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Technology for Free-Viewpoint Broadcasting

Free-Viewpoint AR Streaming Technology

Broadcasting Professional Baseball by using Volumetric-video Technology

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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.

Free-Viewpoint AR Streaming Technology

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1. Introduction

The start of 8K broadcasting, which has evolved through quantitative improvement of specification of two-dimensional (2D) images, has led to expectations that media technology will evolve in an axis other than the improvement of specifications. Therefore, using Augmented Reality/Virtual Reality (AR/VR) technology, which has been attracting a great deal of interest since the beginning of 8K broadcasting, we propose a new viewing style that combines three-dimensional (3D) content with broadcasting, and is engaged in research and development of a transmission technology to achieve this viewing style[1]. The proposed transmission technology aims to efficiently stream 3D contents in order to support live broadcast programs in the future. For the STRL Open House 2022[2], we created content that enables experiencing the proposed new viewing style based on the NHK Special Dinosaur Super World. Viewers board a time capsule with a reporter and travel back in time to the days when dinosaurs existed. While watching the Dinosaur Super World Immersive Special Edition, viewers can enjoy 3D content, such as the Spinosaurus, Ammonite, and other dinosaurs that appear in the program, as AR content. The experience video can be viewed through the link in reference[2].

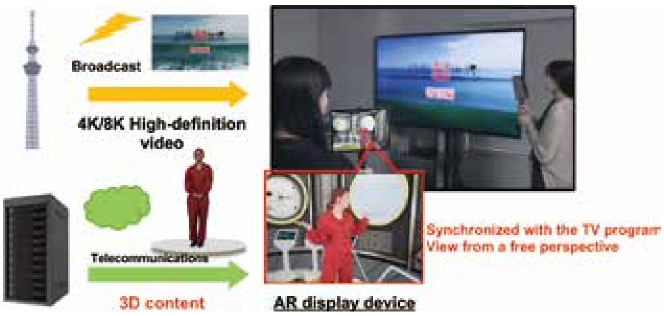
This paper first outlines and describes the requirements of the new viewing style we proposed. Next, we will discuss object-based transmission, which is being researched and developed for the efficient transmission of 3D contents, and the mechanism for improving transmission efficiency by applying object-based transmission. Finally, using the content exhibited at the STRL Open House 2022 as an example, we will introduce a concrete method for creating data to be delivered by actual object-based transmission and packaging the data as a single content.

2. Outline of the proposed viewing style and requirements

Figure 1 shows an overview of the proposed new viewing style. Three-dimensional content that is transmitted via telecommunication (Internet) and synchronized with 2D high-definition video by television broadcasting is presented to mobile display devices by AR. The TV program and 3D content share the same time axis and story, making it possible to render a new visual expression by linking the two contents. For example, in the content exhibited at the STRL Open House 2022, the reporter shown on the TV screen disappears from the TV screen and is transmitted to the AR display device as 3D content. In addition, the ability to view 3D content from a free viewpoint enables providing a new viewing experience not possible for conventional 2D images.

One of the requirements for the above-mentioned service is to stream 3D content in real time. This is to enable reducing the viewer's interaction cost related to downloading the 3D content linked to the broadcast in advance and to synchronize the content with the live broadcast program. On the other hand, since 3D content generally involves a large amount of data, it requires efficient transmission methods. To address this requirement, we are conducting R&D on the object-based transmission method[3].

Figure 1: Proposed viewing style



3. Object-based transmission

The proposed object-based transmission method is a proprietary transmission protocol based on User Datagram Protocol (UDP)/Internet Protocol (IP) that considers each performer and background content to be a single object and transmits it in an identifiable state at the packet level. Figure 2 shows the frame structure of object-based transmission. In object-based transmission, the encoded 3D data described below is framed for transmission by describing the information to uniquely identify the 3D object, called Packet ID, in the header part. Then, each object is framed, and metadata, such as Presentation Time Stamp (PTS) to be presented in the payload header, are described and multiplexed. This method, which enables flexibly processing each object at the packet level unlike when transmitting multiple 3D models together, can be applied to improve transmission efficiency. For example, a 3D model of a motionless background can be transmitted at a lower frame rate than a 3D model of a moving performer, thus reducing the volume of data equivalent to the compressed frame rate. It is also possible to adjust the total amount of transmitted data by assigning priority to each 3D model and adjusting the quality of the 3D model itself.

3.1 3D model for transmission

The 3D model for transmission assumes encoding as mesh geometry and texture image for each frame. Google Draco[4] is used for the compression of mesh geometry, JPEG is used for the compression of texture images, and GLB File Format[5], a binary format of glTF (GL Transmission Format) 2.0, is used for the transmission frame format. A moving 3D model is similar to the mechanism for continuously displaying frames of still images to make a movie. In a single file, a static 3D model is transmitted at around 30 frames per second (fps) and is expressed by continuous rendering on the display device. On the other hand, a 3D model of a static background object transmits the same still image frame at a rate of around 1 fps. Periodic transmission, even for background objects, is carried out for cases when viewers start viewing 3D content midway through.

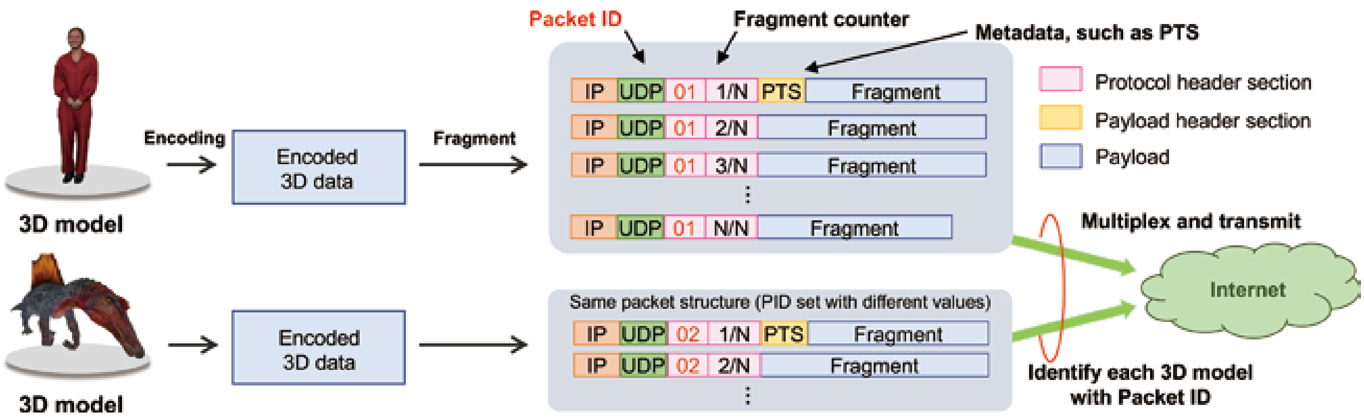
For convenience, the data of the 3D model that is actually distributed by object-based transmission is managed as sequential GLB data with the number of frames to be transmitted as the file name in a folder with each object name as the folder name. For example, the transmission data of a reporter, which is regarded as a single object to be transmitted at 30 fps in the 120-second STRL Open House content, is stored in a folder called "reporter" as sequential data labeled from "00001.glb" to "03600.glb" in which still image frames of the 3D model of the reporter are encoded in the above format.

3.2 Prototyping the viewing app

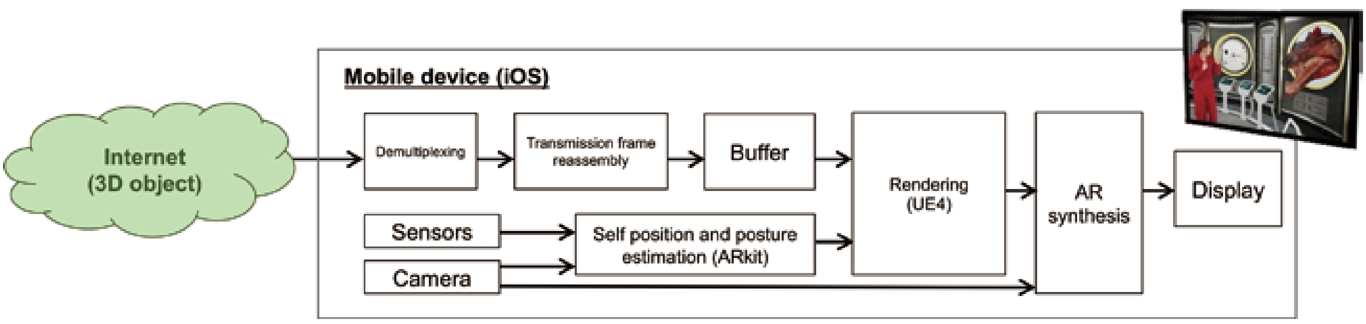
An application that receives 3D data delivered by object-based transmission and renders it in AR was implemented as an app that runs on commercially available mobile devices (iPad/Apple).

Figure 3 shows the block diagram of the application. The receiving application first receives an IP packet framed with an object-based transmission protocol and separates multiple objects that are multiplexed. Next, the transmission frame is reassembled for each object and buffered until the time of rendering according to the time stamp described in the header part of the packet. Then, 3D content is continuously rendered in AR and presented to the screen projected on the terminal. For rendering, AR Kit, an AR support function of iOS/iPad OS, and the game engine (Unreal Engine 4) are used.

■ Figure 2: Frame structure for object-based transmission



■ Figure 3: Block configuration of viewing app



4. Increasing the efficiency of data transmission

We are researching and developing a mechanism to streamline the data transmission volume by applying object-based transmission. This section describes the object filter[6] for streamlining the data delivery volume by optimizing the data delivered in accordance with the audience, and the texture thinning technique[7] for reducing the volume of the 3D data delivered.

