementation of AI, robotics, and other cutting-edge technology in all industries; and (3) achieve the world's most advanced digital network environment. It recommends the government tackle the following projects to facilitate international contributions as a progressive issue-solver nation while aggressively introducing ICT (this is proposed as the x TECH concept) as a general action principle.

- The × TECH Project, which will introduce state-of-the-art technology to all industries
- The Cutting-Edge Solution Export Project, which will offer new regionally created technologies to all seven billion people on the planet.

3 Arrangements of Related Laws

Data is the fundamental core of any big data, IoT, or AI application. On occasion, there are issues with the handling and treatment of data. Although data is a source of competitiveness for companies, the privacy and other concerns of users must be

accounted for. There are also disputes over who owns data. Japan has arranged its related laws to lower the legal risks related to data and its handling and to provide greater predictability for business. These are important to pave the way to greater use of big data, the IoT, and AI.

3.1 The Personal Information Protection Act

ICT advances have made it possible to collect and analyze enormous amounts of data. It is now possible to make use of personal data in ways that were not envisioned when the Personal Information Protection Act was drawn up. This has led to three issues:

- the emergence and expansion of gray zones, where it is difficult to determine whether a given piece of information is personal information;
- the necessity of arranging conditions for the legitimate use and application of big data that contains personal data; and
- the globalization of business activities that has resulted in larger flows of data across borders.

To address these issues, the Personal Information Protection Act was amended in 2015 and the amendments came into force in 2017. The key amendments were:

- clarification of the definition of personal information;
- introduction of a system for anonymized information;
- obligation to verify and keep records when providing personal information to a third party;
- inauguration of the Personal Information Protection Commission; and
- establishment of regulations on the provision of personal data to third parties outside of Japan.

Of interest here is the new definition of anonymized information—that is, personal information that has been processed in such a way that it is not possible to identify a specific individual. As this definition makes the legitimate distribution of big data that contains personal data possible, it has provided a substantial boost to big data applications.

3.2 The Basic Act on the Advancement of Public and Private Sector Data Utilization

The Basic Act on the Advancement of Public and Private Sector Data Utilization was established in 2016. The government recognized the importance of further establishing conditions that help the country solve pressing issues, such as addressing the rapidly progressing low birthrate and aging population, by making use of the extensive and diverse information flowing over the Internet and other advanced information and communication networks. Therefore, the Act was established for the

purpose of contributing to the realization of more comfortable living environments and a society in which citizens could live with greater safety and security. This is to be accomplished by advancing comprehensive and effective measures pertaining to the advancement of legitimate and effective use of public and private sector data.

The Act sets out basic principles on the advancement of the use of public and private sector data. In Article 11 of the Act, it requires further opening up of public and private sector data for use with the following stipulation: "The State and local public entities are to implement necessary measures in relation to the public and private sector data held by themselves, to enable citizens to easily use such data via the Internet or any other advanced information and telecommunications network while ensuring that the rights and interests of individuals and corporations, national security, etc. are not damaged."

3.3 The Copyright Act

The previous Copyright Act allowed considerable freedom in implementing machine learning with AI, as it contained provisions for the reproduction of copyrighted works for the purpose of information analysis by computers. The FY 2018 Copyright Act amendment further extended this leeway when it comes to handling data for machine learning. The amendment permits the duplication of copyrighted works for information analysis by third parties as well as the assignment of copyrighted works to third parties and the public transmission of copyrighted works, in order to permit information analysis by multiple entities.

4 R&D Efforts by the MIC

The MIC promotes the following R&D measures, within the context, described above, surrounding big data, the IoT, and AI. The MIC's aim with these R&D projects is to push ahead with reaping the fruits of these technologies and passing the benefits on to society.

4.1 R&D and Social Implementation of Multilingual Speech Translation Technology

Japan has been working toward developing speech translation technology for over 30 years. The original aim was to realize telephone-call interpretation. These R&D initiatives have flexibly migrated through different translation modalities over this time, from rule-based translation to statistical translation, and more recently, to deep learning translation.

The MIC announced in April 2014 the Global Communication Plan (Ministry of Internal Affairs and Communications 2014a), which was designed to eliminate language barriers and unleash unfettered global communications. The Plan's targets are to increase the number of languages multilingual speech translation technology can handle and improve translation accuracy to a workable level. The Plan set 2020, the year of the Tokyo Olympic and Paralympic Games, as a milepost. Other aims include public pilot projects in actual fields, such as hospitals, where the technology is anticipated to be commercialized, and the creation of cloud-based translation service platforms.

Translation accuracy has improved dramatically with the introduction since June 2017 of technology for deep learning translation. The technology now looks feasible for applications in many fields, situations, and settings beyond basic travel conversation. Consequently, the MIC is promoting technology transfers to private companies, which is beginning to lead to the development of products and services.

Use of translation technology is spreading in the form of translation apps and translation functions for mobile phones. In the future, the MIC expects the technology to expand to products and services capable of more advanced translation, such as embedding translation functions into information provision services and into existing devices like cash registers.

4.2 R&D and Pilot Projects of Advanced Conversational Agents

The MIC promotes R&D and pilot projects of advanced conversational agents. Such agents will be capable of empathic conversations, reflecting the Japanese view of personal relations, typified by Japan's world-renowned omotenashi hospitality. In tandem with R&D and pilot projects, the MIC is leading the formation of development communities and the social implementation of natural language processing technology.

AI speakers and other conversational systems have appeared on the market. But they are limited currently to basic dialogs, and they do not necessarily act the way the user wishes. The aim, therefore, is to develop conversational agents that behave like an attentive concierge. This will require the development of core technologies that will make interpretation of intentions and emotions through natural language processing commonly available.

4.3 R&D into Next-Generation AI Technology

The MIC is seeing the gradual expansion of deep-learning-based AI applications running on neural networks that mathematically model the activity of neurons in human

brains. Deep learning, however, requires massive calculations, and the calculations need vast computing resources, time, and electric power. This presents a significant hurdle for the widespread adoption of such AI applications.

The human brain, however, operates with very little energy. The R&D that the MIC is promoting aims to create next-generation AI technology that emulates the brain's operating mechanisms. In doing so, the technology will be able to extract, classify, and learn features and meanings, while selecting from much smaller data sets or random data sets in real time.

The ultimate aim is to harness next-generation AI technology to push AI applications in fields where it is relatively difficult to prepare large amounts of training data for deep learning and to drive the implementation of AI in small devices and ICT devices.

4.4 R&D and Social Implementation of New Neural Information and Communications Technology

Japan has world-leading capabilities in the basic research field for neural information and communications technology. But there are few support structures, such as budgetary assistance, and the social implementation of neural information and communications technology by private companies is not being promoted at present. Accordingly, the MIC has made R&D in the neural information and communications field a new priority.

By doing so, the MIC is looking to stimulate industry-university cooperation on the social implementation of neural information and communications technology and to greatly expand the footprint of the neural information and communications field. This, in turn, will contribute to higher productivity in Japan, through the creation and activation of a neural information and communications market, and help resolve social problems for older people and the disabled, who will be able to take advantage of neural information and communications technology.

4.5 Projects for the Advancement of the Social Implementation of an IoT, Big Data, and AI Information and Communications Platform

Natural language processing technology is a base technology requiring large-scale computing resources and research investment as well as many years of accumulated research into corpora and dictionaries. By turning this technology into a platform, rapid roll-out of core, cutting-edge AI technology to industrial fields will be possible, as well as value creation through data collection and AI analytics.

For this reason, the MIC is promoting the construction and social implementation of an IoT, big data, and AI information and communications platform. The platform will become the foundation for new value creation and will drive the development of state-of-the-art application models and international standardization through industry-university-government open innovation.

4.6 R&D into Base Technology for Innovative AI Network Integration

The rapid growth of 5G and IoT devices in the coming years is expected to generate new services in many fields, such as transport, medicine and nursing, and agriculture. It is also expected to rapidly diversify service requirements (such as ultra-low latency and multiple simultaneous connections) and make networks much more complex. Another serious issue will be the shortfalls in personnel to operate these complex networks, caused by the shrinking working-age population. Efforts, therefore, are urgently needed to automate network operations using AI. This is why the MIC is promoting R&D into technology that will enable the automation of network operations using AI.

4.7 R&D into Innovative Optical Network Technology that Will Underpin New Public Infrastructure

From 2020 on, forecasts call for an explosion in communication traffic caused by widespread online distribution of 8 K content and the use of remote medicine and other data-intensive applications. Communication congestion problems are predicted for all networks. The problem is compounded by the fact that current technologies to expand network capacity are nearing their limits. Therefore, to sustain the many online services that act as public infrastructure, development is urgently needed of innovative optical communication technologies that will expand the capacity and raise the efficiency of all networks, from backbone networks to access lines.

The MIC recognizes the need to sustain online services in the face of skyrocketing communication traffic and power consumption by communication equipment. Therefore, it is undertaking R&D into innovative optical network technologies that will expand the capacity and raise the efficiency of all networks, from backbone networks to access lines.

4.8 R&D into Quantum Cryptography for Satellite Communications

Industrial use of satellites is on the rise globally, and significant demand growth for satellite applications is expected in the coming years. This is causing an urgent need to construct secure satellite communication networks, given the growing threats of cyberattacks against satellite communications, such as theft or tampering of communications by third parties or hijacking of satellite communications. The MIC is promoting R&D into technology that will contribute to highly secret satellite communications and engaging in international standardization, in order to protect against cyberattacks and enable the construction of secure satellite communication networks.

4.9 Strategic Information and Communications R&D Promotion Program (SCOPE)

SCOPE is a competitive funding scheme that solicits a wide range of proposals for novel R&D projects in the ICT field from universities, national R&D agencies, companies, and research arms of local governments. Outside experts screen and rate the proposals that are accepted for funding. SCOPE is a means for the MIC to create new value for our future society, nurture young ICT researchers, and stimulate local regions through ICT use and application. SCOPE is currently running the following types of projects for FY 2018.

- R&D projects in priority areas

To create new value for our future society, SCOPE has selected priority areas from the fundamental and base R&D fields the country should be pursuing in the ICT field and promotes R&D projects that are integrated with proof-of-concept testing.

- R&D projects for ICT researcher development

SCOPE promotes R&D projects proposed by young researchers and researchers from SMEs, to both develop young personnel who will lead the next generation of researchers in the ICT field and discover novel technologies at SMEs.

- R&D projects promoting effective radio spectrum usage

SCOPE promotes cutting edge, creative R&D projects that will contribute to effective radio spectrum use. The goal is to develop wireless technologies in a timely manner that will address new radio spectrum needs, due to the necessity of even greater effective radio spectrum usage.

- R&D projects aiming for international standardization

SCOPE strategically promotes R&D through cooperation with other governments. This is done to accelerate international standardization and commercialization of R&D outcomes in the ICT field and to help generate innovation and boost international competitiveness.

- (inno)vation, a special category for creative people

SCOPE supports people taking on fantastic and ambitious technological challenges with incredible potential. The ultimate aim is to generate disruptive value creation on a global scale in the ICT field.

5 Conclusion

Technological progress has been stunning in the fields of big data, the IoT, AI, and smart cities. In particular, AI based on deep learning technology is being applied in more and more fields, demand for big data is rising in tandem with this, and wireless environments needed for IoT applications, along with their cost aspects, are being put into place. Because of these developments, policies are needed that are focused on the explosive growth and adoption that the synergies among these technologies will bring. Policy expansion is also needed that looks ahead to situations where smart cities will be a given.

The government pays most attention to base research that leads to the development of seed technologies. At the same time, government policy is also based on pushing the creation of new products and services by the private sector, achieved through the development of bridge technologies and public pilot projects that advance the implementation of base research outcomes in society. Also important is anticipating and carrying out the necessary legal system arrangements and ICT infrastructure establishment.

AI is currently in its third wave, as mentioned previously. We have no way of knowing at present whether this wave will wither at some point and enter another "ice age" or whether AI development and application will continue at a "Goldilocks," with its social implementation going ahead in a considerable range of fields. Some voices expect deep learning technology to hit a wall because, for instance, it is nearly impossible to validate after the fact why AI had made such-and-such a decision. Other voices claim there are vast applications for deep learning technology. Furthermore, it is important to remember what things are impossible for humans to do. For example, fully autonomous vehicles move in concert with other vehicles while communicating at high speeds with each other, and cameras, lasers, and other sensors can continually monitor all around the vehicle and operate without stopping for long periods.

Ultimately, the most important thing about technology is to successfully master it. Irrespective of whether deep learning is all powerful or not, what's desired is a clear awareness that humans and AI each have their strengths and that we broaden AI applications in a way that humans and AI complement each other. We must

remember, of course, that in fields like autonomous vehicles, where we hand over the keys, so to speak, to AI, brings enormous value to users. Efforts aiming in this direction are important too. But there are numerous fields where value can be created by having AI assist humans. We should deploy AI in these areas first and, in parallel, steadily expand the use of big data and the IoT.

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Net Neutrality

Toshiya Jitsuzumi

1 Introduction

As broadband is widely believed to be a precondition for economic prosperity and social progress, many governments have been working hard to realize the broadband society at an early stage. However, this creates a new competitive problem in the broadband ecosystem. Since the latter half of the 2000s, as the speed of broadband penetration and increase in the use of bandwidth-rich content/application have been much faster than capacity building by network operators, network congestion is now an everyday problem for consumers and corporate users in the broadband society. This constraint, when accompanied by cost sub-additivity in their business operations and/or with a scarcity of spectrum resources, allows dominant network operator room to behave in an anti-competitive manner. Relating to this possibility, one of the recently debated topics is "zero-rating," which allows subscribers to access certain content or applications without having that traffic count against their data cap. By offering zero-rating, network operators prioritize certain content/applications over others. Thus, when used in an anti-competitive way by dominant network operators,

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zero-rating is a powerful tool for controlling neighboring markets and may cause a significant loss of efficiency in the broadband ecosystem as a whole.[1]

In order to achieve a broadband society within a competitive framework, policymakers have to take into account the potential impact of significant market powers (SMPs) in the market. Until very recently, network operators represented SMPs and attracted a great deal of policy attention, resulting in a traditional set of policies that combined price regulation and entry/exit controls. However, recently, giant online platforms have started representing SMPs in the broadband ecosystem. Online platforms are now supporting significant part of our lives and making us more and more dependent on their services when purchasing goods and services, finding information/entertainment online, keeping in touch with each other, and in many other ways. Since online platforms can control or adjust what we can watch/enjoy on the Internet and determine which content/application providers can get our attention, they have the power to significantly harm competition in the broadband ecosystem if they behave inappropriately. The potential threat from these online platforms has become so important that it is a frequent topic of discussion across many policy areas. As most powerful platforms cover multi-national markets, such policy discussion calls for close cooperation in international forums, such as the OECD.

Since it cannot always be assumed that the market dynamism can come up with an efficient and fair resource allocation, for nearly a decade, the above possibility has been widely discussed by telecom regulators under the name of "net neutrality," which (in its most basic form) requires "equal" treatment for all Internet traffic. Due to the differences in the broadband ecosystem and existing regulatory frameworks, there is no one-size-fits-all solution for every country. Indeed, policy packages that are actually adopted for dealing with net neutrality "problems" vary significantly among nations. For example, in the USA, the Federal Communications Commission (FCC) had to micromanage the behavior of network operators due to a lack of competitiveness in the broadband market. On the other hand, the Japanese telecom regulator, the Ministry of Internal Affairs and Communications (MIC), employed a market-based "light-touch" approach in order to deal with the problem in the fixed broadband market, relying on an authority that was bestowed originally for controlling natural monopoly of plain old telephone service operators. Treatment of zero-rating is not the same either: Some governments allow it, while others do not.

The remainder of this chapter describes the net neutrality "problems" that policymakers have to deal with (Sect. 2), how Japanese telecom regulation has been

[1]Zero-rating is also a big issue in developing nations where broadband is far from ubiquitous. As broadband Internet is now a key building block of our socioeconomic activities, closing a domestic, as well as an international, digital gap and guaranteeing fair and "neutral" cyber space for citizens have come to be one of the top policy issues for policymakers in many countries from the viewpoint of fostering democracy and freedom of speech. Since the low income is one of main reasons for not using broadband, many governments, especially in developing countries, faced a serious trade-off between (a) free but limited Internet experience of zero-rating, allowing potential harms of gatekeeping platforms, and (b) no Internet at all for poor people, allowing the persistent digital divide.

dealing with these issues (Sect. 3), and what challenges they are facing right now (Sects. 4–6). Section 7 concludes.

2 Net Neutrality "Problems"

"Network neutrality," or "net neutrality" in its short form, is a term coined by Wu (2003) to connote the equal and fair treatment of Internet packets by network operators, but this concept was not completely created from scratch. In fact, a similar concept stretches back to Article 3 of the Pacific Telegraph Act of 1860, or the Act to Facilitate Communication between the Atlantic and Pacific States, which states that "… messages received from any individual, company, or corporation, or from any telegraph lines connecting with this line at either of its termini, shall be impartially transmitted in the order of their reception, excepting that the dispatches of the government shall have priority …." This rule was then inherited by Article 201 (b) and 202 (a) of the Communications Act of 1934. It can be said that net neutrality has long been respected under a different name long before we started using the Internet. Thus, Wu's argument should better be translated as a declaration that a traditional concept for telegraph and telephone should still be applied to Internet services.

The reason why Wu's article attracted such huge attention can be attributed to the market conditions at that time. In the USA, the discussion of net neutrality started when the regional broadband access market came to be virtually duopolized by a telecommunication company (telco) and a cable company (cableco). This situation is due to a series of deregulation by the federal government and aggressive mergers and acquisitions in the network markets. Facing this market, net neutrality proponents argued that the anti-competitive behavior of dominant telcos or cablecos is distorting the resource allocation of the broadband ecosystem and harming consumer welfare. Then, they insisted that the behavior of telcos and cablecos had to be strongly regulated by the government.

From an economic viewpoint, as discussed in Jitsuzumi (2010), there are two aspects to this net neutrality "problem" in the simplest setting (Fig. 1). One is how to efficiently allocate scarce network resources to individual applications, and the other is how to discipline the market power of dominant network operators that control the network bottleneck.

The former aspect becomes important as the broadband Internet becomes popular in the market and stakeholders come to realize that network capacity, especially that of last mile network operators, is a scarce economic resource. Theoretically speaking, this issue has many things in common with road congestion problem, which transportation economists and related policymakers have long been dealing with. Therefore, the former problem is not too difficult to solve, if it stands alone. One of the most popular approaches is the introduction of congestion pricing, which effectively internalizes negative externalities in players' decision making. If network operators charge sufficiently higher fees during peak hours, demand will shift to non-peak times and attain optimal allocation of existing network resources among

competing usages in the short run. Furthermore, in the long run, incentive of profit maximization induces operators to increase network investment and creates more capacity.

However, owing to the SMP of giant network operators that enjoy network effects, economies of scale and scope, and ownership of indispensable resources (e.g., spectrum licenses), an application of such a simple solution results in a complicated issue that policymakers need to address further. As Farrell and Weiser (2003) and van Schewick (2007) show, when certain conditions are met, in order to maximize profit, dominant network operators will leverage their market power to control neighboring markets. They may distort competition in the content and application (CAP) market by prioritizing their own CAP subsidiaries and thus do not incorporate fair or "neutral" allocation of network resources. This can be the situation that was in the eye of US telecom regulators and thus rationalized their heavy-handed approach in 2015, where regulators try to closely manage the traffic control management of operators. Under different conditions that satisfy "Internalizing Complementary Efficiencies" (Farrell and Weiser 2003), network operators have reason to guarantee sufficient competition in the CAP market and thus do not inhibit proper introduction of congestion control measures. Alternatively, if there exists competition among network operators, we have no reason to be concerned about their inefficient leveraging at all. If this is the case, policymakers can deal with congestion management of network providers with much less interventions. The only thing policymakers have to do is to monitor the market and intervene only if there is a serious competitive problem. This is the situation that Japanese government faced in 2007 and justified their "light-touch approach" (see the following section). A similar argument can be found in Lüth (2015) that says "Fostering competition in the access market might therefore be sufficient to prevent exclusionary practices" (p. 322).

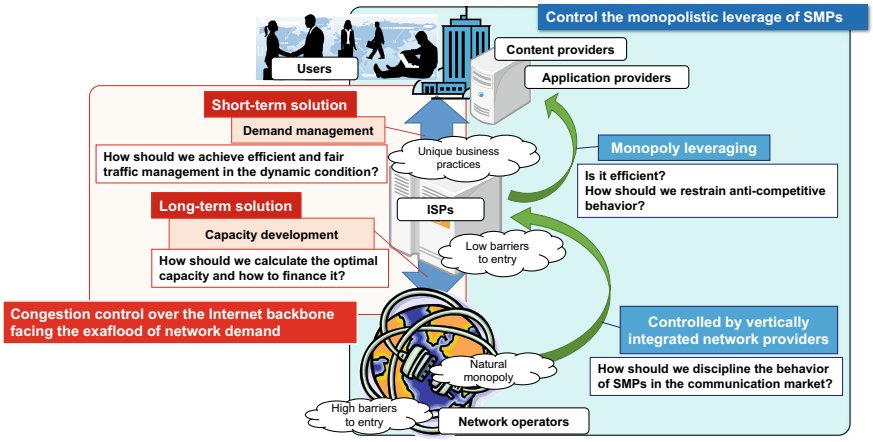


Fig. 1 Core of net neutrality "problems". *Source* Adapted from Fig. 1 in Jitsuzumi (2015a)

Moreover, recently, policymakers in more and more countries face a more complex situation where not only network operators but also online platforms control the broadband market. They have to design a policy package that disciplines two layers of SMPs altogether, each of which has a strong motivation to control the entire value chain. Increasing reliance on a two-sided market concept of broadband players also made the problem even more difficult, because measuring the market power of those players has to take the situation of both markets into consideration simultaneously.

Since there is no universally applicable solution (at least we have not found one yet), in order to produce an efficient solution for the net neutrality "problems," we have first to observe competitive situations of individual markets in the overall broadband ecosystem and calibrate related policies. According to the economic model analysis, whether government intervention for net neutrality can be welfare enhancing depends on the model parameters employed (Easley et al. 2018). For example, Bourreau et al. (2015) proved that assuming a two-sided market with two network operators and many CAPs, paid prioritization, in which network operators charge content providers for smooth delivery even in congestion, which is what net neutrality proponents strongly opposes, is welfare enhancing. Therefore, before designing a policy package, policymakers have to empirically recognize what the "problem" is and understand how far the existing market structure can solve the "problem."

Finally, in the real world, policymakers have to deal with a more complex model where the efficient allocation of network capacity is not the only concern in net neutrality discussions. Concerns for fostering democracy and for securing freedom of speech make the solving of issues via market competition very complicated.

