Event Reports

5G AI IoT

DOCOMO Open House 2018 —5G Innovation and Collaboration—

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NTT DOCOMO held "DOCOMO Open House 2018—5G Innovation and Collaboration—" at Tokyo Big Sight®*1 over two days on December 6 and 7, 2018. This article presents an overview of this event and provides a detailed look at major exhibits.

1. Introduction

"DOCOMO Open House 2018—5G Innovation and Collaboration—" (hereinafter referred to as "this event") was held at Tokyo Big Sight (Tokyo's premier convention and exhibition center) over two days on December 6 and 7, 2018.

Looking to 2020 and beyond, NTT DOCOMO seeks to "amaze" and "inspire" our customers with services exceeding their expectations through co-creation with our business partners of "new value" in many areas. With this in mind, and building upon the past role of "DOCOMO R&D Open House" of conveying to the world the progressiveness and technical power of NTT DOCOMO, this DOCOMO Open House was held as a unified effort by the entire company introducing not only R&D technical achievements but business solutions from its corporate departments and initiatives from its network departments as well. Together with NTT DOCOMO's co-creation business partners, this event introduced new technologies in 5G, AI, and IoT and business solutions applying those technologies while holding a variety of presentations and programs. With about 14,000 visitors in total, DOCOMO Open House 2018 was deemed a great success (**Photo 1**).

This article describes major exhibits and presentations at this event.

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*1 Tokyo Big Sight®: A registered trademark of the Tokyo Metropolitan Government.

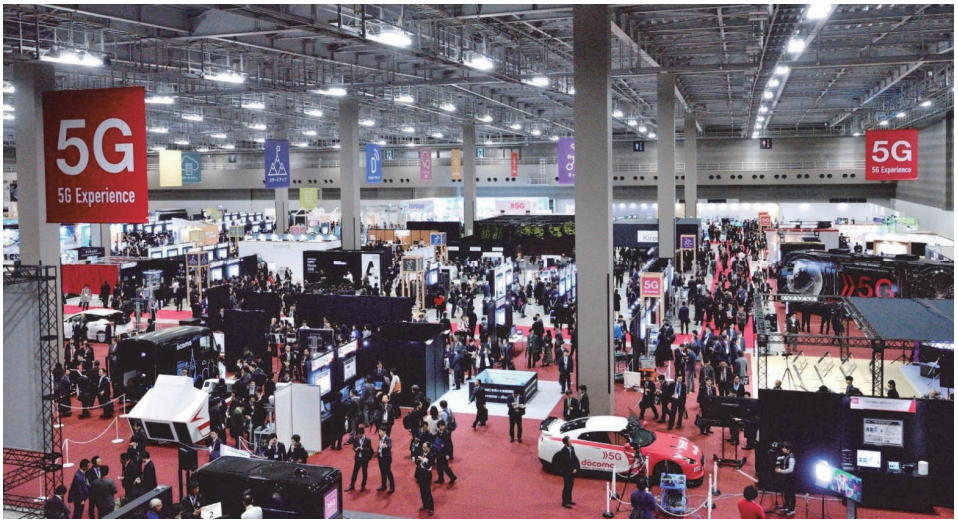

Photo 1 View of DOCOMO Open House 2018

2. Event Overview

This event included 239 exhibits including 9 from NTT divided into the 15 categories of Device-UI/UX, AI, IoT, Smart City, Creation of Innovation, New Exciting, Healthcare, Startup, Digital Marketing, Disaster Preparedness, Network, 5G Solution, 5G Experience, CSR, and 2020. Each exhibit conveyed NTT DOCOMO's worldview to visitors through hands-on experiences and demonstrations using actual equipment.

Kazuhiro Yoshizawa, NTT DOCOMO President and CEO, delivered the keynote presentation on the first day (**Photo 2**). Titled "For a Richer Future with 5G," this presentation introduced NTT DOCOMO's vision of the future in the 5G era and its medium-term strategy. Then, on the second day, Hiroyasu Asami, NTT DOCOMO Senior Executive Vice President, delivered a keynote presentation titled "DOCOMO's Vision for Digital Transformation" (**Photo 3**). This presentation described changes in NTT DOCOMO's marketing environment and associated reforms.