4.1 Object filter

Figure 4 shows the system configuration diagram of object-based transmission including the object filter. As shown in Figure 4, the object filter is installed on the transmission path between the distribution server and the AR display device, and the data to be distributed is optimized in accordance with the position and gaze information of the viewer.

The data to be delivered is optimized by two methods: frustum culling and resolution pattern selection. Frustum culling is a method also used in general CG rendering and only transmits objects within the field of view of the display device. Resolution pattern selection focuses on the fact that the 3D content is displayed smaller when it is far from the display device and larger when it is close to the display device. It is a method for transmitting only data with a resolution corresponding to the distance for objects with multiple resolutions. This makes it possible to carry out more efficient transmission in the section between the object filter and the display device compared with always transmitting high-resolution data. These processes are implemented simply at the IP packet level by using Packet ID as an identifier.

4.2 Texture thinning

Figure 5 shows a conceptual diagram of texture thinning. This method focuses on the fact that polygon topology and texture mapping are the same between frames for non-live-action CG models produced by CG modeling and other tools, and the same texture image is used in all frames. Texture images with a large amount of information are thinned out of the GLB data frames of the 3D model.

The data for which texture image thinning has been carried out cannot be rendered as a 3D model as it is. However, by receiving the frame that includes the texture image once on the receiving side, then caching and using the texture data again, rendering can be carried out without problems on the display device.

Here we discuss the effect of texture thinning using the Spinosaurus used in the STRL Open House 2022 as an example. The data has 63479 vertices and a texture resolution of 1024 x 1024 pixels; and without texture thinning, the transmission bit rate is about 109 Mbps. On the other hand, it was confirmed that the amount of data can be reduced to about 34 Mbps by thinning the encoded data so as to include the texture only once in 30 frames.

■ Figure 4: System configuration of object filter

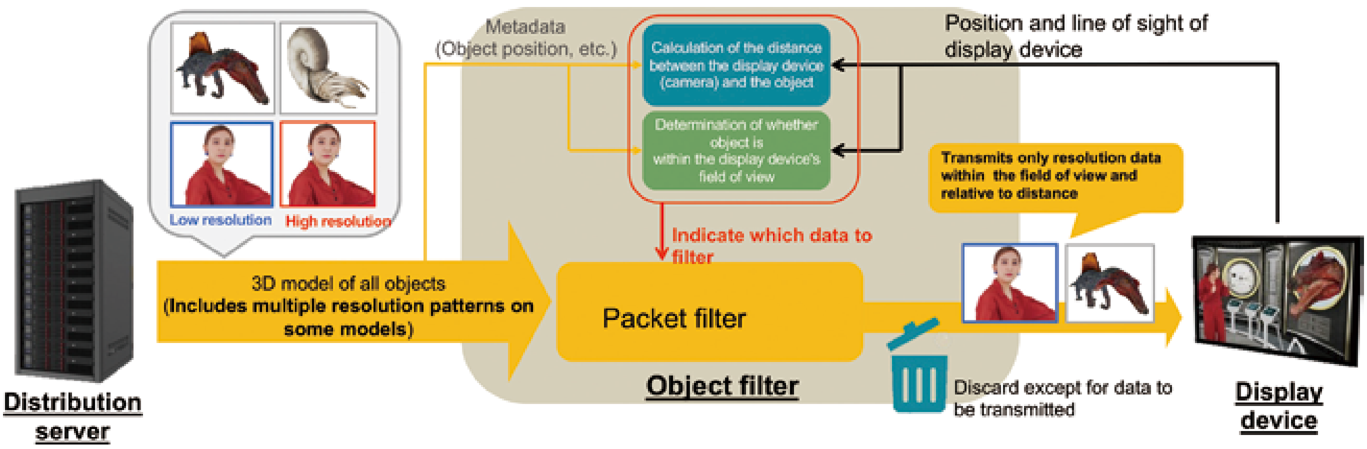
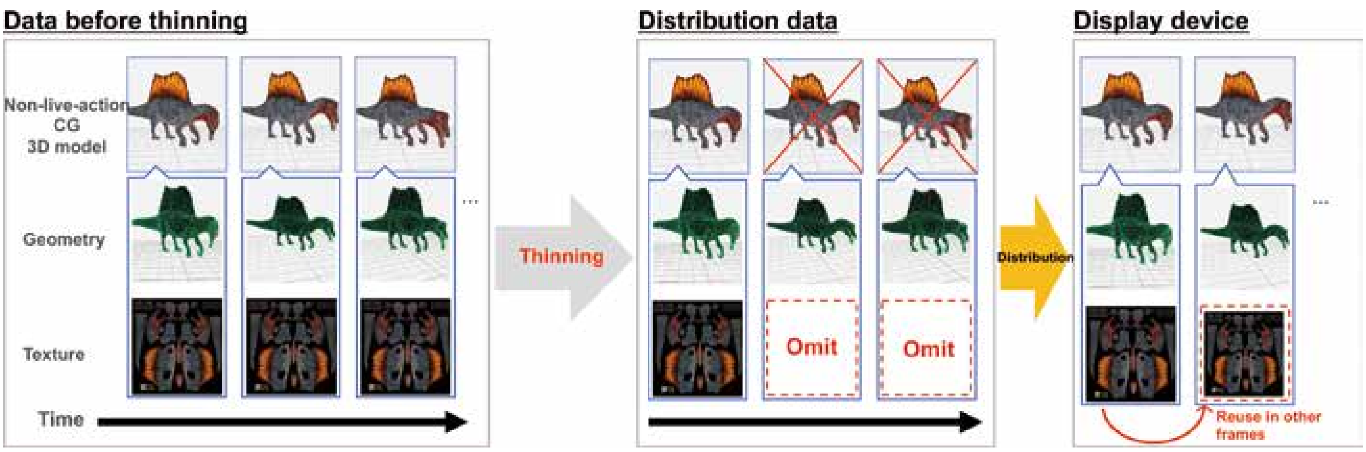


Figure 5: Texture thinning concept



5. Content packaging

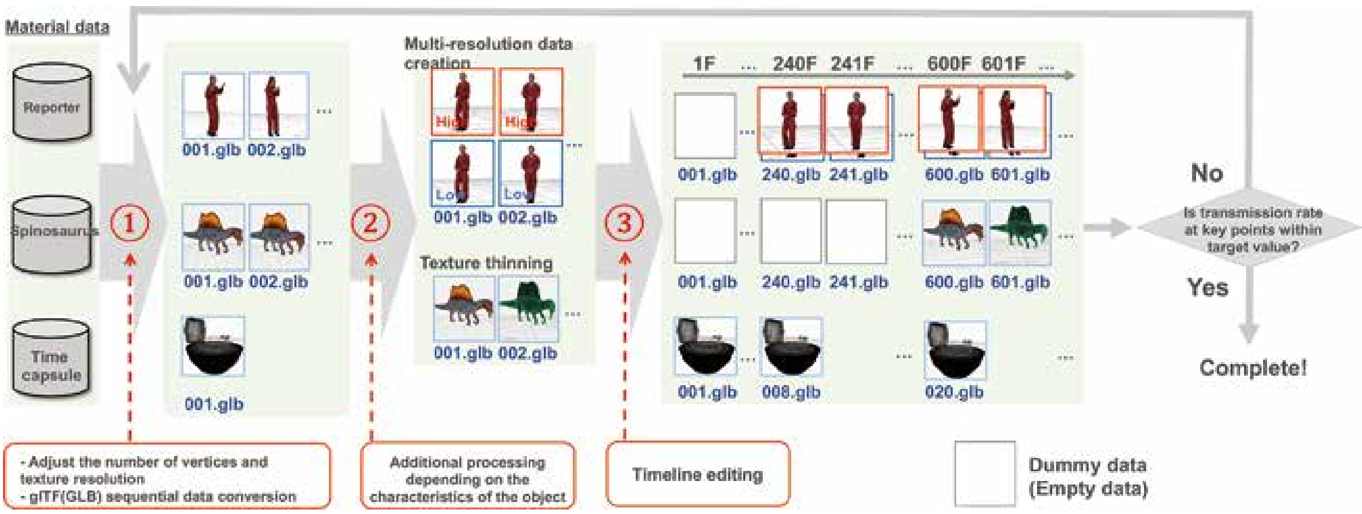
In this section, we will introduce the flow for creating the data to be actually delivered by object-based transmission and packaging the data as content using the content created in STRL Open 2022 as an example.

First, a check is conducted to determine whether the content components can be decomposed into static parts and moving parts. In this example, the time capsule is broken down into two parts; namely, the floor, which is always stationary, and the wall surface and ceiling, which disappear as particles when the scene changes from land to sea, with each part treated as a separate object.