3 Japan's Approach Thus Far[2]

In Japan, policymakers' discussion on net neutrality can be dated back to November 15, 2006, when the MIC convened a "Working Group on Network Neutrality" (WGNN). According to its report (MIC 2007), WGNN's objective was to design competition rules that can respond flexibly to developments in the broadband market. Eventually, after a 10-month-long discussion, on September 19, 2007, WGNN issued a final report (MIC 2007).

In the WGNN report, network neutrality was defined as a situation in which the following three principles are met (p. 7):

Principle 1	Consumers are entitled to use IP-based networks flexibly and access the content/application layer freely.
Principle 2	Consumers are entitled to connect to IP-based networks freely through terminals that comply with technical standards provided by laws and regulations, and these terminals may connect to each other flexibly.
Principle 3	Consumers are entitled to use the communication layer and the platform layer free from discrimination at a reasonable price.

[2]This section relies on Jitsuzumi (2011).

Then, considering not only horizontal relationships among network operators but also vertical relationships with adjacent players such as CAPs, this report proposed "fairness in network cost sharing" and "fairness in network use" as the two basic principles for addressing the net neutrality issues.

For the first principle (fairness in network cost sharing), the report pointed out that "coping with rapid increases in traffic (network congestion) requires dynamic terminal-network collaboration and the flexibility to absorb fluctuations in traffic" (p. 23). Considering the dramatic increase in Internet traffic, the report evaluated several engineering solutions (including peer to peer, IP multicasting, overlay multicasting, content distribution networks, packet shaping, and capacity expansion) to alleviate traffic congestion. It then analyzed how the cost of such solutions could be allocated to various stakeholders and concluded that the MIC should take a "light-touch approach" and allow the market itself to determine such an arrangement. In addition, based on similar logic, the report stated that placing a surcharge on content providers should not be considered a standard treatment and is better left to voluntary negotiations among stakeholders, instead.

The condition that allowed the MIC to take the light-touch approach was that the wholesale Internet service provider (ISP) market in Japan seemed sufficiently competitive at that time (Fig. 2), which could justify a clear difference in net neutrality approach between Japan and the USA. In clear contrast with the USA where telcos and cablecos could utilize market power in the physical layer to control retail ISP market due to a series of deregulation, in the latter half of the 2000s, the dominant NTT group held only 22–31% of the fixed ISP market and the level of the Herfindahl–Hirschman Index (HHI) remained in the 1500s, which indicated that the market was quite competitive (MIC 2009a). However, it is important to mention that, as Jitsuzumi

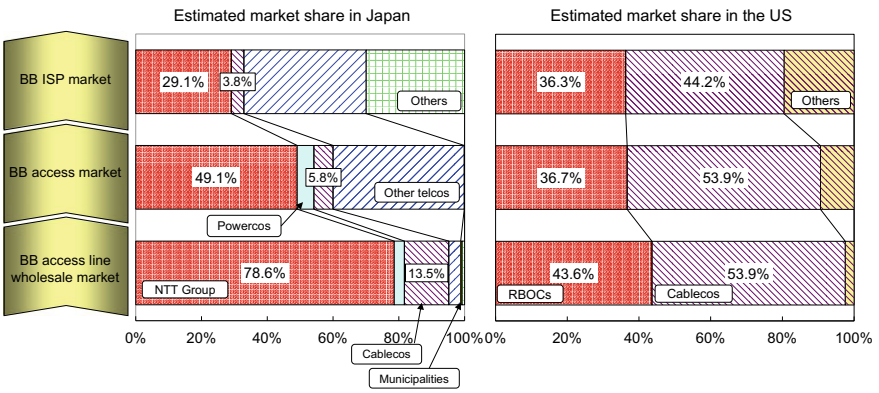


Fig. 2 Competitive situation in Japan and the USA. *Source* Created on the basis of MIC (2008), FCC (2008a, b), and Noam (2009). *Note 1* ISP shares in the US are based on revenues in 2006 (Noam 2009), which include satellite Internet; the shares in other markets are based on the FCC's line count and include fixed lines only. *Note 2* RBOCs stand for Regional Bell Operating Companies, telcos for telecommunications companies, powercos for power companies, and cablecos for cable companies

(2014) empirically pointed out, the actual competition level was much less than HHI indicated.

Long before the introduction of the Internet to the general public, the MIC relied on interconnection requirements and SMP regulations, both of which had been clearly stipulated in the Telecommunications Business Act (TBA), to deal with the possible anti-competitive behavior of incumbent "fixed" network operators. First, every telecom operator in Japan is required to accept a request from other telecom operators to interconnect (Article 32). Furthermore, terms and conditions that are offered by NTT East and NTT West (hereafter, NTTEW) shall obtain authorization from the Minister for Internal Affairs and Communications (Article 33) and NTTEW are not allowed to treat their group ISPs more favorably than others (Articles 30 and 31). In addition, the NTT Law controls one of the most important strategic discretions of NTTEW by listing up the scope of business domain exhaustively in Article 2; thus, NTTEW have still not been allowed to offer ISP services by itself and therefore cannot vertically integrate with ISP functions. As a result, these rules limit the discretion of NTTEW, which in turn helps to maintain competitiveness in the fixed broadband market; these mechanisms were still working when the WGNN report was drafted; and the MIC could count on the competitive dynamism to deal with net neutrality "problems."

One such problem was how to deal with particularly heavy users who consumed a disproportionately large share of network resources. For this problem, the WGNN report recognized the effectiveness of packet shaping, but it also pointed out its anti-competitive potential to stifle competition; therefore, it suggested a two-stage approach:

First stage: Establish minimum rules (packet shaping guidelines) that include operating requirements based on the mutual consent of diverse stakeholders.
Second stage: Allow each ISP to set a specific policy based on the guidelines.

This method reflects a shift toward co-regulation, through which a regulatory body provides legal oversight to the private sector's collaborative efforts. Responding to this call from the MIC, ISPs and network operators organized a committee in September 2007 and presented the "Guideline for Packet Shaping" in May 2008 that set a voluntary baseline regarding the shaping of packets in time of network congestion (Japan Internet Providers Association [JAIPA] et al. 2008). The MIC also let operators revise the Anti-DoS/DDoS Guideline in 2011 (JAIPA et al. 2011), which provides a baseline method for traffic management at the time of a security breach.

The Packet Shaping Guideline declares the following:

1. Increased traffic must be primarily dealt with by network investment or enhancing network capacity; packet shaping must be considered exceptional.
2. Packet shaping should be targeted solely at network congestion, the existence of which must be substantiated by objective data.
3. In order not to jeopardize the secrecy of communication (Article 21 of the Constitution), ISPs must obtain the "clear" and "individual" consent from users.
4. To maintain fairness in use (Article 6 of the TBA), packet shaping must be nondiscriminatory and adequate, unless there are valid reasons.

5. ISPs must disclose their packet shaping information beforehand, as requested by the Guidelines for the TBA Consumer Protection Rules.

In addition, the Guideline states that packet shaping must satisfy the "validity of means" criteria; for example, throttling a certain application that occupies excessive capacity is acceptable, but complete blocking is not. It also stipulates that throttling the traffic of heavy users does not violate the "fairness in use" principle as long as heavy users can experience the same actual speed that average users can.

Concerning the second principle (fairness in network use), the WGNN report is mainly focused on the next-generation network (NGN) provided by NTTEW. An NGN is a carrier-managed network that achieves both the flexibility of an IP-based network and the reliability of a traditional circuit-switching network and can guarantee transmission quality and security; thus, it can be an equal or better substitute for the ordinary Internet. Therefore, if combined with market-dominating power, NGN has the potential to change the industrial organization on which the WGNN report stands. Declaring the need "to maintain an environment in which consumers can freely choose and use networks" (freedom to choose networks) (MIC 2007, p. 8), this report proposed to expand the current asymmetric regulation to cover NTTEW's NGN in order to deal with the possible vertical leveraging of NTTEW.

After concluding WGNN, the MIC convened another meeting, named "Panel on Internet Policy," on February 26, 2008, and reaffirmed the light-touch approach (MIC 2009b). Additionally, in order to guarantee the proper working of market dynamism, the MIC strengthened the transparency requirement of ISPs, by revising the Guidelines for Consumer Protection Rules that mandate ISPs to notify subscribers of the details of their packet shaping practices in order to satisfy the transparency requirement of Article 26 of the TBA (MIC 2009c).

Since then, Japanese telecom regulators have not adopted any special regulations; however, it is not proper to forget that behavioral regulation that was originally designed for plain old telephone service operators provides a robust safeguard for Japanese broadband users. Article 6 of the TBA, which states that "no telecommunications carrier shall engage in unfair and discriminatory treatment with regard to the provision of telecommunications services," has been protecting the equal and fair treatment of communications over the network infrastructure. Because Japanese telecom regulation focuses not on services but on operators, this decades-old safeguard could underpin Japanese net neutrality in the broadband era.

So far, this approach has been working well. Indeed, we have not experienced any major incidents that violate net neutrality principles, in general, at least in the fixed broadband space.

4 Japan's Challenge[3]

Nowadays, the number of people who owns smartphones is larger than the number of people who owns computer, more and more people access the Internet via smartphones than via computers (MIC 2018a) and mobile download traffic is growing much faster than fixed traffic (MIC 2018b), it is widely agreed that ordinary users in Japan have come to value mobile broadband more than fixed broadband.

Compared to its fixed counterpart, the Japanese mobile broadband market is less competitive. Three big mobile network operators (MNOs), NTT Docomo, KDDI, and SoftBank, together control 89.4% of the retail market as of March 2018. HHI of the mobile market is 2,904, which is larger than that of the fixed broadband market (HHI = 2,272) (MIC 2018c). Now, a fourth MNO, Rakuten, is preparing market entry, but considering the strong brand loyalty of Japanese subscribers to incumbent MNOs (e.g., see Jitsuzumi 2015b, 2018) and the underlying network effect, the current oligopolistic situation by three MNOs is expected to stay for the meanwhile. In addition, on May 13, 2014, NTT announced that NTTEW would start wholesaling fiber access services. By utilizing this wholesale framework, mobile operators have gained the ability to provide a one-stop service for a comprehensive broadband experience in the retail market, utilizing their existing market power cultivated on their home ground. For example, since March 1, 2015, NTT Docomo has started providing a fixed fiber access service ("docomo Hikari") combined with bundled discounts to mobile subscribers, which is expected to have a huge impact on the fixed ISP market.

These changes are transforming the core of net neutrality and require the MIC to reconsider the more-than-decade-old "light-touch" approach. In the first place, the industrial structure of mobile broadband in Japan is quite different from that of its fixed counterpart. Mobile broadband access is fully controlled by mobile phone operators, because they are all vertically integrated with ISP functions. In clear contrast to NTTEW, NTT Docomo, one of the major members of the NTT group and 63.31% of its shares are still owned by NTT, is free to expand its business domain and provides Internet access services of its own. Moreover, the TBA's rules on mobile SMPs are less strict than those for fixed ones.

Consequently, the broadband access ecosystem is coming to be, and will possibly be, controlled more and more by vertically integrated mobile operators (Fig. 3), and will possibly require Japanese government to design a new policy package in the end. If the mobile transition continues, the situation in Japan will become similar to the US broadband market, where duopolistic markets forced the FCC to introduce special rules for net neutrality. Once a market loses sufficient competition, Japanese policymakers cannot rely on market dynamism to attain net neutrality, too.

The introduction of zero-rating services has bought an additional challenge to Japanese telecom regulators, because it can have a huge impact on the CAP market. Additionally, it is sometimes stated that deep packet inspection (DPI) is required to

[3]This section relies on Jitsuzumi (2016).

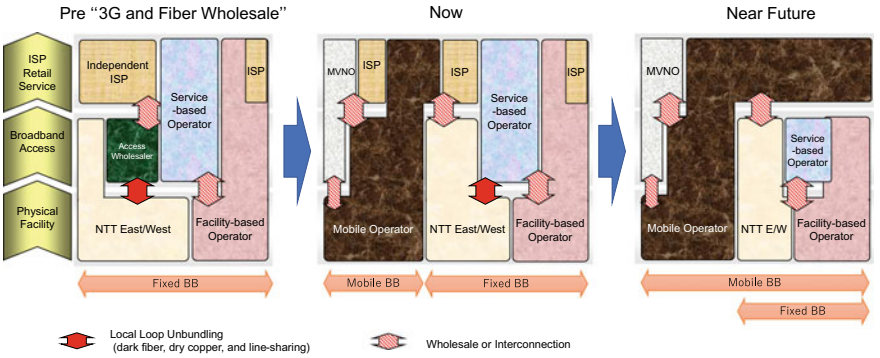
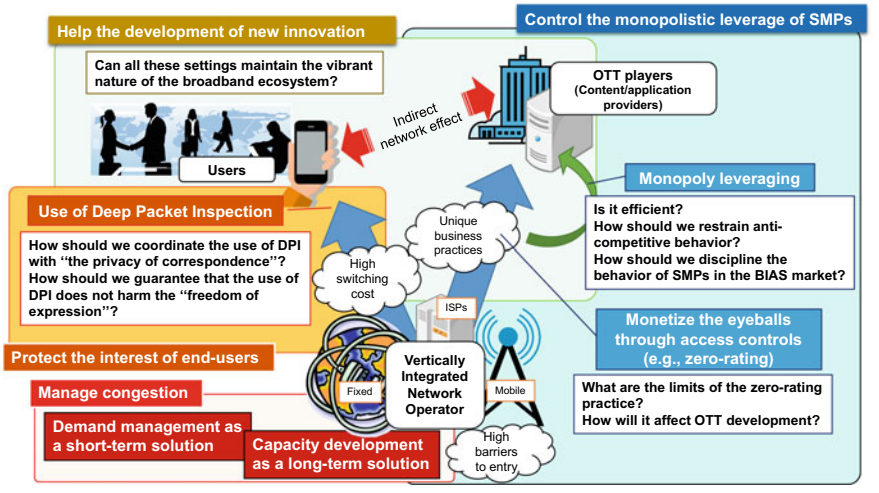


Fig. 3 Changing broadband ecosystem

fine-tune zero-ratings. If this is the case, protecting end users' secrecy of communication and freedom of expression will be among the top issues that policymakers have to deal with.

Consequently, net neutrality, which was nothing but a congestion problem coupled with the anti-competitive issue of network operators (Fig. 1), is evolving to the next level, "net neutrality 2.0" (Fig. 4). This new level reflects the fixed mobile conversion of network services and basically is a combination of previous two issues (congestion management and SMP control, the latter of which slightly changes to include zero-rating) with additional two new issues (the protection of the interests of end users'



Note: OTT stands for over-the-top, and BIAS stands for broadband internet access service.

Fig. 4 Net neutrality 2.0

secrecy of communication and freedom of speech, and the development of optimal innovation policy).

Furthermore, thanks to big data analysis, the development of artificial intelligence (AI), Moore's law, and network effects, a new segment of players that was once considered as broadband users is now becoming key players in the entire ecosystem by providing "online platforms" for neighboring markets. Online platforms can be defined as digital services that facilitate interactions between two or more distinct but interdependent sets of platform subscribers who interact through the service via the Internet. The most famous and the most powerful examples include four US-based firms, Google, Apple, Facebook, and Amazon (GAFA), and three Chinese firms, Baidu, Alibaba, and Tencent (BAT). Netflix and Rakuten are following these top-tier companies. Online platforms support so many of our socioeconomic activities that we have become dependent on them; thus, they have become so important in policy discussion relating to labor and employment, taxation, competition, privacy, and consumer protection. Net neutrality discussion, the ultimate policy goal of which is to attain "neutral" networks, cannot be an exception to this. In order to guarantee "neutral" services to end users, we need cooperation from every layer of the broadband ecosystem, such as devices, networks, platforms, and content. Policymakers have to take the competitive impact of online platforms into consideration in dealing with net neutrality in the future (net neutrality 3.0) (Fig. 5).

Faced by this decreasing level of competition in the mobile broadband market and the continuing transformation of the net neutrality landscape, the MIC has to accept the loss of the fundamental conditions that justify the previous "light-touch approach" and had better start designing an alternative policy package. Currently, as at the point of writing this (December 2018), the MIC is having a study group for net neutrality that ultimately aims to design a competition rule that enables the broadband ecosystem to realize "neutral" networks.

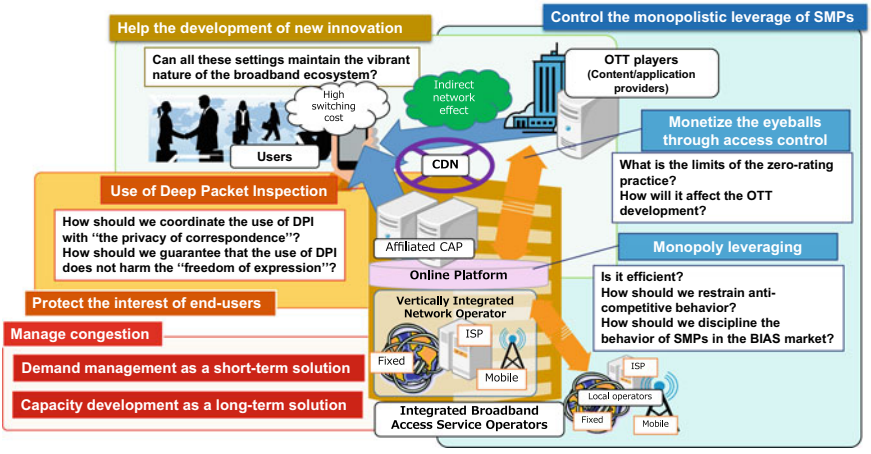


Fig. 5 Net neutrality 3.0

5 Zero-Ratings

One[4] of the recently debated topics on net neutrality is "zero-rating," which has been attracting attention from academia, industry groups, and policymakers. Annex A of DotEcon et al. (2017) provides a good summary of previous articles on zero-rating. In those discussions, zero-rating is widely understood as "a tariff (or tariff option) that allows end-users to access certain content without being charged for the corresponding data consumption" (Krämer and Peitz 2018, p. 5). Since this can result in a competitive edge only when there is usage-based pricing or data caps, it is mainly adopted by mobile broadband operators. From the viewpoint of users, this zero-rating offers a significant discount on the cost of accessing particular content; thus, it is "expected to affect: the decision whether or not to obtain access; the choice of access provider; and the choice of content and the amount of data consumption overall" (DotEcon et al. 2017, p. 2).

According to OECD (2015), there exist three types of zero-rating: One is applied by ISPs to their own content or that of pre-selected partners; the second type is introduced when there is a large difference in cost between on-net and off-net traffic; and the final one is found in developing countries and provides access only to a limited number of websites. The first one primarily aims to increase non-price attractiveness to end users, the second one is for cost minimization, and the last one is to motivate consumers to subscribe to broadband by allowing them to experience the value of the Internet. What we observed in Japan belongs to the first type, and all but one is offered by mobile virtual network operators (MVNOs). The only exception is provided by SoftBank. On August 29, 2018, SoftBank announced that it would start providing zero-rating services for major Internet video services and SNSs starting on September 7, 2018.

The competitive impact of zero-rating cannot easily be determined. In a certain setting, giving preferential treatment to some content is considered as "anti-net-neutral." By offering zero-rating, network operators prioritize certain content/applications over others and can distort the competition in the CAP market, hurting the business prospects of nonzero-rated content owners. When the selection of content is fee based (e.g., "Sponsored Data" by AT&T), players with sufficient financial strength can prosper. Thus, when employed by dominant network operators, zero-rating is a powerful tool for controlling neighboring markets and may cause a significant loss of efficiency in the ecosystem. However, some academic research points out other possibilities: Tripuraneni (2016) briefly analyzes the impact of Free Basics on start-up offerings and finds that it does not deter net neutrality, nor is it discriminatory; Dewenter and Rösch (2016), using a rather simple model, insist that, as long as the market power of the ISP is disciplined, there is no need to regulate net neutrality; also using a model-based approach, Somogyi (2016) shows that zero-rating can be either welfare-enhancing or welfare-decreasing, depending on the attractiveness of the content; and Yoo (2017) sees the zero-rating favorably as an enabler of service differentiation and points out its merits on the demand and supply sides. On the other

[4]This section relies on Jitsuzumi (2016, 2018).

hand, Marsden (2016) questions the appropriateness of zero-rating and insists that it is acceptable only in the short term and as long as it is not exclusive and is "Fair Reasonable and Non-Discriminatory" (p. 254). On the other hand, zero-rating can change the competitive framework in the network market by widening the dimensions along which firms can compete and help small players take over a part of the incumbents' market. This is particularly important when incumbent players have benefited from high entry barriers generated by the network effect. If used mainly by non-dominant players, zero-rating can work as a pro-competition measure, especially in the long run, and increase the efficiency of the broadband ecosystem. The former case provides a reason for stricter governmental intervention, and the latter calls for the adoption of a market-based, or light-touch approach, with strict safeguards against SMP.

Thus, faced by a decreasing level of competition in the mobile broadband market, zero-rating may demand Japanese regulators to act. In general, when there is not sufficient competition, offering zero-rating per se becomes a policy concern. In fact, OECD (2015) states as follows:

> Previous experience in OECD countries has shown that zero-rating becomes less of an issue with increased competition and higher or unlimited data allowances. Indeed, it can be a tool to increase competition. …Nevertheless, in any market with limited competition for access, zero-rating could be an issue of concern (p. 192).

6 Demand for Zero-Rating in Japan[5]

In Japan's case, no zero-rating survey has been conducted that is comparable to the one above. Since the net neutrality debate has been a central issue mainly in the EU and the USA, empirical attention on zero-rating mostly covers cases in those two areas, such as DotEcon et al. (2017); and observations in other areas are very scarce. The exceptions found by the author are Chen et al. (2017), who conducted an in-depth survey of zero-rating in South Africa; and Drossos (2015), who briefly summarizes the situation in OECD markets, points out that "(i)n competitive markets like Finland, where mobile internet access prices are very affordable and volumes are practically unlimited, zero-rating could do no harm" (p. 4).

To the best of the author's knowledge, the first zero-rating in Japan was a plan that was introduced in June 2015 by an MVNO, a subsidiary of a photograph supply shop, to provide free access to its photograph-printing site. Since then, zero-rating has been primarily introduced by MVNOs, which is consistent with the comments of Layton and Calderwood (2015) and Yoo (2017). They suggest that entrant operators such as MVNOs and resellers, who are less able to differentiate based on network quality and price, have often implemented zero-rating. In addition, Stallman and Adams (2016) state that "(i)n markets where new competitors struggle to establish themselves, zero rating may give consumers more competitive choices among carriers" (p. 21).

[5]This section relies on Jitsuzumi (2018).