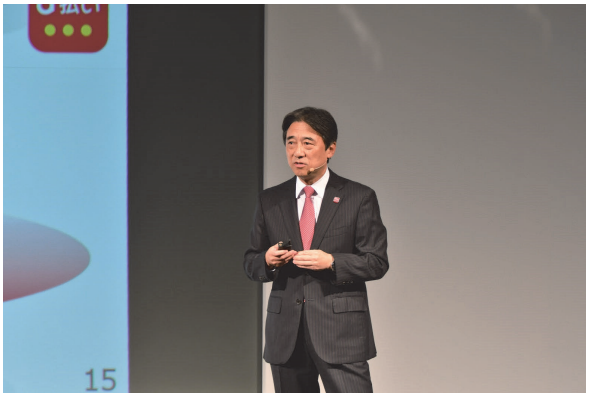

Photo 2 Keynote presentation by Kazuhiro Yoshizawa

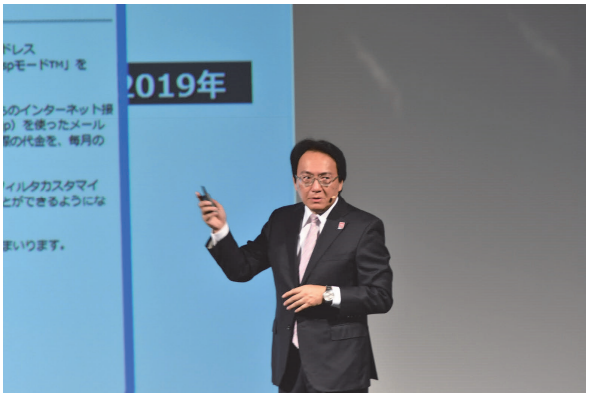

Photo 3 Keynote presentation by Hiroyasu Asami

Furthermore, in addition to other presentations delivered by NTT DOCOMO executives, a variety of presentations on diverse themes were made by a number of NTT DOCOMO business partners. These included presentations delivered by Sunwoo Lee (Korean Telecom), Philippe Lucas (Orange), Masanobu Fujioka (Ericsson Japan), Akira Fukabori (ANA), Kevin Kajitani (ANA), Jungo Kanayama (Shibuya City Tourism Association), and Kenro Suto (Future Design Shibuya).

3. 5G Experience

Exhibits in the 5G Experience area featured trials and demonstrations based on co-creation with partners in a wide range of industries toward the development of new 5G services with a view to commercialization in 2020 (**Photo 4**). They introduced, in particular, near-future services making maximum use of 5G features through hands-on demonstrations via actual 5G communications. These services ranged from remote operation of industrial robots and construction equipment, remote medical care, and a high-presence musical session by remotely located musicians to next-generation mobility initiatives such as connected cars. Also presented were the status and results of research and development toward 5G evolution and 6G.

3.1 Remote Control of Humanoid Robot

This exhibit demonstrated remote control of a humanoid robot (T-HR3®*2) over 5G in collaboration with Toyota Motor Corporation. It connected an operator at a remote location (TOKYO Solamachi®*3) and T-HR3 at Tokyo Big Sight using 5G over a portion of the link. The demonstration showed how 5G could be used to send remote operation and control signals to T-HR3 from the operator and receive feedback from T-HR3 in the form of power (torque) with low latency. In this way, the operator

Photo 4 5G Experience booths

*2 T-HR3®: A registered trademark of Toyota Motor Corporation.
*3 TOKYO Solamachi: A trademark or registered trademark of the Tobu Railway Co., Ltd.

is made to feel at one with T-HR3 enabling free and safe control of the robot by a human. The T-HR3 robot performed a variety of complicated tasks for visitors such as stacking and arranging blocks, guiding a chess piece through a maze while blindfolded using only the sense of touch, and shaking hands with someone, all at a level of control comparable to that of a wired connection. Visitors were quite impressed and offered many comments. Remote control of a humanoid robot in this way is expected to have use in a wide variety of fields, from everyday activities such as housework and caregiving to on-site construction work and medical care.

