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Standardization of Companion Device Architecture of Hybridcast

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C O N T E N T S

About ITU-AJ

The ITU Association of Japan (ITU-AJ) was founded on September 1, 1971, to coordinate Japanese activities in the telecommunication and broadcasting sectors with international activities. Today, the principle activities of the ITU-AJ are to cooperate in various activities of international organizations such as the ITU and to disseminate information about them. The Association also aims to help developing countries by supporting technical assistance, as well as by taking part in general international cooperation, mainly through the Asia-Pacific Telecommunity (APT), so as to contribute to the advance of the telecommunications and broadcasting throughout the world.

Standardization of Companion Device Architecture of Hybridcast

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Japan Broadcasting Corporation (NHK)

1. Introduction

With the recent growth in popularity of the internet and smartphones, it is now easy for information and services to be accessed by anyone, anywhere. On the other hand, television broadcasting has been the principal source of media in people's living-rooms for about the last sixty years. However, if broadcasting is to retain its position as a reliable, topical and familiar communication medium, then we believe that it will have to become capable of cooperating with a wide variety of other services in the future in order to keep up with remarkable changes in people's lifestyles [1].

In 2013, as a means of facilitating cooperation between broadcasting and internet services, an integrated broadcast-broadband system called Hybridcast[2] was standardized by the IPTV Forum Japan and the Association of Radio Industries and Businesses (ARIB). NHK and commercial broadcasters have now started offering a growing range of services, and it is expected that the total number of Hybridcast-compatible televisions shipped in Japan exceeded ten million sets by May 2019[3]. In Hybridcast, it is possible for televisions to display internet content that tracks the progress of broadcast programs, and to provide online "catch-up" services where people can watch programs that were broadcast earlier. It is also possible to provide companion screen services that cooperate with smartphones to offer features such as displaying information about a program that is currently being broadcast. In this way, various broadcasting companies have provided services that use broadcasting as a starting point for linking to internet content.

However, over the last few years, there have been dramatic changes in the amount of time people spend consuming media — while smartphone usage has increased significantly, television viewing has been declining. In particular, survey results show that smartphone usage and television viewing times are reversed among young people[4]. In the light of this changing role of media in people's lives, we think it is important to use the internet as a starting point for facilitating simple collaboration with broadcasting in order to provide better opportunities for people to interact with television broadcasts.

Since 2017, therefore, broadcasting companies and television manufacturers have been promoting studies at IPTV Forum Japan aimed at extending Hybridcast and enabling collaboration of services between broadcasting and the internet so that smartphone applications and IoT-enabled devices (IoT="Internet of Things"), which are expected to become widespread in the future, can initiate collaboration with broadcasting. In September 2019, standards were established by IPTV Forum Japan and ARIB.

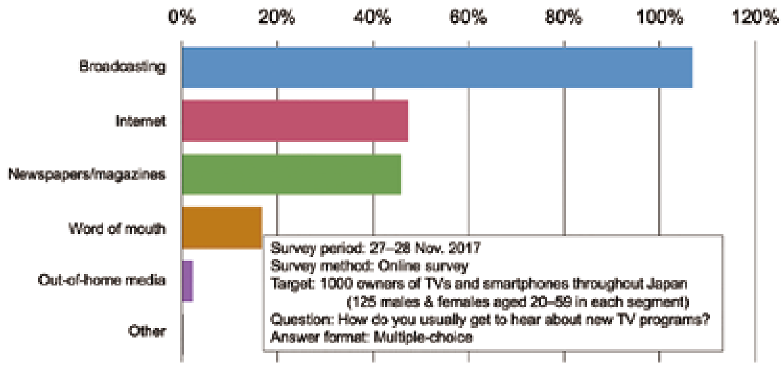
Section 2 of this paper introduces the current status and issues of collaboration between broadcasting and internet services, and section 3 introduces the standard technologies that are used in current integrated broadcast-broadband services and companion screen services. Section 4 then summarizes the newly standardized companion device architecture of Hybridcast, section 5 presents some examples of services that use this architecture, and section 6 describes the trends in Japanese domestic and international standardization. Finally, section 7 discusses the future prospects of this technology, and concludes with a summary.

2. Current status and issues of collaboration between broadcasting and internet services

Since the start of broadcasting in 1953, television has spawned a variety of cultures and social phenomena and has had a major impact on our daily lives. Until the turn of the 21st century, television was the dominant medium of entertainment. Families would watch television together in their living rooms and would discuss the previous night's drama shows at school and at work the following day. Popular programs with high viewing figures would appear one after another. However, the growth in popularity of the internet and smartphones over the last ten years has made it easy for anyone to access whatever information and content they want. As a result of this change in the way people access information, they are gradually spending less time in front of the television. In particular, the results of a survey[4] have shown that younger people spend more time using smartphones than they do watching television, so the role of television in everyday life is changing.

In this way, as people are tending to spend less time watching television and more time discussing broadcast programs online, there are increasing opportunities to obtain information about broadcasts from the internet. For example, it is not at all uncommon to see content related to broadcast programs among the top search results and hot topics on social networking services. Also, another survey[5] has shown that about 70% of people have become accustomed to using smartphones while watching television, and about 40% have used social networking sites. In addition, there are also many cases where broadcasters use the internet for purposes such as providing program-related information and offering VoD (video on demand) catch-up services that people can use to watch previously broadcast programs. It can therefore be said that broadcasting and the internet are highly compatible media.

■ Figure 1: Sources of information about new broadcast program



Therefore, by facilitating smooth collaboration between broadcasting and the internet across devices, we expect to achieve synergistic effects such as increased opportunities to use both types of service, and greater user satisfaction. But although the idea of integrated broadcast-broadband first came to the fore about 15 years ago, it has yet to result in smooth collaboration across a variety of different everyday scenes.

In recent years, the importance of user experience (UX) has attracted attention in the development of various services. In particular, to implement services that are continuously used, we need to come up with a strategy that not only has greater functionality and performance, but also provides service users with an enjoyable and highly satisfying experience, and to design a so-called customer journey — a series of processes that incorporate service elements. This sort of collaboration between broadcasting and internet services gives rise to the following issues from the perspective of UX design.

2.1 Use of internet services triggered by broadcast services

Recently, it has become commonplace for broadcast programs and commercials to contain broadcast-initiated links to related online content by displaying captions containing information such as URLs or search query terms. In such cases, even a user who has a smartphone to hand while watching television will still have to manually enter this URL or search query into a web browser. Another common approach is to use data broadcasting to display a QR code that can be used to access related information, but this still requires the user to perform the operation of capturing an image of this QR code with a smartphone. Users regard these operations as time-consuming interruptions to the viewing experience, and this tends to reduce the likelihood of achieving the goal of seeing related information on the internet. Therefore, to provide viewers with a seamless experience, it is necessary to have a mechanism whereby links from television broadcasts to online content can be provided directly from televisions to smartphones.

2.2 Use of broadcast services triggered by internet services

Meanwhile, on social networking sites and other websites, it is common to see banner ads and comments related to broadcast programs. We conducted an online survey of 1000 television and smartphone owners aged from 20 to 59 and found that 47% heard about new broadcast programs from online sources such as social networking sites, blogs, news articles, online program schedules, and broadcasting station websites[6] (Figure 1). The most common source of information about new broadcast programs was found to be broadcasting, such as electronic program guides (EPGs) or simply by seeing what is on television when it is switched on. In other words, the internet is the most common source of information about broadcast programs outside of broadcasting itself, making it an essential medium for improving the opportunities for introducing programs to viewers.

At present, however, even if a broadcast program is recommended by a friend via a social networking site to someone who is sitting in front of the television, it is still necessary to search for the remote control, turn on the power, and check the channel guide in order to select the correct channel. Once again, these additional tasks interrupt the viewing experience as described in section 2.1, reducing the likelihood of achieving the goal of seeing the recommended broadcast program. Thus, in order to achieve a more reliable flow from the internet to broadcasting, we need a mechanism whereby people can access broadcast programs more simply.

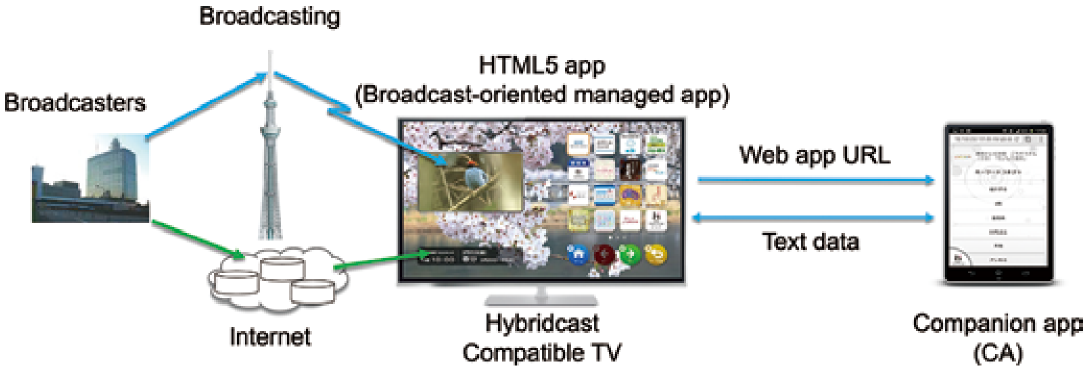
3. Integrated broadcast-broadband systems and companion device architecture

One way in which broadcasting services and internet services can be linked is through the use of an integrated broadcast-broadband system. In an integrated broadcast-broadband system, in addition to providing online content linked to broadcast programs displayed on television screens, it is also possible to provide a multi-screen service by linking televisions and smartphones. This section describes the current state of two representative integrated broadcast-broadband systems: Japan's Hybridcast[2] and Europe's HbbTV[7].

3.1 Hybridcast

Hybridcast is an integrated broadcast-broadband system that attained domestic standard status in 2013 at IPTV Forum Japan and ARIB and is now provided as a service by NHK and commercial broadcasters. The details will be described in section 7, but standardization is mainly being promoted by IPTV Forum Japan, with the standard specifications consisting of two technical specifications (Integrated Broadcast-Broadband System Specification[8] and HTML5 Browser Specifications[9]), and operational specifications (Hybridcast Operational Guideline[10]) that are necessary for implementing services. As of May 2019, the

■ **Figure 2: System model of Hybridcast**



total number of compatible television sets is over ten million[3], and services have been made available by approximately 25 broadcasters throughout Japan[11], with further expansion expected in the future.

