Technology Reports | 5G | DOCOMO 5G Open Partner Program | Solution Co-creation

Special Articles on 5G Pre-commercial Service

NTT DOCOMO Activities toward the 5G Era —Solution Co-creation with Partners—

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NTT DOCOMO is promoting solution co-creation with a variety of business partners toward the 5G era and providing the DOCOMO 5G Open Partner Program to drive this effort forward. Expectations toward 5G are increasing day by day for a wide range of scenarios and it is anticipated that 5G will bring great changes to people's lifestyles. NTT DOCOMO seeks to contribute to the creation of new value and the solution of social problems by simultaneously providing services and solutions for the 5G era.

1. Introduction

NTT DOCOMO has been active in the "co-creation" of new added value and promotion of business growth through collaboration with a wide range of companies and organizations. In 5G, as well, it has been providing the DOCOMO 5G Open Partner Program since February 2018 to promote co-creation. Starting out with about 500 participating companies and organizations, this program continues to grow expanding to more than 3000 participating partners as of September 2019. Far from being limited to large urban areas, these participants come from all over Japan and overseas too while representing a wide range of fields including construction, transport, manufacturing, media, retail sales, finance, and local government administration.

In this article, we describe NTT DOCOMO's activities in co-creation with business partners toward the 5G era.

2. Three Values Provided by DOCOMO 5G Open Partner Program

NTT DOCOMO provides the companies and organizations participating in the DOCOMO 5G Open Partner Program with three key values, namely, "information sharing," "communication," and "5G experience," at no charge (**Figure 1**).

2.1 Information Sharing

Information sharing means the releasing of 5G-related information on a website targeting participants in the DOCOMO 5G Open Partner Program. This includes information related to 5G technologies and specifications, videos related to events held by NTT DOCOMO, and 5G trial reports. Partners can browse this information freely as a source of ideas for creating new solutions and solving problems (**Figure 2**).

2.2 Communication

NTT DOCOMO has been holding workshops and other events with the aim of creating new services and solutions using 5G by promoting communication among the participating partners of the DOCOMO 5G Open Partner Program. Many partners have been participating in these events.

The last four workshops featured talks by NTT DOCOMO and its partners as well as exhibits and demonstrations of partner products. In addition, NTT DOCOMO promoted communication among participants in several ways, such as by holding mini-workshops after those talks to give speakers and fellow partners a chance to casually interact and by enabling participants to post ideas freely on an idea board (**Figure 3**).

NTT DOCOMO also held a 5G Business Camp at six locations around the country with the purpose of accelerating the creation of specific services and solutions in its 5G pre-commercial service. At