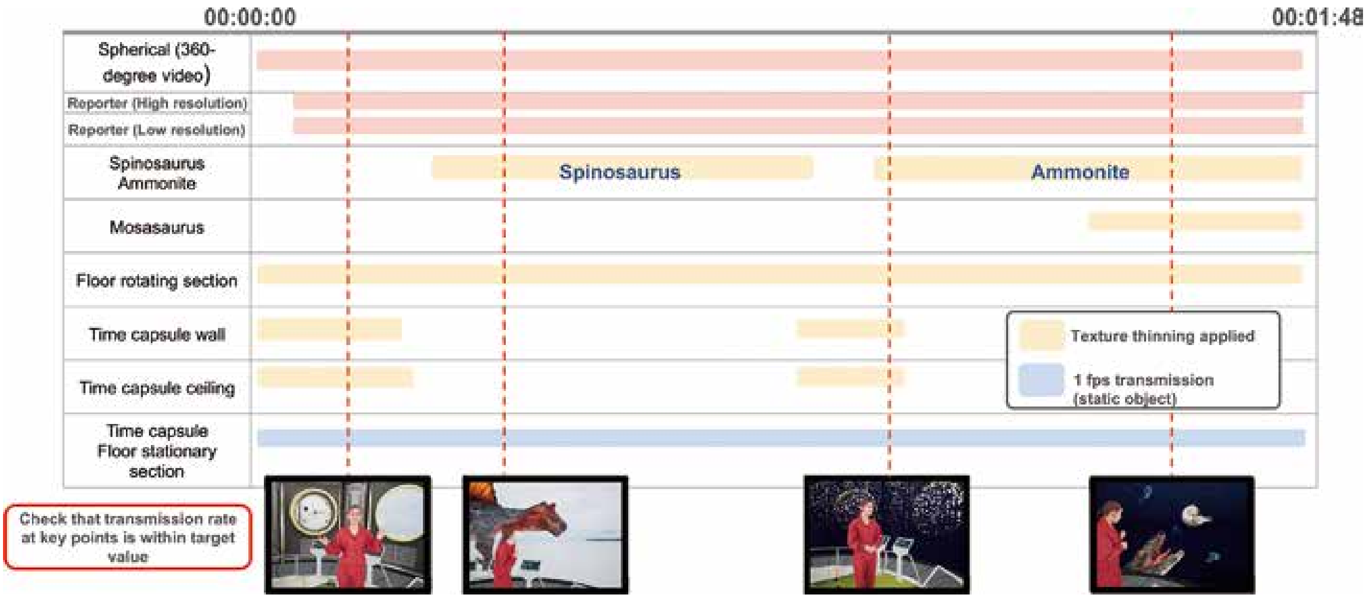
The data to be delivered is then created. Figure 6 shows the flow for creating distribution data. The figure shows a reporter as volumetric video data, the Spinosaurus as non-live-action CG data, and the time capsule (floor) as a static object. As shown in the figure, the production method can be broadly divided into three steps. First, (1) the component data with many vertices and high texture resolution is converted into sequential data in GLB format for each object, along with reducing the number of vertices and texture resolution. In this step, since the static object is the same in all frames, the data to be created consists of only one frame.

Next, (2) for each object, data is created and processed in accordance with the characteristics of the object. Here, for volumetric video, data with multiple resolution patterns is created based on object filters. For non-live-action CG objects, the texture thinning described in section 4.2. is applied. With the exception

Figure 6: Distribution data creation procedure



■ **Figure 7: Timeline of STRL Open House 2022 content**



of volumetric video data, each data reduction method was able to keep high-quality data with many vertices and high texture resolution at a transmission rate that enables stable streaming transmission. Thus, multiple resolutions were not prepared for non-live-action CG objects in this content.

Further, (3) timeline editing is performed to display the data of each created object at the intended timing as the actual content. This involves editing the file names. The figure shows an example of renaming the file from “00001.glb” to “00240.glb,” assuming that the first frame of the reporter’s material data is to be presented at the 240th frame of the actual content. Dummy data is inserted in frames where no object exists to turn off the display of objects.

Finally, a check is conducted to determine whether the transmission bit rate, which varies depending on the transmitted object, is within the target bit rate for stable streaming at key points.

Figure 7 shows the timeline of the content exhibited at the STRL Open House 2022.

As shown in the figure, a check is conducted to determine whether transmission is within the target bit rate, especially when multiple objects are transmitted at the same time. If not, step (1) is repeated by adjusting the number of vertices and texture resolution of the 3D model and creating the data again. If the transmission is within the target rate, actual transmission is carried out and packaging of the delivery data is completed after confirming that stable streaming transmission can be performed.

6. Conclusion

Here, we outlined the service aimed at providing a new viewing experience by synchronizing 3D contents with broadcast programs and discussed the transmission technology we are researching and developing to implement the service. We then explained the actual distribution data creation method using the contents of STRL Open 2022 as an example. Going forward, to actualize the service, we plan to develop methods to reduce the cost and automate the creation of distribution data, develop Transmission Control Protocol (TCP)/IP-based transmission technologies that enable the use of CDN (Content Delivery Network) for large-scale distribution, and develop and verify browser-based applications with low viewer interaction costs.

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Broadcasting Professional Baseball by using Volumetric-video Technology

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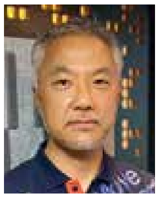

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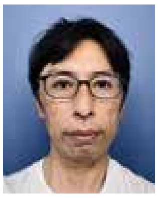


Hajime Sato
Canon Inc.

Atsushi Date
Canon Inc.

1. Introduction

Seventy years have passed since Nippon Television (NTV) became the first commercial broadcaster to broadcast professional baseball on August 29, 1953. What started as a live broadcast with two cameras has evolved to the point that approximately 100 specialized cameras can instantly generate "volumetric video" (or "free-viewpoint video image") that provide a special viewing experience (Figure 1). Introduced for baseball broadcasts as a world's first in April 2022, free-viewpoint video image was implemented for five games in the 2022 season and for all 68 home games (at Tokyo Dome) of the Yomiuri Giants in the 2023 season.

This implementation of free-viewpoint video image has made it possible to generate video replays of any scene, including batting, running between bases, and brilliant defensive coordination, with 360-degree free camerawork. It creates a series of video images from viewpoints that cannot be captured with normal cameras. The series may include video images from the perspective of players that make the viewer feel as if they were on the field or highlights that stop at the moment of an outstanding play and move around freely up, down, left, and right.

■ Figure 1: Free-viewpoint video images in professional baseball broadcast

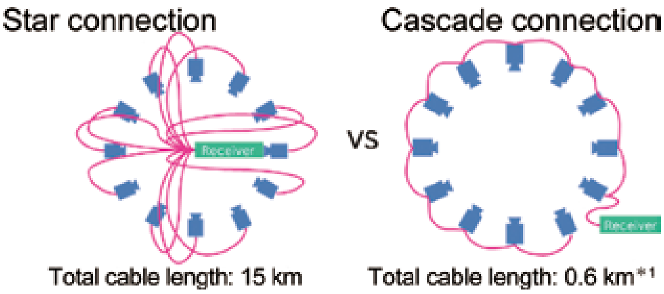
2. Overview of volumetric-video technology

Volumetric-video technology is a means of capturing images of a subject with a number of cameras and generating 3D spatial data from the captured images. Multiple cameras surrounding the subject capture all temporal and spatial changes and generate 3D models. The texture at the time of the captured pictures is attached to the generated 3D models, and free-viewpoint videos images are generated by providing viewpoints from any position or angle in the space.

3. Three features of the implemented volumetric-video system

The three main features of the implemented volumetric-video system are described as follows. The first feature is the method of connecting the cameras. To configure the system by installing multiple cameras in a stadium or arena, it is necessary to wire each camera by cable to a dedicated outside-broadcasting van housing a video-generation server. In that case, if a "star-type connection" is used to connect the cameras and server on a one-to-one basis, the number of cables and distances required would be enormous. If the total circumference of the stadium is estimated as 600 m, the total cable length would be 15 km. Given that fact, we configured the implemented system as a "cascade connection"; that is, the cameras are connected to each other and data is transmitted in a "bucket relay" fashion. This configuration makes it possible to reduce the total cable length and significantly shorten the installation period of the system (Figure 2).

■ **Figure 2: Star- and cascade-type cable connections**

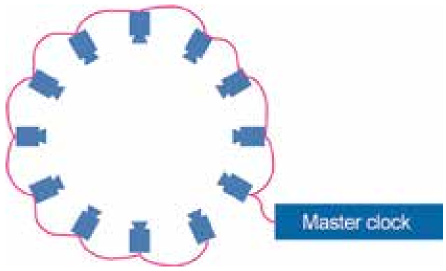


The second feature is a system for highly accurate synchronization of the cameras. Generating free-viewpoint videos images for sports events necessitates accurately capturing fast-moving objects such as bats and balls. To meet that need, it is necessary to synchronize a large number of installed cameras with high precision and capture images accurately at any given moment and without any misalignment of the cameras at any installation point. In response to that necessity, Canon has developed a high-precision video-recording technology that uses a master clock on the network to control a large number of cascaded cameras and synchronize the recording timing of each camera to the order of microseconds (Figure 3). This technology has made it possible to capture the high-speed pitches, bat swings, and struck balls of professional baseball players accurately and generate free-viewpoint TV videos images.

The third feature is the wide image-capturing range.

While working on professional baseball broadcasts, we came to realize that a valuable highlight scene is not only the moment of the batter hitting the ball but also the entire play, including the action leading up to the outs during a double play. In other words, since incredible plays can occur anywhere on the field, homogeneous images must be generated across the entire field. Expanding the image-capturing area to the entire field by using

■ **Figure 3: High-precision synchronization of cameras**



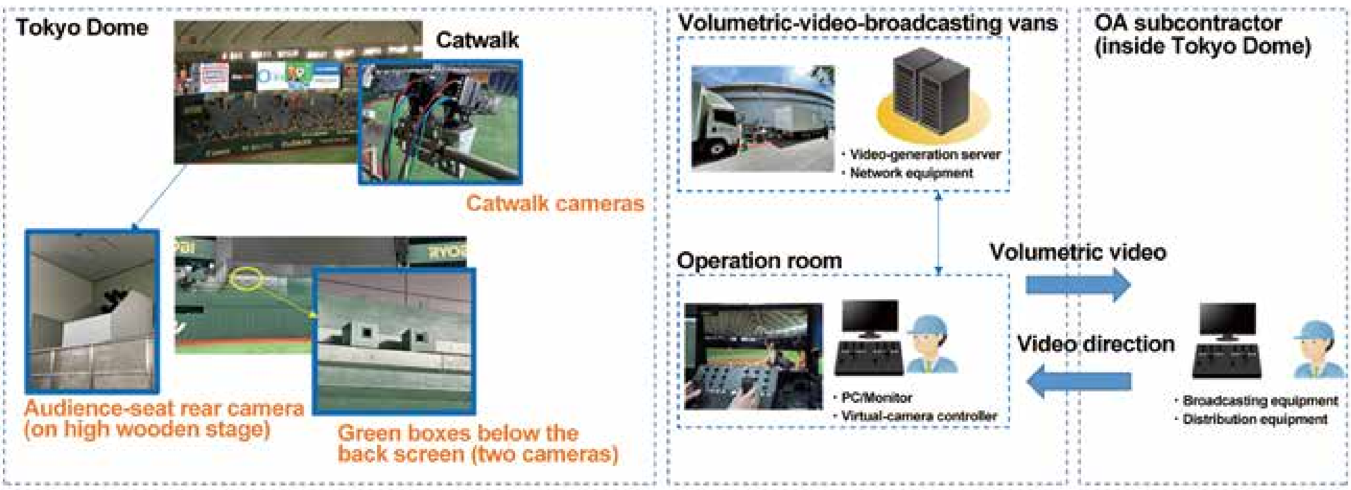
the viewpoint method would require a huge number of cameras, which is unrealistic. Accordingly, through detailed simulations of camera placement, we developed a "full-field method" that covers the entire field with the optimal number of cameras. This new method makes it possible to generate high-quality volumetric-video images from anywhere in the image-capturing area.