As mentioned in the previous section, a possible policy treatment has to be determined on a case-by-case basis, reflecting the situation of the individual market. As a very first step for policy discussion, in order to determine the net neutrality and zero-rating situation in Japan, the author conducted a Web-based questionnaire survey on pre-registered monitors of NTTCom Online Marketing Solutions Corporation in January 2018 (Table 1). It is important to stress that, when this survey was conducted, zero-rating services were provided only by MVNOs.

Although we have to take the higher-than-average IT literacy of the respondents into consideration, it is possible that zero-rating seems significantly attractive in Japan, which is, of course, very good news for zero-rating providers. According to the survey, the penetration of zero-rating among the respondents is 7.1% and an additional 20.9% know about the option but are not using it, meaning one-quarter of the respondents who acknowledge this option actually use it (Fig. 6). This result is not significantly influenced by whether the sample's main handset is MNO or MVNO. This attractiveness of zero-rating may help MVNOs to get market share in Japan where the respondents do not have very positive views of MVNOs. Forty-two percent of the respondents see MVNOs as an inexpensive substitute for MNOs, and 16% value MVNOs as innovative service providers, while the remaining 43% see them as inferior operators.

It is also possible that at least around 10% value zero-rating is a favorable tool to escape the data cap. Eighty percent have never exceeded their mobile monthly data cap[6] (Fig. 7), and responses when the data cap is exceeded are different between those who have experienced data overage and those who have not (Fig. 8). For those with overage experience, the most popular immediate response was to "use home Wi-Fi," followed by "do nothing," and about half of them indicated they would not change their usage pattern in the following months. Those with overage experience

Table 1 Survey descriptive statistics

2018 Survey	
Survey period	January 25, 2018–January 30, 2018; February 9, 2018–February 28, 2018
Number of responses	1,504
Demographics	
Gender	Male: 787 (52.3%) Female: 717 (47.7%)
Average age	45.8 years old 15–29: 282 (18.8%), 30s: 288 (19.1%), 40s: (20.5%), 50s: 313 (20.8%), Over 60: 312 (20.7%)
Average household income	6.3 million yen per annum
Average Internet experience	9.5 years
Average mobile Internet experience	7.5 years

[6]This implies the monthly cap level may be above the optimal level, which might be due to information asymmetry, excessive risk aversion, or the result of prospect theory (Kahneman and Tversky 1979).

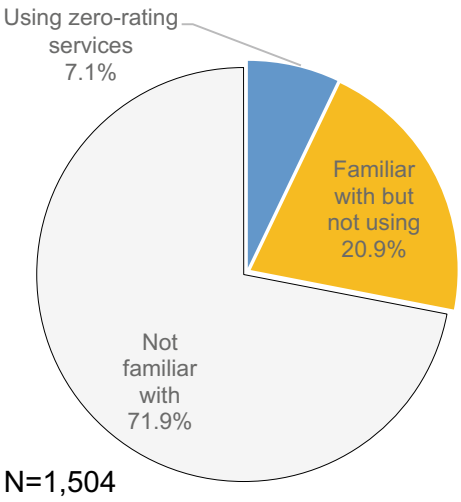


Fig. 6 Penetration of zero-rating in Japan

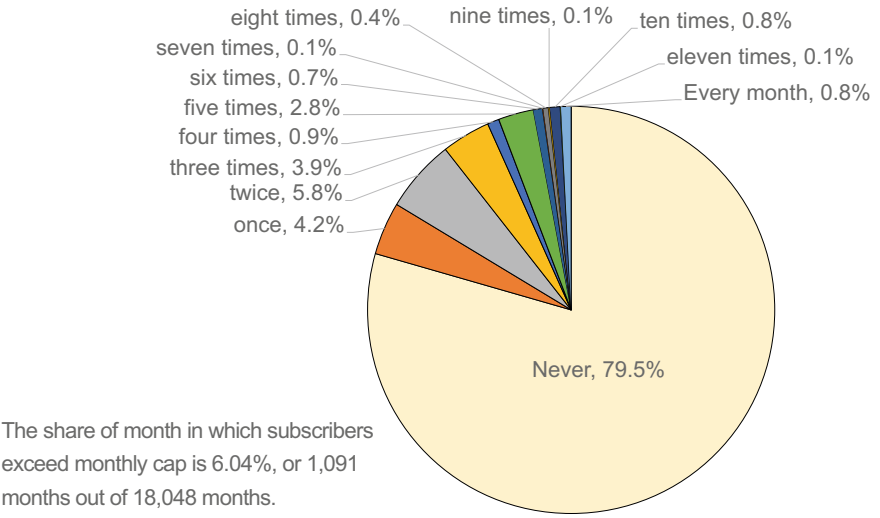


Fig. 7 Number of data overage in 2017

purchase additional data immediately at the point of overage and tend to change their usage pattern by reducing streaming and carrier network usage in the following billing period. Twelve percent of those with overage experience and 5% of those without overage experience would increase their contracted monthly cap, and thus, they are the most probable beneficiary of zero-rating as long as an additional payment required to enjoy zero-rating is less than that to subscribe to a larger cap.

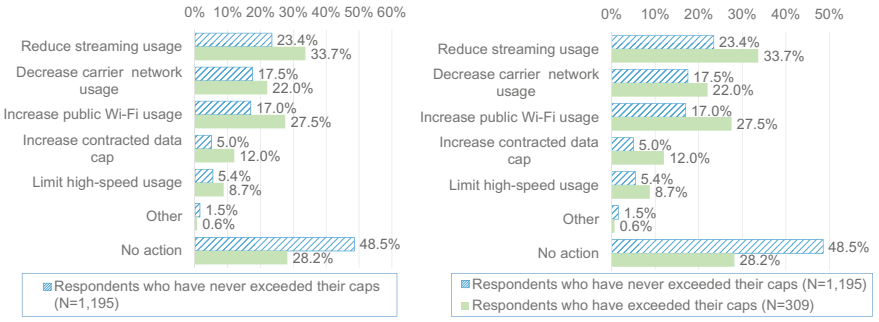


Fig. 8 Responses to data overage

7 Conclusion

The reason why "net neutrality" is so important is that it is an indispensable building block for guaranteeing an efficient use of broadband and maximizing social welfare in the coming information society. However, due to differences in the industrial structure and regulatory framework of each country, there is no one-size-fits-all solution and actual policy treatments adopted vary among nations. This chapter explains why the Japanese government adopted a light-touch approach in the fixed broadband age and why they have to change their approach in the mobile broadband age.

In concluding this chapter, it is important to stress that guaranteeing net neutrality is a necessary but not sufficient condition for welfare maximization, which is the ultimate aim of broadband policy. Since the broadband ecosystem consists of a couple of layers (Fig. 9), in order to achieve the policy objective via a market-based approach, it is important either to maintain competitiveness in each layer or to guarantee interface conditions fairly or neutrally when competitiveness is not sufficient. When designing a proper policy package for net neutrality, we have to take overall competitiveness and interface conditions among layers into consideration. If the insufficient market dynamism in some layers, or unfair interface among them cause far larger efficiency losses than insufficient neutrality, policymakers should better focus on them. Therefore, discussing net neutrality is the most important when network operators are so powerful that they dominate the entire ecosystem. Now that the increasing popularity of online platforms has come to threaten the long-lasting dominance of network operators, the rank of platform neutrality or search engine neutrality is rising in terms of policy agenda. For example, the Japan Fair Trade Commission issued a study group report[7] on June 6, 2017, and presented its intention to monitor the development of platform dominance. On April 26, 2018, European Commission submitted a proposal for a regulation on promoting fairness and transparency for business users of online platforms (European Commission 2018). Furthermore, in September 2018, the US

[7] https://www.jftc.go.jp/en/pressreleases/yearly-2017/June/170606_files/170606-4.pdf.

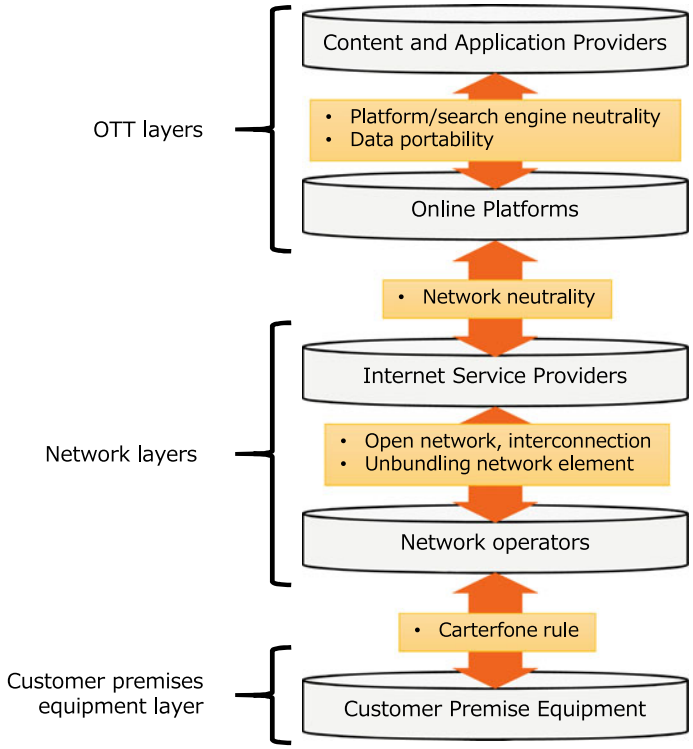


Fig. 9 Broadband ecosystem and interface issues

Federal Trade Commission started a series of hearings on competition and consumer protection in the twenty-first century.[8]

Finally, the above consideration has to be data-driven. Unless empirical studies confirm the existence of efficiency loss in the ecosystem and discover that the lack of network neutrality is the primary reason, it is better for policymakers to refrain from introducing net neutrality packages. Moreover, from the viewpoint of maximum use of competitiveness, in the policy package, improving end users' literacy about the value of neutral networks has to be one of the important components.

Acknowledgements This work was partly supported by JSPS KAKENHI Grant Number JP 16K03630.

[8] https://www.ftc.gov/news-events/press-releases/2018/09/ftc-hearings-competition-consumer-protection-21st-century.

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R&D Strategy and Its Deployment in the ICT Field Toward Realizing Society 5.0

Tetsuya Yamano, Chie Fukushima and Koji Toda

1 Introduction

The Council for Science, Technology, and Innovation in the Cabinet Office steers Japan's overall research and development (R&D) policy. This includes the information and communication technology (ICT) field which is under the jurisdiction of the Ministry of Internal Affairs and Communications (hereinafter referred to as MIC). The Council is headed up by the Prime Minister, with six Cabinet ministers as members, including the MIC, and an additional eight expert members representing academia and industry. Related government ministries plan and execute specific R&D policies based on the current 5th Science and Technology Basic Plan (spanning five years from 2016 through to 2020) created by the Council and approved by the Cabinet in January 2016.

The 5th Science and Technology Basic Plan (Council for Science, Technology and Innovation 2016a, b) presents the concept of the super-smart society, in which the cyber world and the physical world (real society) will be tightly integrated by using advanced ICT. It also defines a series of initiatives, known as Society 5.0, to create the super-smart society. The Basic Plan sets as a target for the entire government, guiding Japan toward becoming "the most innovation-friendly country in the world"

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by pushing ahead with Society 5.0. Society 5.0 is so named because it is an initiative to generate transformations through science, technology, and innovation that will produce a new society—following the succession of hunter/gatherer societies, agrarian societies, industrial societies, and information societies.

Realizing Society 5.0 is predicated on making the maximum utility of advanced ICT, as public infrastructure, that exceeds our current technological levels. Society 5.0 will also require cutting-edge ICT in many fields, such as data collection with the Internet of things (IoT), big data analyses of collected data, and the derivation of new knowledge with artificial intelligence (AI) technologies. Consequently, strategic R&D is essential. The MIC, based on the government's strategy, strategically promotes R&D aimed at realizing cutting-edge ICT.

This chapter presents strategic R&D policy in the ICT field. It also provides an outline of efforts to implement R&D outcomes in society using disaster response and disaster mitigation as examples, joint international research and other forms of international cooperation, and initiatives on international standardization.

2 Strategic R&D Policy in the ICT Field

2.1 Formulation of R&D Policy

The MIC establishes R&D strategies tailored for the ICT field based on the previously mentioned 5th Science and Technology Basic Plan and other long-term, government-wide basic policy. Because the ICT field is subject to exceedingly fast transformations, the Ministry must constantly study fresh "tactics" to address new technological trends appropriately.

For this reason, in recent years the Ministry has either established or updated R&D strategies to reflect the latest technology trends in the ICT field nearly every year. At the present time, the Technology Strategy Committee under the Information and Communications Council—an advisory body to the MIC—is examining the Ideal State of New Information and Communications Technology Strategy. Based on the Committee's examinations, the Information and Communications Council compiled a third interim report in July 2017. The third interim report (Information and Communications Council 2017) consists of two main strategies. One strategy is for the social implementation of next-generation AI that can understand human sensibilities and make decisions. The other strategy is to promote the arrangement of conditions (ICT datability) to use next-generation AI to create new value from all kinds of data sets. The Committee is continuing its examinations toward completing a final report planned for 2019.

The primary matters the Committee is examining are:

- R&D issues the country should tackle—fields and issues where R&D should be taken based on social conditions and needs as well as fields and issues where R&D should be promoted from a long-term viewpoint; and

- methods of promoting R&D outcomes from technology development to social implementation—approaches to research promotion schemes tailored to the characteristics of each issue (theme-specific R&D and publicly theme-proposal R&D) and integrated promotion methods for technology development, personnel activation, and research outcome deployment.

2.2 R&D Project Schemes and Key Examples

Theme-specific commissioned R&D projects are effective in accelerating social implementation for technological themes the government deems commercially promising and will cover the necessary budgets for R&D and testing. But it is also important to have R&D schemes that scoop up a broad range of novel concepts and cutting-edge technologies belonging to private companies, universities, and other organizations. Since around 2000, the government as a whole has promoted more expansive R&D using competitive research funding. The MIC too has expanded the projects it assists through the use of competitive research funding. Two other aspects are also crucial: the ongoing and steady progress of fundamental and base R&D done by national research institutes and the nurturing of promising seeds necessary for future innovation creation.

The MIC presently promotes R&D in the ICT field with budget allocations in three main schemes, described below. This arrangement is based on the Final Report on the State of Policy for Information and Communications Technology toward Creation of Innovation (Information and Communications Council 2014) and the three interim reports on the Ideal State of New Information and Communications Technology Strategy (Information and Communications Council 2015, 2016, 2017).

The first R&D scheme funds theme-specific R&D projects picked by the MIC. The Ministry selects technology themes with significant social impact in the ICT field that, through concentrated R&D and testing using budgetary assistance from the Ministry, are likely to reach the commercialization stage shortly and are suitable candidates for obtaining international standards. Under this scheme, after selecting the research themes and setting targets and other goals, the Ministry commissions the R&D to private companies, universities, and other organizations.

The timetable and budget sizes vary with each project, so the Ministry picks projects and ensures sufficient budgetary resources each fiscal year. The Ministry runs a plan–do–check–act (PDCA) cycle for the R&D projects that make use of its budgetary resources. This involves outside experts who do a detailed review of every project at the start, while in progress, and at the end. Furthermore, tracking reviews are done generally five years after a project ends to determine whether the project's outcomes have been adequately commercialized and deployed in real society and whether they have led to the acquisition of international standards.

Key R&D projects currently underway through this scheme include an R&D and demonstration testing project that is increasing the number of languages supported

by multilingual speech translation technology and improving translation accuracy, an R&D project on next-generation AI technology, an R&D and demonstration testing project on advanced conversational agents technology, an R&D project on innovative optical network technology that will underpin new public infrastructure, and an R&D project on quantum cryptography for satellite communications.

The second R&D scheme assists the creation of innovation using competitive research funding. The funded projects are theme-proposal R&D projects, and the Ministry publicly solicits R&D projects including those themes. Program directors and program officers screen submissions and the Ministry commissions the selected R&D projects to private companies, universities, and other organizations. The Ministry sets certain submission categories based on policy needs, such as developing young researchers, obtaining international standards, and stimulating regional economies.

Here, I will introduce two major competitive research funding programs the Ministry is currently operating. The first funding program is the Strategic Information and Communications R&D Promotion Program (hereinafter referred to as SCOPE). SCOPE solicits a wide range of proposals for novel R&D themes from universities, companies, research arms of local governments, and other organizations. The goals are to stimulate regional societies through the use of ICT, discover novel technologies at SMEs, develop young researchers in ICT field, and obtain international standards through joint research with other countries. SCOPE has set up a special category called the "inno"vation program. Its purpose is to support creative people taking on fantastic and ambitious technological challenges with incredible potential. In this connection, "inno" pronounces "INOU" in Japanese, and this noun means an ingenious person with a special talent in Japanese. The second funding program is I-Challenge! a program that supports ICT innovation creation. I-Challenge! aims to bridge the barrier between R&D and commercialization—the so-called valley of death. To do this, it provides assistance for demonstrating business models (through prototyping, demonstration tests, etc.) by teaming up with experts in venture capital and other commercialization aid. The aim is to achieve commercialization of new technologies by venture companies, universities, and other organizations. To date, numerous venture companies have made use of I-Challenge! to grow businesses that utilize new, cutting-edge technology.

The third, and final, R&D scheme is research conducted by the National Institute of Information and Communications Technology (hereinafter referred to as NICT). NICT is the only public research institute that specializes in the ICT field in Japan. The NICT Act sets out NICT's objective and the scope of its affairs. NICT carries out fundamental and base R&D in the ICT field following five-year targets set by the Ministry (the current target period is FY (Fiscal Year) 2016 through to FY 2020). In addition to its own operations to realize the full potential of R&D outcomes, the Institute assists research activities by venture companies and universities. It also promotes personnel development initiatives.

The main funding source for NICT R&D is a management expense grant (approximately 30 billion yen for FY 2018) provided for in the Ministry's budget. In addition, year by year NICT has successfully increased the external funding it receives from

other funding organizations, such as the Japan Science and Technology Agency (hereinafter referred to as JST) and the Japan Society for the Promotion of Science (hereinafter referred to as JSPS).

NICT serves two roles: promoting R&D to resolve issues in line with the Ministry's strategies and opening up new, world-leading frontiers using outstanding ideas from researchers. It is important to balance these two roles in keeping with the needs of the times. To this end, the Ministry flexibly revises and optimizes the allocation of NICT resources—namely research organizations, budgets, and facilities—while monitoring global technology trends.

2.3 Overview of NICT

In this section, an overview of NICT is provided. As mentioned above, NICT is the only public research institute that specializes in the ICT field in Japan. It has around 1100 employees in total, of which 400 are full-time researchers. Although its headquartered in the Koganei District of Tokyo, the wireless network research laboratory is located in Yokosuka, the laboratory for base research leading to the creation of future seeds is in Kobe, Hyogo, and the laboratory for multilingual speech translation and AI is in Keihanna Science City, Kyoto. The world-leading Center for Information and Neural Networks is located within Osaka University in Osaka, and the base for resilient ICT research is sited within Tohoku University in Miyagi. These two research centers also serve as bases for industry–university–government cooperation.

NICT is engaged in fundamental and basic R&D into cutting-edge ICT that will pioneer future societies. During the current five-year target period, NICT has strategically invested its research resources into five research clusters. The following is a brief synopsis of each cluster.

- Sensing fundamentals: This research cluster concentrates on *watching* society using the latest ICT. Examples of research are remote sensing technology for early detection of localized torrential rain and space environment measurement technology which measures and forecasts the space environment that can affect radio signal propagation and other communications.
- Integrated ICT: This research cluster concentrates on *connecting* society using the latest ICT. Examples of research are innovative network architecture technology to support future IoT services, wireless network technology that connects people, devices, information, big data, and everything else, and large-capacity multicore optical switching technology for the creation of the world's leading optical-fiber networks.
- Data utilization and analytics platform: This research cluster concentrates on *creating* new value using the latest ICT. Examples of research are multilingual speech translation technology using AI technologies, "social-wisdom" analysis technology that discovers and identifies problems in society and information related to

those problems from online information, such as enormous websites or social networking services (SNS), and neural information and communications technology that decodes human brain functions and applies them to the development of next-generation AI.
- Cyber security: This research cluster concentrates on *protecting* society using the latest ICT. Examples of research are next-generation technology to analyze cyber attacks and lightweight cryptographic and authentication technology that can be implemented on IoT devices.
- Frontier research: This base research cluster concentrates on *developing* future societies and producing seeds using the latest ICT. Examples of research are quantum optical network technology that will achieve the fastest theoretical communication speeds without the dangers of interception or deciphering and technology for the development of gallium oxide devices and deep ultraviolet (UV) light-emitting devices.

NICT is involved in other projects to maximize the outcomes of the R&D listed above. For example, NICT has constructed and runs test beds that bring together technology-proving tests and public trials. The Institute also promotes industry–university–government cooperation for the creation of open innovation, is active in strategic international standardization, promotes international adoption of its R&D outcomes, and deploys research findings to achieve disaster-resilient ICT.

In addition, under the NICT Act, NICT is mandated to emit standard radio signals, generate and broadcast Japan Standard Time, forecast space weather, and test and calibrate wireless equipment. And under its research support and business stimulation remit, the Institute is active in inviting distinguished researchers from outside Japan, assisting commercialization by ICT venture companies, and developing ICT personnel.

3 Disaster-Resilient ICT

The March 2011 Great East Japan Earthquake caused severe damage to ICT networks, including mobile-phone base stations and relay stations and cables for fixed-line communications. Given that ICT is an essential public infrastructure for daily life, the MIC drew lessons from the damage and destruction of information and communication networks caused by the Great East Japan Earthquake. It then moved ahead with various theme-specific R&D projects to bolster the disaster resilience of ICT. Many R&D projects were conducted, not just to develop disaster-resilient ICT networks and protect ICT from natural disasters but also to protect society with ICT—i.e., taking advantage of ICT to ensure the safety and security of daily life.

The following sections present some implementations of R&D outcomes in disaster-resilient ICT in society at large. These represent examples of applying the outcomes of Ministry R&D projects and NICT R&D.

3.1 Briefcase-Type ICT Units

The Ministry commissioned two R&D projects: an R&D project to create the technology to construct and reassemble a resource unit applicable to communication networks during major natural disasters, and an R&D project to create a portable ICT unit with multiple connectivity methods capable of being rapidly deployed to disaster sites. Making use of these projects' results, the NTT Advanced Technology Corporation produced a practical emergency communications unit. It is a portable IP-private branch exchange (IP-PBX) device that hosts an ad hoc communications network. The unit can be transported into an area out of radio signal range and be used to rapidly set up a communications environment, even if mobile carrier services are down because of a disaster.