3.2 "Mobile SCOT" Remote Smart Medical Care

This exhibit demonstrated "Mobile SCOT (Smart Cyber Operating Theater)*4" using 5G in collaboration with Tokyo Women's Medical University. It showed visitors how advanced surgery could be performed by enabling surgeons to share surgery-related video and information with a doctor at a remote "mobile strategy desk" over a 5G connection so that a consensus on how to proceed can be reached. It demonstrated, in particular, that the status of a surgical procedure could be understood in real time by high-quality video even from a remote location through a high-speed/low-latency 5G connection and that a high standard of medical care could be received "at anytime from anywhere." For example, Mobile SCOT could provide surgical support regardless of where a specialist with extensive experience may currently be located, or it could enable the best diagnosis to be given and advanced treatment to be performed at the time of an emergency when transport to a hospital is difficult. In short, it can provide a high-standard medical care environment even in sparsely populated areas where doctors are scarce or at the scene of a disaster.

3.3 Reflector Applying Metamaterial Technology

With a view to setting up 5G areas using radio waves in high-frequency bands, this exhibit conducted a 5G demonstration in which a reflector applying metamaterial*5 technology developed by Metawave Corporation was actually installed at this event's venue. The exhibit also introduced the circumstances behind the world's first successful field trial of a 5G transmission incorporating the metamaterial reflector. This reflector, whose design depends on its installation location, can guide reflected waves in a specific direction so that a high-quality 5G coverage can be expanded to even locations in the shadow of buildings or outside the line-of-sight of the base station. In more detail, this exhibit introduced the results of a 5G field trial using this reflector conducted in November 2018 at this venue. It also held a demonstration of forming a 5G area within the venue by actually installing a metamaterial reflector so that visitors could see with their own eyes the arrival of 5G radio waves in the 28 GHz band with a real-time radio wave visualizer. In this way, it was shown that a 5G area could be efficiently and flexibly set up and expanded even for radio waves in high-frequency bands having highly directional propagation.

Together with progress in the development of a 5G system toward the launch of commercial services in 2020, the design and commercialization of new services that can be achieved through 5G is accelerating reflecting a shift toward the next stage

*4 SCOT®: A remote smart healthcare support system and a registered trademark of Tokyo Women's Medical University.

*5 Metamaterial: An artificial material that behaves with respect to electromagnetic waves in ways not found in natural materials.

of development. Through hands-on demonstrations using 5G communications co-created with partners in diverse industries, the 5G Experience area enabled visitors to experience for themselves the benefits of 5G in a variety of industries and to be surprised and inspired many times over. In addition, this exhibit showed how NTT DOCOMO R&D is progressing rapidly toward NTT DOCOMO's vision of 5G and beyond while fostering innovation in the creation of new value.

4. AI

NTT DOCOMO is moving forward on the development of AI technology and AI solutions with the aim of "achieving the ultimate personal agent" and "solving social issues and enhancing industrial efficiency."

In the AI area of this event, the latest AI technologies and actual applications were put on display such as technology supporting the NTT DOCOMO "my daiz" AI agent, NTT DOCOMO's Natural-language Dialogue Platform, and image recognition. Visitors were encouraged to experience these exhibits for themselves.

4.1 AI Agent × AI Geeks

The AI Agent × AI Geeks booths introduced 27 solutions using AI agents all within a single area in the form of a shopping mall (**Photo 5**). These were presented in collaboration with 21 partner companies that had taken the lead in using NTT DOCOMO's AI Agent Application Program Interface (API)*6. On viewing many solutions and application examples, visitors commented that they could imagine using them in all sorts of ways in their companies. They also asked the partner companies that had collaborated with NTT DOCOMO many questions, which showed how this exhibit had become a good opportunity for visitors and partners to connect.