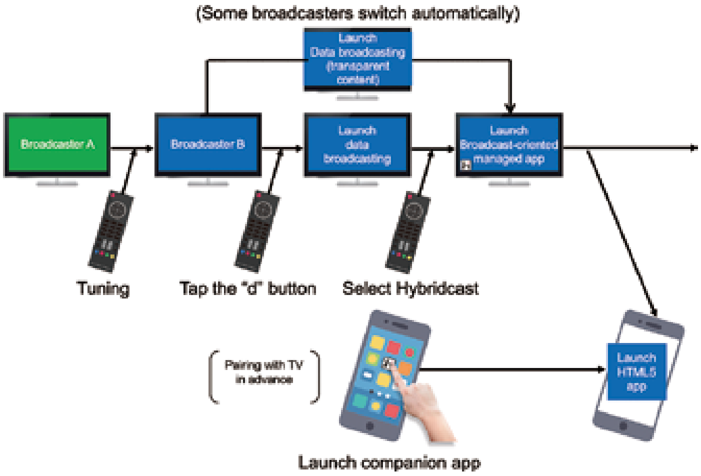
Figure 2 shows the Hybridcast system model. Hybridcast is a system based on HTML5 Web technology as standardized by the World Wide Web Consortium (W3C). Compatible televisions are equipped with an HTML5 browser whereby users can use an HTML5 application (hereinafter referred to as a broadcast-oriented managed application) to obtain online information about each channel from each broadcaster. This browser has an extended API for collaboration with broadcasting and can also control the behavior of the broadcast-oriented managed application while a program is being broadcast. By multiplexing with the broadcast signal, broadcasters can send either an Application Information Table (AIT), which consists of information used to control a broadcast-oriented managed application, or the URL of an AIT located elsewhere. The television can then use this AIT to launch a broadcast-oriented managed application. Currently, many broadcasters provide services using a method whereby an AIT URL is included in data broadcasts so that the broadcast-oriented managed application can be launched from a data broadcast.

In Hybridcast, it is also possible to play videos in the HTML5 browser. In 2014, a profile for the operation of services that distribute video content to televisions using the MPEG-DASH (MPEG Dynamic Adaptive Streaming over HTTP) international standard[12] was formulated in the 2.0 version of the Hybridcast Operation Guideline[10]. This profile has made it possible to play back 2K and 4K internet video on video players such as dashNX[15], which is written in JavaScript using the MSE/EME API (Media Source Extensions[13] / Encrypted Media Extensions[14]). Furthermore, IPTV Forum Japan has drawn up specifications clarifying the technical requirements, such as the functions that should be implemented in televisions, while organizing the requirements of broadcasters' video distribution services and how they should operate. In 2018, brand names and logos for 2K-compatible "Hybridcast Video" and 4K-compatible "Hybridcast 4K Video" were announced for televisions and video distribution services conforming to these specifications[16].

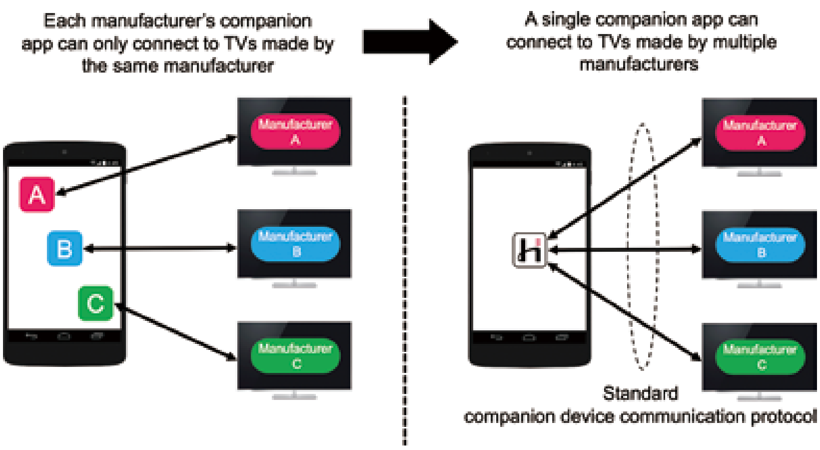
Hybridcast can also use a smartphone companion application (CA) to provide multi-screen services on televisions and smartphones. Specifically, in an environment where a television and CA are connected on a network in the same segment, the HTML5 application on the CA can be launched from the broadcast-oriented managed application on the television. Furthermore, since data messaging works both ways, the user can initiate a companion screen service from a television broadcast. For example, various broadcasters provide diverse services to CAs, such as linking them to the home page of the program currently being viewed[17].

Figure 3 shows the procedure whereby a user can access a companion screen service via Hybridcast. As a preliminary

■ **Figure 3: Set-up procedure for companion screen service**



■ **Figure 4: Standardization of companion device communication protocol**



step, the user has to install the CA on a smartphone. When using a service, the CA is started up on the smartphone, and then the remote control of a compatible television is used to select a channel. Next, the user activates data broadcasting by pressing the "d" button on the remote control, and the content is operated to start up the broadcast-oriented managed application. (Some broadcasters may start up the broadcast-oriented managed application automatically via a data broadcasting.) Thereafter, in response to instructions from the broadcast-oriented managed application, the HTML5 application is launched on the CA so that the companion screen service can be used. In order to use the service, the television and CA must first be associated with each other, and this is performed by pairing the device layers. Therefore, the service can easily be used without performing user account registration or login operations either in the CA or in the broadcast-oriented managed application.

As of July 2019, companion screen services are operated by using a CA equipped with a companion device communication protocol for collaboration between smartphone applications and televisions provided by each television manufacturer. Specifically, CA functions are implemented as part of each manufacturer's remote-control application, and the user must install each manufacturer's application on a smartphone. On the other hand, in 2016, v1.0 of the companion device communication protocol was standardized in version 2.4 of the Hybridcast Operational Guidelines in order to improve interoperability between different television manufacturers and deal with the diversification of smartphone applications providing companion screen services. Specially, as protocols whereby smartphones can search for and discover televisions, specifications were drawn up for the use of DIAL (Discovery And Launch)[18], which was devised as an open protocol mainly developed by Netflix, and WebSockets[19], which is used for messaging between broadcast-oriented managed applications and CAs. Whereas there have previously been limits on the CAs that can be used by television manufacturers, this standardization means that a single CA (common CA) can now be linked to televisions from different manufacturers (Figure 4).

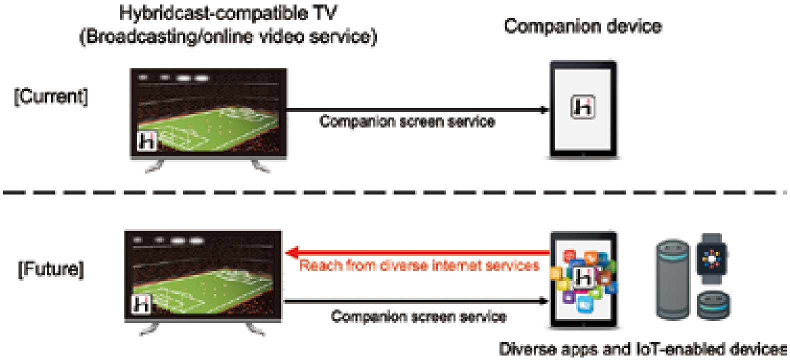
By using Hybridcast in this way, it is possible to achieve collaboration between broadcast and internet services across different devices including televisions and smartphones. However, since the current system design originates from television, it is difficult to establish collaboration from internet services on smartphones to broadcasting services on televisions. On the other hand, although the technical specifications of non-broadcast-oriented managed applications that can be started by non-broadcasting entities such as smartphones are specified in the Integrated Broadcast-Broadband System Specification[8], services that use this type of application are not yet available. It is thus presumed that a non-broadcast-oriented managed application is used across channels, which raises issues regarding their inability to launch when tuned to another channel, as can be achieved by a broadcast-oriented managed application.

3.2 HbbTV

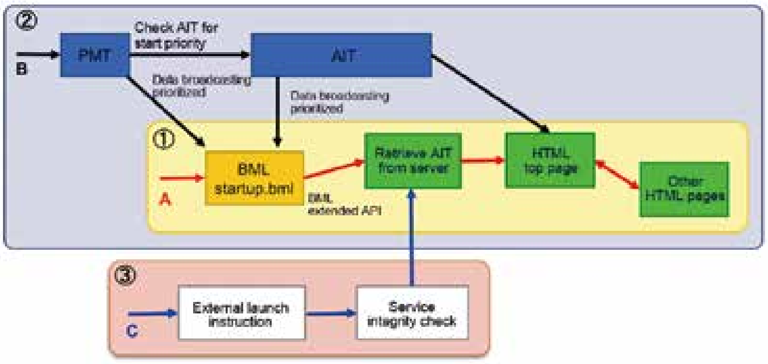
HbbTV is an integrated broadcast-broadband system developed in Europe. In 2010, HbbTV1.0[20] was standardized by the ETSI (European Telecommunications Standards Institute), and services were started in Germany and France. According to the HbbTV Association, as of February 2019, there are 44 million compatible televisions in 35 countries[7], almost all of which are compatible with HbbTV1.0. The HbbTV1.0 standard is based on the CE-HTML (HTML4) application execution environment, but a new HbbTV2.0 standard[21] was created in 2016 to support more advanced services. The HbbTV2.0 standard is almost the same as Hybridcast. It allows HTML5 applications to be run on televisions and supports companion device architecture between televisions and smartphones. Services conforming to HbbTV2.0 were started in Italy and the UK in 2017, and additional services are expected to be introduced throughout Europe in the future. HbbTV also defines two types of application that can be operated simultaneously: broadcast-related applications that are linked to broadcast channels in the same way as broadcast-oriented managed application, and broadcast-independent applications that can be used across multiple channels in the same way as non-broadcast-oriented managed applications. A broadcast-independent application is used as a platform for audience measurement with the permission of users and VOD players.

Companion screen services in HbbTV are implemented as follows. First, in HbbTV1.0, methods were defined whereby televisions and smartphones could communicate via a relay server. To pair the television with the smartphone, the user had to use a smartphone application to scan a QR code displayed in

■ **Figure 5: Concept of collaboration from internet to broadcast service**



■ **Figure 6: Launch method of a broadcast-oriented managed application**



*Source: IPTVFJ STD-0013 Hybridcast Operational Guidelines v2.7 section 4

a broadcast-related application running on the television. This QR code contained a link to the relay server. Since this system required a relay server, it was liable to incur longer response times depending on the status of the network and relay server. Therefore, HbbTV2.0 defines a method whereby the television and smartphone communicate directly over the same network. The communication protocols used in this system include DIAL, which is used for television device discovery, and WebSockets, which is used for messaging between televisions and smartphones. This facilitates the provision of companion screen services similar to Hybridcast. In this way, although HbbTV also facilitates broadcast-initiated internet service collaboration across devices, it suffers from the same issue as Hybridcast in that it does not support collaboration with television broadcast services initiated by internet services on a smartphone. Also, although a broadcast-independent application can be started from a smartphone, it is difficult for it to collaborate with broadcasting because it can only run as an application independently of broadcasting.