Figure 1 DOCOMO 5G Open Partner Program

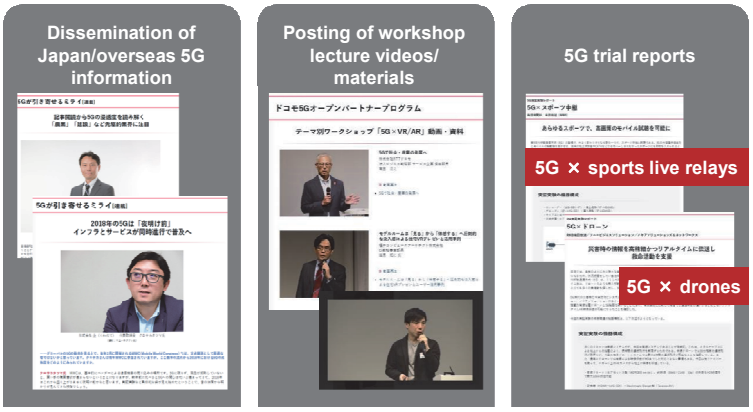

Figure 2 Provision of 5G information

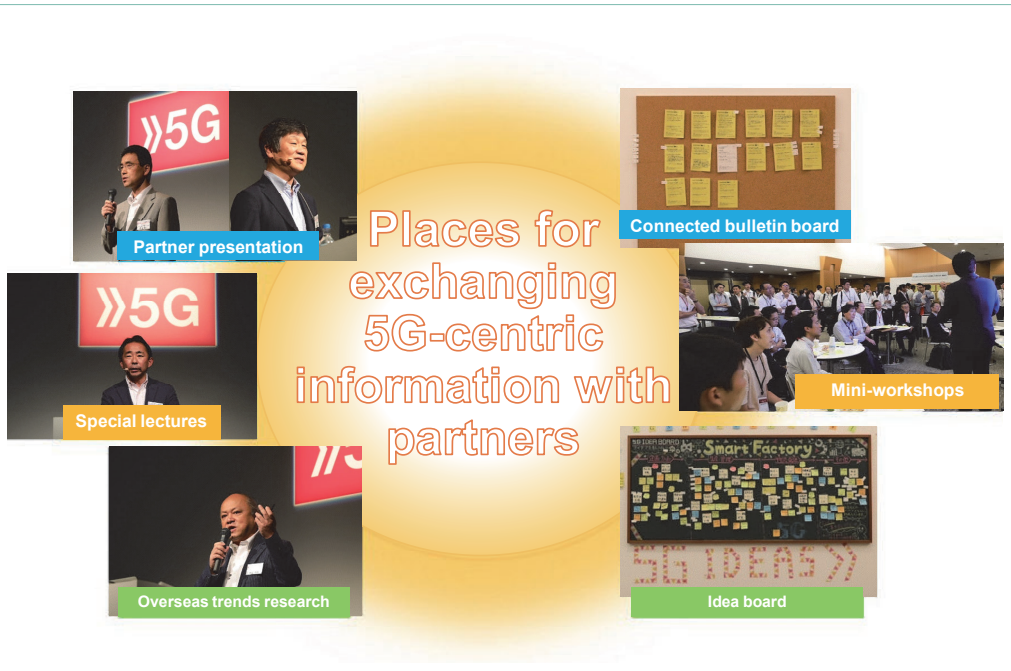

Figure 3 Information exchange with partners centered about 5G

this event, NTT DOCOMO gave talks on its approach to pre-commercial services and introduced many products via an "idea creation zone" that introduces ideas for solutions, a "service creation environment zone" that introduces peripheral devices, and a "solution exhibition zone" that displays solutions for the 5G era. About 1,000 partner companies and 2,500 individuals attended this event at

all six venues with more than 100 companies expressing a desire to use some of the solutions being provided in the 5G pre-commercial service. NTT DOCOMO's corporate sales members are active in making this a reality (Table 1).

NTT DOCOMO includes corporate sales members in all of Japan's prefectures as well as 2,300 docomo Shops throughout the country. It also provides Business Plus®*1 as a scheme for introducing partner products to other enterprises by NTT DOCOMO corporate sales. For NTT DOCOMO, providing this sales power on behalf of its partners is an important key to rolling out created solutions as a business.

2.3 5G Experience

With the aim of expanding activities toward the creation of new 5G usage scenarios together with a wide array of partners, NTT DOCOMO has opened up permanent 5G technology verification environments under the name of "DOCOMO 5G Open Lab" so that partner companies and organizations participating in the DOCOMO 5G Open Partner Program can experience for themselves 5G experimental base stations and other 5G-related equipment at no charge.

A DOCOMO 5G Open Lab is equipped with 5G experimental equipment (base stations, mobile stations, etc.) for conducting 5G connection tests, 5G demonstration environments, and a variety of devices that connect to 5G experimental equipment. Partners may also bring their own devices for connecting to this equipment. The aim here is to

Table 1 Workshop results

	Date(s)	Venue	No. of participants
5G Partner Workshop	February 21, 2018	Bellesalle Shiodome	389 companies (731 attendees)
Workshop "5G × VR/AR"	May 24, 2018	Tokyo Fashion Town (TFT) Building	152 companies (229 attendees)
Workshop "5G × Industry Reform/Creation"	September 6, 2018	Herbis Hall Osaka	161 companies (276 attendees)
5G Idea Co-creation Workshop (Held during DOCOMO OPEN HOUSE 2018)	December 6–7, 2018	Tokyo Big Sight	482 companies (4,061 attendees)
5G Business Camp in Tokyo	March 8, 2019	Bellesalle Shiodome	314 companies (676 attendees)
5G Business Camp in Osaka	March 20, 2019	MyDome Osaka	138 companies (261 attendees)
5G Business Camp in Nagoya	April 19, 2019	Nagoya Convention Hall	113 companies (371 attendees)
5G Business Camp in Sendai	May 10, 2019	Sendai Kokusai Hotel	134 companies (342 attendees)
ICT Seminar in Okinawa 2019	May 22, 2019	Okinawa Kariyushi Urban Resort Naha	179 companies (437 attendees)
5G Business Camp in Fukuoka	Jun 3, 2019	Hotel New Otani Hakata	144 companies (382 attendees)