4.2 Natural-language Dialogue Platform

The AI area presented many dialogue systems using NTT DOCOMO's Natural-language Dialogue Platform. For example, the "Chatbot*7 for Sport Spectators" can engage in conversation reflecting

Photo 5 AI Agent × AI Geeks

*6 API: General-purpose interfaces for using functions and data.
*7 Chatbot: A program that automatically conducts dialog with people with speech or text chat.

real-time changes in the state of a match and provide in-depth information on teams and athletes using a knowledge database. The "chat-oriented dialogue service katarai™*8," meanwhile, enables the provision of a dialogue service in a short period of time without the need for creating scenarios thanks to its scenario database on a scale of 40-million utterances. The "xAIML SUNABA™" development environment that simplifies the task of developing a natural-language platform for developers was also introduced and the development of multi-language capabilities to support dialogue services in languages other than Japanese was also described. Also on display were services that had already been commercialized such as "Natural Dialog Engine FAQ Chatbot" and "my daiz" as examples of NTT DOCOMO's efforts in introducing voice-interactive technologies for a wide variety of usage scenarios.

4.3 Image Recognition

The "Image Recognition for 5G Security Camera" exhibit showed how image recognition technologies such as individual detection, tracking, and attribute estimation on a cloud platform connected directly to NTT DOCOMO's 5G network could be applied to security cameras. This scheme enables advanced image recognition technology to be applied without transmitting security camera video over the Internet, which should enable the provision of security camera solutions that take into account security and privacy. In addition, the "Field Weeding Robot using AI" exhibit introduced a robot that can distinguish crops from weeds in a field and remove those weeds while moving about autonomously using onboard image recognition technology.

In this way, visitors to this event were able to understand how NTT DOCOMO is striving to enhance added value through total solutions that include the 5G network and edge devices in addition to image recognition technologies.

NTT DOCOMO seeks to develop services and solutions using AI and big data with the aim of expanding the user experience and opening up new markets through co-creation with partners in diverse industries.

5. IoT

The IoT area introduced NTT DOCOMO IoT technologies for solving a wide range of problems that currently affect modern society under the theme of "changing the way people live and work through new value" (**Photo 6**). Visitors expressed much interest in these technologies and asked many interesting questions revealing deep expectations of NTT DOCOMO IoT.

5.1 docomo IoT Smart Maintenance Package

The "docomo IoT Smart Maintenance Package™*9" is a package service that uses vibration data collected from sensors that can be retroactively fitted in industrial facilities to (1) monitor the operation of facilities, (2) detect abnormal vibrations, and (3) detect signs of failures in vibrations.

Launched in December 2018, this service features a variety of key technologies. In addition to storing vibration data on the cloud and enabling its visualization, it can perform quantitative diagnosis conforming to diagnostic criteria of rotating facilities*10 stipulated by ISO 10816*11 and predict the

*8 katarai™: "katarai" and "SUNABA" are trademarks of NTT DOCOMO.

*9 docomo IoT Smart Maintenance Package™: "docomo IoT Smart Maintenance Package" and "AI Infotainment Service" are trademarks of registered trademarks of NTT DOCOMO.

*10 Rotating facilities: Facilities having a mechanism that rotates about an axis such as a motor, pump, or compressor.

*11 ISO10816: A widely used standard for comprehensively judging the condition of rotating machinery.

Photo 6 IoT area

transition of vibration features using machine learning.

With this service, customers can monitor their facilities, detect abnormalities, predict failures, and perform appropriate maintenance. It supports the operation of a manufacturing line without facility breakdowns and stoppages.

5.2 AI Infotainment Service

The "AI Infotainment Service®" is a cloud-based service that changes the automobile from simply a means of mobility to a convenient and enjoyable "mobility space." It features the following technologies.

- "Natural-language dialogue technology" featuring noisy speech recognition with world-class accuracy that enables necessary car-related tasks such as destination searching to be performed through natural dialogue.
- "Behavior anticipation technology" that learns the daily behavior of a person and recommends optimal behavior that reflects an understanding of that person's interests and preferences.
- "Advanced information searching and delivery technology" that can perform a variety of tasks such as searching for popular facilities, delivering information at just the right time such as on much-talked-about events, and predicting traffic jams.
- "Emotion recognition technology" for analyzing user sentiment from the user's voice pitch, tone, intonation, etc.