4. Expansion of the Hybridcast companion device architecture

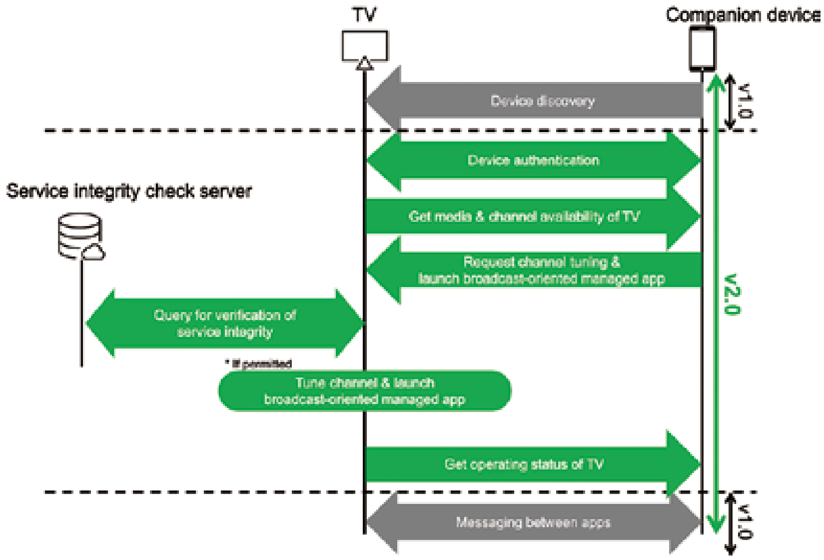
As described in section 3, integrated broadcast-broadband systems such as Hybridcast and HbbTV have enabled smooth collaboration with internet services initiated from broadcasting but have major difficulties in providing smooth collaboration with broadcasting initiated in the opposite direction from internet services. Therefore, as shown in Figure 5, a companion device architecture was standardized by IPTV Forum Japan in September 2018 in order to facilitate smooth collaboration with broadcasting from internet services using Hybridcast. This architecture combines device-centric operation with conventional television-centric operation, and was published as version 2.2 of the Integrated Broadcast-Broadband System Specification and as version 2.7 of the Hybridcast Operational Guidelines. This section presents an overview of the newly defined mechanism for launching a broadcast-oriented managed application from companion devices, extended companion device communication protocol and APIs between televisions and companion devices.

4.1 Mechanism for launching a broadcast-oriented managed application from a companion device

Until now, Hybridcast broadcast-oriented managed applications have only been launched from broadcast services as discussed in section 3.1. Specifically, two sequences are defined for this purpose. These are initiated via a data broadcast (A in Figure 6) or an AIT multiplexed in a broadcast signal (B in Figure 6). Here, to facilitate collaboration with broadcasting initiated by a companion device, new specifications were added to define the sequence for launching a broadcast-oriented managed application from a companion device corresponding to C in Figure 6. Note that a launch initiated by a companion device is defined as an "external launch" in the published standard.

In conventional standards, a broadcast-oriented managed application is defined as an application whose launch and termination can be controlled from broadcasting. Therefore, it has technically been guaranteed that each broadcaster can launch only its own broadcast-oriented managed applications over its own broadcast channel. For example, in broadcaster A's channel,

■ **Figure 7: Overview of companion device communication protocol**



it has not been possible to launch broadcaster B's application other than by an instruction from broadcaster A. However, if a companion device (non-broadcasting entity) can launch and control these applications, then it will be possible to launch every application in every channel. This deviates from the concept of a broadcast-oriented managed application. Therefore, the concept of "service integrity check" was introduced so that broadcasters can check integrity between broadcast channel and launching application in the same way as conventional broadcast-oriented managed application. When requesting the launch of a broadcast-oriented managed application from a companion device, only applications that have been pre-approved by the broadcaster providing the channel can be launched by the service integrity check mechanism. With the addition of this launch method for a broadcast-oriented managed application from a companion device, the specifications of protocols and APIs for communication between a television and a companion device, receiver functions, and so on, were standardized.

4.2 Companion device communication protocol

The new companion device communication protocol v2.0 was implemented by extending the companion device communication protocol v1.0 as specified by version 2.4 of the Hybridcast Operational Guidelines in 2016. This section presents an outline of the protocol using the typical sequence shown in Figure 7, where a broadcast-oriented managed application is launched from a companion device, up to the point where a companion screen service is executed. The gray parts of Figure 7 indicate v1.0 protocols, and the green parts indicate protocols that are newly specified in v2.0.

First, in accordance with the provisions of the companion device communication protocol v1.0, device discovery for television is performed from a companion device using the DIAL protocol. Thereafter, negotiation is performed between the companion device and the television according to a protocol newly defined in v2.0. Following device discovery, when establishing a connection between the companion device and the television, the television performs authentication with the companion device to confirm whether or not the device is certificated. If the companion device is found to be valid at this authentication step, then the companion device tries to launch the broadcast-oriented managed application by transmitting two types of data to the television: information about the broadcast channel to which the television should be tuned, and information about the location of the AIT of the broadcast-oriented managed application. The service integrity check is made at this point. Specifically, the television queries an online integrity check server to determine whether or not the application can be launched based on information received from the companion device. In this procedure, for example, the broadcast-oriented managed application of broadcaster A can be prevented from being erroneously launched on the broadcast channel of broadcaster B, thereby preventing the launch of an application that is not related to the channel that the viewer is currently watching. If the integrity check server accepts the request and the television receives the acceptance message from the service, the television tunes the channel specified by the companion device and launches the broadcast-oriented managed application. After that, messaging between the broadcast-oriented managed application and the companion device is started, and the companion screen service can be used. This messaging is performed using WebSockets as specified in v1.0.

4.3 APIs

The companion device communication protocol v2.0 specifies an API whereby a companion device can control a television and query its status, and an API for querying an integrity check server from a television when launching a broadcast-oriented managed application based on a request from a companion device.

In addition, whereas version 1.0 of the protocol specifies that a companion device is only assumed to be an HTML5 application running on a smartphone CA, version 2.0 regards diverse smartphone applications as well as IoT-enabled devices such as smart speakers as being able to link with televisions in the future. As a result, two forms of API are defined. One is an API that can be accessed from JavaScript in CA web applications as before, and the other is a RESTful API that allows other applications and devices to be called via HTTP. These APIs are summarized below.

4.3.1 APIs between a companion device and a television

• GET APIs for obtaining a television's media and channel availability

Before tuning a channel or launching a broadcast-oriented managed application from a companion device, these APIs can be used to check which broadcast channels and what sorts of media (terrestrial digital broadcasting/broadcast satellite digital broadcasting/communication satellite digital broadcasting) it can tune. Specifically, the companion device can obtain media availability information and identifiers (original_network_id, transport_stream_id, service_id) specifying the channels that can be selected in each medium from the television. Although the same smartphone application can be used throughout Japan, the television channels that can be received vary depending on the area where the television is located and on the user's settings. Therefore, these APIs were specified so that a single smartphone application can provide the same service regardless of where the user lives.

• POST API for requesting channel tuning and launching a broadcast-oriented managed application

This API was specified to allow a companion device to request the tuning of a particular channel and the launch of a broadcast-oriented managed application on a television. Specifically, it is used to transmit information from a companion device to a television, including channel designation identifiers that are used to request a channel, and the AIT URL of the broadcast-oriented managed application to be launched. Note that a query parameter used when calling the API can specify whether the action to be performed is simply tuning the channel, or whether it includes launching a broadcast-oriented managed application. It is also specified that when a compatible television receives a launch request while switched off, it may execute the requested action after it has switched on.

• GET API for acquiring the operating status of a television

This API is defined for confirming the operational status of a television from a companion device so that it is possible to modify the behavior of the companion device according to the status of the television, such as providing a button for tuning a desired channel that is not currently being shown on the television. Specifically, it is possible to acquire information about the identifier of the tuned channel, the number of companion devices connected to the same television, and the processing results and HTML5 browser status of the television when the selection of a channel and launch of a broadcast-oriented managed application has been requested from a television by a companion device.

4.3.2 API between a television and a service integrity check server

As described in section 4.1, the service integrity is checked to prevent a broadcast-oriented managed application from being launched according to an request from a companion device if it concerns an unrelated television channel. In the Hybridcast Operational Guidelines, an API is specified whereby a television can ask an integrity check server for a judgment when it receives a request to launch a broadcast-oriented managed application from a companion device. Specifically, the television receives a request from a companion device (including an identifier specifying a channel and the AIT URL of the broadcast-oriented managed application to launch) and sends it to a check server. The check server confirms the validity of the pair of identifiers corresponding to the channel and the AIT URL. The server is pre-programmed with a whitelist of AIT URLs of broadcast-oriented managed applications that are permitted to launch. The server checks the contents of the request received from the television against this whitelist, and sends the results (OK/NG) back as a response to the television. The specification requires that communication between the television and the integrity check server is performed using HTTPS in order to maintain security.

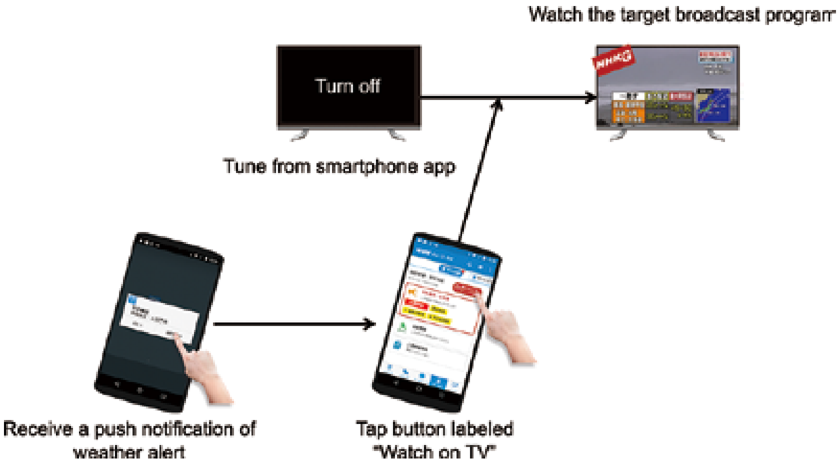
5. Service use cases

The expansion of Hybridcast companion device architecture as described in Chapter 4 will enable smooth service collaboration initiated not only from broadcasting but also from internet services. In 2016, NHK and commercial broadcasters began studying various service use cases with the aim of standardizing and promoting this architecture, prototypes of which were constructed and demonstrated at exhibitions. NHK has also contributed to the prototyping of service use cases by developing reference software called the Hybridcast Connect Library[22], which can easily implement this architecture in smartphone applications and IoT-enabled devices. This section introduces some typical service examples that use this companion device architecture.

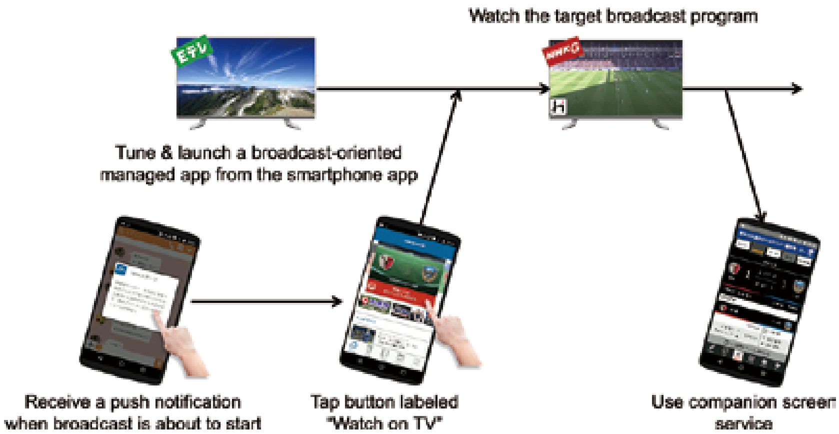
5.1 Watching broadcasts from smartphone applications

As an example of broadcast viewing initiated from a smartphone application, NHK presented an example involving use of the NHK NEWS & Disaster Info application[23][24]. Users of this application receive breaking news and weather alerts via online push notifications. In this example, the smartphone application incorporates the Hybridcast Connect Library, and when alerted by a push notification, the user simply taps a button in the smartphone application to switch on the television (if it is

■ **Figure 8: Example of watching broadcast from a smartphone application**



■ **Figure 9: Example of using a companion screen service from smartphone application**



not on already) and tune in to NHK General TV to show a news bulletin. Figure 8 shows the sequence of operations performed by the television and smartphone application. Further details can be found on the NHK website[25].