*1 Business Plus®: A registered trademark of NTT DOCOMO. Business Plus is a cloud-based service that can be used for a fixed monthly fee to improve business efficiency using corporate smartphones and other devices.

create diverse services and solutions while expanding usage needs by enabling partners to quickly conduct all sorts of tests and trials. A DOCOMO 5G Open Lab was opened in Tokyo in April 2018, Osaka in September 2018, Okinawa in January 2019, and Guam in March 2019. More than 400 partner companies and 2000 individuals have so far visited and used a DOCOMO 5G Open Lab (Table 2).

An overview of DOCOMO 5G Open Lab is shown in Figure 4 and examples of trials conducted at DOCOMO 5G Open Labs are shown in Figures 5 and 6.

3. 5G Benefits Observed from Trials

In Japan, laboratory tests and regional trials of 5G technologies can help bring the goal of "conquering time and distance"—the essence of communications—even closer to reality. For example, a common scenario at present is to have a skilled person travel to a site with a problem to perform maintenance work or instruct others in a very time-consuming process. However, the 5G features of high speed and large capacity make it possible to observe the conditions at a problem site via high-definition video from a separate location thereby

Table 2 DOCOMO 5G Open Lab locations and opening dates

Name	Opening date
DOCOMO 5G Open Lab Yotsuya	April 2018
DOCOMO 5G Open Lab OSAKA	September 2018
DOCOMO 5G Open Lab OKINAWA	January 2019
DOCOMO 5G Open Lab Guam	March 2019