4. Configuration of system

The configuration of the system used for capturing volumetric-video images during a live baseball game at Tokyo Dome is shown schematically in Figure 4. The area from which volumetric video images were captured was the infield portion of the Dome's baseball field, which was covered by a determined number and placement of cameras. The cameras and their control boxes were clamped to the railing of the catwalk at the top of Tokyo Dome. Below the giant screens, which are inaccessible from the catwalk, a temporary wooden stage above and behind the audience seating area was constructed, and cameras were installed on it. With prior permission from the relevant authority, cameras were also installed in green boxes under the back screen in a way that would not obstruct the view of the players.

For rehearsals and the actual game, an outside-broadcast van was brought in from Canon and parked outside Tokyo Dome, and the free-viewpoint video images were generated from the van. The van was equipped with servers for generating free-viewpoint video images and connected to approximately 100 sets of cameras and their control boxes attached to the catwalk by optical cable via a network switch between them. A system-control unit was also installed in an operation room in the Dome, where Canon's technicians took charge of system operation. For

■ **Figure 4: Optimal placement of cameras**



generating the volumetric-video images, it is necessary to operate a virtual camera; accordingly, NTV's camera operators were trained to generate two streams of free-viewpoint video images under the instructions of a director so as to generate 1080i video and 48-kHz/24-bit audio data. One of these streams continuously assigns camera-motion paths from the start to the end of the game and continues to generate free-viewpoint video every about three seconds, and the other stream assigns camera-motion paths to the immediately preceding play and generates replay video. The audio data collected by NTV is imported into the volumetric-video-generation servers and synchronized by the servers to generate the free-viewpoint video.

5. Graphics

The volumetric-video images of the players are backed by a view of the Tokyo Dome, which is also computer-generated. The key to making a live baseball game look realistic is the realism of the 3D graphics. The space for the volumetric-video images is constructed from 3D data and textures scanned inside Tokyo Dome in advance. To minimize the difference between the volumetric-video images and images captured by regular broadcast cameras, we paid close attention to details like grass and soil, and we individually adjusted each object, repeatedly checking and correcting them, to create a space that looked like the inside of the real Tokyo Dome (Figure 5).

■ Figure 5: Created CG images of realistic field and bases

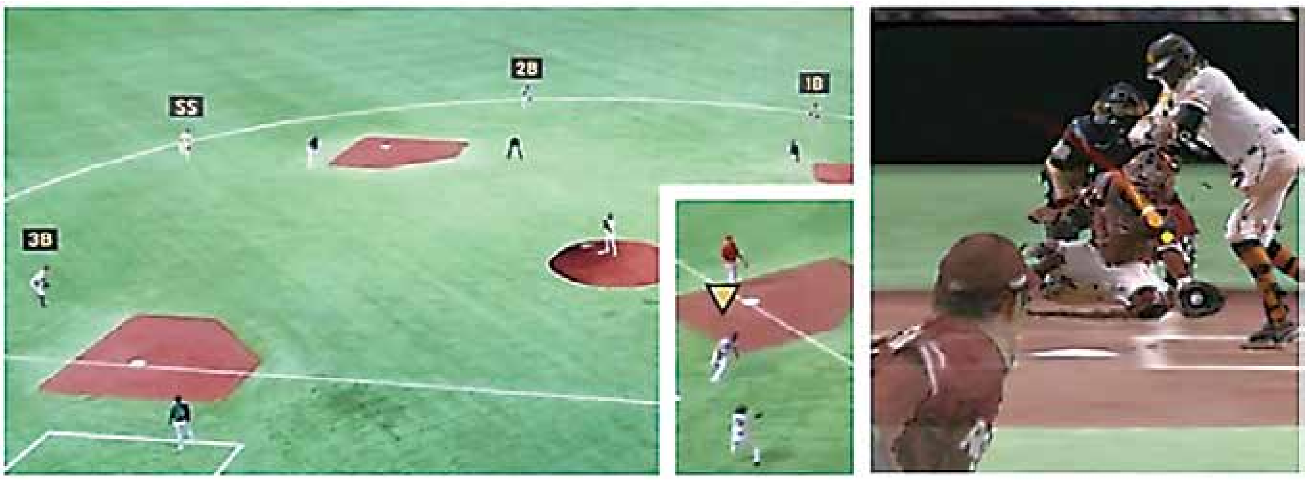
From the opening-season game in 2023, a dedicated camera was installed for capturing real-time texture with respect to the giant-screen content above the back screen and spectator seating, and the captured textures were texture-mapped to a background model to reproduce the giant screens, ribbon display, and spectator seating. The player-introduction video and direction of cheering are reflected realistically, and the excitement of the ballpark is conveyed as realistically as possible by the realistic background (Figures 6 and 7).

■ Figure 6: Camera for capturing background texture (blue frames)

■ Figure 7: Realistic background and placement of imaginary objects

Objects that do not actually exist inside the stadium, such as airships and banners, were placed in the volumetric-video space, and they were also used for program production and advertisements. AI recognition of objects in the space is combined with advanced CG expressions such as drawing the trajectory of pitches, tracking of players in wide-angle images to make it easier to see defensive formations, and tracking of markers in accordance with the movements of runners of interest (Figure 8).

■ Figure 8: AI representation of pitch trajectory and player tracking



6. Operation

Although a lot of know-how about live broadcasting using volumetric video is available, camera operation in virtual space is focused on hereafter. To manipulate the camera in virtual space, eight parameters are used: “x-axis,” “y-axis,” “z-axis,” “pan,” “tilt,” “roll,” “forwards/backwards,” and “zoom,” and one person must control them simultaneously using their fingers only (Figure 9). In the case of recording with a normal broadcast camera, although multiple operations may be performed simultaneously, the physical limitations on the camera’s range of motion make it easy to get an idea of the camera’s movement. However, in the case of recording with the virtual-space broadcast camera, the free viewpoint allows the camera to move infinitely within the virtual space; as a result, it is very difficult to get a sense of where the camera is positioned with respect to its central axis, and without sufficient training, the production is not viable. It therefore took some time to get used to the camera while adjusting the speed and sensitivity of the movement for each parameter.

■ **Figure 9: Operation status**

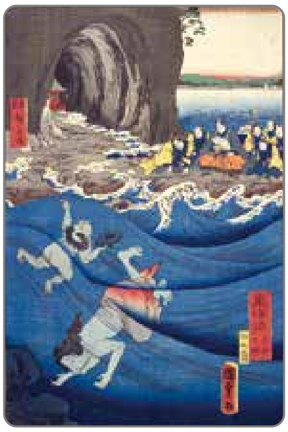
Moreover, the production director had too much freedom in using words to convey their own impressions of the volumetric-video images, and it sometimes took time for communication among the people in charge to get used to the system. More than a regular program, a live volumetric-video broadcast is not possible without each person having a common purpose and visual impression. Our know-how and experience inherited from 70 years of baseball broadcasting and the great efforts of numerous personnel with a common goal made it possible to take on new creative challenges and provide a new viewing experience.

7. Conclusion

The number of cameras set up around the catwalk giant display in the Tokyo Dome started with 87 and exceeded 100 as we improved the volumetric-video technology. The 3D models created instantly from the TV images captured by these cameras produced a series of images from angles and perspectives never seen before in a manner that lead to the creation of a new viewing experience. Being not limited to baseball, this volumetric-video technology could also be applied to other sports. We will continue to be constantly aware of “new perspectives” and strive to produce programs that convey the fun of sports even more than before.

Finally, we thank all those involved for their cooperation in the above-described broadcasting through the introduction of volumetric-video (free-viewpoint video image) technology.

Cover Art



Enoshima, from Famous Views of Tokaido Road

Utagawa Kunisada
(1786-1864)

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Beyond 5G International Conference

Yusuke Maruyama
Deputy Director
Global Strategy Division Global Strategy Bureau
Ministry of Internal Affairs and Communications

1. Introduction

In conjunction with the Beyond 5G Promotion Consortium, Japan's Ministry of Internal Affairs and Communications (MIC) co-hosted the "Beyond 5G International Conference" over two days, February 1 to 2, 2024, at the New Otani Hotel (Chiyoda Ward, Tokyo) in a hybrid format with online support.