A similar example using the NHK Sports application (end of service on December 2018) was also demonstrated. In this example, as shown in Figure 9, the user launches the application by receiving a push notification delivered just before a live soccer match is broadcast, and is able to tune the channel showing the match simply by tapping a button in the application. In this way, the user can be sure to watch the entire match from the beginning. Furthermore, by launching a broadcast-oriented managed application as well as tuning the channel, program-related information such as the score line and player stats can be provided automatically on the smartphone as the match progresses by using conventional television-centric companion device architecture. As shown in section 3.1, the use of companion screen services previously required complex operations, but in this example we showed that services can be easily used simply by tapping a button on a smartphone. Further details can be found on the NHK website[26].

5.2 Support for a video casting style of operation

In smart TVs that support Netflix and YouTube, and HDMI-compatible dongle-type devices such as Google Chromecast and Amazon Fire TV Stick, it is possible to use a cast function based on the DIAL protocol to cast video playback from a smartphone to a television with a simple operation. Even with Hybridcast, by combining the new companion device architecture with Hybridcast video, it became possible to provide users with the same experience as this cast function.

NHK has demonstrated an example in which a smartphone application selects a program that the user missed and issues a playback instruction, whereupon the broadcast is switched so that the selected online catchup video can easily be watched on television. The video returns to the original broadcast when the playback ends or is stopped (Figure 10)[24]. Further details on how this operates can be found on the NHK website[25]. In addition, Asahi Television Broadcasting has proposed an example where push notifications are delivered to smartphone applications during sports broadcasts, and Hybridcast 4K video is used to allow users to watch concurrently broadcast programs from the beginning, and a trick play function is used to watch programs from the middle[27]. This shows that users can easily watch programs from wherever they want by using smartphones to combine live broadcasts and online video.

Note that these examples are implemented by companion device architecture from a smartphone application. The smartphone application launches a broadcast-oriented managed application that uses the dashNX HTML5-based video player.

5.3 Linking IoT-enabled devices and broadcasting

IoT-enabled devices such as smart speakers are expected to become popular in the future. In addition to smartphone applications, research in collaboration with broadcast and IoT-enabled devices is also ongoing. NHK and TV Asahi have proposed examples of service use cases using the companion device architecture and IoT-enabled devices implemented using the Hybridcast Connect Library.

NHK has shown an example where a user says the name of an NHK TV program that is currently on air to a smart speaker or smart watch, whereupon the television is tuned to the corresponding channel and the broadcast program can be

■ **Figure 10: Example of watching online video content on TV from a smartphone application**

easily viewed[28]. Here, the required channel is identified from the broadcast program extracted using the NHK program guide API[29] and the name that the user spoke to the device, and the companion device architecture is used to tune the television to the required channel (Figure 11).

In addition, TV Asahi presented an example where a user uses a smart speaker to purchase a product or make a reservation for a store introduced during the broadcast of an information program or an infomercial program[30]. In this case, even if the user issues instructions to the smart speaker that are ambiguous, such as "Reserve this restaurant" or "Buy this product", it is possible to perform reservations or purchases reliably as the program progresses. Here, metadata about the restaurant and product information matched to the progress of the program are prepared in advance at a cloud server. When the smart speaker recognizes a verbal instruction from the user, it sends the instruction together with time information to the cloud, where it is collated with pre-prepared metadata and used to start a reservation or purchase interaction. At this time, the smart speaker uses the companion device architecture to obtain the identifier of the tuned channel in order to prevent the erroneous provision of services when another channel is tuned on the television and confirms that this is a channel that provides a service. By performing this sort of processing sequence, it is possible to handle interactions according to the progress of the program even when given ambiguous instructions containing words such as "this".

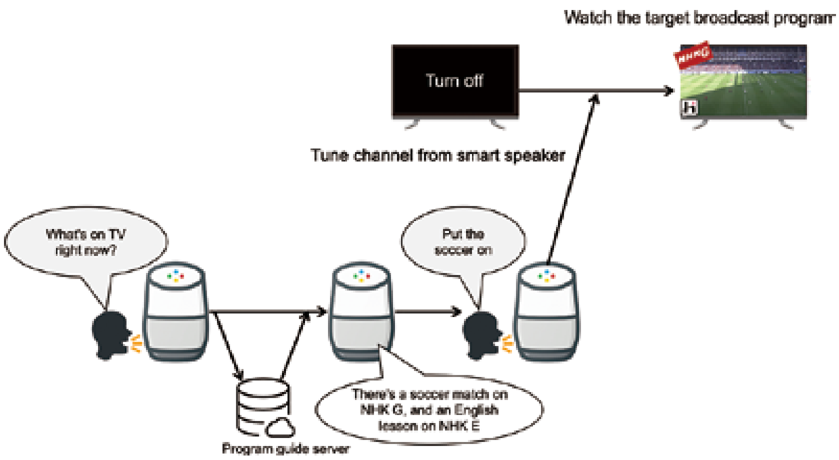
5.4 Linking outdoor activities and broadcasting

In Sections 5.1 to 5.3, we discussed examples of everyday scenes where the user is in front of a television, but in the future we expect that the starting point of collaboration with broadcasting will be implemented by collaboration between broadcasting and everyday activities away from the television by performing device linkage with such as smartphones that users carry wherever they go.

Tokyo Broadcasting System Television proposed a new idea that takes the user's purchasing behavior in the city as a starting point[31]. For example, a user that visits a supermarket to buy the ingredients of home-made sweets as a Mother's Day gift might be given a card printed with a QR code for participating in a sales campaign. When this QR code is scanned by an application provided by the supermarket, the user receives a push notification before a sponsored program is broadcast. This application is equipped with the Hybridcast Connect Library, so the user simply has to tap a notification button in order to set the television to the correct channel for this program and launch the broadcast-oriented managed application. A Mother's Day message or photograph that has been pre-registered in the application could then be displayed in the program as part of a commercial for the supermarket as an opportunity for the user to surprise his or her mother with a gift while watching television together. In this example, since it is easy to display personalized information in a broadcast aimed at a mass audience, and since it is possible to use the companion device architecture to directly transmit personal messages and/or photos from a smartphone to a broadcast-oriented managed application in a television, this has attracted a lot of attention as a new type of service and system model, in part because it can be implemented without the broadcaster or sponsor having to store personal data on a server.

Hokkaido Television Broadcasting, DENSO, and NHK have proposed an example involving collaboration between in-car services and broadcasting[32]. In this example, by gathering data on a user's movement history from a navigation application installed on a smartphone and the user's common CA viewing history acquired by device linkage, the user can be presented with

■ **Figure 11: Example of using smart speakers to watch broadcast**



information about tourist spots introduced in Hokkaido Television Broadcasting or NHK programs seen by the user that are close to the vehicle route chosen by the navigation application, and the common CA can recommended programs related to tourist spots visited on that day. Furthermore, as shown in the example of section 5.2, Hybridcast video and companion device architecture can be used to watch the recommended VoD programs on a television. Further details on how this operates can be found on the NHK website[25]. This case was studied with the aim of verifying the inter-service collaboration model across the barriers between different broadcasters, and across the barriers between the broadcasting and automobile industries.

6. Standardization trends

With regard to Hybridcast and its companion device architecture, this section describes the trends of standardization efforts being made in Japan and overseas.

6.1 Domestic standardization trends

Hybridcast is an integrated broadcast-broadband system that spans between the two fields of broadcasting and communications. As a result, the specifications for Hybridcast are standardized by two organizations in Japan. The functions and system models involving the use of communication are mostly being standardized by IPTV Forum Japan, while the broadcast-related parts are being standardized by ARIB. In 2013, IPTV Forum Japan formulated two technical specifications: an Integrated Broadcast-Broadband System Specification[8] and an HTML5 Browser Specification[9]. The Integrated Broadcast-Broadband System Specification includes the Hybridcast system model, application model and receiver specifications, and the HTML5 Browser Specification includes a browser extension API for receivers that broadcast-oriented managed applications can use. In addition, the Hybridcast Operational Guidelines[10] have been established as a standard for implementing integrated broadcast-broadband services based on these technical specifications. This specification includes the technical details that must be shared between operators, and functions that should be implemented in receiver equipment. On the other hand, with regard to ARIB's efforts to standardize the broadcasting parts, the transmission method and description format for AITs in broadcast-oriented managed applications are specified in ARIB STD-B24[33], while ARIB TR-B14[34] and B15[35] specify the functions for launching a broadcast-oriented managed application from data broadcasts and the like, and the operation rules whereby broadcast-oriented managed applications can access broadcast resources.

Standards for Hybridcast companion device architecture are mainly formulated by IPTV Forum Japan. Specifically, these include the system model for device linkage and the interface model for receivers and companion devices in the Integrated Broadcast-Broadband System Specification, the browser extension API required for collaborative operation by a broadcast-oriented managed application in the HTML5 Browser Specification, the CA model and basic specifications of companion devices in the Hybridcast Operational Guidelines, and the companion device communication protocol.

In September 2018, the extension of companion device architecture introduced in this article, was defined in version 2.2 of the Integrated Broadcast-Broadband System Specification and version 2.7 of the Hybridcast Operational Guidelines. On this occasion, it was necessary to add a method for launching a broadcast-oriented managed application and provisions regarding the interaction between receivers and companion devices. Therefore, the Integrated Broadcast-Broadband System Specifications were provided with additional specifications for a method for launching a broadcast-oriented managed application from companion devices, receiver functions needed for launching and stopping an application, and a system model and interface model for device linkage. The Hybridcast Operational Guidelines were provided with additional specifications for CA basic specifications and the companion device communication protocol described in section 4. In addition, version 6.4 of ARIB TR-B14 and version 7.7 of ARIB TR-B15 defined a method for launching a broadcast-oriented managed application.

6.2 International standardization trends

Hybridcast is also closely related to international standardization. Hybridcast is built around the standard HTML5 technology formulated by W3C, and its overall system architecture is standardized by the International Telecommunication Union (ITU).

At the ITU, multiple recommendations and reports relating to Integrated Broadcast-Broadband (IBB) systems have been established by ITU-T (ITU Telecommunications standardization sector) and ITU-R (ITU Radiocommunication standardization sector). In 2010, ITU-T began researching the requirements of IBB systems in SG9, which is responsible for cable television. In 2012, general requirements and a detailed system model reflecting the concept of Hybridcast (Integrated Broadcast-Broadband System Specifications and HTML5 Browser Specifications) were drawn up in ITU-T Recommendation J.205[36]. In addition, ITU-T Recommendation J.206[37] was formulated in 2013 to specify a reference architecture that conforms to Recommendation J.205. ITU-R SG6, which is responsible for broadcasting and has a cooperative relationship with ITU-T SG9. At ITU-R, two documents were published in 2013: ITU-R Report BT.2267[38], which provides diverse technical information related to IBB systems including Hybridcast and HbbTV, and ITU-R Recommendation BT.2037[39], which specifies general requirements for IBB systems. These were followed by the publication in 2014 of ITU-R Recommendation BT.2053[40], which defines technical requirements based on ITU-T Recommendation J.205, and the 2015 publication of ITU-R Recommendation BT.2075[41], which provides information comparing IBB systems such as Hybridcast and HbbTV. In 2016, the ITU-T published ITU-T Recommendation J.207[42], which relates to IBB systems in the same way as ITU-R Recommendation BT.2075, and discussions are still ongoing.