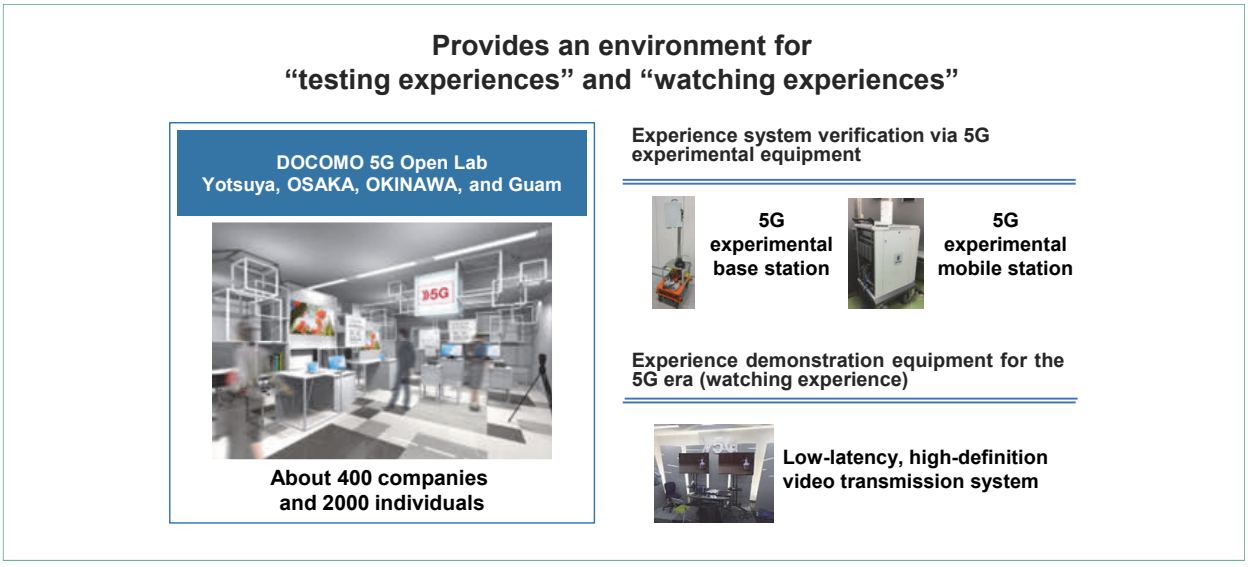

Figure 4 Overview of DOCOMO 5G Open Lab

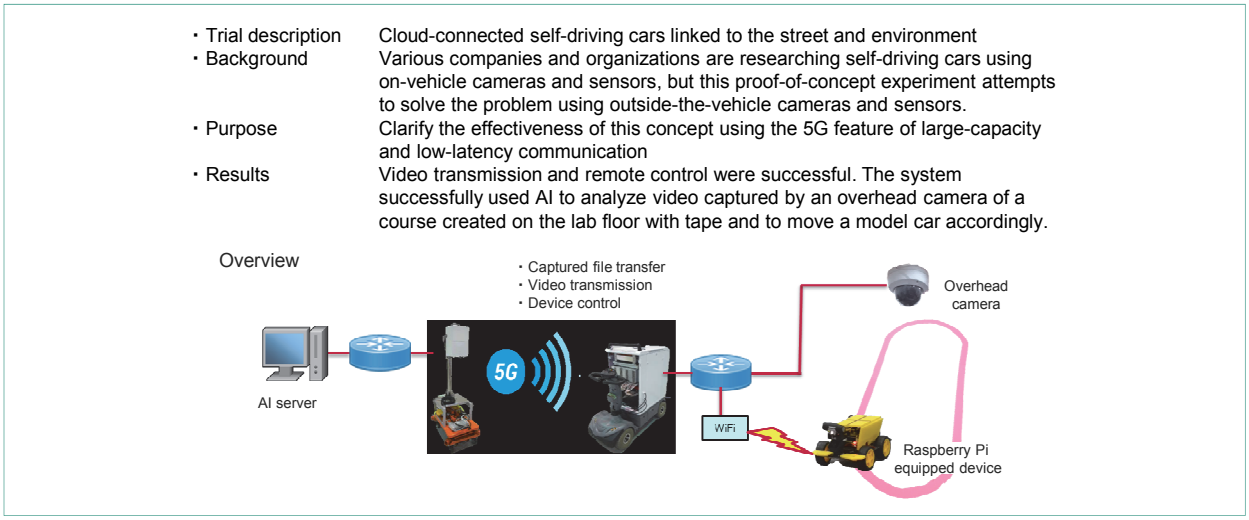

Figure 5 DOCOMO 5G Open Lab trial example (1)

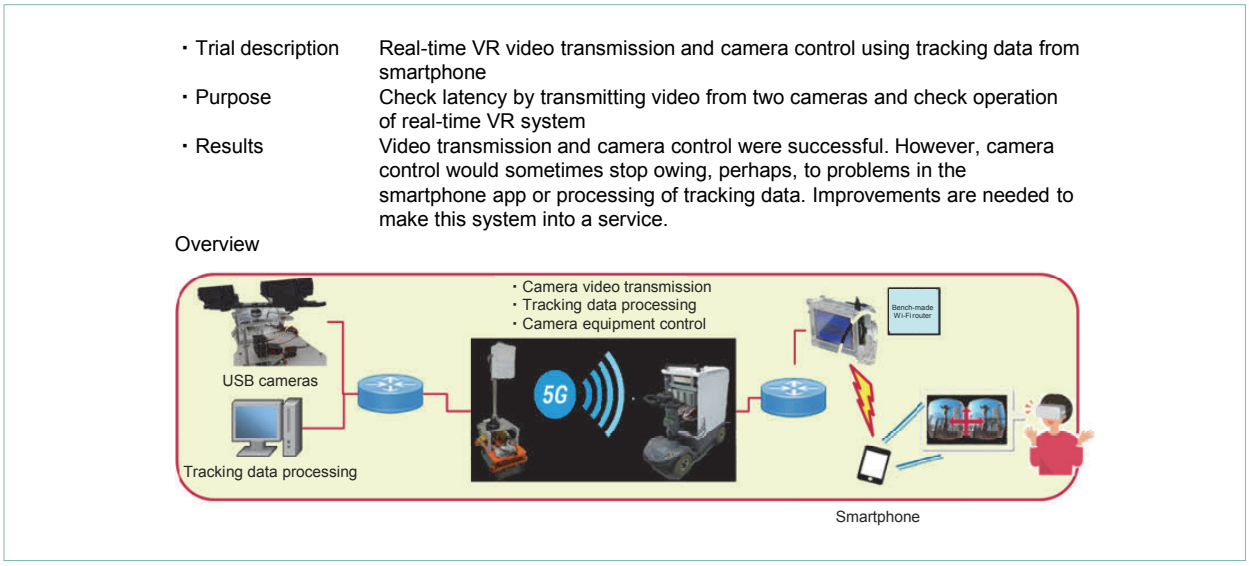

Figure 6 DOCOMO 5G Open Lab trial example (2)

enabling remote support without having to travel.