The unit uses Wi-Fi connectivity to create an extension-call environment in which regular smartphone numbers are used as extension numbers. Communications outside the local area are possible by connecting a satellite phone or other device to the unit. It houses a long-life battery, so it can operate during power outages without a separate power supply. And because it is compact and lightweight, the high-performance unit can be packed in a briefcase and carried onboard aircraft. This portability allows it to be quickly and easily deployed in emergencies.

In the wake of the April 2016 Kumamoto Earthquake, local municipalities in disaster sites used the ICT unit for communications. As of June 30, 2018, 46 units had been deployed in Japan and seven units abroad. It is also decided to provide ICT units to the International Telecommunication Union (hereinafter referred to as ITU) as emergency communication systems to be deployed in disaster sites around the world.

3.2 NerveNet

NerveNet (National Institute of Information and Communications Technology, n.d.) is an NICT-developed distributed grid network system for constructing disaster-resilient local government networks. NerveNet can operate without a server, unlike conventional client–server networks, so it is not susceptible to network outages when servers are damaged in a disaster. NerveNet can also maintain communication lines by routing around damaged areas of networks in the event of damage to mobile-phone communication equipment or servers. By installing NerveNet as their communication network in advance, local governments can readily confirm safety and report information during a disaster.

For example, the town of Shirahama, Wakayama, has installed NerveNet. The town normally uses NerveNet as a communication network for tourists. In the event of an emergency, Shirahama has prepared a system to deploy NerveNet for disaster-response communications. Other municipalities used NerveNet during the Kumamoto Earthquake as a temporary communication network in disaster areas.

Furthermore, the disaster-response headquarters of several government ministries use NerveNet for disaster-response exercises in the Tachikawa District of Tokyo, the location of the government's alternate headquarters in the event of a disaster.

3.3 DISAANA and D-SUMM

The Disaster-Information Analyzer (hereinafter referred to as DISAANA) relies on NICT-developed natural language processing technology. NICT has made DISAANA open to the public, so anyone can use it by connecting to the Internet from a computer or smartphone. DISAANA collects and analyzes in real time large amounts of information related to disasters on Twitter and other SNSs. It then arranges and displays the results in a format specifically for disasters. The system aids rescuers, disaster victims, local governments, NPOs, and others in determining accurate information and assessing conditions (National Institute of Information and Communications Technology 2015, n.d.). And the Disaster-Information Summarizer (hereinafter referred to as D-SUMM) arranges and summarizes this disaster information in an easily understood format. It can superimpose information on maps and show analysis results as they change over time. NICT has also made D-SUMM open to the public (National Institute of Information and Communications Technology 2016, n.d.).

In addition, the Cabinet Secretariat's Twitter analysis team used DISAANA and D-SUMM during the Kumamoto Earthquake, and the Oita Prefectural government office used the systems for information analysis during the July 2017 torrential rains that struck northern Kyushu. Many examples have been reported of the systems letting people quickly ascertain detailed conditions during disasters, because the systems analyze enormous amounts of real-time information on social media, such as Twitter, in very short amounts of time.

3.4 Disaster-Resilient ICT Guidelines for Municipalities

The 2011 Great East Japan Earthquake severely damaged or destroyed many ICT networks, making it impossible for municipalities to carry out many of their tasks. The MIC, NICT, universities, private companies, and other organizations came together to form the Resilient ICT Research Council to promote the social deployment of R&D outcomes related to disaster-resilient ICT networks. The Council cooperates and collaborates with municipalities, universities, research institutes, and related companies.

The Council established a set of guidelines in June 2014 based on R&D outcomes up to that time (MIC 2014). The guidelines compiled how to install ICT networks that can aid the smooth execution of tasks by municipal officials in the event of a major disaster. Four years later, the Council created and released a second edition of the guidelines in July 2018 (MIC 2018a). The second edition was designed from the

perspective of municipal officials in cooperation with many municipalities. The new edition also addressed recent advances in technology.

The second edition of the guidelines focused on technologies that would be truly useful for and easy to use by municipal officials in emergencies and presented how to use the technologies in a straightforward manner. The guidelines also provided specific examples from real disasters. The Ministry and NICT have actively promoted the guidelines, by providing them to make it publicly available on Web sites, making municipal disaster-response officials aware of the guidelines, and using the guidelines in disaster-response exercises in various regions.

4 International Cooperation on ICT R&D

The globalization of markets in the ICT field is happening quickly. Consequently, in the interest of creating innovation and boosting international competitiveness, it is important for Japan to build international cooperation relationships early on. Such relationships are viewed as creating entry points in the earliest R&D stages to international standardization and commercialization.

In light of this situation, at the June 2011 Japan-EU ICT Policy Dialogue, Japan and the EU shared an understanding that R&D in the ICT field plays a crucial role in the social and economic activities of both sides and agreed to promote joint Japan-EU research. The MIC, in turn, decided to commission R&D projects in response to proposals from Japanese research institutions that conduct R&D jointly with research institutions in EU member countries starting in FY 2012. The projects were commissioned within the SCOPE program of competitive research funding, described above. Three projects in the information security field and one project in the optical communications field were selected.

At a May 2012 Japan-EU ministerial meeting, the two sides agreed to promote joint international research by means of joint calls for research proposals. The Ministry and the European Commission adopted a format for joint calls for research proposals, beginning with projects to start in FY 2013. As shown in Fig. 1, the scheme consists of five stages: (1) the Ministry and the European Commission discuss and agree on R&D fields and the details of joint calls; (2) the Ministry and the European Commission make joint calls with the agreed-on details; (3) research institutions in Japan and the EU create joint proposals; (4) the Japanese and the EU research institutions submit the proposal to the Ministry and the European Commission respectively; (5) after a consensus review of the joint proposal by the Japan and EU sides, the Ministry and the European Commission allocate research funds to the respective research institutions.

To date, joint calls have been made for three research themes for projects starting in FY 2013 (optical communications, wireless communications, and information security), two research themes for projects starting in FY 2014 (big data and optical communications), two research themes for projects starting in FY 2016 (5G (wireless

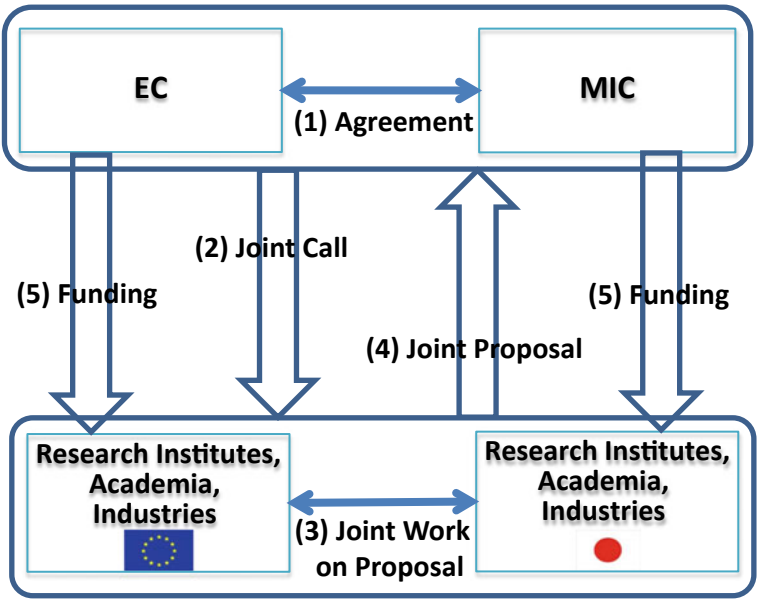

Fig. 1 Scheme of EU-Japan Joint ICT Research Projects. *Source* Ministry of Internal Affairs and Communications, Japan

and networks) and ICT robotics), and two research themes for projects starting in FY 2018 [smart cities and 5G (applications)].

The Final Report on the State of Policy for Information and Communications Technology toward Creation of Innovation recommended that: joint international research be enlarged both in scale and in the number of countries eligible for joint research (Information and Communications Council 2014). In the wake of this recommendation, Japan began joint research projects with the USA in FY 2016. Calls have been made for projects starting in FY 2016 on one research theme (smart cities) and for projects starting in FY 2018 on one research theme (infrastructure maintenance and management).

Through these joint international research frameworks, as of 2018, over 100 university and corporate research institutions in Japan, Europe, and the USA have formed consortiums for their respective projects. The project outcomes have furthered R&D and resulted in international standards. In addition, the growing networks of international researchers through participation in these projects have created a virtuous cycle, encouraging researchers to take on new R&D projects together.

5 Strategic Standardization Activities

International standardization in the ICT field is crucial for creating global markets and boosting international competitiveness. This is because international standardization—by sharing common standards for networks and services—ensures compatibility among communication devices and networks and adequate quality levels for products. Accordingly, the MIC strategically promotes international standardization initiatives in the ICT field.

International standards can be divided up into de jure standards, forum standards, and de facto standards, depending on how they are established. De jure standards are established at standards bodies with public standing in accordance with prescribed procedures and through consensus of the concerned parties. Examples of de jure standards are standards published by the ITU, International Organization for Standardization (hereinafter referred to as ISO), and International Electrotechnical Commission (hereinafter referred to as IEC). Forum standards, on the other hand, are established by forums comprising multiple companies that, although not public or official, have open standardization procedures. Standards drawn up by the Internet Engineering Task Force (hereinafter referred to as IETF) or Institute of Electrical and Electronics Engineers (hereinafter referred to as IEEE) are typical examples of forum standards. De facto standards, on the other hand, are not created through an open process. Rather they result from a product or products dominating a market to such an extent that they become an established standard for all intents and purposes.

The changes in ICT field standardization given below have been observed in recent years. Consequently, the Ministry has broadened its support of international standardization initiatives to include not just ITU and other de jure standards but also standardization activities in priority areas by various standards developing organizations and forums.

- In addition to consensus-driven de jure standards at organizations like the ITU where each country has a vote, various forums led by the private sector have been very active in standardization.
- There are more cases where, due to market needs, a forum standard has been created first and is later confirmed by a de jure standards developing organization.

The sections below describe the MIC's efforts with respect to activities at the ITU-T and forums. This is followed by an outline of corresponding private standards developing organizations and, finally, examples of international standardization promotion in Japan through industry–university–government collaborations.

5.1 ITU-T

The ITU is an international organization established in 1932 with the merger of the International Telegraph Union, established in Paris in 1865, and the International

Radiotelegraph Union, formed in Berlin in 1906. Japan is an active contributor to the ITU, submitting proposals on many standardization issues. First as a member of the Radio Regulations Board (RRB), Japan has sent many officials to serve as chair and vice-chair of Study Groups (SGs) in many fields and experts responsible for specific research topics. The following are Japan's initiatives in the ITU-T sector, one of ITU's three sectors.

The Ministry of Internal Affairs and Communications set up the ITU Section, under the Information and Communications Council, to be Japan's domestic deliberation body. The Telecommunication Systems Committee under the ITU Section deliberates and approves Contributions from Japan before their submission at SG meetings at the ITU-T. With regard to strategies for SG meetings and examining Contributions from individual companies, not Japan, the Ministry respects examinations done by private-sector standards developing organizations, such as the Telecommunication Technology Committee (hereinafter referred to as TTC). Relevant sections of the Ministry attend TTC meetings as observers.

In short, official Contributions from Japan are submitted to the ITU-T from the Ministry after deliberations at the Information and Communications Council. Other Contributions are submitted from the respective sector member after deliberations at the TTC or other private-sector standards developing organizations.

5.2 Forum Standards in the ICT Field

As mentioned above, forums have become quite active in standardization in recent years in the ICT field. Frequently, the technical specifications that form the core of standards are primarily determined at forums and then later ratified as de jure standards. Given this reality, industry, universities, and the government must cooperate and collaborate closely on standardization activities at forums.

The Ministry of Internal Affairs and Communications is active in monitoring trends in forum standards (especially at the W3C, IEEE, and IETF), assisting the creation of recommendations, and working to promote the widespread adoption of forum standards.

The Ministry specifically sends Japanese experts to attend meetings at international standards developing bodies and organizations (such as the ITU, W3C, IETF, and IEEE) and covers their travel expenses, meeting participation fees, and other necessary expenses to monitor the latest developments in standardization. This is a part of the Ministry's objective to pursue strategic and ongoing international standardization at these bodies.

The Ministry also supports standardization initiatives aimed at standards in Japan's leading industries and standards that Japan should obtain to secure a lead in the IoT era. The Ministry also runs events and other activities to promote the adoption of standards once they have been obtained. Examples include initiatives at the World Wide Web Consortium (hereinafter referred to as W3C) in the WoT Web of Things (WoT), the Web and automobiles, and vertically oriented text layouts, which are key

fields for Japanese companies. The Ministry provides support for the establishment of standards in these areas.

5.3 Domestic Standards Bodies

Two private-sector standards developing organizations operating in the ICT field in Japan are the Association of Radio Industries and Businesses (ARIB), which is engaged in standardization for radio systems in the communications and broadcasting sector, and TTC, which is engaged in standardization for information and communication networks. TTC will be introduced here because of its close involvement with ITU-T activities.

TTC's purposes are to contribute to standardization in the information and communications field and promote the adoption of standards by creating standards for information and communication networks. TTC had established 860 standards as of March 2017. As an organization that establishes domestic standards for Japan, TTC helps construct and facilitate a safe and secure society that makes use of ICT, which is progressing at a remarkable pace.

Next is a description of the relationship between ITU-T SGs and TTC's working groups. The working groups set up within TTC are assigned in a way that corresponds to the technical issues at each ITU-T SG. Each working group discusses strategies and Contribution in their area. Where multiple working groups are assigned to one SG, a lead working group is determined to consolidate the Contributions of all the working groups.

When sector member submits a Contribution to one of the SGs, it is possible to work on standardization in cooperation with related people by becoming a member of the TTC, and by participating in the working group of the eleven ITU-T SGs, the Ministry of Internal Affairs and Communications is directly in charge of SG3, which handles economic and policy issues, and Japan Cable Laboratories is in charge of SG9, which deals with broadband cable and TV.

5.4 International Standardization Promotion Through Industry-University-Government Collaborations

The 2018 White Paper on Information and Communications in Japan (MIC 2018b) includes a forecast that with the full arrival of the IoT society, around 40 billion IoT devices will be connected to networks in the 2020s and traffic volumes will triple from current levels. Responding to this skyrocketing growth in communication traffic is an urgent issue.

To create an array of IoT services and address the connectivity needs from huge numbers of IoT devices to these many services, the MIC has, since FY 2016, been

conducting R&D into common platform technologies. Examples include technologies that will connect massive numbers of IoT devices quickly and efficiently and technologies that will allow efficient and secure networks to connect to and handle the capacity of IoT devices and services that use different wireless standards. Furthermore, the Ministry works with the Smart IoT Acceleration Forum, a cross-discipline promotion framework founded through industry–university–government cooperation, to move ahead with international standardization of technologies necessary for the IoT age.

6 Conclusion

This chapter has presented an overview of Japan's R&D in the ICT field. The MIC, working from government-wide policy, formulates a strategy to clarify its priority areas and other matters. The Ministry then proceeds with comprehensive measures to advance R&D in the ICT field, such as budgetary provisions for R&D projects, promotion of the social implementation of R&D outcomes, and assistance for international standardization. Globalization has advanced further in the ICT field than any other. For this reason, the Ministry has steadily expanded joint international research with Europe and the USA in recent years.

Close collaboration among industry, universities, and the government—including universities, private companies, related ministries and agencies, and local governments—is necessary to effectively promote R&D in the ICT field. NICT plays a particularly large role in fundamental and base R&D in the ICT field from a long-term perspective.

ICT has become an essential part of our lives, as global infrastructure sustaining all kinds of social lives and economic activities. It is clear that ICT's importance will only grow as we face the coming implementation of AI technology in society at large and the full realization of IoT societies. The MIC will continue to engage with cutting-edge R&D to further develop ICT infrastructure for Japan and the world by means of industry–university–government collaboration and international cooperation. The Ministry will also arrange conditions for Japan to steadily create new innovation,

such as the generation of creative seeds through competitive research funding. The ultimate aim of the Ministry, through these measures, is to help solve global societal issues with ICT.

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ICT in the Global Context

Utilization of ICT in Elementary and Secondary Education in Japan: Its Policies and Effects

Hitoshi Mitomo

1 Introduction

This chapter reviews the policies and public works projects for using information and communication technology (ICT) in primary and secondary education and discusses how ICT can address challenges facing education in Japan. The Ministry of Internal Affairs and Communications (MIC) has been working on ICT in education for a decade in collaboration with the Ministry of Education, Culture, Sports, Science and Technology (MEXT). Since ICT is expected to enhance the effectiveness of education, it has been used in many developed countries such as Finland, Singapore, and the Republic of Korea. Each of them has developed a new education system that augments students' capabilities. Japan is catching up with these countries in taking advantage of ICT based on its well-developed network infrastructure.

The MIC has conducted a series of projects for promoting the use of ICT in education in accordance with its policies since ICT is recognized as an efficient tool for education. It is shown that ICT was initially used for addressing problems in education such as mitigating the burden of teachers in school administration. ICT is further used to create value added in education by enhancing the effect of education. Most typically, active learning is empowered by adopting ICT in education.

At the beginning of this century, the information and communication infrastructure in Japan, especially broadband, progressed rapidly. Regarding fixed network systems, the optical fiber network is among the world's most advanced, and household

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coverage rate is almost 100%. In addition, regarding mobile systems, since fourth-generation mobile phones have spread nationwide due to progress in communication technology by the middle of the 2010s, the environment for high-speed mobile communication using smartphones and tablets has been developed.

However, although Japan has world-class infrastructure for information and communication, its utilization is insufficient. As an example, the poor labor productivity of Japan has been pointed out. Utilizing ICT is a way to increase the basic efficiency and reduce expenses. Therefore, its effective utilization will boost the productivity of labor. However, the international ranking of Japan's labor productivity has been steadily declining since reaching a peak in 2000 and is now the lowest among developed countries. Despite Japan's rapid broadband development starting in 2000, labor productivity has remained low compared to various other developed countries, which suggests inefficient use of ICT.

It is no exaggeration to say that the use of ICT in education and its diffusion lagged behind other developed countries even considering the special circumstances of education. The MIC has continued demonstration projects to promote the use of ICT especially in elementary and secondary education. Since educational administration is under the jurisdiction of MEXT, the involvement of the MIC in education initially used to center around developing the ICT environment. Later, ICT education was promoted in cooperation with MEXT, and projects are focusing on the school education system.

This chapter, after describing the progress of ICT education demonstration projects promoting the use of ICT in Japan's education by MIC, discusses its characteristics and issues. From the fact that ICT is used not only as an education tool and that the workload of teachers is extremely high, ICT is being used to reduce the burden of teachers to contribute to the effectiveness of education indirectly.

Through a sequence of demonstration projects conducted in the 2010s, it is clear that the initial purpose of solving educational issues gradually shifted to even higher use of ICT that includes growth of responsiveness to society. Through a series of the projects, knowledge gained in a project is utilized in the next one. MEXT (2016b) also advocated to raise the quality of education through three perspectives: practical skills in using information, scientific understanding of information, and attitude toward information society. In other words, the aim is mainly to effectively use ICT in learning processes through active learning.

The author witnessed implementation difficulties as well as its effectiveness by experience and involvement in ICT utilization promotion policies in education and demonstration projects, as described later. Especially, the effect is significant in remote areas with poor educational conditions. In metropolitan cities, there are many areas with advanced ICT education based on financial strength; however, because the issues to be solved are different between urban ICT education and rural ICT education, the method of using ICT will differ. This chapter, while considering ICT education in disadvantaged areas, outlines the changes in ICT education from the development side of ICT and its effects and issues.

2 Introduction of ICT in Education

2.1 Expectations for ICT Education and the Necessity of Information Literacy

Since ICT is an effective tool for elementary and secondary education, the use of ICT in education in Japan is expected to advance to other developed countries such as Finland, other Scandinavian countries, South Korea, and Singapore. The major direct effects expected by using ICT in education are summarized below.

(1) Improvement of ability

Improvement of knowledge and understanding
Improvement of communication skills
Improvement of ability to solve issues and problems

(2) Increased opportunities

Expansion of active learning
Network formation with people outside school and interchange opportunities

(3) Improvement of efficiency

Diversification of educational methods
Reduction of administrative work of teachers

(4) Reduction of disparities

Reduction of "educational divide"
Support for students who cannot come to school

(5) Improvement of information literacy

Improvement of information literacy of teachers
Improvement of information literacy of students.

Information literacy in particular is expected to improve through ICT education. It is necessary for ICT education and for using ICT in daily life. No matter how much the use of ICT is restricted to keep children away from danger, there are limits on its effectiveness. Instead, by making them understand the merits of ICT, teaching how to use it correctly, and making them recognize the impact of using it incorrectly, children should be taught how to use ICT correctly as a tool. In daily learning, children can nurture their judgment ability regarding the use of ICT by effectively using ICT as a tool and knowing the various problems caused by improper use. Then, they can deal with bullying on the Internet and understand the meaning of problems of leakage of personal information, which has become an issue recently.

At the same time, information literacy of teachers is essential for ICT education. To gain sufficient literacy, prior training is important. However, such training does not guarantee sufficient skills. It is necessary to improve these skills through actual

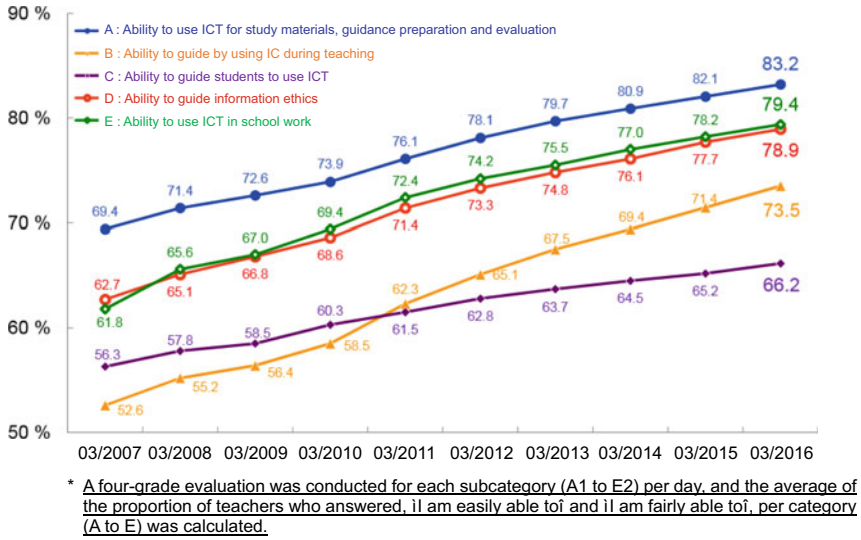

Fig. 1 Trend of ICT utilization led by teachers. MEXT (2016c)

ICT education. Figure 1 shows the changes of the ability of teachers to teach how to use ICT depending on skill. Though ICT is increasingly being used to prepare study materials, few teachers are confident in their ability to teach ICT to children and use ICT in classes. Teachers in Japan work hard; however, the ratio of time spent on education in their total work hours is low compared to other countries. The reality is that they spend a lot of time on extracurricular activities and other work (for an international comparison of the conditions of teachers, refer to OECD (2013)). Therefore, they have little time to improve their literacy.