The Hybridcast companion device architecture has been defined since the first edition of each of the above ITU recommendations and reports. ITU-R Report BT.2267 describes device linkage system models and service examples, but its descriptions have been updated as the technical specifications and operational guidelines of IPTV Forum Japan have been revised and its services have been expanded. The Hybridcast companion device communication protocol standardized in 2016 was added to ITU-R Report BT.2267 in 2017 and ITU-R Recommendation BT.2075 in January 2019. Also, ITU-T Recommendation J.207 is currently in the process of being revised in the same way as ITU-R Recommendation BT.2075.

Discussions of a new companion device architecture introduced in this paper were also started by ITU-R SG6 in July 2019. The overview of the companion device communication protocol v2.0 described in section 4.2, and the service use cases of using a smartphone application to view broadcast and VoD content on a television as described in sections 5.1 and 5.2 have been added to ITU-R Report BT.2267. In view of the relationship so far between Japan's standardization and the international standardization at the ITU, it is expected that recommendations will be made in ITU-R Recommendation BT.2075 and ITU-T Recommendation J.207 in the near future.

7. Conclusion

This article has introduced a companion device architecture that makes it possible to tune television channels and launch broadcast-oriented managed applications from companion devices such as smartphone applications and IoT-enabled devices, which were standardized by IPTV Forum Japan and ARIB in September 2018, with some service use cases. Technical verification of this companion device architecture is currently under way, centered on IPTV Forum Japan, and it is expected that services will be able to start soon. This companion device architecture makes it possible for televisions, smartphones and IoT-enabled devices to interconnect, allowing broadcasting to break away from the living room and collaborate easily with internet services in diverse everyday scenes both indoors and outdoors. In the smart society of the future, it is expected that the diversification of lifestyle will be further advanced by having all sorts of devices connected to the internet. Hopefully, new services that provide new value to people will soon be created based on smooth collaboration between broadcasting and the internet services.

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Approval of Specified Base Station Deployment Plans for Introduction of 5G

—For early, widespread national deployment of 5G—

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1. Introduction

1. Introduction

On April 10 this year, the Ministry of Internal Affairs and Communications (MIC) approved* plans for deployment of specified base stations for 5th Generation mobile communication systems (5G) by four operators, which are NTT DOCOMO, KDDI/Okinawa Cellular, SoftBank, and Rakuten Mobile. 5G will extend previous mobile communications systems in both speed and capacity with "Ultra-high speed" (up to 10 Gbps), but will also have new features such as "Large numbers of simultaneous connections" (up to a million devices/km^2), enabling communication with all kinds of IoT devices such as appliances and sensors, and "Ultra-low latency (latency on the order of 1 ms)," enabling remote, real-time communication. 5G is also expected to become core infrastructure, essential for life in the 21st century in the same way as expressways and Shinkansen high-speed trains. It will revitalize regions, increase activity, and provide services as rapidly as possible throughout the country.

This article describes concepts regarding deployment policies for specified base stations (hereinafter, "deployment policies"), which determine factors such as the indices used when allocating 5G frequencies and the obligations of authorized operators. We also give an overview of the deployment plans of these operators.

2. 5G Deployment Policy Concepts (allocation indices)

Currently, 4G is used mainly by smartphones and other mobile terminals, for voice calls and to connect to the Internet. Mobile phones are intended to be carried by a person at all times, so one of the most important indices used for allocating frequencies in deployment policies for 4G and earlier was "population coverage", which indicates the percentage of people living within the communication range of a base station and able to use the communication services, based on population.

For example, policies for installing specified base stations when 4G was deployed required approved operators to ensure population coverage of 50% or greater within four years. Generally, a greater proportion of the population can be covered by installing base stations in urban areas than in more remote areas, so priority was given to installing base stations in urban areas, to guarantee population coverage rates more efficiently.

On the other hand, 5G has features suitable for IoT so beyond mobile phones, all kinds of objects in various industries can connect with base stations, such as automobiles, smart meters and devices used in agriculture, manufacturing, and medicine. With such potential to bring new value to various industries, 5G is anticipated for resolving regional issues and local development, so there is demand to ensure that 5G infrastructure is deployed early in all areas of the country that have business development potential, both urban and rural. Accordingly, policies for deployment of 5G have defined a new allocation index called "5G infrastructure deployment rate" (Figure 1), which will be used instead of "population coverage".

5G infrastructure deployment rate divides all of Japan into a 10 km square meshes, and indicates the percent of all mesh sections that have 5G advanced specified base stations deployed. This includes all sections that have business potential, excluding areas such as uninhabited islands (approximately 4,500 mesh sections). A 5G advanced specified base station (parent base station) is one that is connected to a high capacity (10 Gbps) line, and can connect to multiple 5G specified base stations (child stations). In mesh sections where an applicable 5G advanced specified base station is deployed, 5G services can be extended with flexibility (Figure 2).

In 5G deployment policies, approved operators are obliged to ensure that 5G infrastructure deployment rate exceeds 50% within five years. The contribution to population cover rate is larger when a base station is installed in an urban area than in a remote area, but the contribution to 5G infrastructure deployment rate when a 5G advanced specified base station is installed in a mesh section in an urban area is about the same as in a rural area. Thus, by introducing 5G infrastructure deployment rate, urban and rural

* Under the deployment plan approval system, operators receiving approval have exclusive permission to apply for specified base station licenses for the specified frequencies.

Figure 1: An example of deployment of 5G infrastructure in all areas of Japan

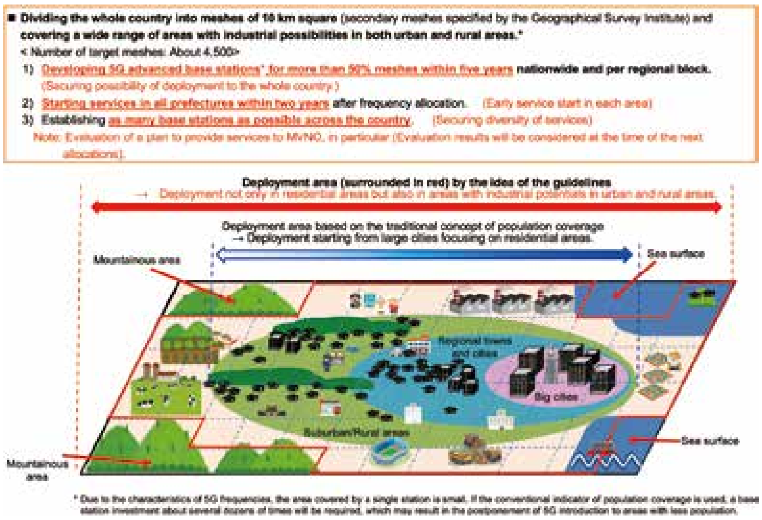
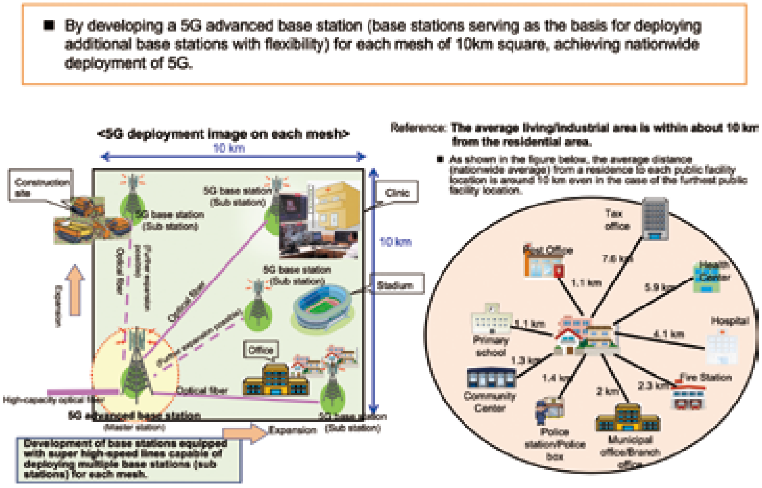


Figure 2: An example of deployment of 5G base stations



areas will be evaluated equally, and this will contribute to broad deployment of 5G throughout Japan. These same deployment policies also require services to be started in all areas of Japan by the end of FY2020, among other duties, reducing differences in when services begin between urban and rural areas. When comparing deployment plans from each operator, emphasis was given to plans that will yield higher 5G infrastructure deployment rates, but also to aspects such as the number of base stations deployed nationally, and comprehensive plans to provide services to Mobile Virtual Network Operators (MVNOs).

3. Overview of 5G Deployment Plans for each Provider

Overviews of the 5G deployment plans from the four applicants are shown in Figure 3. For items emphasized in evaluation of the deployment policies, NTT DOCOMO had the highest values for 5G infrastructure deployment rate, with 97.0%, and KDDI/Okinawa Cellular had the highest numbers of base stations, with 30,107 in the 3.7 GHz and 4.5 GHz bands, and 12,756 in the 28 GHz band. Regarding plans to provide services to MVNOs, Rakuten mobile had 41 companies with L2 connections, but NTT DOCOMO planned for the largest number of MVNO subscribers, at 8.5 million. Each applicant also gave plans for other items, such as ensuring safety and reliability, expanding utilization of 5G, and reducing size of dead zones in terms of population.

Applications were examined in these areas according to the method shown in Figure 4. As a result, all applicants met the minimum requirements, but there was duplication in the frequency frames requested by the applicants. As such, a comparative examination was done (points were assigned for each item, and rankings decided). For the 3.7 GHz and 4.5 GHz bands, applicants were ranked in decreasing order as: NTT DOCOMO, KDDI/Okinawa Cellular, Rakuten Mobile, and SoftBank. For the 28 GHz band, they were ranked as: KDDI/Okinawa Cellular, NTT DOCOMO, Rakuten Mobile, and SoftBank. Frequencies were specified according to the frames requested by each applicant, resulting in the frequency allocations as summarized in Figure 5. NTT DOCOMO and KDDI/Okinawa Cellular were each allocated a total of 600 MHz of

Figure 3: Outline of 5G deployment plans from four applicants

○Between January 24 and February 25 of this year, **four applications** for approval were received, for plans to establish specified base stations deploying 5G mobile communication systems

■ Four applicants

○ NTT DOCOMO Corp., KDDI Corp./Okinawa Cellular Inc.*, SoftBank Corp., Rakuten Mobile Corp.

* The applications from KDDI Corp. and Okinawa Cellular Inc. were for each of their regions respectively, so examinations were done as a single application based on plans to deploy specified base stations for introduction of the 5G mobile communication system.

■ Allocated frames and number frames requested

○ For 3.7 GHz and 4.5 GHz bands, a total of 7 frames were requested for the 6 100-MHz frames. → One frame can be allocated to each of the four applicants. For the three applicants requesting a 2nd frame, only two of these can be fulfilled

○ For the 28 GHz band, a total of 4 frames were requested for the 4 400 MHz bands.
→ 1 frame can be allocated to each of the 4 applicants.