3.1 Examples of Trials

The following introduces some of the trials that NTT DOCOMO has so far performed.

1) Disaster Prevention and Disaster Mitigation

NTT DOCOMO considers that combining 5G, high-definition street cameras, and Artificial Intelligence (AI) will enable the automatic detection of disasters or accidents in real time with high accuracy and thereby contribute to disaster prevention and disaster mitigation.

Focusing on disaster response, fire fighting, etc. in the city of Aso, Kumamoto Prefecture, Japan,

this experiment used 5G equipment and a wire-powered (tethered) drone equipped with a 4K*2 camera to perform real-time 4K video transmission (**Figure 7**, **Table 3**). Shooting aerial 4K video in this manner enabled those concerned to assess conditions over a wide range and check on places difficult for people to enter via high-definition video. In the future, we expect that combining this system with AI and image analysis technology should enable its application to the inspection of high-rise buildings including the automatic detection of cracks, fires, etc.

2) Education

The 5G feature of ultra-high-speed communications can be used to receive classes from experts in real time regardless of location. In addition, the enriching of educational content can deepen a student's involvement in the learning process.

With this in mind, NTT DOCOMO conducted a trial on the 5G-based delivery of Virtual Reality (VR)*3 and Augmented Reality (AR)*4 content for history education at Nakijin Castle in Okinawa Prefecture in collaboration with Okinawa Convention & Visitors Bureau and Toppan Printing Co., Ltd. (**Table 4**, **Figure 8**).

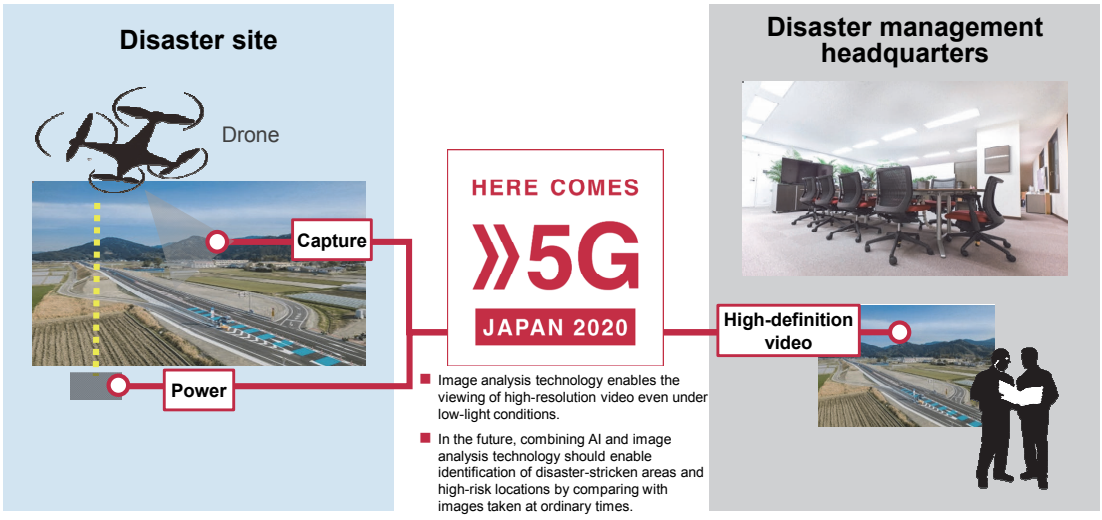

Figure 7 Trial (disaster prevention/mitigation)

Table 3 Overview of solution package in the disaster prevention/mitigation field

Industrial fields	Disaster prevention, security
Service targets	Public offices, local governments, security businesses
Service description	Urban monitoring for disaster prevention/mitigation
Main functions used	High speed and large capacity

*2 4K: Picture format having a display resolution of 3,840×2,160 pix or 4,096×2,340 pix.