The effects of using ICT for education are evaluated in various ways. However, the focus is on qualitative evaluation; there is not enough quantitative and statistical measurement on the effects. Shimizu et al. (2008) showed using factor analysis that high effectiveness could be obtained when ICT was used for all of the extracted factors. Sakakura (2015) conducted an economic analysis by including ICT explicitly in education production functions (e.g., Kojio et al. 2009).

Since ICT may not always bring positive effects for children, it tends to be difficult to gain the understanding of parents and teachers. Especially, ICT's negative effects on children are likely to be emphasized. Unfortunately, bullying through SNS, etc., occurs. Therefore, it is important to verify the effect of introducing ICT in education through objective and quantitative indices.

2.2 Current State of ICT Implementation on Education

MEXT conducted a study on the digitization of education at school and published its results (MEXT 2016a). According to the study, the spread of computers, networks, and interactive whiteboards (IWB, electronic blackboards) necessary for ICT education is as shown in Figs. 2, 3, 4 and 5 as of March 2016. As shown in Fig. 2, the number of students per educational computer is 6.2 (Fig. 2). Since it was 7.7 students in March 2006, it has decreased by 1.5 in 10 years. Implementation of IWB in general classrooms has advanced rapidly since 2009; however, it was still less than 22% by the end of fiscal year (FY) 2016 (Fig. 3).

The LAN installation rate for general classrooms is 87.7%, but that for wireless LAN is only 26.1% (Fig. 4). Regarding Internet speed, 84.2% of schools have a high-speed Internet connection of 30 Mbps or more, but only 38.4% have optical fiber lines of 100 Mbps. Though the number of installed IWBs is steadily increasing, only 21.9% of general classrooms are equipped with it.

Among households in Japan, 100% have broadband and 99.9% have ultra-high-speed broadband as of March 2014; in comparison, Internet access at school is poor. Computers for education are also used beyond their lifespan. The operating system is often not the latest, and computers cannot handle large capacity and complex content.

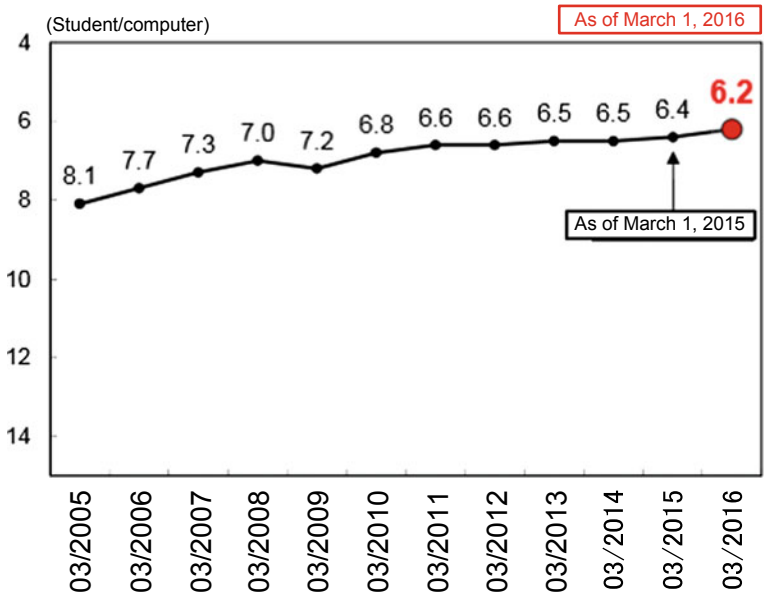

Fig. 2 Number of students per educational computer

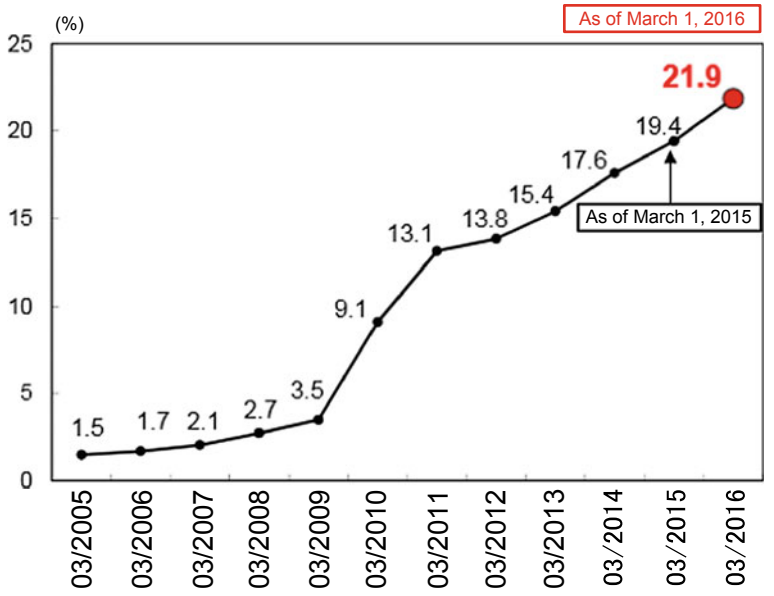

Fig. 3 Readiness rate of electronic blackboards in regular classrooms

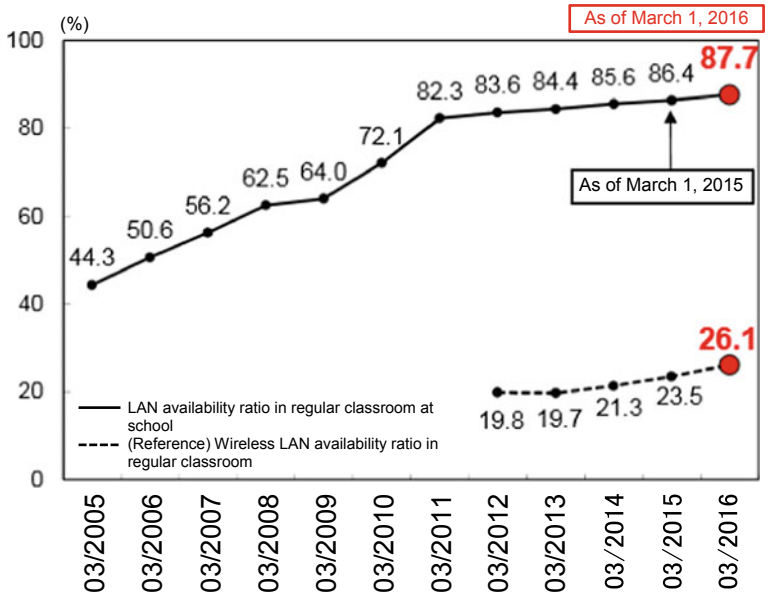

Fig. 4 Readiness rate of in-school LAN in regular classrooms

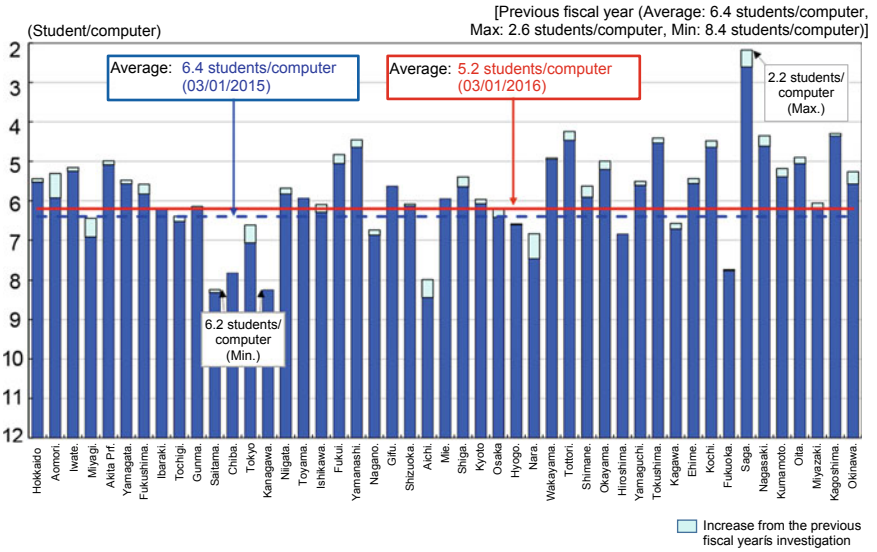

Fig. 5 Number of students per educational computer. Reference: MEXT (2016c)

The level of information technology differs depending on municipalities. Some areas provide one computer per student, but others lag far behind in information technology. These differences are caused by the differing financial strength of municipalities; however, municipalities where the head actively introduces ICT in education tend to have better information technology.

Figure 5 shows the number of students per computer for education in each prefecture. The worst in Japan is Kanagawa Prefecture and Saitama Prefecture (average: 8.2/computer in 2015). The readiness rate is below the national average in various prefectures including major cities such as Tokyo, Chiba, Aichi, and Fukuoka. On the other hand, the readiness rate is high in prefectures such as Saga (2.2/computer), Tottori, Kagoshima, Tokushima, and Yamanashi which have relatively small populations. The difference in ICT environment in classrooms is also large: According to the same study, the readiness rate of wireless LAN in general classrooms ranges from 62.3% (Shizuoka Prefecture) to 5.9% (Ehime Prefecture). The readiness rate of electronic blackboards in general classrooms ranges from 126.0% (Saga Prefecture) to 10.1% (Gunma Prefecture). Thus, the digital divide among prefectures is significantly large.

3 Genealogy of ICT Education Demonstration Projects by MIC

The MIC has jurisdiction over the regulations and the use of information and communication infrastructure. In the education field, the use of ICT has been promoted through various demonstration projects, promotion policies, and researches. Cooperation with MEXT in education is essential. Major demonstration projects were conducted jointly with MEXT, and the use of ICT has been promoted. MEXT has focused on education effects and the MIC on the ICT environment. Major projects are shown in Table 1.

3.1 "Broadband Open Model Demonstration Experiment" Project by MIC (2010)

As a part of the method of using optical fiber broadband, the "Optical fiber broadband utilization policy investigation team" (from November 2009) of the MIC examined reducing costs by improving convenience for residents with local public services while preventing waste and conducted two demonstrations, "Administrative renovation model demonstration of municipalities" and "Demonstration of local problem-solving support system," and verified that a broadband open model could be used for local problem-solving.

In the "Demonstration of local problem-solving support system," in addition to constructing a network for sharing medical statistical information and providing opportunities to acquire the latest skills for people with challenges, assistance for elementary and secondary school employees was identified as an important issue. A demonstration project was conducted in Miyakojima City in Okinawa Prefecture. A software for managing grades of students and records on home visits was provided through a cloud-based service to PCs distributed to elementary and secondary school teachers in Miyakojima City, in order to verify specific effects of reduced

Table 1 ICT education demonstration projects by MIC

Demonstration project	Period	Collaborating MEXT projects
"Broadband Open Model Demonstration Experiment" Project	2010 FY	–
Future School Promotion Project	2010 to 2013 FY	Learning Innovation Project
Pioneering Education System Demonstration Project and ICT Dream School Demonstration Model	2014 to 2016 FY	Pioneering education system structure project
Smart School and Platform Demonstration Project	From 2017 FY	Next-generation school support model structure project

software usage fees and security maintenance with no data stored on PCs (MIC 2011).

According to a report on the same demonstration project (Nippon Telegraph and Telephone Corporation 2011, p. 1), this demonstration experiment is aiming to spread a teacher's school work support system using broadband in elementary and secondary schools through examining the effectiveness of the broadband open model in terms of reduction in the workload of teachers, evaluation of usability and network requirements for operation of the schoolwork support system. Even though the project aims to support teachers, the demonstration items focus on the hardware and verifying the network requirements for stable operation of the system. The educational content itself is under the jurisdiction of MEXT, and so the MIC was reluctant to enter the jurisdiction of another ministry.

In Miyakojima City of Okinawa Prefecture where the demonstration was conducted, the schoolwork support system using the cloud system was implemented for the first time in Japan, aiming to increase the effectiveness and security of PCs for schoolwork distributed to the Board of Education and teachers in all elementary and secondary schools. The cloud-based schoolwork function, schedule function, and groupware function were provided to elementary schools (20 schools), secondary schools (15 schools), and the Board of Education in the city, and the students' management function was provided to the model schools. Table 2 shows the main functions that were provided in the project.

In Miyakojima City which is prone to natural disasters such as typhoons and in small remote islands not connected by bridges (at the time), before the system was implemented, ICT implementation was poor and most communications were done by phone and fax. Only one email address per school was assigned, and teachers did not have their own email address. When materials were distributed by the Board of Education to each school, they were printed on the previous day and delivered on the next day. However, with the introduction of this system, it became easier to share information between the Board of Education and each school, send documents, share stored documents, manage schedules, and create school diaries and weekly plans. Also, it became possible to compile attendance records, manage grades, and create grade reports, survey documents, and guidance summaries. The time used for school-related works was reduced, and the problem of being unable to deliver documents to remote islands due to the weather was largely resolved.

Although there was resistance from some conservative teachers at the beginning of system implementation, most teachers were highly satisfied since their school workload was largely reduced, and after the experiment, it was decided to continue using the system with the city budget. Today, it is still used after being updated. The success at Miyakojima City spawned new business opportunities for businesses by using the cloud-based schoolwork support system.

Table 2 Main functions of school work support system in Miyakojima City

Functions provided to general and model schools	Groupware function	Communication bulletin	Bulletin board on which information can be shared between the Board of Education and each school
		Individual communication	Messages can be sent/received as email between teachers within a city
		Communication by documents	Able to send documents to schools
		Meetings	Electronic meeting function in which information can be shared between the Board of Education and each school
		Storage (Shared folder)	Able to easily share application forms and manuals that are common in the city
	School work and schedule function	Schedule table	Able to create and manage schedule of the area, school, and individual
		Facilities/items reservation	Able to register facilities and items in school, and manage reservations of facilities and items
		School daily journal	Able to create school daily journal by reusing information registered in other functions
		Weekly proposal	Able to create and register weekly guidance plan per teacher and class, and enter actual results Able to record and calculate a total hours per class

(continued)

Table 2 (continued)

Functions provided only to model schools	Management function of students	Attendance book/Missing lesson book	Able to create attendance book based on daily attendance and absence. Based on attendance book information, missing-class management for each class hour can be conducted
		Finding good points	Register and accumulate daily observations of students
		Grade management	Able to create a list of grades, grade reports, records, and investigation documents, which can be managed together
		Investigation document	Able to create an investigation document by copying data from report books
		Guidance record	Able to create a guidance record by copying data from report books

Resource Nippon Telegraph and Telephone East Corporation (2011)

3.2 Future School Promotion Project

The future school promotion project is a pioneering educational ICT project led by the MIC. Based on the guidance of the future school promotion study group (Chairperson: Yasutaka Shimizu, Tokyo Institute of Technology, professor emeritus), a network environment using ICT equipment was built and a demonstration study was conducted to identify and analyze issues regarding information communication technology at schools. The study was conducted from FY 2010 at 10 elementary schools. In the next FY, a demonstration study was conducted in an additional 8 secondary schools and 2 special support education schools in cooperation with the "Learning innovation project" by MEXT. Therefore, for the same demonstration schools, systems for promoting ICT education through different perspectives were established: "Future school promotion project" by the MIC and "Learning innovation project" by MEXT.

The MIC published a pamphlet called "Creating a future learning environment" and promoted digitization in education using ICT. By fostering a learning environment using the characteristics of ICT, various effects were emphasized, such as enhancing the ability to solve problems through collective learning; promoting individual learning and collaborative learning; developing the ability to find and solve problems; and promoting subjective action in learning and judgment capacity. Specifically, through lecture materials, group discussion, and study presentation, it is possible to increase the diversity and effectiveness of teaching. Further advancement is planned through interaction with remote areas, securing safety in times of a natural disaster, utilization in extracurricular activities, and cooperation with families. On the other hand, MEXT published several reports and pamphlets, including "Realizing subjective learning of children by using ICT effectively" (MEXT 2014), which described educational methods utilizing ICT, and suggestions for identifying its effects through academic exams and questionnaires.

Shimoji secondary school in Miyakojima City, which aimed to improve academic ability in remote islands, was chosen as a future school promotion project of MIC (between FY 2010 to 2013, and from FY 2010 for a secondary school). As described in the beginning of the result report (2014) by the Board of Education in Miyakojima City, "There are many remote islands around Miyakojima, and since the issues the area is facing such as long commuting distance and education are closely related" (page 2 of the report), the objective is "to enhance linkage among families, schools and local communities to solve problems specific to Miyakojima" (page 2), and various efforts were made to improve classroom teaching.

Miyakojima City has many schools for its population size, and excluding the central urban area, the number of students in each school is small. In addition, since it is geographically dispersed, it is difficult to provide a high level of education at all schools. To solve such issues, class construction using the merits of ICT was attempted. Reasonable results were gained such as by providing a tablet PC for each student and teacher, installing an interactive whiteboard and wireless LAN in all general classrooms, promoting cooperative education using ICT, promoting

linkage among schools, families and areas, and promoting interaction among schools (Mitomo 2014).

3.3 *Pioneering Education System Demonstration Project and ICT Dream School Practice Model*

After the future school promotion project ended, the MIC newly started the "ICT dream school discussion group" in June 2014 with the purpose of using ICT in education, accelerate its spread, and discuss the future education and learning environment using ICT and diffusion method.

ICT is progressing rapidly through the spread of inexpensive and high-performance information devices, development of the broadband environment, development of cloud technology, and emergence of big data analysis. All these make it easier to provide a learning environment with opportunities to overcome differences, a seamless education environment through education platforms, and a learning environment corresponding to individual progress by using learning record data. "The purpose is to discuss the future education and learning environment with the latest ICT, policies for diffusion, and the development of new business" (MIC 2014a).

The discussion results of the group were summarized as "ICT dream school",[1] and the following three types were proposed as practical model ideas, "Learning linkage type of school, family, and region," "Regional revitalization and town development type," and "Advanced learning style type." By using the cloud that had just emerged, it was aiming at constructing a low-cost system, distributing digital teaching materials, and an operating system-independent environment. The proposed contents were promoted by linking with "Pioneering education system demonstration project (ICT dream school innovation demonstration study)" (FY 2014 to 2016) of the MIC.

The joint project between the MIC and MEXT was implemented successfully in the future school promotion project, and so joint efforts were planned also on the "Pioneering education system demonstration project." Furthermore, one of the major characteristics is cooperation with "ICT CONNECT 21 (Future learning co-development meeting)" which aims to develop the digitization of education based on cooperation among education ICT-related groups, companies, and experts along with the trend of participation in the ICT education business by the private sector.

Utilization of the cloud was a significant issue, and the project aimed to achieve linkage among schools and parents, and educational support for education ICT. In the "Examination study on pioneering ICT utilization in the education field" conducted in 2013, knowledge was gained on the importance and technological methods of using the cloud, and preparations to use the cloud were made. As described in "Implementation guidelines on the selection of the demonstration area" (MIC 2014b), the issues are "Constructing the learning and education cloud platform as the diffusion model,

[1]The name "Dream school" is derived from "Dream School Project," an education ICT project using the cloud in Finland.

demonstrating daily operation and utilization methods, discussing the functions and technological specifications required for the diffusion model of a low-cost, standardized education ICT system, and verifying its effectiveness and issues" (MIC 2014b). Therefore, a platform using HTML5, the international standard technology for the cloud and browsers, was newly built, three areas were selected as demonstration areas, the effectiveness of the education cloud platform was verified, and its results were promoted as the diffusion model. Shinchi-machi in Fukushima Prefecture, Arakawa district in Tokyo, and Saga Prefecture were selected as the demonstration areas, and the education cloud platform was built through the cooperation of many business entities and vendors.

In addition to the three demonstration areas, 68 schools participated in the project as verification cooperation schools in three years. Among them, 8 full cloud model schools and 20 overseas education facilities are included.

Based on the demonstration results in three years, "Education ICT Guidebook version 1" (MIC 2017c), which summarized pioneering cases of cloud utilization under the slogan of "Better education with the cloud," and implementation procedures were created and distributed to schools and the Board of Education. Furthermore, "Education cloud platform: Reference technological specifications" and "Education cloud platform: Reference procurement specifications" were presented, and technological guidelines for education cloud implementation were proposed. In the "Demonstration practice report regarding the education cloud platform using pioneering information communication technology" (MIC 2017b), the final report of the pioneering education system demonstration project evaluation committee (Chairperson: Hirotaka Shimizu, Tokyo Institute of Technology, professor emeritus) presented in December 2017, the effects on schools, municipalities, the Board of Education, business entities, and markets as the results of the specification of development and standardization on demonstration environment regarding the education cloud platform were presented. Especially, since a primary merit of the cloud is cost reduction by sharing, the degree of cost reduction with the education cloud platform was calculated and compared to the case of individual in-school server development. Relative to "Local intranet/in-school server structure" for which the cost per school was the largest as 100, it was found that a cost reduction of approximately 40% was possible by using the cloud. Furthermore, when the cost of various technologies was compared by fixing the municipality size, it was found that the cost was lowest when direct Internet was established with a school and the education cloud platform was used (See Fig. 6).