Attending the conference were, from Japan, Makoto Gonokami, President of RIKEN (and Chairman of the Beyond 5G Promotion Consortium), Hideyuki Tokuda, President of the National Institute of Information and Communications Technology (NICT), Susumu Yoshida, Chairman of the Fifth Generation Mobile Communications Promotion Forum, Professor Emeritus of Kyoto University (Vice Chairman of the Consortium), Akihiro Nakao, Professor, Graduate School of Engineering, the University of Tokyo (Chairman of the International Committee of the Consortium), and representatives from industry, academia, and government, including telecommunications carriers and vendors, as well as many experts from overseas, including government officials from the United States, South Korea, Finland, Germany, the United Kingdom, Brazil, and India, vendors, and "Beyond 5G/6G"-promotion organizations. It was evident from the conference that expectations for Beyond 5G are growing both domestically and internationally and momentum toward the realization of Beyond 5G is increasing. Welcoming a total of about 260 attending participants and 1080 online participants, the two-day meeting was a great success.

2. Initiatives by industry, academia, and government to achieve "Beyond 5G"

In his opening remarks, Chairman Gonokami of the Beyond 5G Promotion Consortium, emphasized the importance of international collaboration concerning information and telecommunications and promotion of research and development of advanced semiconductors, AI, quantum computing, and next-generation communication technologies in a unified and interrelated manner. He also delivered a strong message about his desire to expand the circle of international collaboration for the promotion of Beyond 5G around the world.

Following the opening remarks, in the government session, Mark Cullinane, Director of Bilateral and Regional Affairs, Cyberspace and Digital Policy Bureau, U.S. Department of State, explained that Beyond 5G/6G is reliable and safe, and he pointed out that Beyond 5G/6G networks must be open and interoperable and introduced a project to support the deployment of Open RAN in Palau through Japan-U.S. cooperation. Kyeongrae Cho, Director of Innovation Network Team, Ministry of Science and ICT (MSIT), South Korea, explained the "K-Network 2030" strategy formulated in February 2023 and the areas that R&D will focus on toward commercialization of 6G. Laura Eiro, Director-General of the Data, Safety and Security Department, Ministry of Transport and Communications, Finland, explained the importance of security, sustainability, and standardization in regard to Beyond 5G/6G technologies. As for the development of Beyond 5G/6G technology, Tina Klüwer, Director-General of Directorate 5 - Research for Technological Sovereignty and Innovation, Federal Ministry of Education and Research (BMBF), Germany, emphasized the needs, sustainability, and resilience and safety of digital systems and networks.

Figure 1: Opening speech by Makoto Gonokami, President of RIKEN

Figure 2: Lecture by Director Mark Cullinane of the U.S. Department of State

In addition to that emphasis, she gave a presentation on the promotion of joint research and development between Japan and Germany.

Major international vendors then gave presentations on their initiatives and visions. Magnus Ewerbring, Ericsson's CTO for Asia-Pacific, explained that the innovation that continues to build and expand 5G networks will be utilized for the future standardization of Beyond 5G/6G. Dr. Wen Tong, CTO of Huawei Wireless, introduced how to design 6G networks in the coming AI era. Peter Vetter, President of Bell Labs Core Research, Nokia, gave a presentation on the importance of placing 6G networks as a main pillar complementing the use of AI and cloud computing. Dr. John Smee, Senior Vice President of Engineering at Qualcomm, explained that the company must consider how 6G systems should be built in consideration of lessons learned from investments in 5G.

As for presentations from domestic vendors, Nozomu Watanabe, Corporate Executive of NEC Corporation, spoke about Living Lab's efforts through industry-university co-creation with universities; Mototaka Taneya, Executive Managing Officer, CTO, Head of R&D, Sharp Corporation, spoke about the spread of Beyond 5G in the world and Sharp's efforts in response to that spread; and Shingo Mizuno, Corporate Executive Officer EVP, Vice Head of System Platform Business (in charge of Network Business), Fujitsu Ltd., spoke about the use of AI and efforts to achieve openness for the transition to 6G.

At the end of the first day, Seizo Onoe, Director of the Telecommunication Standardization Bureau of the International Telecommunication Union (ITU), took the stage and explained the importance of worldwide outreach through standardization to bridge the gap between developed and developing countries in regard to mobile networking and the evolution of elemental technologies regardless of generation.

3. Japan's efforts to implement Beyond 5G

At the beginning of the second day, Hideyuki Tokuda, President of NICT, gave a presentation on research and development concerning Beyond 5G/6G, AI, quantum ICT, and cybersecurity, testbed and research-grant initiatives, and international cooperation with Germany and France. From the Beyond 5G Promotion Consortium, Morio Toyoshima, Director-General of the Wireless Networks Research Center, Network Research Institute, NICT, spoke about the Scalability Working Group of the International Committee Technology Subcommittee; Iwao Hosako, Executive Director of NICT's Beyond 5G R&D Promotion Unit, talked about the subcommittee's High Frequency WG; and Takehiro Nakamura, Chief Standardization Officer of NTT Docomo, Inc., spoke about the White Paper Subcommittee of the Committee for Planning and Strategy.

After the above-described speeches, representatives from domestic telecommunications carriers gave presentations on their visions and efforts toward implementing Beyond 5G. Sachiko Oonishi, Executive Vice President and Head of Research and Development Market Strategy Division, NTT, explained about the Innovative Optical Wireless Network (IOWN) and NTT's version of a large-scale language model (LLM), called "tsuzumi," that achieves low power consumption. Toshikazu Youkai, Chief Network Officer, Managing Executive Officer, and Deputy General Manager of Technology Sector, KDDI Corporation, spoke about improving the quality of their robust telecommunications infrastructure, the evolution of the power to connect through partnering in Japan and overseas, and efforts toward a digital twin in the 6G era. Tomohiro Sekiwa, Senior Vice President & CNO of SoftBank Corporation, introduced the use of aerial solutions concerning the Noto Peninsula earthquake and the integration of AI into communications. Ryoji Osaka, Executive Advanced Technology Engineering Division Manager, Rakuten Mobile, Inc. explained the use of Open RAN and non-terrestrial networks (NTN) as effective disaster countermeasures.

In the government session, Yasuo Tawara, Director-General of the Global Strategy Bureau at the Ministry of Internal Affairs and Communications, said that in addition to supporting ultra-high-speed, large-capacity, low-latency, and numerous connections as an extension of 5G, NICT's funds will support R&D in areas such as optical networks and non-terrestrial networks (NTNs) with the aim of creating a Beyond 5G network that is reliable, safe, autonomous, while consuming less power. After that, Holly Creek, Acting Director of Digital Infrastructure, Department for Science, Innovation & Technology, UK, introduced the spectrum policy based on the UK's "Wireless Infrastructure

Figure 3: Lecture by Director Kyeongrae Cho of MSIT of South Korea

Figure 4: Lecture by Director Seizo Onoe of ITU Telecommunications Standardization

■ **Figure 5: Lecture by Director-General Yasuo Tawara of the Global Strategy Bureau, Ministry of Internal Affairs and Communications**

■ **Figure 6: Speech by Holly Creek, Acting Director, Department for Science, Innovation & Technology, UK**

Strategy," which was announced in April 2023. Hermano Tercius, Secretary of Telecommunications of Brazil's Ministry of Communications, gave a presentation on the status of 5G deployment in Brazil as well as the goals of their 6G project. Ravi A. Robert Jerard, Deputy Director-General (Standards-R&D-Innovation), Department of Telecommunications, Ministry of Communications, India, introduced the use of security, AI and quantum computing in regard to Beyond 5G/6G.

4. Future outlook

For this international conference, the Beyond 5G Promotion Consortium invited representatives from overseas 6G-promotion organizations that have signed a memorandum of cooperation. David Young, Managing Director of Next G Alliance in the USA, Colin Willcock, Chairman of the Governing Board Europe's 6G Smart Networks and Services Industry Association (6G-IA), and Pathak Rajesh Kumar, Director-General of India's Bharat 6G Alliance, each took the stage to discuss initiatives in each country and region and share the status of cooperation in various industries around the world.

In addition, moderated by Professor Nakao of the University of Tokyo Graduate School and Chair of the Beyond 5G Promotion Consortium International Committee, a panel discussion was held to discuss expectations for 6G initiatives and collaborations around the world.

Professor Matti Latva-aho, University of Oulu, and Director for Finland's 6G Flagship, Abhimanyu Gosain, Senior Director of Northeastern University's Wireless IoT Laboratory of PAWR (USA), and Professor Lee HyunWoo of Dankook University's 6G Forum (South Korea) participated in the meeting and confirmed the need for international collaboration and cooperation to efficiently promote standardization of 6G technologies.

Professor Nakao also delivered a message of international cooperation to establish values that can be shared across countries.

In closing the two-day conference, Susumu Yoshida, Chairman of the Fifth Generation Mobile Communications Promotion Forum, expressed his hope for further strengthening of international collaboration on future R&D of Beyond 5G and its future popularization and deployment.

At the Beyond 5G International Conference, in addition to discussing the further development and deployment of 5G, the participants shared their recognition of the need for long-term industry-academia-government collaboration—ranging from research of elemental technologies to social implementation and innovation—for promoting Beyond 5G, and they confirmed their commitment to international cooperation.

Note: The official posts of the "Beyond 5G Promotion Consortium" and "5th Generation Mobile Promotion Forum" are valid as of February 2024.

■ **Figure 7: Panel discussion facilitated by Professor Nakao of the University of Tokyo Graduate School**

■ **Figure 8: Closing remarks by Susumu Yoshida, Chairman of the Fifth Generation Mobile Communications Promotion Forum**

Results of the 3rd Germany-Japan Beyond 5G/6G Research Workshop

Masafumi Hashimoto
Director
Innovation Promotion Department
Standardization Promotion Office
National Instituted of Information and Communications Technology

1. Introduction

The National Institute of Information and Communications Technology (NICT) is engaged in international exchange on Beyond 5G/6G research. NICT co-hosted the 3rd Germany-Japan Beyond 5G/6G Research Workshop with 6G Platform Germany, an organization that organizes 6G research projects in Germany.