NTT DOCOMO uses these AI technologies to understand the user and provide him or her with a safe, convenient, and enjoyable infotainment service.

5.3 Remote Monitoring Service

The "Remote Monitoring Service" provides a privacy-oriented means of monitoring people who are living alone but need support by analyzing ambient sounds such as coughing, snoring, and television noise with Fujitsu's original algorithm making use of sound analysis technology cultivated by Fujitsu

Limited in mobile phone development (**Photo 7**). Its main features are twofold. First, it can sense sounds or human movement through IoT devices installed in rooms and can determine an abnormal situation by detecting noise above a previously established threshold or no human movement for longer that a certain period of time. At that time, the service notifies a call center that dispatches an on-call nurse to check on that person's state of health. Second, the sensing data collected by the service can be used to support health consultations or health-related advice offered during periodic contact.

6. Device-UI/UX

The Device-UI/UX area presented 23 exhibits surveying device technologies for driving the evolution of mobile services and technologies for achieving new UI/UX (**Photo 8**). For example, visitors were asked to experience for themselves a "device cluster" service that enables new ways of using devices, an AR/MR platform that provides a consistent Augmented Reality (AR)[*12]/Mixed Reality (MR)[*13] experience regardless of device or OS, and applications that use an avatar communication platform enabling communication while sharing materials and video (XR telepresence meeting and "dSPS" avatar communication). Visitors offered a variety of reactions to these exhibits.

6.1 Device Cluster

This exhibit presented new formats for using devices appropriate for the 5G era such as the sharing of smartphones, tablets, and peripheral devices and information linking with public devices. This technology constitutes a platform equipped with diverse functions such as user authentication, device management and control, and billing. It would enable, for example, a user who normally uses a smartphone to rent a tablet during a trip while continuing to use one's own applications and data. Additionally, for a user wondering which way to proceed when exiting a train station gate, it would enable navigation information specifically for that user to be displayed on that gate.

Going forward, NTT DOCOMO plans to open

Photo 7 Remote Monitoring Service

*12 AR: Technology for superposing digital information on video taken of the real world and presenting the result to the user.

*13 MR: Technology for superposing digital information on video taken of the real world and presenting the result to the user. In contrast to AR, MR makes information appear as if it's actually there in the real world from any viewpoint.

Photo 8 Device-UI/UX area

up this technology and to expand tie-ups and co-creation with business partners providing supported devices and services.

6.2 AR/MR Platform

Recognizing that AR/MR is slated to become a new experiential service in the 5G era, this exhibit introduced technology for providing a uniform AR/MR experience independent of device or OS. It featured a demo experience corner where visitors could enjoy AR/MR content interactively among multiple terminals running Android™*14, iOS*15, and Windows®*16. This corner included a screen for controlling position, slant, and field of vision in real time within the AR/MR space of such multiple devices.

Visitors could sense the advanced nature of this technology through an "AR/MR experience of Christmas living" on an AR large-screen display that included decorating a Christmas tree with virtual ornaments and coloring of a 3D Santa Claus or snowman.

6.3 XR Telepresence Meeting and "dSPS" Avatar Communication

This exhibit presented an avatar communication platform as a new form of communication enabling people within a VR space to become avatars while sharing materials, video, etc. It introduced, in particular, the application of this technology platform to (1) a telepresence meeting application using a 3D full-body scanner enabling immediate avatar generation and (2) an application that enables conversation and video to be enjoyed while viewing video on a large screen.

Many visitors commented that they look forward to the commercialization of this technology as they could sense great potential in communicating and viewing video within a VR space.

NTT DOCOMO plans to continue its R&D efforts in devices and UI/UX with the aim of providing

*14 Android™: A trademark or registered trademark of Google LLC., United States.
*15 iOS: A trademark or registered trademark of Cisco in the United States and other countries and is used under license.
*16 Windows®: A trademark of Microsoft Corp. in the United States and other countries.

new value to customers and achieving compelling services through co-creation with business partners.