Since only a limited number of municipalities participated in the project, the sharing effect was not observed, which is a characteristic of the cloud system. It is anticipated that the more municipalities or schools would participate, the less the cost burden per municipality or school could be. Therefore, the sharing effect of the cloud could not be verified from the demonstration results. The MIC was focused on system development in this demonstration project. Although one of the purposes was to verify the effect of the cloud and the focus was placed on the cost reduction effect, a sufficient number of data were not obtained to confirm the merits of the cloud. However, the education cloud foundation, which was built with the nation's

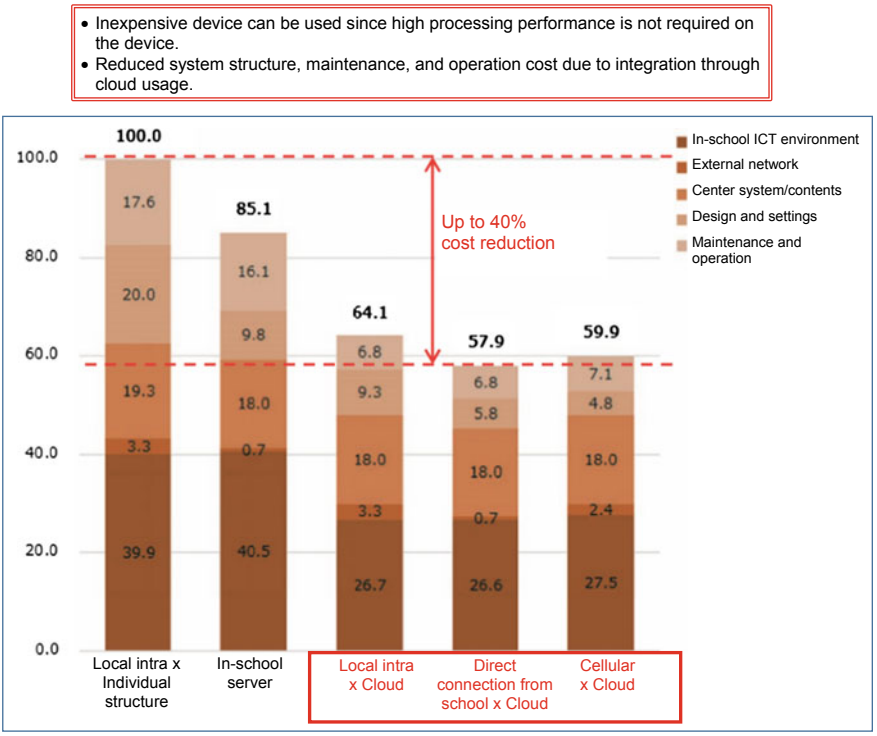

Fig. 6 Comparison of total cost per technology (annual price per school assuming 5 years). MIC (2017b)

support through this project, was continued later as a private project by NTT Communications, which was the managing underwriter of this project. The method that the country builds the education cloud foundation which is then gradually migrated to the private sector is the same approach as the dream school project in Finland, and operation by the private sector is sought to realize in the future.[2]

[2]EduCloud in Finland consists of infrastructure services that provide authentication, security, and data storage functions, management services that provide settlement and license management, and customer services that provide distribution of teaching materials. The major characteristic of the promotion system of the EduCloud project is that responsibilities are assigned, and cloud development and operation are conducted by the government and people with the roles and responsibilities clearly divided. The EduCloud project is promoted by the government and a private consortium who pay the cost; however, at the start, the country took the leading role. To operate EduCloud continuously and independently, Finland is gradually reducing its involvement and will migrate to project operation mainly by a private consortium called EduCloud Alliance (Mitomo 2015).

3.4 Smart School Platform Demonstration Project

The smart school platform demonstration project was started in 2017 with the aim of increasing ICT in education in the future. As before, the project is conducted jointly with MEXT ("Next-generation school support model structure project" for MEXT). Along with this project, the MIC is conducting a demonstration project to develop the "Next-generation school ICT environment."

The purpose of the project is to integrate the education ICT system (teaching and learning) and schoolwork support system that have been developed separately, to effectively combine the data generated from the both sytems, and to standardize the integrated system. The MIC calls this cloud-based system "Smart school platform."

To date, the two systems were not combined mainly due to security concerns. However, when security is ensured and it becomes possible to share and associate data mutually between both systems, even more efficient educational operation will be achieved, the workload of teachers will be reduced, and the system cost will be lowered. Finally, more human resources can be applied to education itself, contributing to the improvement of education quality. As a result of a public tender, 19 schools in 5 areas were chosen, and the demonstration project will be deployed in the future (MIC 2017a).

On the other hand, according to the public tender for the demonstration area to participate in the "Next-generation school support model structure project" of MEXT, the purposes of the project are "to conduct a demonstration that improves class and school operation and the quality of study guidance and student guidance by teachers through linking schoolwork information with learning record data on students (classroom and study records such as learning histories and study results) effectively and through visualization of the linked data" (MIC 2017a).

At the time of writing of this paper, practical discussions by the evaluation committee of the smart school platform demonstration project had just begun. Since there are various opinions on combining the classroom/learning system and the schoolwork system, the success of this project depends on whether a truly secure integrated system can be built and its merits can be materialized.

3.5 Public Wireless LAN System Construction Assistance Project

This project is based on the Construction Plan of Wi-Fi Systems for Improved Disaster Response, a three-year plan running from FY 2017 through FY 2019 (MIC 2016a). Under the Project, MIC provides assistance to local governments and municipalities to construct Wi-Fi systems to improve disaster response capabilities at disaster relief centers (such as schools and other evacuation shelters, evacuation sites, and public offices) and public centers (museums, cultural properties, nature parks, etc.) where stronger disaster protection is needed in areas susceptible to natural disasters. The

Wi-Fi systems are intended to ensure means of communication in the event of a disaster.

4 Programming Education Initiatives

4.1 The Program to Promote Youth Programming Education in FY 2016 and 2017

Prior to compulsory programming education in 2020, MIC worked on developing teaching materials and training teachers with the FY 2016 and 2017 Project to Promote Programming Education for the Young Generation (MIC 2016b). MIC ran 40 trial programs in 36 prefectures as models for implementing programming education while sharing and using online teaching material content and teaching knowledge, as well as developing local personnel to be instructors. The goal was to provide every child with high-quality programming education regardless of their geographic or physical conditions. MIC also conducted traveling classes primarily in prefectures where no trial programs took place.

MIC then held presentation meetings on the results of the initiatives in the trial regions contained in the FY 2016 supplementary budget and the FY 2017 initial budget. The meetings were held in 11 locations across the country—Sapporo, Sendai, Tokyo, Nagano, Kanazawa, Nagoya, Osaka, Hiroshima, Takamatsu, Fukuoka, and Naha. The implementing organizations gave presentations and held panel discussions at these meetings.

The developed teaching materials and other outcomes were posted for the public for free on a Web site. MEXT, MIC and the Ministry of Economy, Trade and Industry (hereinafter referred to as METI) are cooperating on expanding the adoption of these materials through the Future Learning Consortium (MEXT et al. 2017), which was established in March 2017 with educational and IT companies and ventures.

4.2 The FY 2018 Regional IoT Learning Promotion Project (Regional ICT Clubs)

MIC is running the Regional IoT Learning Promotion Project (MIC 2018), a two-year plan starting in FY 2018. As part of this project, MIC took proposals from April 10 to May 18, 2018, of programs to demonstrate structures (regional ICT clubs) that enable students and residents (including adult workers, older people, and disabled people) in local regions to learn programming and other ICT skills together in a fun environment and to form bonds for the new era. MIC announced on June 29 the 19 trial programs, after those 4 programs were added that would be run. Regional

ICT clubs have been launched, as of January 2019, in 23 locations stretching from Hokkaido to Okinawa.

The regional ICT clubs are intended to verify respective issues from 10 different perspectives: (1) progress (introductory level and intermediate level, etc.), (2) intergeneration exchanges, (3) coordination and support for ICT acquisition by the disabled, (4) coordination with elementary and junior high schools and students, (5) local contributions from universities and other organizations, (6) development of successors for local industries (sharing of knowledge from older people, etc.), (7) community building and revitalization by local companies and shopping districts, (8) distance learning in collaboration with remote islands, (9) resolution of local issues, and (10) exchanges with people outside Japan.

4.3 Further Policy Efforts

The Study Group on Future Creation for the New IoT (Internet of Things) Age set up under the Information and Communications Council's Information and Communications Policy Section in November 2017 and the Personnel Development Working Group set up under the Study Group have been examining approaches to education to develop the personnel that will be required in the upcoming era, in which IoT, artificial intelligence (AI), robotics, and other technologies will have permeated broadly into our daily lives, workplaces, and public spaces (MIC 2017d). In August 2018, the Information and Communications Council issued its fifth interim report on the question of New Approaches to Information and Communications Policy for the IoT/Big Data Era (Inquiry No. 23 of 2015). The report recommended "the creation of new local communities around regional ICT clubs and similar programs" and proposed the need for "the establishment of environments where everyone can learn ICT together (formation of new communities)."

The report called for the creation of regional ICT clubs tailored to local circumstances where preschool children and elementary school and junior high school children can acquire programming and other skills from early childhood and where adult workers, older people, and disabled people can also join and learn together. Such regional ICT clubs are desirable in the interest of preparing for the full advent of the IoT and AI era. This involves acquiring twenty-first-century skills (creativity, logical thinking, communication skills, ICT literacy, and other skills people will need to be productive workers in the twenty-first century) and addressing the coming transformations in employment structures, as IoT and AI may supplant workers in simple standardized operations. The report also recommends the provision of opportunities for young generations to experience success and to experience business first hand, along with the establishment of processes to develop entrepreneurs and to develop advanced network and security personnel and personnel to serve at IoT and AI user companies.

5 Advancement of ICT Utilization: ICT Utilization from Problem-Solving Type to Value Creation Type

ICT is a tool for solving problems. Especially, after ICT infrastructure was developed through a series of priority measures since 2000, the use of ICT to solve regional problems was promoted to encourage ICT utilization in regions. ICT utilization in education is also an important field to utilize the developed foundation for regional ICT. However, because the development of the ICT foundation for schools is delayed, it is difficult to expect contributions to promoting usage of the regional ICT foundation. Therefore, for information-related projects in education by the MIC as well, the main purpose is to help increase efficiency and promote problem-solving in the education field.

Furthermore, in recent years, much effort to increase the value added by using ICT in various areas has been made. Through ICT, innovative renovations such as new services and the creation of new projects are made. In education, through ICT utilization, in addition to solving problems, attempts are being made to raise the quality of education and efficiency by providing new education opportunities and new types of education.

The MIC positions ICT as "a tool that has various effects such as making learning subjective, cooperative and inquisitive (active), providing adequate material for each student (adaptive), and improving and conquering obstacles that prevent learning (assistive)",[3] and aims to deliver various effects by promoting digitization.

On the other hand, MEXT (2016b) is planning to achieve the following objectives with education digitization toward the 2020s:

- Improvement of the classroom and enrichment of learning for individuals through active, subjective, interactive, and deep learning that is necessary for future society
- Increase of ability to use information including programing and information ethics
- Promotion of evidence-based school and classroom operation
- Development of an environment in which individual teachers can fully exercise their ability and spare time for students.

To achieve these objectives, it is necessary to cooperate with related organizations, share ideas, and collaborate with industry, academia, and government.

5.1 ICT Use of the Problem-Solving Type

Since ICT equipment and networks are not widely used in schools, it is necessary to start by improving the ICT environment in the education field. It could be said that digitization of education simply boosted by ICT development, but gradually ICT has been recognized as a tool for improving education and deep learning.

[3] "Promotion of education digitization," Ministry of Internal Affairs and Communications' Web site http://www.soumu.go.jp/main_sosiki/joho_tsusin/kyouiku_joho-ka/index.html

There are two approaches to introducing ICT in primary and secondary education. One is to introduce ICT in education itself in the classroom and learning to improve education. The other is the so-called "Schoolwork support system" which assists the administrative work of teachers.

The field of education is diverse and has various issues. Solving or reducing such issues to deepen learning is the first step for ICT utilization. Along with the arrival of the information society and borderless society, it is important to nurture the ability to judge conditions for oneself. To do this, it is necessary to promote subjective consideration, cooperation with society, enhancement of communication ability, and improvement of the ability to identify and solve problems. On the other hand, regarding problems, the main targets are social problems such as lack of autonomy, bullying and school absenteeism, isolation, lack of sociability, and lack of problem-defining and -solving ability. Some of these have arisen from ICT itself.

By preparing appropriately designed education with network and ICT equipment, which are the responsibility of the MIC, many of these issues could be addressed. However, to achieve the effects expected by society, it is necessary to increase the use of ICT in education in general. To date, advanced ICT education has been limited to the areas and schools that played a pioneering role in the demonstration projects. The proportion of these schools to the total number of schools is very small, and it is difficult to generate ripple effects.

A major impediment to the spread of ICT education is its huge associated cost. Each school is required to make a large investment in ICT education such as for the introduction of ICT equipment, installation of networks, usage fees for educational contents, and maintenance and management expenses. For devices, fixed costs could be reduced with bring your own device (BYOD); however, there are pros and cons about BYOD as it may become an obstacle because the system must support multiple operating systems, and it may reflect the disparity of household income and degree of understanding of families.

5.2 ICT Use of the Value Creation Type

Japan's ICT utilization, in general, tends to lean toward solving problems and reducing cost. There is little focus on new value creation. The policy on using problem-solving-type ICT resulted from the development of broadband and advanced communication infrastructure; however, its utilization did not advance and so efforts have been made to find effective applications.

In B-to-B utilization, cost reduction is the largest issue and ICT is an important method to apply. However, for B to C, instead of cost reduction, it is important to gain satisfaction and convenience for end customers and users.

Children of the digital generation quickly learn how to use ICT equipment such as PCs and tablets. However, they do not feel excited by the equipment itself like with a new toy, so it is necessary to know what kinds of enjoyment or motivations they can get from using ICT. Therefore, ICT should be something to make them appreciate

the efficiency of learning, raise their learning achievement, and experience deeper understanding.

The purpose of active learning is to foster ability by raising subjective learning and learning activities. The effective use of ICT is expected to reinforce its effects. Though it is difficult to approach the contents of education from the ICT side, introducing ICT can be an important opportunity to change education methods for students who are accustomed to receptive learning and for teachers who structure education accordingly. To conduct education effectively by using ICT, a different education method from the conventional type is necessary, and through such approach, the benefits of ICT can be gained for the first time. Though active learning tends to be interpreted broadly, expectations for it are high.

Flip teaching is also facilitated by ICT. According to Matsubara et al. (2014), in the flip teaching conducted at higher grades of elementary schools in Takeo City of Saga Prefecture, the students found more fun in flip-teaching classes; however, the teachers pointed out that further preparation was necessary to convert from uniform-type to cooperative-type lessons. Also, there is an urgent need to effectively use ICT for the development of programing education and science, technology, engineering, and mathematics (STEM).

5.3 *Providing Educational Opportunities—Remedial Teaching*

ICT can be an important tool for the inclusion of people with disabilities in education. Various supportive approaches have been considered (e.g., Sekimoto 2006, 2009). On the other hand, the number of students who cannot attend school has increased since 2012, with no signs of a decrease (Fig. 7). According to a study by MEXT

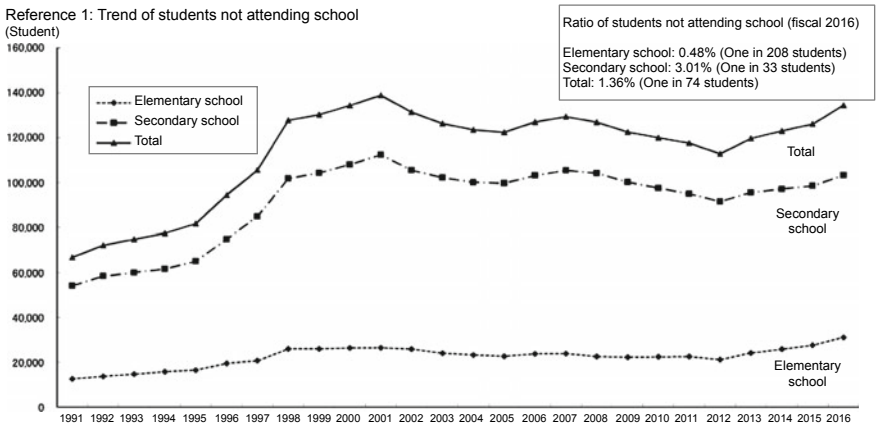

Fig. 7 Changes in number of students who do not attend school. Reference: MEXT (2017a)

(2017a), the number of students not attending school in elementary and secondary schools is 134,398, which is 1.4% of all students. The figure was 125,991 in the previous year (1.3%). According to the study, the main reasons for not attending school related to the student himself/herself were "anxiety" and "lethargy." Regarding factors related to schools and families, they were almost equally split between the two. Especially for the former, "issues in friendships excluding bullying" and "poor academic achievement" were dominant.

In addition to the students who do not attend school, even if students could go to school, they cannot study in the classroom due to such issues as fear of bullying and interpersonal relationships, and so many students attend small classes called an adaptive guidance classroom, and stay in the school infirmary to study. For those students who need special support due to disability, etc., Chapter 1 Article 2-4-2 (10) in "Special education elementary school and secondary school curriculum guidelines" (MEXT 2009) specifies that "For guidance of each subject, students shall get accustomed to information measures such as computers and information communication networks, and learn about basic operation and information ethics. While learning activities are fulfilled to utilize them adequately, subjectively and actively, in addition to these information measures, adequate teaching materials and measures such as audiovisual materials and education equipment are needed. Also, the creative use of study materials and education equipment matching the state of disability and characteristics of students shall be made, and the learning environment shall be designed to increase the effects of guidance." Thus, the effective use of ICT is suggested.[4]

Among the ICT dream school demonstration model projects, in "Remedial education model for students who have difficulties in attending school and learning" (2015, Sharp Corp., 2016, NTT Learning Systems), a demonstration experiment was conducted on a remedial education model for students who have difficulties in attending school and learning. In the project conducted in 2016, to help students attending adaptive guidance classes to return to regular classes, the regular classroom and adaptive guidance classroom are connected by a large television conference system that monitors changes in their awareness and motivates them to return to the regular classroom, and its effects were verified. Since the demonstration experiment period was short and the number of target students was limited, it was not found to be significantly effective; however, some signs were shown that such a learning environment motivated the students to return to the regular classroom (Fig. 8).

[4]In the guideline published in April 2017, "Guideline for special support school teaching" (MEXT 2017b), to nurture information utilization ability, "In each school, the necessary environment shall be developed to utilize information measures such as computers and information communication networks, and enhance the learning activities through adequate use thereof. Also, adequate use of teaching materials and education tools such as various statistical materials, newspapers, audiovisual materials, and education equipment shall be provided" (Chapter 1, Section 4-1(3), page 14). Also, depending on the types of disabilities, it states "Information equipment such as computers shall be utilized effectively and to increase the effect of guidance" (Chapter 2, Section 1-1-2 (6), page 24 and others), and thus, more precise use of ICT is sought.

Fig. 8 Miyakojima in Okinawa Prefecture—remedial educational model adaptive guidance classroom (picture by the author). *Note* When shooting, it was projected on only one side (existing school classroom picture)

6 Issues on ICT Education from the ICT Side

6.1 Issue on Network and Equipment

As described in Section 2 (2), the deployment of ICT infrastructure in schools is lagging, and the network capacity is not sufficient. Especially when schools access the Internet through the intranet of the local municipality, there are communication restrictions due to security reasons, and the speed is too slow. Once such a problem occur during remote communication through a network that the speed is suddenly reduced with too many people accessing the network, the educational effect is reduced. An independent access line can solve this problem, but is costly.

Introducing equipment is very expensive. If the service is provided for free to students, the burden on the municipality is heavy. In Saga Prefecture, all new students in public high schools were required to purchase a tablet device from 2014. But this caused so many problems that they switched to the free rental method. Also, information devices quickly become obsolete, and the performance becomes inadequate before ending the devices' life.

Regarding BYOD, whereby students bring their own device, there are cases overseas such as Finland[5]; but this is difficult in Japan. In addition to the burden on the family and equality of educational opportunity, the different types of device and operating system can make the system unstable, pushing up the operation cost. However, it is expected that these problems will be rapidly solved by technological development.

For teachers to focus on education, when conducting ICT education, the presence of an ICT support personnel to maintain and manage the system and hardware is essential. Therefore, personnel resources and budget must be secured to ensure effective ICT education; otherwise, teachers end up solving troubles with devices and networks and cannot make time for education. Especially, since problems are likely to occur upon introduction and switching the system, such personnel have a key role to play.

6.2 Issues on Implementation of the Cloud

In all demonstration projects, the major ICT trend is the cloud. One of the benefits of the cloud is lowering costs because users can share the same applications and contents on the same platform or linked platforms. In addition, since the system does not have to depend on the size of the municipality, schools even in small to medium-sized municipalities will be able to participate.

The cost effectiveness of education on the cloud has not been evaluated. For reference, somewhat old data of the MIC (2003) showed the results of simulating the cost reduction effect of shared usage of the system by multiple local public groups. In the simulation, a municipality with approximately 15,000 residents was assumed, and the average cost for each municipality in 4 years was compared. The number of municipalities (n) was set to 10, 20, 30, and 50 under certain assumptions. The results of the simulation showed that, assuming the total maintenance cost was set at 100 when the maintenance was conducted independently, the cost would decrease to 57.3 ($n = 10$), 38.8 ($n = 20$), 31.7 ($n = 30$), and 26.1 ($n = 50$). Although these were hypothetical values calculated under certain assumptions, they suggest that cost can be greatly reduced by joining.

However, there are problems when municipalities are joined. When an on-premise service is migrated into the cloud-based platform, the sales revenue for the service provider tends to decrease due to the joint effect. To prevent this and to maintain the revenue, the platform provider tends to offer customized specifications for each municipality. Also, it is difficult to maintain multiple platforms competitively. When multiple platforms exist, competition occurs, but once it becomes monopolistic, the service may become rigid and the fees may remain high. The platform business has

[5] Kasavuori Junior High School in Finland, which the author visited in February 2015 for the survey of MIC, uses BYOD.

monopolistic features caused by the network effect (e.g., Parker et al. 2016). For the same type of services, it would finally result in a monopolistic state.

Regarding problems on the municipality side, they are willing to customize the system specifications by including additional functions. When unique specifications are required, cost reduction through joint effects cannot be expected. Through customization, a system becomes complicated and maintenance cost increases. Also, especially in a small municipality, skilled personnel are limited and so they must depend on a vendor for technical issues, and it is difficult to escape from being locked into the vendor. Also, each municipality has a different degree of commitment to implementing education ICT, making the entire deployment very difficult. A cloud service does not require geographical proximity. If municipalities can obtain a certain scale through mutual linkage, they will gain negotiating power, which can be an advantage at the time of implementation.

7 Conclusion

Japan is not a pioneer in the use of ICT for education. The causes include a lack of financial resources, literacy of teachers, and undeveloped infrastructure; however, it is not clear which is the main factor hindering the development of ICT education. There are many examples overseas where countries achieve good results with much worse communication infrastructure than in Japan. The trend toward using ICT in elementary and secondary schools is progressing steadily, but the main reason deterring active use of ICT for education is because its true benefits are not foreseen.

For the schoolwork support system, since teachers can actually feel the reduction of hours and effort they put into schoolwork once they get used to the system, the system is spreading rapidly. In order for education using ICT to increase its effectiveness, the education system needs to be overhauled. When ICT spread in offices, the companies that renovated the organization simultaneously gained major benefits, but when renovation of the organization was not conducted, efficiency did not improve and productivity even declined. By the same token, the education system needs to be overhauled to attain the effective use of ICT. If the effects of ICT for education cannot be clarified by showing the mechanism of the effects, society will not be convinced. It is difficult to grasp the effects of education quantitatively rather than just through the improvement of grades; however, the effects are not clearly shown. Though some effects can be recognized, they are not enough to make society turn toward ICT education.