Dates: February 5 (Mon) to 6 (Tue), 2024

Venue: NICT Innovation Center (15th floor, Nihombashi Tower, Tokyo)

Participants: Open to anyone interested in Beyond 5G/6G research activities

The first day was the day after "Risshun" (the first day of spring), but the weather was unexpected, with snow starting to fall in the afternoon to a few centimeters in Tokyo. Nonetheless, 75 participants (52 from Japan and 23 from Germany) participated and engaged in an enthusiastic exchange of opinions.

2. Review of previous events

This workshop started as a research-level international exchange activity following the exchange of opinions between Japan's Ministry of Internal Affairs and Communications (MIC) and the German Federal Ministry of Education and Research (BMBF). The two countries are working to build cooperative relationships between universities, research institutes, and the private sector through Beyond 5G/6G R&D collaborations. Mr. Takeaki Matsumoto, Minister for Internal Affairs and Communications, and Ms. Bettina Stark-Watzinger, Federal Minister of Education and Research, signed a Memorandum of Cooperation in the field of communications technology on May 11, 2023.

The 1st Germany-Japan Beyond 5G/6G Research Workshop was held from April 24 to 25, 2023 at the NICT Headquarters in Koganei. The workshop was attended by 73 participants (51 from Japan and 22 from Germany). From Japan, participants included researchers from NICT and Beyond 5G R&D Fund commissioned research institutions, members of the Beyond 5G Promotion Consortium, representatives of telecommunications carriers, vendors, and academic societies. From Germany, participants included representatives from the BMBF 6G Research Hubs of 6G (6GEM, 6G-Life, 6G-RIC, and Open6GHub), 6G Platform Germany, universities, and private companies.

The first workshop included presentations of research activities on Beyond 5G/6G in both countries, a poster session, and a panel discussion to explore the possibilities and directions of cooperation between Japan and Germany. In a questionnaire survey conducted after the event, positive comments were received such as "the event was very helpful in giving an idea of the concrete initiatives of Japan and Germany for Beyond 5G/6G" and "it provided ample time to discuss with participants from Japan and Germany."

The 2nd Germany-Japan Beyond 5G/6G Research Workshop was held in Berlin at the same time as the Berlin 6G Conference from June 27 to 29, 2023. The Berlin 6G Conference is an exchange event that brings together people engaged in 6G from all over Germany. Despite being held for the first time, the event was attended by more than 1,000 people. From Japan, 12 representatives from the Beyond 5G R&D Fund commissioned research institutions, NICT, Beyond 5G Consortium, and the Japanese Embassy in

Figure 1: Group photo of participants

Germany participated.

In the plenary session on the first day, Japanese participants took the stage and took commemorative photos with officials from the German Federal Ministry of Education and Research and 6G Platform Germany. In addition, Dr. Iwao Hosako, Director General of the Beyond 5G R&D Promotion Unit at NICT, Mr. Yoji Kishi, Executive Director of KDDI Research Inc., and Mr. Takehiro Nakamura, Director at NTT DoCoMo, who represented the Beyond 5G Consortium, each gave a lecture.

The Germany-Japan Beyond 5G/6G Research Workshop was held as one of the parallel sessions of the Berlin 6G Conference and was attended by more than 60 participants. There were 13 proposals from both countries on research themes for cooperation between Japan and Germany that were accepted beforehand. A representative from the Federal Ministry of Education and Research of Germany announced that it would provide budget support for around one year starting from the following year for Germany-Japan R&D collaborative projects. Also, a tour of the Berlin 6G Conference demonstration exhibit showcased the various use cases of 6G.

3. Initiatives of the German and Japanese governments

Lectures were delivered on the initiatives of the German and Japanese governments on Beyond 5G/6G. It became a valuable opportunity to grasp the policy trends of the MIC and the BMBF.

Mr. Takahiro Tanaka (Deputy Director, MIC) gave a lecture on Japan's Beyond 5G/6G promotion strategy. In addition to the R&D and testbed maintenance that have been carried out since FY2021, he explained about the launch of the 81.2-billion-yen R&D fund in FY2023. He also mentioned that a new Beyond 5G/6G strategy will be announced this summer.

Mr. Kai Börner (VDI/VDE Innovation + Technik) introduced Startup Connect, a BMBF initiative to support start-ups in the field of telecommunications. Four incubators were set up to provide start-ups with information, measurement equipment, and networking contacts. Start-ups also receive funding to accelerate the transfer of research results into the market. He also mentioned that BMBF and MIC are discussing ways to implement Germany-Japan cooperation projects. The first phase of the Germany-Japan cooperation project will be presented at the 4th Germany-Japan research workshop to be held in Berlin in July 2024.

Figure 2: Photo from the first workshop

Figure 3: Photo from the second workshop

Figure 4: Lecture by Mr. Takahiro Tanaka

Figure 5: Lecture by Mr. Kai Börner

4. Panel Discussion

The two-day panel discussions delved on the possibilities of Germany-Japan cooperation in research and development on Beyond 5G/6G. The panelists and the audience engaged in lively discussions.

1. Overview of the first day

The panelists on the first day were Prof. Akihiro Nakao (University of Tokyo), Prof. Kei Sakaguchi (Tokyo Tech), Dr. Takayuki Kuroda (NEC), Mr. Takehiro Nakamura (NTT DoCoMo), Prof. Aydin Sezgin (Ruhr University Bochum), Dr. Renato Cavalcante (Fraunhofer HHI), and Dr. Szabolcs Malomsoky (Ericsson). Dr. Kentaro Ishizu (NICT) served as the moderator.

In the discussions, the question of the importance of using digital twins in the Beyond 5G/6G era not only for

■ Figure 6: Panel discussion on the first day

■ Figure 7: Panel discussion on the second day

monitoring but also for services that involve interaction with people was raised. A participant expressed the view that digital twins will undergo gradual advancement, wherein today's digital twins are still in the 0th stage of monitoring and sensing. This will be followed by the first stage of visualization, the second stage of optimization, and the third stage of prediction. He also mentioned that digital twins could be used to predict lightning strikes, traffic congestion, and people's health conditions. Initiatives of telecom operators in using digital twins to autonomously manage their networks and increase their resilience were also introduced, and the use of digital twins outside of the telecom industry was also suggested.

Next, concerns were raised about the sustainability of artificial intelligence (AI) and digital twins as they consume large amounts of energy. Efforts to develop lightweight AI with emphasis on Japanese language processing in Japan were then introduced. In addition, the necessity to control the network and reduce power consumption in accordance with the communication demand was pointed out. The importance of sustainability as well as the pursuit of performance in the system design of Beyond 5G/6G was also noted.

As AI and machine learning (ML) have become increasingly used in research, researchers discussed whether they should focus more on mathematical analysis or AI/ML data. Some were of the opinion that since Beyond 5G/6G is AI-native, young researchers should actively use AI/ML while keeping in mind the ethical issues of their use.

Lastly, discussions were held on potential topics for cooperation between Germany and Japan, concluding that resilience, digital twins, energy consumption, and AI will continue to be considered as candidates.

2. Overview of the second day

The panelists on the second day were Mr. Hideaki Takahashi (Nokia), Dr. Satoshi Konishi (KDDI Research Inc.), Dr. Takeshi Matsumura (NICT), Mr. Yuji Tazaki (Fujitsu), Prof. Andreas Stöhr (Univ. Duisburg-Essen), and Mr. Niels König (Fraunhofer IPT). Prof. Haris Gačanin (RWTH Aachen Univ.) served as the moderator.

First, measures to curb energy consumption were discussed. Among the measures cited were the use of optical fibers and the transition from centralized processing to distributed processing. The ability of NICT's wireless emulator, which enables demonstration of a large-scale wireless system in a virtual space, to make system construction efficient was mentioned.

Next, the fusion of radio and light was discussed. The difficulty of installing optical fibers in different sorts of areas in Japan was pointed out, along with the necessity to strengthen the entire network, rather than choosing between wireless or optical, in light of the doubling of traffic every three years. It was also mentioned that customers view networks from an end-to-end perspective.

With the advent of the new generations of 4G, 5G, and Beyond 5G/6G, it was noted that the management of heterogeneous networks will become crucial. Efforts to develop a standard that allows flexible frequency selection at 3GPP were introduced. Also, the effectiveness of evaluating the response using AI to avoid network failures was suggested since the optimal solution differs from generation to generation.

Regarding topics for Germany-Japan cooperation, the panelists have agreed that research institutes, vendors, and operators should continue considering issues of common interest.

5. Lectures by researchers

The rich variety of presentations from researchers showed that Beyond 5G/6G can serve as the foundation of all industries and social activities.

Dr. Tetsuya Ido (NICT) introduced the Wi-Wi space-time synchronization technology. For satellites, a technology has been established to compare time between UTC (Coordinated Universal Time) and JST (Japan Standard Time) with an accuracy in nano (10^{-9}) seconds. Wi-Wi makes this possible between small wireless devices. They are also developing an antenna that reduces the phase error arising from the transmission and reception angles.

Dr. Motoaki Hara (NICT) presented the development roadmap for an ultra-compact atomic clock with a size of 0.5 cc or less and the latest development progress. He also introduced the cluster clock infrastructure, in which numerous communication nodes equipped with atomic clocks cooperate to achieve highly stable and reliable time synchronization, and introduced the new time-series algorithm required for this technology.

Dr. Ryosuke Isogai (NICT) reported the success of a demonstration experiment for transmitting 120 MB of data in about 0.5 seconds, the time it takes for drones to pass each other. Two drones were equipped with IEEE802.15.3e-compliant 60-GHz wireless devices, and high-frequency communication was established within the short period of time that the two drones passed each other, enabling high-capacity data transmission.