Applicant	NTT DOCOMO	KDDI／Okinawa Cellular	SoftBank	Rakuten Mobile
Requested band (frames requested) (1) 3.7 GHz band and 4.5 GHz band (2) 28 GHz band	200 MHz (2 frames) 400 MHz (1 frame)	200 MHz (2 frames) 400 MHz (1 frame)	200 MHz (2 frames) 400 MHz (1 frame)	100 MHz (1 frames) 400 MHz (1 frame)
Service start time frame	Spring 2020	March 2020	March 2020	June 2020
Approx. capital investment in specified base stations, etc. (* Investment related to construction of base station, switching and transmission infrastructure)	795 billion yen	467 billion yen	206 billion yen	195 billion yen
5G infrastructure deployment rate	97.0% (nationally)	93.2% (nationally)	64.0% (nationally)	56.1% (nationally)
No. of advanced 5G base stations	4,331 (4,331grid sections)	4,160 (4,160 grid sections)	2,855 (2,855 grid sections)	7,948 (2,506 grid sections)
No. of specified base stations (excluding those installed indoors, etc.) (1) 3.7 GHz and 4.5 GHz bands	Note: Bold-underline figures are numbers of deployed base stations in deployment plans for frequencies allocated at this time.			
3,600 MHz - 4,000 MHz	8,001	30,107	7,355	15,787
4,000 MHz - 4,100 MHz	5,001	4,160	1,861	-
4,500 MHz - 4,600 MHz	5,001	-	3,373	-
(2) 28 GHz band	5,001	12,756	3,855	7,948
No. of MVNOs/subscribers (L2 connections only)	24/8.5M	7/1.19M	5/200K	41/706K

* Values for capital expenditures, 5G deployment rates, numbers of specified base stations, and numbers of MVNOs are from plans to FY2024.

Figure 4: Examining method

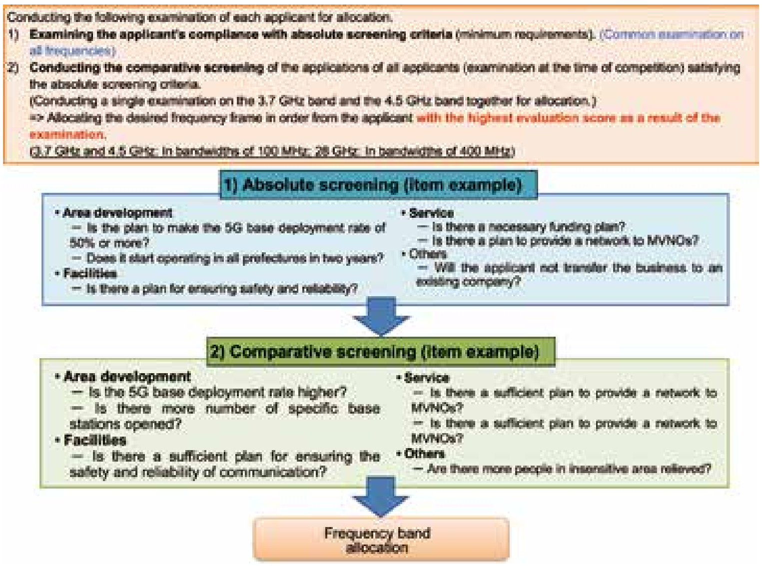
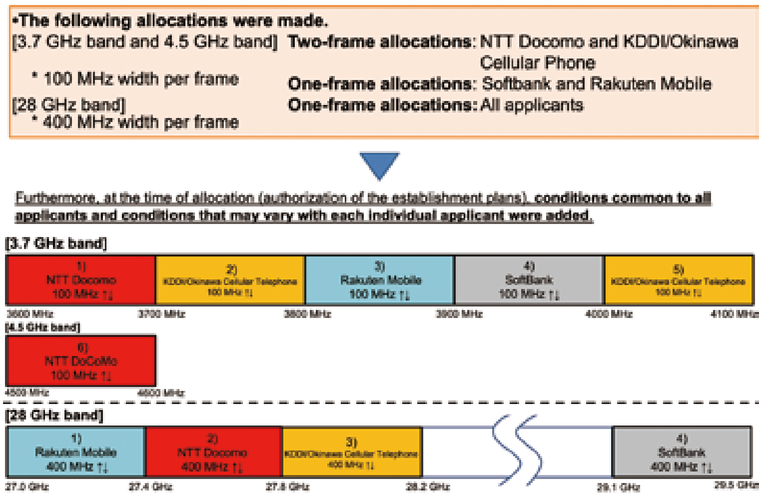


Figure 5: Summary of frequency allocations



bandwidth, and SoftBank and Rakuten Mobile received a total of 500 MHz of bandwidth.

Note that with the approval of deployment plans for each applicant, the following conditions were applied, based on the objectives of the deployment policies.

<Approval Conditions>

1. To have an appropriate understanding of emerging needs, for both urban and rural areas, and to work steadily for the wide-ranging spread of diverse services utilizing the features of 5G mobile communications systems, in all regions with business potential.
2. In building a network, work to ensure appropriate and adequate optical fiber, which will be essential for providing diverse services that make full use of the features of 5G mobile communications systems.
3. Work to improve safety and reliability of telecommunication facilities with measures addressing power outages, congestion and communication interruptions, in light of communication failures caused by events such as the heavy rain in July 2018 and the Hokkaido Eastern Iburi earthquake in 2018 (except SoftBank).
4. Follow "Safety and Security Standards for Data Communication Networks" (1987, Posts and Telecommunications Ministry Bulletin No. 73), "Common Standards for Information Security Measures for Government Agencies and Related Agencies" (FY2018 edition), and "Arrangement regarding policies and procedures for public procurement of IT related goods and services" (Dec. 10, 2018 arrangement of related ministries and agencies), and take adequate cyber security measures, including coverage of supply chain risk.
5. For parties not receiving allocation of frequencies, work to promote use of specified base stations through connection to telecommunication facilities, wholesale telecommunication services or other means. In particular, work to promote use of specified base stations through electrical connection, communicating using GPRS tunneling protocol.
6. Work to establish easy-to-use fees that support diverse user needs for 5G mobile communication systems, including IoT services and individual end-user oriented services.
7. Take measures to prevent interference and other obstructions on radio stations and other facilities operated by existing licensees.
8. Recognizing that mobile communications systems are important for the livelihood of citizens, work steadily to establish base stations in dead zones.
9. Work to facilitate negotiation when proposals for contract or agreement are received, using frequencies between 4,600 and 4,800 MHz or between 28.2 and 29.1 GHz, by providing wholesale telecommunications services, connection to telecommunication facilities and other means, to promote utilization of specified base stations.

[Conditions imposed on Softbank only]

3. Work comprehensively on measures to prevent reoccurrence of past serious incidents, and to improve safety and reliability of telecommunication facilities with measures addressing power outages, congestion and communication interruptions, in light of communication failures caused by events such as the heavy rain in July 2018 and the Hokkaido Eastern Iburi earthquake in 2018.

[Conditions imposed on Rakuten Mobile only]

10 Work steadily to establish base stations according to the principle that authorized mobile communication operators are developing their business with the intention of building their own networks.

11 Work to secure locations for installing base stations and collaborative agreements with construction companies so that completion of specified base stations can proceed smoothly and steadily.

12 Work to establish the internal systems necessary for reliable operation as a telecommunications provider. In particular, work to secure and deploy the technical and other personnel such as radio technicians, required for proper operation of specified base stations and other telecommunication equipment, and personnel to build such infrastructure.

13 Work to secure capital investment, operating funds and soundness of other financial affairs, as necessary to provide stable services, even in the event that the business environment changes due to competition.

4. Conclusion

This article has given an overview of "Approval of Specified Base Station Deployment Plans for Introduction of 5G." With the start of commercial 5G services in the spring of 2020, MIC will continue to monitor the expansion plans of each operator, and continue promoting initiatives that encourage utilization of 5G, to lead the world with nation-wide expansion of 5G services.

Cover Art

Picture of kabuki actor Nakamura Shikan as Chienai

Utagawa Toyokuni III
(1786-1865)

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Object number: arcUP0115

Overview of the 2019 White Paper on Information and Communications in Japan

Economic Research Office, ICT Strategy Policy Division
Information and Communications Bureau
Ministry of Internal Affairs and Communications

1. Introduction

The Ministry of Internal Affairs and Communications (MIC) published the 2019 White Paper on Information and Communications in Japan," on July 9, 2019*1. This is the first white paper of the new Reiwa Era, with the theme, "The Evolving Digital Economy and the Approaching Society 5.0." Recently, the attitudes and behavior of people appear to be changing, from wanting to own things, to being happy borrowing and using them when they need them. Regarding work, people are also focusing on taking work through the Internet, as it appears or for limited periods of time in the freelance market, rather than joining an enterprise or other organization.

It is not only economic activity that is changing. People can now reach many people, posting videos, songs, paintings, novels, messages or other works using various sharing sites and social networking services (SNS), and overcoming the bounds of geography and human relationships in the real world.

As such, new social and economic structures and even new ways of life are appearing, and many feel that this is strongly related to the development and spread of the Internet and other information and communication technologies (ICT). This new economy and the society brought by the development and spread of ICT have come to be called the *digital economy*.

In this, the first information and communication white paper of the Reiwa Era, we examine how this digital economy has evolved (Chapter 1), and its prospects for the future (Chapter 2) (Figure 1).

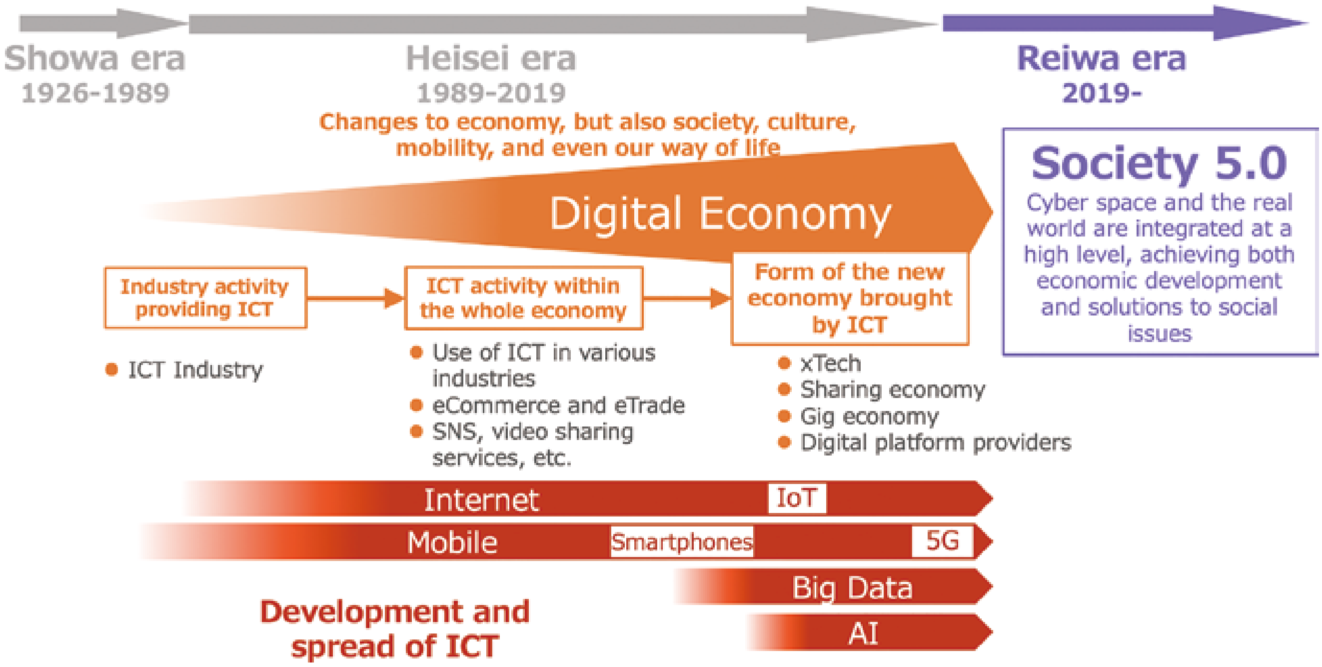
2. Chapter 1: How have ICT and the digital economy evolved?