Higashihara (2008) systematically summarized the transitions of using ICT to improve learning ability in elementary and secondary schools between 1970 and 2008. In conclusion, it states, “Teachers should know that ICT can be used with conventional ideas or only with innovative ideas” (Higashihara 2008, p. 250). Obviously, it is necessary to establish an innovative method to use ICT as an effective tool.

A lesson obtained from the education ICT demonstration experiment projects of the MIC is that, in order to make a change to effective education using ICT, demonstration experiments lack a sense of scale and linkage. Projects in Japan are still in the early stage and are not viable for the private sector by nature. Once project schools are selected, each proceeds with a demonstration project independently. The MIC checks the state of progress, but there is little linkage effect between the schools. The only exception is that teachers visit each other. An overall project management is necessary that shares the conditions and issues of utilizing ICT through developing a network of project schools. Education is regarded as an important tool for international cooperation in addition to human resource development. The new smart school platform demonstration project that begins from FY 2017 should focus on new innovation toward this end.

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International Cooperation ODA

Yuji Hatakeyama

Abstract A telecommunications network is an essential component of a national infrastructure for both socioeconomic development and modernization. Since the middle of the twentieth century, Japan's government and industries have made significant financial and human resource investments in conducting a variety of ODA programs. This chapter provides an overview of Japan's international cooperation in the field of telecommunications, describing the characteristics of its assistance compared to other major donors and the specific support for the development of telecommunications infrastructure in developing countries. Furthermore, Japan's approach to multilateral frameworks specializing particularly on the telecommunications sector and the direction of future international cooperation in the ICT field are summarized.

1 Introduction

Official development assistance (hereinafter referred to as ODA) is defined by the Organization for Economic Cooperation and Development (OECD) as government aid designed to promote the economic development and welfare of developing countries. Aid may be provided bilaterally, from donor to recipient, or channeled through a multilateral development agency such as the United Nations or the World Bank. Aid includes grants, "soft" loans (where the grant portion is at least 25% of the total), and the provision of technical assistance.

Just after the end of World War II, Japan was a recipient of such aid. The Government Appropriation Relief in Occupied Areas (GARIOA) and the Economic Rehabilitation in Occupied Areas (EROA) programs from the United State provided emergency aid for daily necessities and played a significant role in Japan's postwar rehabilitation. The World Bank continued to provide financing from 1953 until 1966, an effort that eventually totaled $860 million. Soon after it stopped being a recipient country, Japan became a direct donor. Japan, therefore, was able to provide assistance

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to recipient countries from the perspective of a nation that had once been a recipient. Thus, Japan has a unique history that makes it different from other donor countries (Nishigaki et al. 2009).

Japan's ODA programs can be roughly divided into bilateral and multilateral aid as shown in Table 1. The Japan Bank for International Corporation (formerly the Overseas Economic Cooperation Fund) lends funds at a Japanese yen base rate to the governments of developing countries. Grants are a form of non-reimbursable aid and are used to fund not-for-profit projects that provide significant public benefits. Technical cooperation includes training personnel from recipient countries, sending Japanese technical experts abroad, and donating equipment. Multilateral cooperation means making contributions to international organizations.

Japan's government is currently appealing to the world about the importance of investment for high-quality infrastructure in developing countries not only for telecommunications but also in other sectors. In order to spread awareness of the concept of high-quality infrastructure on a global basis and to improve the quality of infrastructure in each country, the Ministry of Internal Affairs and Communications (hereinafter referred to as MIC) has established the guidelines for Information and Communication Technology (ICT) and has been promoting its benefits.

From the time that Japan began to distribute foreign aid, it has actively worked to develop infrastructure in developing countries through ODA loans. It has also considered technology transfer and human resource development to be equally important in enabling developing countries to maintain and develop their own infrastructure after the completion of ODA loan projects. Japan's ODA activities commenced in 1954 as part of its commitment to the Colombo Plan which sought to develop south Asia and the southeastern Asian countries. Japan started accepting telecommunications trainees from the Asian region in 1955. Since that time, Japan's government

Table 1 Categorization of foreign aid activities

Activities			
ODA (official development assistance)	Bilateral aid	Financial aid	Loan assistance
			Grant aid
		Technical cooperation (grant aid)	Acceptance of trainees
			Dispatch of experts
			Dispatch of JOCV[a]
			Technical cooperation projects
			Development studies
	Multilateral aid (contribution to international organization)		
OOF (other official flows)	Export credit Direct investment, etc.		
Private flow	Export credit Direct investment, etc.		

[a]*JOCV* Japan overseas cooperation volunteers (young persons with specialized knowledge)

and industries have made significant financial and human resource investments, conducted a variety of ODA programs, and contributed to expanding the telecommunications infrastructure and human resource development in developing countries, especially in Asia.

A telecommunications network is an essential component of a national infrastructure for both socioeconomic development and modernization. For developing countries, the development and expansion of their networks are a fundamental prerequisite for economic growth. Since the middle of the twentieth century, assistance to developing countries in the telecommunications field has become increasingly important. Japan's ODA programs have generally been implemented, as appropriate, in terms of the recipient country's level of development, as shown in Fig. 1.

This chapter provides an overview of Japan's international cooperation in the field of telecommunications, focusing on ODA activities. Section 2 describes the position of the telecommunications sector in Japan's ODA and the characteristics of its assistance compared to other major donors. Section 3 outlines the current situation and specific support for the development of telecommunications infrastructure in developing countries. Section 4 describes Japan's approach to multilateral frameworks specializing particularly in the telecommunications sector. Section 5 summarizes the direction of future international cooperation in the ICT field.

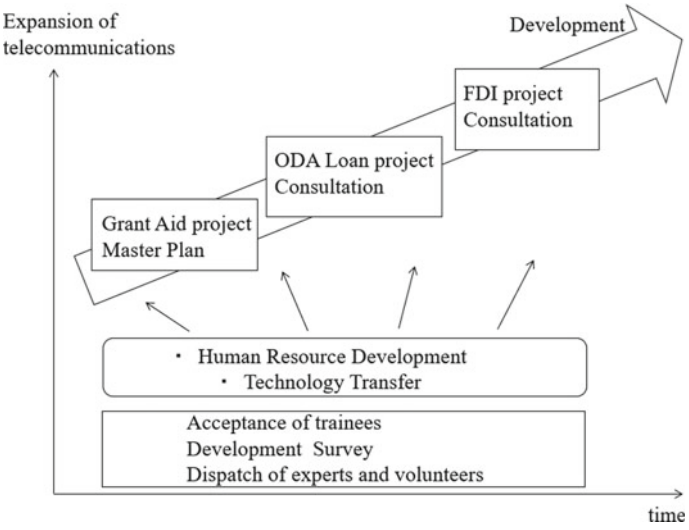

Fig. 1 ODA programs and development. *Source* derived from Hatakeyama (1997)

2 Performance of Japan's ODA in the Telecommunications Sector

For more than half a century, Japan has provided various types of support for ICT development in developing countries. Comparing the results with those of other aid agencies and analyzing their characteristics will clarify Japan's aid policies and concepts.

2.1 Largest Donor in the Telecommunications Sector

Japan's ODA steadily increased until the 1990s; its annual contribution became the largest in the world. General accounts budgets, however, were reduced due to financial constraints after the peak in 1997. In addition, summing up the size of the commitment shows that ODA's size in the telecommunications sector has been decreasing since the 1990s as shown in Fig. 2. The change in the telecommunications sector's share of ODA for Japan and Development Assistance Committee (hereinafter referred to as DAC) countries is shown in Fig. 3. Although Japan, DAC countries, and the World Bank have shown a tendency to decrease the amount of funding, compared with other developed countries, Japan has maintained a higher ratio of its telecommunication's share. This means that Japan has continued to regard the telecommunications sector as important.

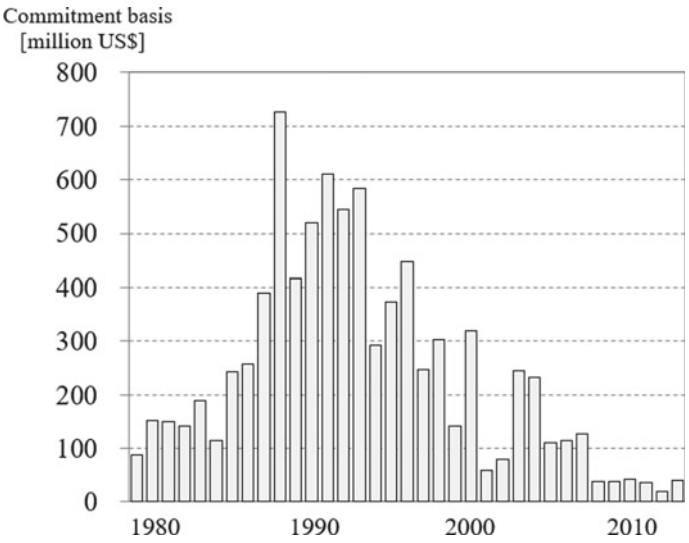

Fig. 2 Japan's bilateral ODA disbursement to the telecommunications field. *Source* Hatakeyama and Mitomo (2013)

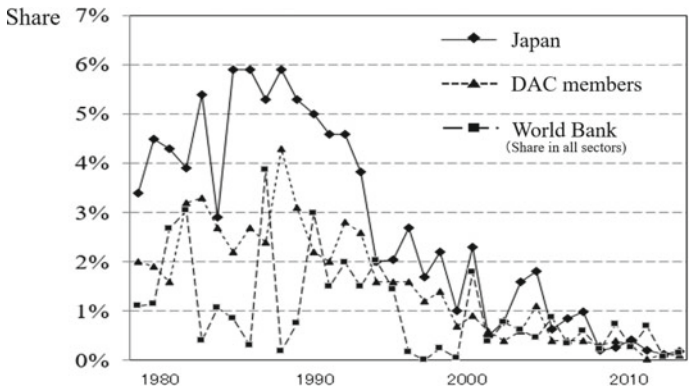

Fig. 3 Transition of telecommunication's share in bilateral ODA. *Source* Hatakeyama and Mitomo (2013)

As shown in Fig. 4, although Japan's ratio as a donor to global bilateral aid ODA is 15%, the ratio of Japan's contribution in the telecommunications field is 32%. It has been said that Japan has always regarded economic infrastructure as important and the telecommunications field as being even more important.

In addition to bilateral assistance, Japan has continuously provided a large contribution to international organizations engaged in activities in the information and communications field, such as the World Bank, the United Nations Development Programme (UNDP), the International Telecommunication Union (ITU), and the Asia-Pacific Telecommunications Community (APT). Japan has become the world's largest provider of aid in the telecommunications field.

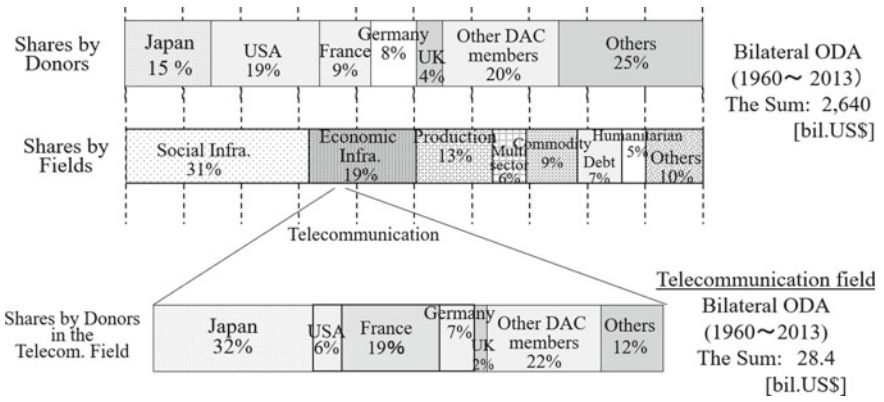

Fig. 4 Shares of bilateral ODA and telecommunication field by donors. *Source* Hatakeyama and Mitomo (2013)

2.2 Significant Allocation to the Asian Region

Japan's ODA efforts began with its participation in the Colombo Plan and Japan initially promoted ODA together with its World War II reparations. Therefore, Japan's assistance has been focused on Asia. The regional allocation of each of Japan's assistance programs in the telecommunications field is shown in Fig. 5. The regional allocation of total DAC member's ODA, and the telecommunications sector's ODA from the World Bank are appended for reference. Across all the programs, the proportion of Japan's ODA efforts in Asia is quite high.

The ratio is particularly high in Thailand, Indonesia, and the Philippines in the telecommunications sector. After the normalization of diplomatic relations with China, China's received share of ODA aid rose in the 1980s. Compared with the World Bank and DAC, Japan has a higher ratio of its effort in Southeast Asia in the telecommunications sector.

The development survey program of the Japan International Cooperation Agency (JICA), which conducts feasibility studies and master planning for financial ODA projects in Japan, has allocated a high proportion of ODA to the Asian region since the beginning of ODA activities. Loan/grant aid projects were established based on the results of a survey. The Asian region was naturally a significant recipient. The allocation of grant aid to the Asian region exceeded 70% in the 1970s. Although the annual sum to the Asian regions continued to increase until the 1990s, however, the proportion of ODA allocated to Africa increased after the 1980s because the number of eligible countries there increased. Moreover, with regard to loans that recipients were required to reimburse, the proportion allocated to Asia, where growth was expected, was high. The portion allocated to Africa was low.

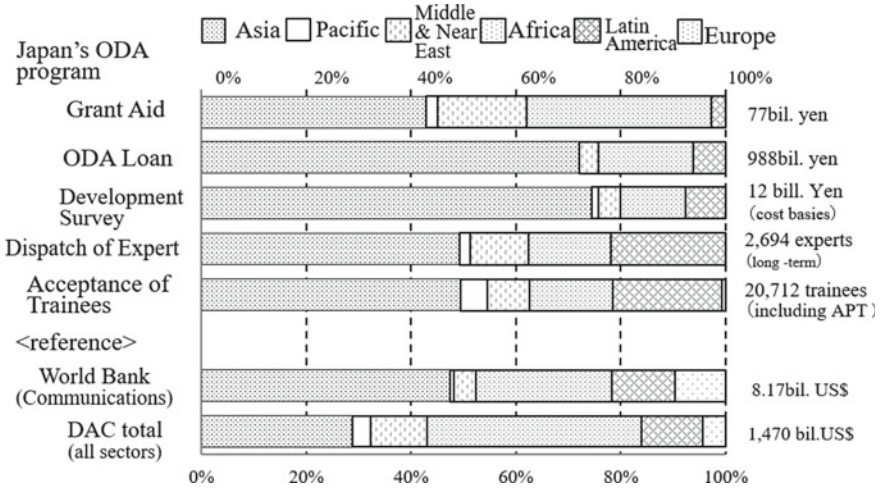

Fig. 5 Geographical distribution of Japan's bilateral ODA (cumulative total from 1955 to 2013). *Source* Hatakeyama and Mitomo (2013)

Regarding the expert assignment program, the proportion allocated to the Asian region is also high. In Latin America, however, which has a large population of Japanese descent, the number of experts dispatched there is higher than that for other assistance programs. Human resource development was important for the Latin American region. Although the proportion of aid allocated to Asia is also higher than that allocated to other regions for training programs, Japan has accepted trainees from all parts of the world. Most countries, other than developed countries, have sent trainees to Japan's programs.

2.3 A High Ratio of Loans

After World War II, Japan received many loans from the World Bank, which contributed to its infrastructure and industrial development during the subsequent economic high-growth period. Based on this experience, Japan has focused on infrastructure development and provided ODA loans, so-called yen loans, as its main source of assistance. It is said that in order to encourage self-reliance on the part of developing countries that receive this aid, the proportion of ODA loans with reimbursement obligations has increased.

In addition, since the latter part of the 1970s, Japan's increasing trade surplus has become an international issue. Japan has had to seek quantitative expansion of ODA as one measure to deal with this problem. Thus, yen loans utilizing financial investment were used (Udagawa 2011). In fact, more than 60% of Japan's total bilateral ODA was allocated to yen loans. In the telecommunications sector, the percentage of yen loans is even higher, at more than 75% (calculated by the author based on the DAC Statistics).

In developed countries in Europe and the USA, grant aid is common. Therefore, for DAC members the total loan share, excluding Japan, was 18%. However, in the field of telecommunications, loans account for 45% of the total ODA of DAC except for Japan. It is clear that Telecommunications projects have been generally evaluated as a profitable and successful course in the future (Hatakeyama and Mitomo 2013).

2.4 Human Resource Development

Network expansion projects, financially supported by a donor country, can produce tangible results in a relatively short period of time. In the areas of technology transfer and human resource development, the results are not as immediate. In the 1990s, the opinion of the World Bank and Western countries was that technical assistance did not contribute to capacity development in the target sector or the country as a whole and had little long-term impact (UNDP 1991). Japan's technical cooperation, however, has taken the position of supporting efforts to develop self-reliance in developing countries, based on Japan's experience as a country that has received aid. Therefore,

Japan has provided ODA loans with a reimbursement obligation and has carried out technical cooperation for human resource development in developing countries.

As for the acceptance of trainees in the field of ICT, Japan's government and telecommunications operators developed courses tailored to the needs of developing countries. It has provided a wealth of practical courses at training centers of incumbent telecommunications operators using the same facilities used in commercial operations. On the other hand, most developed countries in Western donor countries pay college expenses and utilize existing courses at universities and research institutes (JICA 2003).

Each of Japan's ODA programs integrates human resource development in the recipient country. Japan's technical cooperation has emphasized the cultivation of human ability. In accordance with this principle, for over half a century, Japan has continually offered telecommunications engineers from other countries the opportunity to receive training in Japan. Moreover, after summarizing changes to the theme and contents of the training courses as shown in Fig. 6, it is clear that the contents of infrastructure-related courses have changed according to the effects of technological progress, moving to digital and Internet Protocol (IP) from analog. Training themes have shifted from the planning, construction, and maintenance of legacy infrastructure systems to mobile IP or applications such as telemedicine and disaster prevention. On the other hand, management seminars for executives have continued relatively unchanged for over 50 years because their universal themes are still applicable. Although the number of training programs has not decreased, other aid programs in the telecommunications field have done so. It is clear that the acceptance

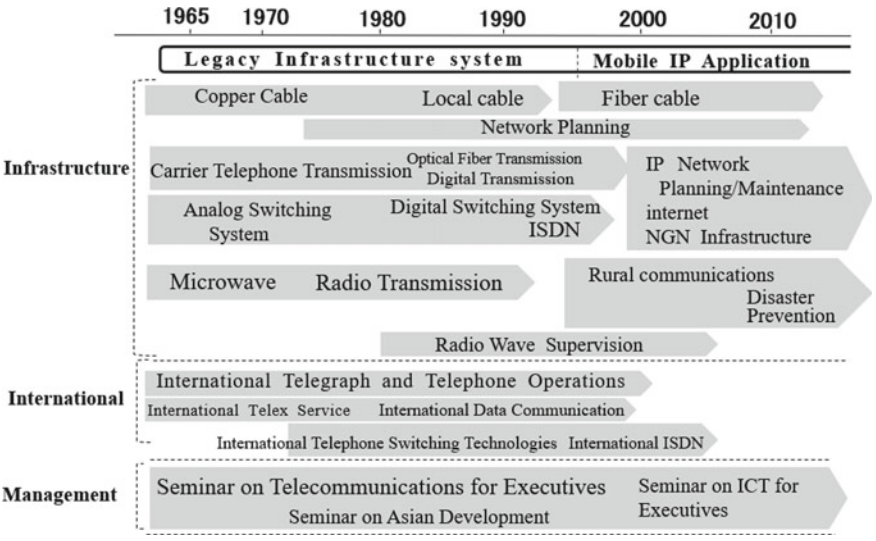

Fig. 6 Changes of the Training Program. *Source* Compiled by the author from Japan's white papers on ICT and JICA annual reports

of trainees is beneficial for the development of human resources and the transfer of technology to developing countries.

Japan has established telecommunications training centers in Southeast Asian and Latin American countries. In these countries, following project implementation, the network is developed smoothly because experts are dispatched where they are needed and training programs are carried out simultaneously. The King Mongkut's Institute of Technology Ladkrabang (KMITL) projects in Thailand have been recognized as the most successful example of Japan's all-ODA projects with developing countries, and not just in the telecommunications sector. KMITL, developed from the telecommunications training center established by the Japanese ODA half a century ago, has become one of Thailand's most prestigious universities. Following Thailand, regional training center projects were implemented in other southeastern Asian countries. Further, in Latin America, eight telecommunications training center projects were conducted in five countries through project-type technical cooperation.

3 International Cooperation on High-Quality Infrastructure

There is a strong correlation between infrastructure investment and economic growth. As for the ICT infrastructure, it is possible to achieve long-term growth through economic innovation and technological progress by constructing and maintaining a domestic infrastructure (Straub et al. 2008). Currently, The Government of Japan as a whole is making efforts to establish "high-quality infrastructure" investment internationally. In the ICT field, "high-quality infrastructure" must be reliable, scalable, cost effective in the long term and able to provide various kinds of services. Japan's ODA effort has contributed to the development of telecommunications infrastructure and human resources in developing countries as described in the previous section. Although the ODA budget has decreased, Japan still contributes toward promoting high-quality infrastructure investment using the latest technologies, mainly in developing Asian countries by enlightening and training activity and supporting Japanese companies that expand overseas.

In order to promote the concept of "high-quality infrastructure" internationally in the field of ICT and to improve the quality of infrastructure in each developing country, MIC established the "investment guidelines 'High-Quality ICT infrastructure'" in July 2017. It is working to share the guidelines with ICT policy-makers in each country through its diplomatic missions overseas.

3.1 Paradigm Shift in Telecommunications Infrastructure

Information and communications services are an indispensable element in various fields, including medical care, disaster prevention, and education. At present, many applications, utilizing IoT and big data, useful not only for developed countries but in developing countries as well, will be deployed using the telecommunications infrastructure as shown in Fig. 7.

Advances in IP technology and mobile communications technology have led to a shift from dedicated technologies for telecommunications operator to universal technologies in the public market as shown in Fig. 8. In accordance with market principles, widely accepted de facto standards have begun to be adopted in telecommunications equipment. The shift also coincided with the timing of privatization in telecommunications and the introduction of the competitive environment. Therefore, telecommunications technology has come to be more innovated by private companies, and the private sector should be involved strongly in future ODA activities.