Mr. Kentaro Tani (NGK Insulators) introduced a hybrid bonded wafer for sub-terahertz band antenna. The wafer, which is made of a silica glass functional layer and a silicon base substrate directly bonded together, has low loss characteristics over a wide frequency band of 100 GHz or more, and is resistant to high temperatures and high humidity.

Dr. Yusuke Dohi (JR East) introduced the efforts of the Research and Development Center of JR East toward the utilization of Local 5G and discussed the necessity of technical and institutional studies to construct linear wireless areas such as for railway tracks. The paper by Dr. Dohi reporting on Local 5G verification test on Shinkansen Deadhead Line won the 39th Telecom System Technology Award of the Telecommunications Advancement Foundation.

Mr. Niels König (Fraunhofer IPT) introduced production research conducted at the 5G-Industry Campus Europe. This research is aimed at concurrently solving problems of quality, time, and cost with the use of 5G. They demonstrated that a 5G multi-sensor platform enabled a 5-axis milling machine to accurately create aircraft engine blades by transmitting data such as acceleration, strain, temperature, and humidity.

Mr. Till Witt (NXP Semiconductors) introduced German initiatives in quantum computing. The German government included 2 billion euros for R&D on quantum technologies and quantum computing in the budgetary package for economic stimulus in 2020. NXP semiconductors is involved in three governmental projects; namely, demonstration of a 10-Qbit computer, development of a 50-Qbit prototype computer, and construction of a modular platform.

6. Poster session

Japanese and German researchers engaged in active discussions with participants in front of the posters. The following poster presentation overview excludes posters related to research presented in the lectures and demonstrations.

Dr. Tobias Meuser (TU Darmstadt) presented their experiments with functions for switching the components of the wireless access network and switching the various nodes of the core network by ML in order to increase the resiliency of 5G and 6G networks.

Mr. Michael Weimer (Fraunhofer FHR) presented their research on joint communication and sensing (JCS), which uses radio waves for wireless communication in combination with sensing. They presented initial results towards formulating the concept for a long-range OFDM radar for demonstration of JCS and its required technologies.

Mr. Andreas Bathelt (Fraunhofer FHR) presented his research on time synchronization for JCS. He discussed a basic algorithm that creates a virtual, common clock using a consensus approach among multiple devices and then adjusts the different local times of these devices. He also presented an asynchronous operation of this algorithm.

Dr. Sören Kerner (Fraunhofer IML) presented their research on the PACE Lab, a robotics 3D-data acquisition test field featuring a high-precision motion capturing system as well as software-defined radio system to develop 6G-driven services in the context of the 6GEM project. Within the PACE Lab, the simulation-based digital twin reproduces the experiment implemented in physical space in real time, including shadowing effects by obstacles.

Mr. Niels König (Fraunhofer IPT) presented their collaborative research with an interdisciplinary consortium on manufacturing, cybersecurity, mobile technology, and academia to analyze security risks posed by 5G and to develop measures for prevention, detection, and response at the 5G-Industry Campus

Figure 8: Lecture from the Japanese side (Dr. Tetsuya Ido)

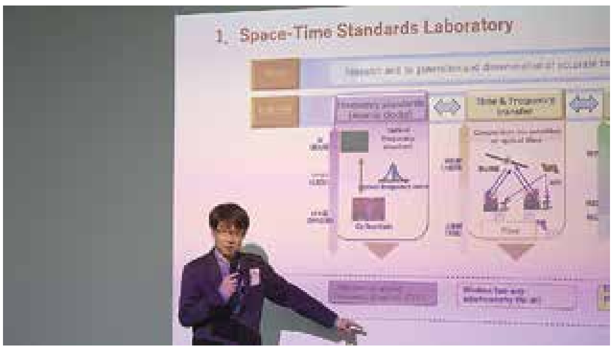

Figure 9: Lecture from the German side (Mr. Till Witt)

Europe. Furthermore, he also presented a testbed activity investigating mmW in industrial applications, especially the bandwidth implications on propagation, performance, and use cases.

Dr. Renato Cavalcante (Fraunhofer HHI) introduced the activities of the 6G Research and Innovation Center (6G-RIC). The highlights of their activities include verification experiments on the world's first long-range D-band system and channel charting for indoor localization.

Dr. Dirk Wübben (University of Bremen) and Mr. Till Witt (NXP Semiconductors) presented their research on the integration of terrestrial and non-terrestrial networks. They are investigating technical aspects such as functional split and RAN placement among satellites, HAPS, drones, and terrestrial systems and information-preserving compression for efficient and reliable transmission.

Prof. Haris Gačanin (RWTH Aachen University) presented their research on the applications of machine learning in wireless communication. They developed a prototype system to improve energy efficiency by efficient utilization of FPGA based on operational data and learning functions.

Prof. Andreas Stöhr (University Duisburg-Essen) presented their demonstrations on wireless communication in THz band such as multi-beams serving two users and high data rates of 200 Gbit/s.

Dr. Nidal Zarifeh (University Duisburg-Essen) presented their research on reliable THz connection in a smart hospital. They are modelling THz channels in a surgery room scenario and conducting related measurements and experiments to establish connection between the THz access point and VR headset.

Dr. Yuki Yoshida (NICT) presented their research on data sharing between the Germany-Japan optical network testbeds in a way that is compliant with utilization policies that uphold data sovereignty, i.e., policies that are defined by the data owner, in order to accelerate research on network AI.

Dr. Kentaro Furusawa (NICT) introduced a method for generating high-quality terahertz reference signals from lasers used for frequency standards using compact, power-saving device called microcomb, and reported on their efforts to fabricate and evaluate devices.

Prof. Sangyeop Lee (Tokyo Tech) reported that they have fabricated and evaluated film-type absorber, reflector, and radome with characteristics of millimeter- and terahertz-wave bands and obtained favorable results.

Dr. Takahiro Kaji (NICT) presented their research on radio-over-fiber (ROF), which transmits terahertz frequency signals using optical fibers. They have fabricated a D-band (110-170 GHz band) modulator with antennas and demonstrated high-speed direct conversion between terahertz waves and light.

Mr. Yoichi Kansaku (JR East) presented their research on an integrated service that covers international tourism experience to satisfy the end-to-end needs of inbound tourists in Japan. The service supports tourists in online planning from their country of departure and in guiding them to their destinations after arrival.

Figure 10: Poster session

7. Demonstration session

Two demonstrations were presented by researchers from Germany. Both were demonstrations that allowed participants to experience the service and attracted wide attention among the participants.

Prof. Aydin Sezgin (Ruhr University Bochum) presented their research on reconfigurable intelligent surfaces (RIS). They showed a demonstration video in which an RIS-equipped drone was used for angle-of-arrival estimation.

Prof. Christian Zenger (Ruhr University Bochum) presented a demonstration video on remote monitoring in security areas through the detection of radio frequency signals using PHYSEC's anti-tamper radios. In case of physical intrusion and destruction, the changes detected in radio frequency signals trigger a warning.

Figure 11: Demonstration by Prof. Aydin Sezgin

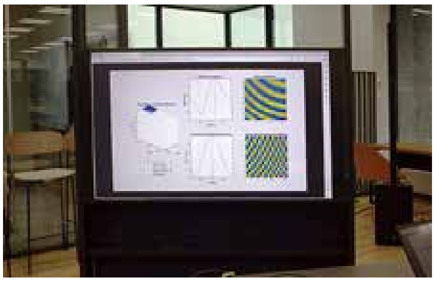

Figure 12: Demonstration by Prof. Christian Zenger

8. Conclusion

Lively discussions took place among the participants in all the sessions, reflecting the commitment of Japanese and German researchers towards the advancement of Beyond 5G/6G. It seemed that research on the Japanese side focused on important technological seeds, while that on the German side focused on services that are easy to visualize. The keen interest among the German researchers in reducing energy consumption was remarkable.

The 4th German-Japan Beyond 5G/6G Research Workshop will be held from July 1 to 4, 2024 in Berlin. It will be open to anyone interested in Beyond 5G/6G research activities, so we hope that many people will be able to attend.

56th Celebration of World Telecommunication and Information Society Day

The ITU Association of Japan
Planning Department

The 56th Celebration of World Telecommunication and Information Society Day was held by The ITU Association of Japan (ITU-AJ) on May 17, 2024 at the Keio Plaza Hotel in Nishishinjuku, Tokyo. It was attended by approximately 110 guests from the Japanese government, telecommunications and broadcasting industries and other related organizations. A celebration party was held after the ceremony.

May 17 is the day in 1865 on which the first International Telegraph Convention was signed laying the foundation for today's International Telecommunication Union (ITU). Named "World Telecommunication and Information Society Day," ITU-AJ holds a ceremony in Japan to commemorate this anniversary in unison with ITU and other countries. Continuing a long tradition, the MIC Minister's Award and ITU-AJ awards were presented at this ceremony for the 52nd time to honor the achievements of individuals who have been active in a wide range of information-communications and broadcasting fields in conjunction with international standardization and international cooperation.

At the ceremony, Mr. Koichi Watanabe, State-Minister for Internal Affairs and Communications, talked about the important role that Japan has come to play in deepening international cooperation, such as by holding the G7 Digital and Tech Ministers' Meeting and Internet Governance Forum (IGF) last year, and about Japan's ongoing commitment to making proactive contributions through ITU activities. In addition, Mr. Yoshifumi Tsuge, State Minister for Foreign Affairs, explained how ITU-AJ, by cooperating in initiatives led by the ITU, Asia-Pacific Telecommunity (APT), and other institutions and contributing to the development of telecommunications and broadcasting technologies in Japan and throughout the world, has come to expand its activities as a key facilitator of cooperation between Japan and those institutions. He also told us about the efforts of ITU-AJ in obtaining executive posts for Japan in international institutions. Continuing on, Dr. Hideyuki Tokuda, Chair of the ITU-AJ Award Selection Board, reported on this year's selections.