7. TOPGUN

The TOPGUN area introduced solution-creation activities promoted by NTT DOCOMO since October 2017 based on three-party collaboration among corporate customers, NTT DOCOMO R&D departments, and NTT DOCOMO corporate sales departments (**Photo 9**). Consisting of 13 exhibits in all, one provided an overview of these TOPGUN activities, 11 introduced 11 projects in progress, and one previewed a project scheduled for launch in the near future.

7.1 Location Net

Location Net is a solution that enables human and object positioning using Bluetooth® Low Energy (BLE)*17 technology. To give visitors to this exhibit an idea of how this solution can be used to detect the positions of employees or perform flow management, detectors were installed at 22 locations with the event venue and a heat map of the positions of BLE tags given out to event visitors was displayed on a large liquid-crystal display in real time. This heat map is shown in **Photo 10**.

7.2 Robot for Programming Education: embot

This is a programming kit geared to elementary school students that enables a robot assembled from cardboard and a printed circuit board to be programmed and controlled on a tablet device. A giant embot was placed at the entrance to the TOPGUN area in a welcoming pose (**Photo 11**) and exhibition and sale of the kit was also conducted.

7.3 Information Board with Touch and Voice

The "Information Board with Touch and Voice" is an interactive AI-based information and reception service that responds to user touch on a screen and human voices. This board was displayed as

Photo 9 TOPGUN area

*17 BLE: An extension function of Bluetooth®, and a standard defined for low powered devices as part of the Bluetooth 4.0 standard. Bluetooth is a short-range wireless communication specification for radio connection of mobile terminals, and is a registered trademark of Bluetooth SIB Inc. in the United States.

shown in **Photo 12** so that visitors could experience interaction with Saya[*18] for themselves.

This event on the whole was enthusiastically received, and many visitors dropped by the TOPGUN area showing much interest in TOPGUN activities, that is, in the co-creation of solutions, the problems that can be solved by each project, and associated usage scenarios. This included consultations on specific customer issues that led in some cases to specific solution proposals and negotiations at a later date. TOPGUN was an extremely significant exhibit as it helped visitors understand the value that NTT DOCOMO can provide to customers while providing a forum that could lead to specific business opportunities.

8. 5G Solution

The 5G Solution area exhibited 5G solutions co-created with a variety of partners participating in the DOCOMO 5G Open Partner Program. It was also the scene of a number of programs including 5G open seminars and workshops (**Photo 13**). The number of business partners and organizations participating in the 5G Open Partner Program launched in February 2018 continues to increase having exceeded 2,000 companies and organizations as of April 2019 spanning all sorts of industries and business areas (**Photo 14**).

This area included a panel looking back at the content of workshops held three times in the past in collaboration with various regions in Japan that have been a part of this program from the start. In this way, visitors could see for themselves how NTT DOCOMO is advancing steadily toward achieving a 5G future.

Photo 10 Real-time heat map within venue by Location Net

Photo 11 Giant embot

Photo 12 Information board with touch and voice

*18 Saya: An original virtual human created by a husband and wife duo known professionally as TELYUKA. Using advanced computer graphics as an expressive medium, Saya was announced in 2015 becoming a worldwide sensation practically overnight. Born as a handmaid, Saya is an ongoing project showing evolution and growth as she searches out a new role (guide) with a unique organic existence different from humans.

Photo 13 Introduction to 5G Open Partner Program

Photo 14 Nationally expanding Open Partner Program

The exhibit area presented 31 solutions leveraging the high-speed, low-latency, and large-capacity features of 5G in the fields of AR/VR, AI, image recognition, 8K video, drones, IoT, digital signage*19, and more.

8.1 Wireless IoT Technology Demonstration Contest for Colleges of Technology

This exhibit presented two technologies adopted by the 5G division of this contest held with an eye to solving regional problems and creating new services. The first technology developed by the National Institute of Technology, Okinawa College applies "5G + AR" technology to diving goggles to provide a diver with various types of information. The second technology developed by the National Institute of Technology, Toyota College enables users to experience high sense of presence in 3D by VR in sports.

*19 Digital signage: Advertising media using digital technology. Using displays or projectors to change advertising content in response to time or location, this technology is gaining attention as an alternative to conventional advertising media such as posters etc.