(1) Development and spread of ICT networks

The Internet began at the beginning and expanded throughout the Heisei Era (1989-2019), and has created new venues and opportunities for communication for people. It has also become important infrastructure supporting wide ranging activity in society and the economy.

The "telephone of the future" that surprised everyone at Expo '70 in Osaka was a mobile phone. With the spread of smartphones, the mobile phone has now become more than a communication tool. It is the most familiar device in daily life and is able to do perform a wide range of tasks. As mobile communication systems have developed, they are also being used

Figure 1: Evolving digital economy and the approaching Society 5.0



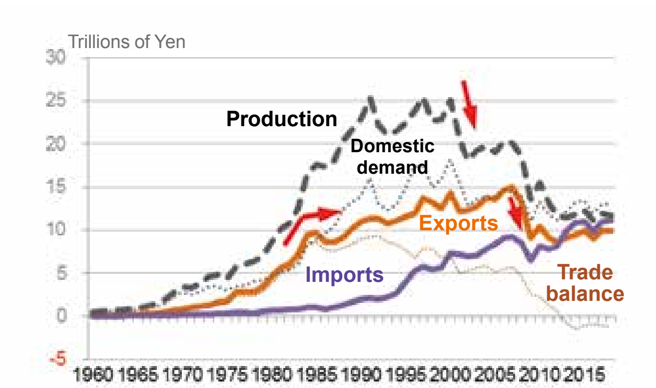
*1 The full text of this white paper is published on the Information and Communication White Paper Web page (http://www.soumu.go.jp/johotsusintokei/whitepaper/index.html).

for more than just communication between people. With the rise of the Internet of Things (IoT), they are also connecting objects together. IoT creates and produces value from digital data, and we expect to advance development even further by combining it with artificial intelligence (AI) and 5th generation mobile communications systems (5G).

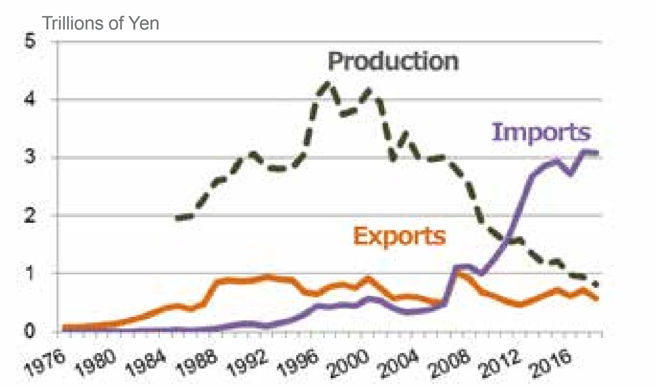
(2) ICT industry changes

After the liberalization of the telecommunications market in Japan in 1985, there was great development generating services that increased convenience for the population, due to vigorous competition among various businesses. In manufacture of ICT devices, a shadow gradually fell over Japan's former glory as a nation built on electronics. For example, from 1985 onward, exports of ICT-related devices*2, which had previously been increasing steadily, began to slow, and by 2000, both production and export had begun to decline. Then in 2013, the value of imports actually surpassed exports (Figure 2). Looking at just communication devices, production has decreased since its peak in 1997, and with the spread of the smartphone, imports have increased sharply since the latter half of 2000s (Figure 3).

■ **Figure 2: Trends in production/import/export/etc. of ICT related devices**



■ **Figure 3: Trends in production/import/export of communication devices**



(3) New trends in ICT

Japan has also been affected by digital platform providers, mainly from the USA, which are new ICT businesses that have a global presence.

Looking at the overall economy, Japan has been plagued by deflation after the collapse of the economic bubble, and has not yet regained strong growth. We would expect use of ICT to increase productivity in various industries and contribute strongly to economic growth, but even though Internet use has grown in enterprise, the effects of this have not materialized significantly, at least in the GDP statistics of Japan.

On the other hand, in emerging and developing countries, deployment and use of ICT infrastructure is focusing on mobile communication and is advancing rapidly, in leap-frog fashion. Development and deployment of ICT globally is accelerating, with a global value chain that partitions work on a global scale, growing the economies of participating countries.

3. Chapter 2: What is needed to utilize the value of Society 5.0?

(1) Characteristics of the digital economy

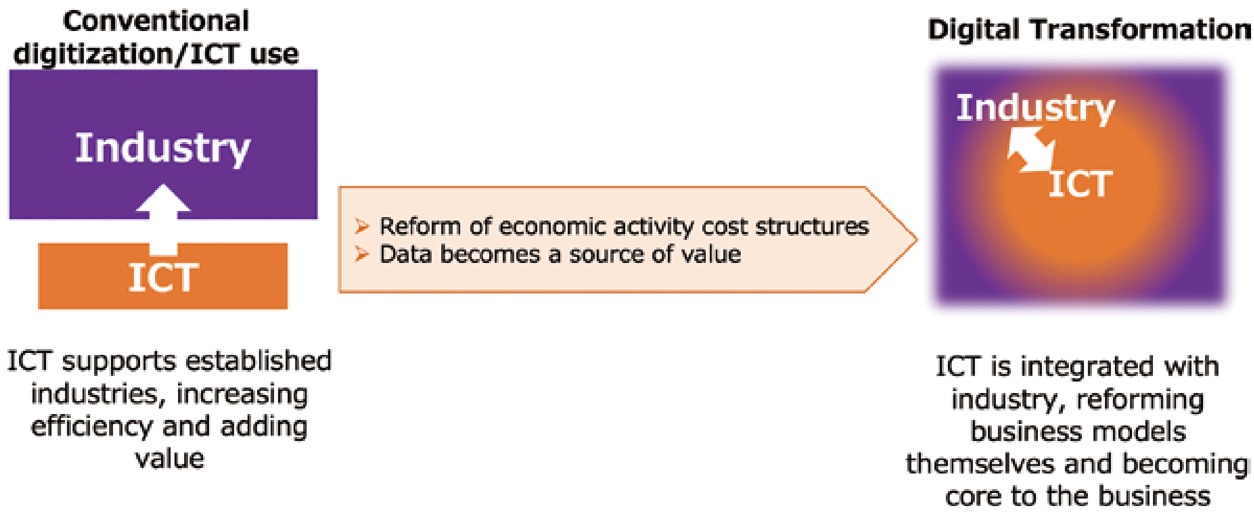
In the digital economy, data is a source for value creation, and ICT is changing cost structures, which are fundamental to economic activity. In particular, markets are expanding, which facilitates activities that overcome the constraints of time and place, and markets are also segmenting, which facilitates the formation of niche markets that overcome constraints of scale. The new cost structures accompanying ICT are also forcing relationships between companies, and between people and companies to be restructured.

(2) Digital transformation

Under such conditions, ICT enterprises with new business models suited to the new cost structures are appearing in all kinds

*2 Consumer electronics, industrial electrical devices, electronic components and devices

■ Figure 4: Differences between conventional digitization/ICT use and digital transformation



of industries. This is making conventional business models no longer viable, and causing a so-called *digital disruption*. To deal with these changes, the traditional players in all kinds of industries need to undergo a digital transformation, bringing ICT into the core of their businesses, integrating with it, and reforming their business models (Figure 4).

(3) Society brought by evolution of the digital economy

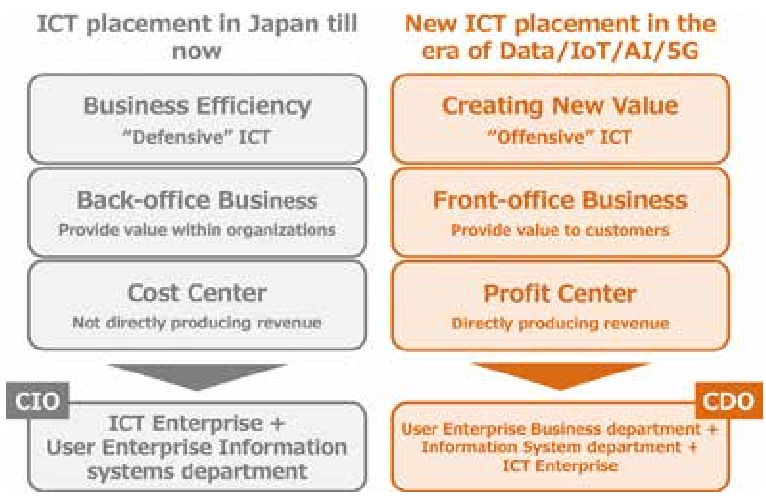
As countries around the world have continued introducing ICT, and since the financial crisis in 2008, all developed countries have experienced stagnation in GDP growth. As such, technology pessimism has appeared, skeptical of the effects of ICT on economic growth. As free services and the sharing economy spread, discussion is also growing around issues such as whether GDP is an effective index, and whether such services can be counted as technology, have value, or can be captured in the GDP. Further, ICT is affecting employment and distribution for the middle class, particularly in developed countries, and this is being perceived as contributing to disparity within these countries.

However, important technologies emerging in the past, such as steam engines or electricity, also had effects that required comprehensive reform, and there was a time lag between the appearance of technology and appearance of these effects. With ICT as well, the digital economy will evolve through comprehensive reforms, leading to Society 5.0, contributing to sustainable development goals (SDGs) in various fields such as medicine, education and agriculture, and with the potential to go beyond simple economic development, to realize solutions to societal issues.