These talks were followed by the presentation ceremony for the MIC Minister's Award and ITU-AJ awards. The MIC Minister's Award was presented to Dr. Yukihiro Nishida, Japan Broadcasting Corporation, who served as chairman of ITU-R SG6 for an eight-year period from 2015–2023, led initiatives for introducing new technologies such as AI and immersive media in broadcasting including the formulation of recommendations for an Ultra High Definition Television (UHDTV) video system and High-Dynamic Range Television (HDR-TV) system, and received the 75th Engineering, Science & Technology Emmy Award from the National Academy of Television Arts and Sciences. Next, the ITU-AJ Special Achievement Award was presented to Dr. Maki Sugimoto, CEO of Holoeyes, Inc., professor at the Innovation Lab, Okinaga Research Institute, Teikyo University, and surgeon in the Department of HPB Surgery, Teikyo University School of Medicine, who has promoted the use of ICT technology in the medical field (surgery) and has recently been active in the development, provision, and spread of specific products for applying XR, VR, AR, and MR technologies to surgical procedures.

In addition, the ITU-AJ Accomplishment Award was presented to eight individuals and one organization and the ITU-AJ Encouragement Award was presented to 15 individuals. These awards honor contributions to ITU activities or ITU-related activities in Japan, contributions to implementing the Declaration

■ Commemorative group photo

of Principles and Plan of Action at the World Summit on the Information Society, contributions to international cooperation activities in the information-communications, broadcasting, and postal fields, and other achievements related to international activities in information-communications and broadcasting.

After the presentation ceremony, Dr. Maki Sugimoto, recipient of the ITU-AJ Special Achievement Award, gave the Anniversary Keynote Presentation under the theme of "Digital Transformation in Surgical Medicine."

This year, as well, we are grateful that the MIC Minister's Award and ITU-AJ awards could be presented at the ceremony venue. We wish all the award recipients great success and good health in the years to come, and we extend our gratitude to the award recommending organizations and to everyone who graciously supported this ceremony. Please visit the ITU-AJ website to view an outline and other photos of the ceremony.

https://www.ituaj.jp/?page_id=31982 (Japanese only)

Dr. Yukihiro Nishida, MIC Minister's Award

Dr. Maki Sugimoto, ITU-AJ Special Achievement Award

Recipients of the ITU-AJ Accomplishment Award

Recipients of the ITU-AJ Encouragement Award

List of Recipients of the MIC Minister's Award and 52nd ITU-AJ Awards

(Titles omitted) (Affiliations at time of recommendation)

MIC Minister's Award
Dr. NISHIDA Yukihiro (Japan Broadcasting Corporation)
ITU-AJ Special Achievement Award
"Dr. SUGIMOTO Maki (Holoeyes Inc. Innovation Lab,Teikyo University Okinaga Research Institute Department of HPB Surgery, Teikyo University School of Medicine)"
ITU-AJ Accomplishment Awards
Mr. INOUE Masazumi (KDDI Foundation) Mr. IMATA Satoshi (KDDI CORPORATION) Ms. IWASAKI Junko (NEC Corporation) Dr. IWAMA Tsukasa (National Institute of Information and Communications Technology) Mr. GUNJI Yoshimasa (BHN Association) Dr. KONDO Yoshihiro (NTT Advanced Technology Corporation) Dr. NAKAMURA Hirotaka (NTT Innovative Devices Corporation) Dr. YAMADA Wataru (Nippon Telegraph and Telephone Corporation) HAPS GLOBAL SPECTRUM STANDARDIZATION TEAM (SoftBank Corp.)
ITU-AJ Encouragement Awards
Mr. AGATA Mikiya (KDDI CORPORATION) Mr. UTSUNOMIYA Ryusuke (Rakuten Mobile, Inc.) Dr. UNNO Kyohei (KDDI Research, Inc.) Mr. KAWASAKI Junichi (KDDI Research, Inc.) Mr. SUGASAWA Koichi (NTT e-Asia Corporation) Mr. SUZUKI Yasuki (KDDI CORPORATION) Ms. SUYAMA Momoko (Japan Broadcasting Corporation) Mr. TAKEDA Daiki (NTT DOCOMO, INC.) Ms. CHEN Wenjing (NTT DOCOMO, INC.) Dr. NANBA Shinobu (KDDI CORPORATION) Dr. FUJII Katsumi (National Institute of Information and Communications Technology) Mr. FUSHIKI Masashi (Fujitsu Limited) Mr. MATSUKAWA Ryusuke (NTT DOCOMO, INC.) Mr. YAMAZAKI Hiroto (Japan International Cooperation Agency) Dr. WATANABE Junji (Nippon Telegraph and Telephone Corporation)

= A Serial Introduction Part 4 =
Winners of ITU-AJ Encouragement Awards 2023

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.

Toshikazu Yurugi

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Fields of activity: ICT Development in the Asia and Pacific Region

Overcoming Pandemic Challenges facing International Collaborative Projects

Being deeply honored to receive the ITU-AJ Encouragement Award, I sincerely thank the members of the ITU Association of Japan and everyone who has collaborated with me on my endeavors. The international collaborative projects recognized by this award were primarily part of the Asia-Pacific Telecommunity (APT) initiative aimed at bridging the digital divide. These projects, carried out in developing countries and rural areas, started with establishing the physical layer, such as constructing a robust terrestrial optical fiber network based on technology developed by Japan. After that, the projects were extended beyond the physical layer to deal with a wide range of social issues, including healthcare, education, disaster management, and reducing disparities for the disabled, through deployment of the application layer. From identifying challenges to implementing solutions during these projects, I found that active communication with the partner country is critical.

The COVID-19-pandemic-induced disruption to international travel posed a significant challenge to the progress of the projects. Communication was confined to online channels, and we had to rely on remote coordination based on local information and verbal instructions from remote locations.

Despite these hurdles, we made steady progress in areas that could be advanced remotely, such as finalizing system specifications and remote procurement, with an online communication tool that developed rapidly as a result of the pandemic. Thanks to those efforts, we could quickly resume project activities once the pandemic subsided after mid-2022, and we could achieve the expected results soon after the resumption. This accomplishment is a typical example of overcoming the various obstacles we encountered through utilization of ICT. Thus, thanks to the solid ICT infrastructure developed as a result of the pandemic, the projects could rapidly introduce the benefits of new ICT technologies to developing countries and rural areas soon after the pandemic subsided. By utilizing the upward spiral of ICT, I intend to accelerate my international contributions.

Soichiro Wami

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Fields of activity: Promote ICT development in Vietnam and other Southeast Asian countries

Utilizing ICT to Develop Local Communities in Southeast Asia

I am grateful to receive the Japan ITU-AJ Encouragement Award, and I express my sincere gratitude to the ITU Association of Japan and all those involved who provided guidance and cooperation on a daily basis.

From 2004 to 2008, under a Business Cooperation Contract between the Vietnam Posts and Telecommunications Group (VNPT) and NTT Vietnam (now NTT e-Asia), a group company of NTT East, I worked with VNPT members on the construction and operation of telecommunications facilities. During that time, starting in 2006, I was involved in conducting joint trial projects concerning the deployment of FTTH in Vietnam, in which FTTH had not yet been introduced. We dispatched experts from Japan to transfer know-how on equipment design, construction techniques, and maintenance operations to local engineers. I believe that these projects contributed to the development of FTTH services in Vietnam. From 2019, in accordance with a Memorandum of Understanding of cooperation on promotion of smart cities signed by NTT East with BECAMEX IDC in Binh Duong Province, Vietnam, NTT East has been discussing and studying in conjunction with its group telecommunications company VNTT and others on solving social issues through ICT. We are currently expanding our activities beyond Vietnam; namely, we are working to create businesses in Vietnam and other Southeast Asian countries that solve local community issues by combining NTT East's assets with those of our local partners.

Many companies in Southeast-Asian countries that possess ICT technology superior to that of Japan have recently emerged, and we are working to partner with such companies to solve Japan's problems. In conjunction with various partners, we intend to create new businesses that contribute to the development of Southeast Asian countries by utilizing ICT.

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Fields of activity: Clock Synchronization

Steps toward Space-Time Synchronization

We are honored to receive this prestigious ITU-AJ Encouragement Award. Since 2021, NICT Space-time Standards Laboratory has been actively involved in ITU-R WP5D standardization activities, such as introducing the concept of "space-time synchronization" as a novel trend in future technology. Initially unfamiliar with these activities, we cautiously participated in meetings while learning from colleagues in the standardization division at NICT.

The importance of space-time synchronization in the context of the emerging 5G era is becoming more pronounced as the need for accurate and stable time increases and efficient coordination between people, objects, and events becomes more crucial. We propose combining ultra-compact atomic clocks, high-precision wireless time synchronization, and large-scale network timing to achieve ubiquitous high-precision time synchronization that makes it easier to measure device location.

Despite time synchronization of current mobile device being accurate to milliseconds, implementing organic coordination requires synchronization at the nanosecond level, which poses a significant challenge. Although we acknowledge the difficulty of advancing technological development, market creation, standardization, and international networking simultaneously, we are determined to overcome these obstacles with the help of experts.

The acceptance of space-time synchronization as a "future technology trend" at the ITU-R WP5D meeting marks a significant milestone that lays the groundwork for its implementation. While we recognize we are just at the beginning of this journey, receiving the encouragement award serves as motivation to persist firmly.

We pledge to continue striving towards promoting the migration to space-time synchronization, including standardization efforts, and we express deep gratitude to our colleagues at NICT for their indispensable support.

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The ITU Association of Japan