8.2 AVATAR MUSEUM

As an initiative promoted by ANA Holdings Inc., Toppan Printing Co., Ltd., and Rekimoto Lab of the University of Tokyo, the "AVATAR MUSEUM" presented a solution for experiencing sightseeing from a remote location with a high sense of presence. This is accomplished by viewing real-time, omnidirectional video captured by an "avatar robot" equipped with a 4K 360-degree camera and installed at a tourist site such as an art gallery, aquarium, or museum (**Photo 15**).

Photo 15 AVATAR MUSEUM

8.3 DOCOMO 5G Open Lab

NTT DOCOMO has set up DOCOMO 5G Open Lab in Yotsuya (Tokyo), Osaka, Okinawa, and Guam as a site for experiencing 5G. It has come to be used by many business partners. This exhibit featured a reproduction of a verification experiment actually performed by a business partner at such a site (**Photo 16**).

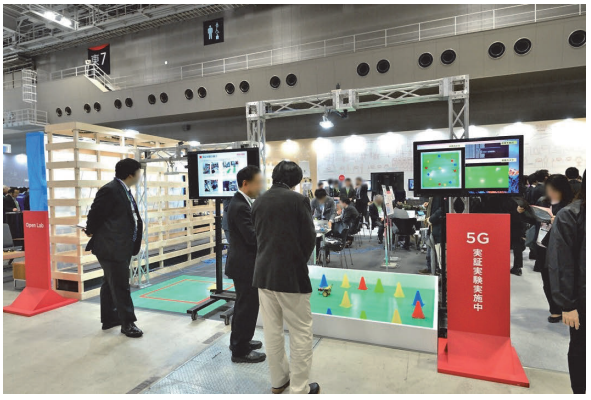

Photo 16 Reproduction of DOCOMO 5G Open Lab verification experiment

8.4 Open Partner Events

DOCOMO Open House 2018 held many practical events such as presentations by business partners and brainstorming workshops for a relatively small number of participants (**Photo 17**).

A workshop titled "Putting Open Innovation into Practice using SDGs × 5G" was held on the morning of both the first and second day of the event. This workshop divided several dozen participants into groups of several individuals at different tables to train them on thinking about business problems and their solutions from the viewpoint of Sustainable Development Goals (SDGs)*20 using a worksheet.

In addition, a workshop titled "5G Exhibits x Workshop" was held on both days. This workshop likewise divided participants into small groups for a "5G Exhibit Tour" guided by an NTT DOCOMO employee who took them around the venue while explaining the 5G exhibits. This tour was followed by a participatory-type brainstorming workshop conducted for each group.

In terms of presentations by business partners, "IoT x 5G Special Session" was held in the afternoon of the first day. This session, presented by ELIIY Power, Fujitsu, and UNIADEX, introduced IoT solutions development activities for solving social problems from the viewpoint of SDGs.

*20 SDGs: A set of global goals adopted by United Nations General Assembly in 2015 for the period from 2016 to 2030. They consist of 17 goals and 169 targets with the aim of achieving a sustainable society.


Open innovation in practice using SDGs x 5G


Brainstorming workshop

IoT solution development activity

5G Co-Creation Session

Photo 17 Open Partner events

Next, partners participating in DOCOMO 5G Open Cloud™*21 held "5G Co-Creation Session" in the afternoon of the second day. In this session, Wacon, Trend Micro, RICOH, and NTT TechnoCross each ascended the stage to introduce solutions from various viewpoints such as VR, security, IoT, and AI.

9. Conclusion

This article introduced "DOCOMO Open House 2018—5G Innovation and Collaboration—" held by NTT DOCOMO on December 6 and 7, 2018 and described the exhibits presented. With the launch of 5G services scheduled for 2019, NTT DOCOMO seeks to create services that bring joy and amazement to its customers and to foster innovation in customer experience, lifestyle, and work style. NTT DOCOMO is committed to finding solutions to social problems with the aim of promoting growth in Japan and achieving a prosperous society.

*21 DOCOMO 5G Open Cloud™: A trademark of NTT DOCOMO.