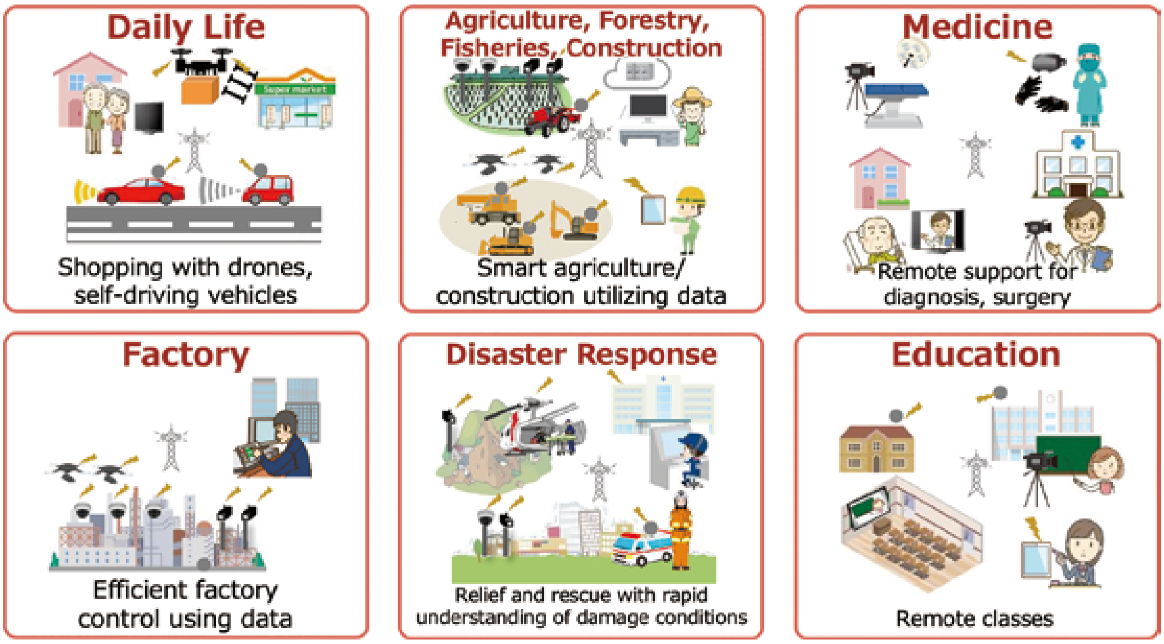
(4) Necessary reforms

The sorts of reforms needed in Japan due to the effects of

■ Figure 5: Transition of the placement of ICT



■ Figure 6: Resolving issues in remote areas through use of 5G



ICT must be considered. In industry, ICT must be considered as more than just a means of improving efficiency; rather, it must be seen as something that produces new value, and systems must be transformed accordingly (Figure 5). This requires shedding closed innovations and letting M&As and other open innovations proceed. In particular, this may require changes to the very ecosystem surrounding startup enterprises in Japan, in which M&A activity by large corporations has tended to be oriented toward reaching an IPO. It will be important to restructure relationships between enterprises, and between people and enterprises, according to the digital economy, including this point. On the other hand, for these reforms to advance, people-related reforms such as recurrent education and reforming work styles will also be important.

As the digital economy advances, it will bring some fluctuation to existing relationships, and this can provide opportunity for regional interests. In order to exploit such opportunities, remote areas will need to advance their own digital transformations. It will be particularly important for them to complete their 5G infrastructure, advance their utilization of data, and cultivate new collaborative partnerships (Figure 6).

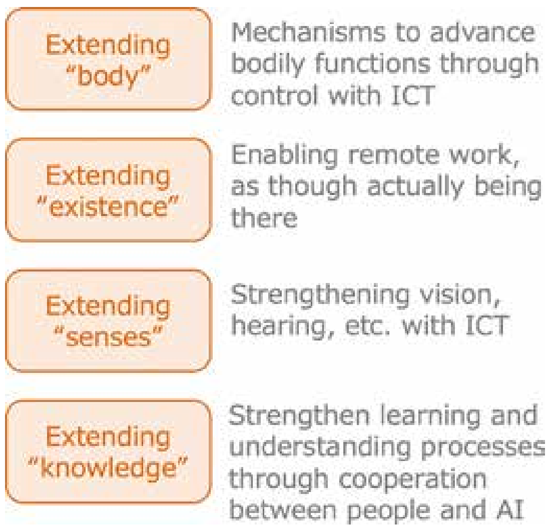
It will also be necessary to prepare for even further changes, questioning things that have been taken as self-evident till now, starting with principles of capitalism that have been established since the industrial revolution. As part of this, we can expect that systems will need to be reexamined constantly in order to utilize the effects of ICT reforms.

(5) New relationships between people and ICT

Japan also suffered several large disasters during the Heisei Era. Special mention must also be made of how technologies such as the Internet and mobile phones have changed transmission of information during times of disaster. The torrential rainstorms of July 2018 have suggested the possible need for detailed information of conditions in individual areas in times of disaster. Another lesson is that, beyond simply conveying information, there is an important connection between conveying the information and taking concrete action.

Finally, technology has historically extended humanity, enhancing what people can do. In the same way, ICT and new technologies such as AI will expand what people can do in their daily lives and work. This will also lead to building new relationships between people and ICT (Figure 7).

■ Figure 7: Extending humanity through ICT



= A Serial Introduction Part 1 =
Winners of ITU-AJ Encouragement Awards 2019

In May every year, The ITU Association of Japan (ITU-AJ) proudly presents ITU-AJ Encouragement Awards to people who have made outstanding contributions in the field of international standardization and have helped in the ongoing development of ICT.
These Awards are also an embodiment of our sincere desire to encourage further contributions from these individuals in the future.
If you happen to run into these winners at another meeting in the future, please say hello to them.
But first, as part of the introductory series of Award Winners, allow us to introduce some of those remarkable winners.

Minami Ishii

Association of Radio Industries and Businesses
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Fields of activity: Mobile communication

Secretariat activities of the Japanese delegation at ITU-R WP 5D

I am grateful to receive this Encouragement Award from the Japan ITU Association. I would like to take this opportunity to express my gratitude for the guidance given by the members of the Association of Radio Industries and Businesses (ARIB) and the ITU-R WP 5D Japanese delegation.

In 2016, the ITU was working on the standardization of the Fifth Generation Mobile Communications System (5G), called IMT-2020. In Circular Letter 5/LCCE/59, the ITU invited submission of proposals for candidate radio interface technologies for the terrestrial components of IMT -2020. In response, ARIB also invited submission of draft proposals for candidate radio interface technologies for the terrestrial components of IMT -2020 in Japan.

Since domestic companies were actively participating in 3GPP meetings from the early stages of the development of 5G standard specifications, we initially envisaged that there would be no proposal for candidate radio interface technologies other than 3GPP proposals in Japan. However, even in that case, the following measures had to be considered:

- Are there any concerns if Japan decides not to make a proposal to ITU for the fifth generation mobile communications system, though Japan had submitted proposals to ITU in the third and fourth generation mobile communications systems?
- If a proposal from Japan is submitted, will it be different from other 3GPP radio interface proposals?
- What will we propose, if there are no differences between the Japanese proposal and other 3GPP radio interface proposals?
- Development of Japan's draft policy response to proposals from other countries, etc.

There was also a proposal for a component technology that was not initially expected, so we had to consider how to deal with this proposal.

As I proceeded with the above measures, I learned the importance of fully listening to the opinions of the participants of meetings and the background of those opinions, and advancing the discussion after understanding the other party's position.

There were also cases where, while respecting the other party's position, they could not listen to each other's assertions. However, I also learned that even in such cases, experienced people, including the Japanese delegation, could gradually soften their positions by sharing the past procedures, the process, and the current situation, and by holding discussions among the participants, and that they could propose constructive alternatives to advance the discussions that had previously been held in parallel.

Due to a personnel transfer, I was not able to continue this activity until the IMT -2020 radio interface technology became established. However, I would like to contribute to international standardization and international cooperation, making use of the above experiences gained through activities with the secretariat of the Japanese delegation at ITU-R WP 5D.

Eiichiro Ichikawa

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Fields of activity: ICT human resource development

International Collaboration through ICT Human Resource Development

I am very pleased to receive this Encouragement Award from the Japan ITU Association. I would like to express sincere thanks to the Japan ITU Association and all those involved.

I have been involved in international collaboration since 2000, when I participated in the JICA Japan Overseas Cooperation Volunteers for two years. I connected laboratory PCs to the Internet and set up an environment for students to perform literature research and other activities at Church Teacher's College in Jamaica.

For three and a half years starting in 2005, I worked for the

Global Business Office of NTT East, at the JICA Okinawa International Center, as the leader of the network courses, part of their computer course, planning, giving lectures, and managing the overall course. We focused particularly on action plans for the trainees after they return to their countries, discussing the local conditions and issues repeatedly with trainees and designing practical plans that will be very feasible. We also maintained contact with trainees after they returned to their countries, supporting their activities there.

In 2014, I returned to the Global Business Office of NTT East, creating proposals for international cooperation. Fortunately, just before moving, I was able to create a disaster prevention project. I believe the most important factors in achieving this were the enthusiasm of the those involved; specialists that have the trust of the local people, JICA, and the people from NTT East.

In retrospect, I believe that having local trust relationships and incorporating the thoughts of project participants mobilized those on the periphery, contributing to success. I also hope to continue to be involved in international cooperation, continuing to emphasize human relationships.

Takeshi Usui

KDDI Research, Inc Mobile Network Group

Fields of activity: Mobile Network & 5G Standardization

*Member of the above organization, when notified of receiving the award.

5G System Standardization

I appreciate my colleagues at KDDI and KDDI Research. They gave me valuable help and service requirement. I also appreciate my 3GPP SA2 colleagues. They helped provide the basis for my contribution and with revisions. Without the discussion and help from KDDI, KDDI Research, and SA2 colleagues, I would not have been able to get approval for my contribution.

5G technology is mainly focused on wireless technology. However, 5G services cannot be provided with wireless technology alone. Standardization of the 5G System (i.e.: terminals and mobile core network) is also important. I hope this award will encourage my juniors, who also engaged in 5G System standardization.

Actually, my contribution was to UE policy in the standardization of the 5G System. Without UE policy, the users would need to configure terminals by themselves when using 5G services (e.g.: network slicing and MEC). I engaged in the standardization of 5G System to increase the benefits of 5G services for users. These features will promote the benefits of 5G services. In the future, I will work toward introducing these features in the actual commercial network.

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Fields of activity: ITU-R SG6

Activities towards launch on HDR-TV broadcasting service

It is a great honor for me to receive the ITU-AJ Encouragement Award. I appreciate all the work done by those who have been eagerly participating in related activities, and would like to thank all members involved in nomination and selection.

Development of a recommendation and reports related to HDR-TV is important for both broadcasters and production equipment developers. The documents introduce a new era in broadcast production, so producers and technicians will need to accustom themselves to a new style of workflow. My activities are mainly to give guidance for introduction of these new technologies in documents being published for Japanese broadcasters, and to contribute documents with Japanese related information and technologies as input to WP6C, with much aid from Japanese broadcasters and production equipment companies.

One of the contributions has been to provide information on facial skin tones in Japanese broadcast content, which can provide a reference level for conversion between HDR content and SDR content. About 700 sample images were contributed by broadcasters and analyzed.

This technical information was published in the report ITU-R BT.2408. This work was performed by HDR Ad-Hoc, which is an umbrella study group under the Association of Radio Industries and Business (ARIB). This Ad-Hoc was established with the endorsement of the Japan Commercial Broadcasters Association (JBA) to publish a technical reports on operational guidelines for HDR video program production. This helps to provide technical guidelines for exchange of programs on new 4K/8K satellite broadcast services, which commenced on Dec. 1st 2018. I hope this information will help broadcasters worldwide.

Producers and technicians currently have less experience in program production for HDR-TV than conventional SDR. It is possible that much more experience they gain in the future will lead more new ideas for contributions on HDR-TV and others.

I would like to continue my work providing contributions in the field of new image formats.

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The ITU Association of Japan