In the era of analog technology in the latter half of the twentieth century, the world's telecommunications equipment manufacturers developed and exported small-capacity telephone switching systems and transmission systems to developing countries. Neither system has been widely deployed due to cost and operational problems. However, in the twenty-first century, systems developed and introduced in developed countries using new technologies such as IP and wireless became applicable to developing countries, even in rural areas. Because of the paradigm shift shown in Fig. 8, public telecommunications operators are required to construct highly reliable networks as a public network while using general-purpose technologies and systems for consumers. Therefore, Japan has to assist developing countries, showing them how to construct high-quality and resilient ICT infrastructure.

ICT infrastructure is constructed with various network elements as shown in Fig. 7. Local fiber cable is now utilized as a means to connect radio base stations and core networks as a part of a mobile network, rather than as subscriber circuits, fiber to the

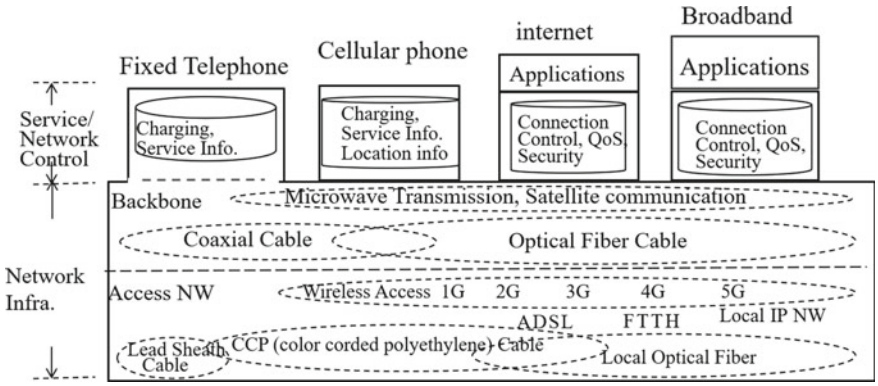

Fig. 7 Structure of infrastructure and services. *Source* Hatakeyama and Mitomo (2017)

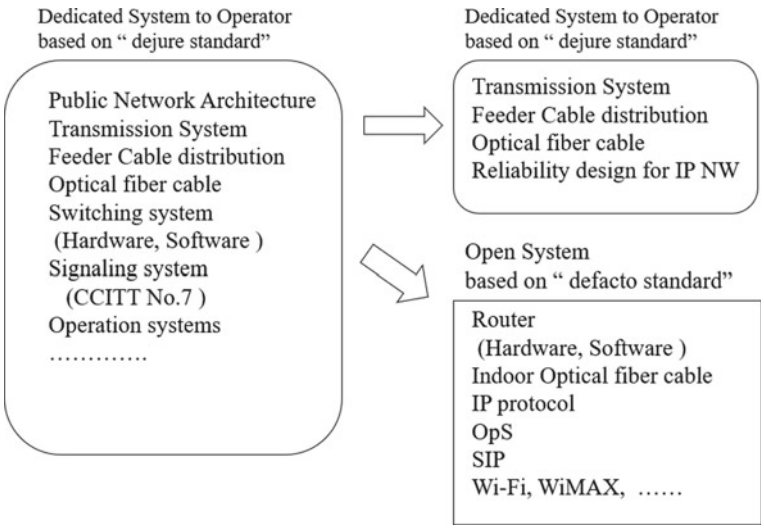

Fig. 8 Paradigm shift of telecommunications system. *Source* Hatakeyama and Mitomo (2017)

home (FTTH). The fifth-generation mobile communication system requires larger capacity and shorter delays. Even in developing countries, in order to spread broadband services universally and equally, it is essential to convert local networks from copper to optical networks. High-quality infrastructure needs sufficient terrestrial facilities. As ICT infrastructure becomes important, large investment is required. Financial support and technical cooperation through ODA will still be necessary in the future.

3.2 Infrastructure and Applications

Since the 1990s, both developed and developing countries have privatized their telecommunications businesses and Japan's ODA budgets for the telecommunications sector have decreased (Fig. 2). In the rural areas of less developed countries, much of the demand for telecommunications infrastructure is not concentrated. Therefore, it is difficult for private companies to invest in infrastructure. There is a limit to the extent to which private companies can be expected to engage in international cooperation activities from the perspective of corporate social responsibility.

Developing countries in Asia and Africa, however, still have substantial requirements for investments in telecommunications infrastructure. As shown in Fig. 7, various application services are implemented on the telecommunications infrastructure. By creating business models and applications that meet regional needs for people

in developing countries, it will become possible to stimulate demand for telecommunications infrastructure and to manage it as a business. There are a variety of applications for the local community. Applications can also be used for community management to transmit information on local products and tourism using the Internet, construction of a system to protect the natural environment such as weather observation, and emergency communication during natural disasters. Remote education and telemedicine are also effective applications. Business models and applications deployed on the telecommunications infrastructure as the platform need to be locally appropriate and proper to stimulate demand for infrastructure investment. As a result, the infrastructure expands and more convenient services are provided on the expanded infrastructure. This kind of development leads to positive feedback. Therefore, it is worth Japan's ODA enhancing telecommunications training courses on infrastructure and applications to address regional issues.

In the 1990s, the development of infrastructure itself through private finance initiative (PFI) such as build, operate, and transfer (BOT), and build, own, and operate (BOO) attracted attention. However, today's ICT business needs to include applications. Figure 9 shows an ICT business financing method. This method calls for using private capital to fund profitable parts of the project and public funding for the unprofitable parts. In the case of large-scale infrastructure projects, ODA must be utilized. This method, in which the public and private sectors cooperate to provide funds for highly public applications, is effective.

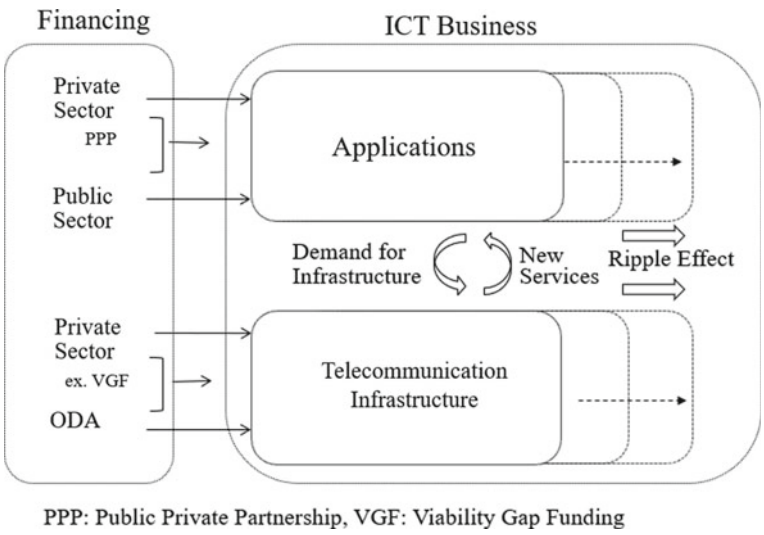

Fig. 9 An example of financing method for ICT business system. *Source* Hatakeyama (2009)

3.3 Overseas Deployment of High-Quality Infrastructure

In the era of global networks, in which a large amount of information streams across national borders, it is important for developed countries and their telecommunications operators to enhance networks in developing countries due to "demand externality" (Mitomo 1995). It is also essential for international standardization activities and the overseas expansion of Japanese telecommunications operators and manufacturing companies to gain a better understanding of Japan's information and communications technology and experience gained from many developing countries through ODA activities.

Recently, Japan's government has concluded the "Memorandum on Cooperation in the Field of Information and Communications Technology" with Indonesia in 2015 and Philippines in 2017, respectively. They are proceeding to enhance their infrastructures for broadband networks. For Myanmar, Japan has supported the improvement of the telecommunications infrastructure through ODA loans (maximum 10.5 billion yen). In Vietnam, a memorandum of understanding has been concluded and renewed that strengthens cooperation on 4G and 5G radio policies, cyber security, and IoT (MIC 2018).

The telecommunications infrastructure is continuously expanding and developing, and it takes time for its effectiveness to be achieved. This goal requires a long-term commitment by the donor countries. It is necessary to coordinate not only ODA projects but also foreign direct investment (FDI) by the Japanese companies, and for both to be engaged continuously or in parallel.

To that end, it is also important to improve the investment environment by supporting the regulations and policies within the recipient Nations. In a wireless-based infrastructure and multicarrier environment, it is important to establish regulations governing frequency allocation, interconnection, and tariff structure, as well as to establish regulatory bodies for fair administration. In the least developed countries, it is also necessary to transfer practical knowledge such as the ICT policies that Japan has experienced in response to changes (Fuke 2007). JICA and international organizations, such as the World Bank and the International Monetary Fund (IMF), provide long-term policy advisors and training for developing countries. This assistance should be strengthened through ODA activities.

With regard to African, particularly sub-Saharan countries, Japan provided ODA loans to 10 countries in the region, but the results were not satisfactory. Their former colonial powers and Japan did not provide continuous and long-term support and involvement. Neither did they provide sufficient assistance for facility construction and human resource development. This failure is a major factor behind the stagnation that has existed in the development of telecommunications there. Japan should utilize its experience in Asian countries to support the development of ICT in Africa. The Japanese government is supporting development in all sectors, including ICT, through the Tokyo International Conference on African Development (TICAD). On the other hand, currently, Chinese companies are entering their telecommunications markets under the leadership of the government. For donor countries, from a

long-term perspective, providing assistance for human resource development and technology transfer is indispensable.

3.4 Overseas Expansion of the Japanese Type of Digital Terrestrial Television Broadcasting

Broadcasting networks are a key infrastructure component along with telecommunications networks for broadband and interactive services. With the aim of improving the quality, multimedia use, and frequency efficiency of television broadcasting networks, digitization has been promoted worldwide since 2000. There are three ITU-recognized transmission standards for digital terrestrial TV. These are ATSC (developed in the USA), DVB-T (developed in Europe), and ISDB-T (developed in Japan). In Japan, digital terrestrial broadcasting was launched in December 2003 (MIC 2018).

MIC is energetically working for the adoption of the Japanese standard for terrestrial digital TV and further dissemination of this standard. Further, the expansion of cooperative relationships created in the field of terrestrial digital broadcasting to the entirety of the ICT field is also a goal. In the field of terrestrial digital broadcasting, MIC is working to spread ISDB-T with sufficient force within its unique functions to accomplish three objectives: to broadcast emergency warnings to protect people's lives, to enable reception of TV broadcasts with mobile terminals (One-Seg service), and to provide diverse services through data broadcasting (MIC 2018).

MIC dispatched appropriate experts on digital terrestrial television broadcasting to Latin American countries under the ODA program. As a result, many Latin American countries adopted the Japanese system. In Peru, a wide-area disaster prevention system, equipped with an emergency warning broadcast system (EWBS) using digital terrestrial broadcasting, was implemented in January 2016. The Maldives and Japanese governments exchanged letters concerning grant aid for the development of digital terrestrial broadcasting systems in 2016. Additionally, in the Philippines, digital television transmitters supplied by the Japanese companies were used to transmit full-scale Japanese terrestrial digital TV signals in the Metro Manila area and surrounding areas in January 2018. The number of countries adopting the ISDB-T standard has increased to 19 as of March 2018 (MIC 2018).

Digital terrestrial broadcasting is effective as a disaster prevention solution for developing countries where natural disasters such as earthquakes, tsunamis, and floods occur frequently. Japan should use its ODA program to provide aid not only to Asian and Latin countries but also African countries. Disaster prevention is a matter of public welfare and is also relevant to the UN's Sustainable Development Goals (SDGs).

4 Contribution to Multilateral Frameworks

Japan has been actively cooperating with various international organizations. MIC is involved in multilateral policy consultations with multilateral frameworks, including Group 7 (G7)/Group 20 (G20), Asia-Pacific Economic Cooperation (APEC), APT, Association of Southeast Asian Nations (ASEAN), ITU, United Nations, Internet Governance Forum (IGF), World Trade organization (WTO) and OECD and actively leading global collaboration efforts concerning the ICT field. Efforts include the promotion of the free distribution of information, creation of safe and secure cyberspace, development of high-quality ICT infrastructure, and contributions to the UN's SDGs (MIC 2018).

4.1 International Telecommunication Union (ITU)

ITU was founded in Paris in 1865 as the International Telegraph Union. It took its present name in 1934, and in 1947, became a specialized agency of the United Nations (ITU 2018). ITU aims to promote international cooperation for the improvement and rational use of telecommunications. It promotes the development and efficient operation of a technical means for the increased use and dissemination of telecommunications services.

ITU comprises three sectors. These are the ITU Radiocommunication Sector (ITU-R), the ITU Telecommunications Standardization Sector (ITU-T), and the ITU Telecommunications Development Sector (ITU-D), as shown in Fig. 10. Japan, including telecommunications operators, manufacturers, and academics, has made active contributions, such as proposing recommendations and appointing a large number of chairmen and vice chairmen of study groups (SG) in each sector and experts in charge of research subjects. From 1999 to 2007 Utsumi, Yoshio from Japan had served as secretary-general of ITU. The Government of Japan has been the largest financial contributor, along with the USA. While only contributions to the ITU-D are counted as ODA, Japan believes that the ITU-R and the ITU-T activities are also helping to develop telecommunications throughout the world, including in developing countries.

ITU-R conducts research on the use of frequencies and develops standards for wireless communications to ensure the rational, efficient, economical, and fair use of radio frequencies by all wireless communication services. Radio spectrum management through ITU is quite important. Japan will ensure global radio spectrum allocation through ITU deliberations and regional preparatory meetings. ITU will also gain an understanding of Japan's policies on spectrum allocation systems. In addition, Japan will secure and maintain its interests through discussion on adjusting its satellite orbit and frequency issues.

ITU-T is studying international standards for the technology and operation of telecommunications networks and the technical aspects necessary to develop them.

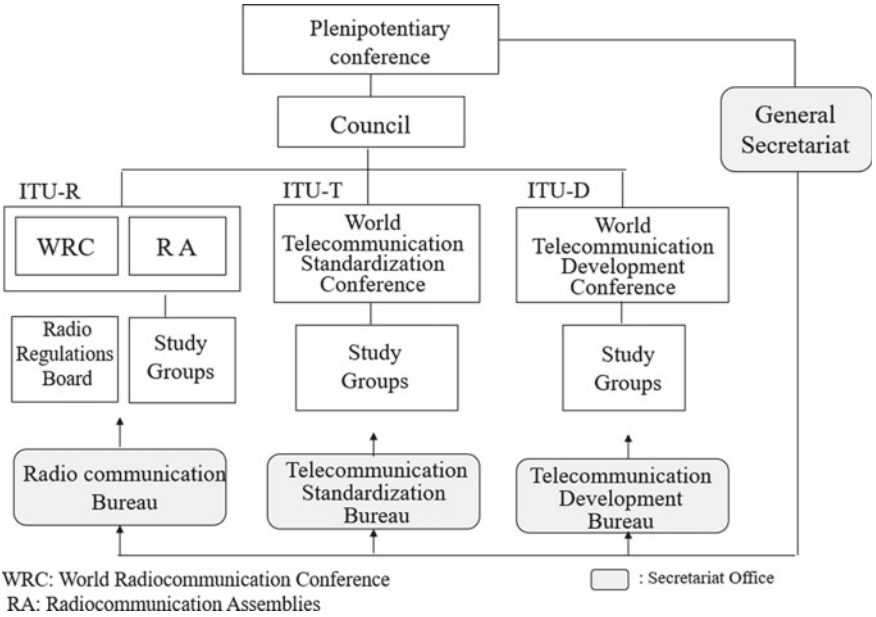

Fig. 10 ITU organization chart

Japan's government and private sector recognize the importance of technical standardization through the ITU. They have been providing SG chairmen and rapporteurs to influence standardization activities.

The telecommunications market is changing rapidly due to the digitalization of technology and the penetration of the Internet. It has become difficult for the ITU de jure standard, which is based on unanimity, to follow these market movements. Japan is promoting the adoption and coordination of de facto standards in ITU-T, which are the results of the forum activities led by the private sector.

In Europe, European Telecommunications Standards Institute (ETSI), a regional standardization body, is exercising its influence by gathering the views of members and making recommendations. Japan thought it is necessary to compile opinions from the Asia-Pacific region and make proposals to the ITU-T. Japan is promoting the adoption of Japanese and regional proposals and technologies as international standards through the ITU and Asia-Pacific Telecommunity Standardization Program (ASTAP) which is the regional cooperation on standardization among APT Members.

ITU-D supports the development of information and communications in developing countries. Various research issues, including rural communications, access for persons with disabilities, smart cities, e-health, cyber security, and disaster prevention, are discussed. Japan provides appropriate experts as rapporteurs to study issues, share best practices, and formulate guidelines that are discussed to promote ICT international strategy. Japan aims to eliminate the digital divide in developing countries.

Japan is addressing ITU-D activities from a long-term perspective. If developing countries improve their infrastructure and introduce new technologies, the Japanese telecommunications industries will be more active in these countries. Through ITU-D activities, it is possible to understand the specific needs of developing countries. Government and private sectors then can network with key people in developing countries.

4.2 Asia-Pacific Telecommunity (APT)

APT was established in 1979 as an intergovernmental organization for the development of telecommunications in the Asia-Pacific region under Japan's leadership. In addition to its regular contributions, Japan's Government has made extra budgetary contributions to the APT since 1992 for the purpose of international contributions, secure regional leadership, and support overseas development of ICT industries. Japan is annually bearing more than 50% of the total cost of APT's activities (calculated by the author based on (MOFA 2018)). All contributions to APT are ODA disbursements. Since its establishment, Japanese bureaucrats have been elected to serve as secretary-general or deputy secretary-general. To eliminate the gap between developed and developing countries and between urban and rural areas in the region, APT conducts human resource development through training and seminars, and regional policy coordination such as standardization and wireless communications. Through its contributions to the APT, Japan supports activities such as the acceptance of trainees and the exchange of ICT engineers and researchers in ICT fields in which Japan is competitive. These activities include broadband and wireless communications. In 2017, Japan supported the implementation of study visits, international joint studies, and two pilot projects.

In addition to development assistance, APT gathers regional opinions and proposes them to international organizations such as the ITU. In terms of standardization, APT formed ASTAP in 1998 to establish regional cooperation on standardization among APT members and to contribute to global standardization activities. It is one of the major APT work programs in the area of standardization and technology development. Over the years, ASTAP has matured to fulfil its objectives and has become a regional platform for cooperative standardization activities. Currently, ASTAP is working on many important areas related to standardization and technology development (APT 2018).

The APT Wireless Group (AWG) is covering various aspects of emerging wireless systems including 4G/5G to meet the upcoming digital convergence era in the Asia-Pacific region. It is assisting in the process of providing cost-effective radio communications solutions and facilitating technology transfer. Japanese industry experts have been appointed to the posts of chairman of the AWG and vice chairmen of expert groups.

4.3 G7 and G20

As globalization and digitization of socioeconomic activities promote information distribution and business services across borders, active discussions are taking place within the G7 and G20 frameworks. The meeting of the G7 ministers of information and communications in Japan in 2016 was the first meeting under the framework of the G7. That meeting accomplished four objectives. First was the resolution of the digital divide through high-quality ICT infrastructure. The second objective was the promotion of the free distribution of information based on cyber security and privacy protection. The third objective was to promote new innovations such as IoT, big data, and AI. Finally, the meeting encouraged the utilization of ICT for global issues such as disaster prevention and health care.

The G20 framework, which includes China, Russia, and India, also continues to discuss the digital economy. Based on the results of the G7/G20, Japan is working to develop high-quality ICT infrastructure overseas, to examine international guidelines for AI development, to encourage international cooperation to promote IoT through public-private consortiums, and to promote international cooperation in the sharing of cyber-attack information.

Along with the G7 and the G20, Japan will also work with relevant countries in other international forums such as the OECD, APEC, ASEAN, and WTO to disseminate Japan's ideas and opinions to support for a multi-stakeholder approach, and to reflect these messages in the outcome documents of these international forums. These efforts include the promotion of free distribution of information, creation of safe and secure cyberspace, development of high-quality ICT infrastructure, and contributing to the UN SDGs (MIC 2018).

5 Conclusion

Since the 1950s, Japan has supported the development of telecommunications networks in developing countries based on the experience gained in its rapid postwar reconstruction and expansion of the telephone network during the period of high economic growth. In the latter half of the twentieth century, Japan provided reimbursable ODA loans, mainly to developing Asian countries.

In the area of ODA in the field of telecommunications, Japan has contributed to a large percentage of the world's donor groups. In terms of regional distribution, Africa accounted for the highest proportion in the World Bank and DAC countries, while Japan had the highest proportion in Asia, especially in Southeast Asia. Based on the principles of self-reliance efforts and ownership, Japan's ODA has invested significant aid resources, human, and financial resources, in ODA loan projects, which are reimbursable, to promote their self-reliant development and to meet the human resource development needs of the telecommunications business through technical cooperation with ODA.

When implementing ODA loan projects, Japan provided various technical cooperation programs in response to the human resource development needs of the telecommunications business and also supported sustainable development after the projects. Japan's ODA has contributed to the development of telecommunications infrastructure and human resources in developing countries. Japan has accomplished high-quality ODA activities in the telecommunications field.

In the twentieth century, telecommunications carriers provided telephone services based on hardware technologies such as telephone switching systems and metallic cables. Currently, however, various application services such as telemedicine, disaster prevention, and distance learning are deployed and provided in the infrastructure comprising IP protocol, wireless broadband, and optical fiber cable (Fig. 7). It is also necessary to consider using ODA to develop rural areas in combination with other sectors to stimulate investment in infrastructure development. Japan will continue to provide assistance while emphasizing ICT infrastructure and incorporating effective application services. Furthermore, ODA must be effective for international organizations such as ITU-D or APT to conduct pilot projects and present successful examples in rural areas of least developed countries.

Japan actively cooperates with various international organizations. In the field of telecommunications, Japan has contributed to the activities of the ITU and APT, in particular, in order to promote Japanese technologies and high-quality infrastructure in developing countries. Recipient countries have to improve the investment environment by supporting regulations and policies domestically. Therefore, it is important to establish regulations governing frequency allocation, interconnection, and tariff structure, as well as to establish regulatory bodies for fair competition. Japan will lead to policy consultations and international ICT cooperation through its participation in the G7/G20 and other frameworks.

ICT infrastructure is a form of social common capital that supports all private industries from agriculture to commerce, as well as public services such as administration, education, and health care. Now that the ODA budget has been reduced, Japan should provide high-quality ICT development assistance from a quantitative perspective. Specifically, Japan's cooperating public and private sectors must implement continuous international cooperation activities from a long-term perspective. These activities include human resources development, infrastructure development support, financial support, and private direct investment.

ICT plays a significant role in the process of achieving the UN's SDGs. With that into consideration, ODA resources should be allocated. Japan's ICT industry cannot expand overseas without development cooperation and coordination with developing countries.

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