*3 VR: Technology that gives the user the illusion of being in a virtual world.

*4 AR: Technology for superposing digital information on real-world video in such a way that it appears to the user to be an actual part of that scene.

Table 4 Overview of solution package in the education field

Industrial fields	Education field
Service targets	Students, etc.
Service description	Intuitive learning experience through VR/AR content using 5G
Main functions used	High speed and large capacity

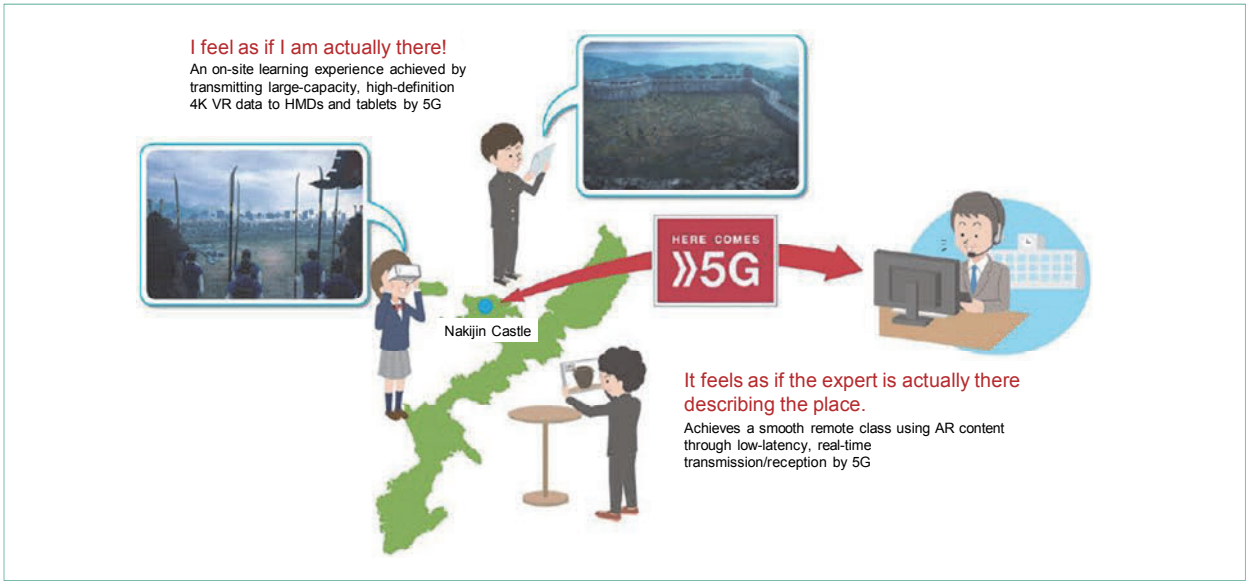

Figure 8 Trial experiment (education)

Under the supervision of Takashi Uezato, researcher at Hosei University Institute for Okinawan Studies, this experiment reproduced with a high sense of immersion the situation of Nakijin Castle in the Sanzan period focusing on castle structure and the king and his soldiers. This was accomplished by delivering high-definition 4K VR content to devices such as Head-Mounted Displays (HMDs)*5 and tablets using 5G with the aim of providing middle-school and high-school students visiting Nakijin Castle on school excursions an intuitive learning experience on the history of that castle. In addition, NTT DOCOMO used 5G to deliver a remote lecture by Mr. Uezato on historic sites and archeological artifacts using AR content in real time to tablets.

This trial made it possible to study material that has traditionally been presented by text and simple illustrations as an experience much closer to reality. Students who participated in this experiment made comments like "It was as if the teacher was explaining everything by my side!" and "It felt as if I had traveled back in time to that period!"

3.2 Creation of 5G Use Cases Based on Activities to Date

Based on a variety of activities as described above, NTT DOCOMO has been creating use

*5 HMD: Display equipment which is worn on the head, in the form of goggles or a helmet, with small display screens positioned directly in front of the eyes. There are monocular types, which display an image for only one eye, and binocular types, which display images for both eyes.

cases in collaboration with business partners. Typical examples of these creative efforts are listed in Table 5.

3.3 Activities with Local Governments

NTT DOCOMO has also been building up its collaborative relationships with local governments. About 100 local governments are participating in the DOCOMO 5G Open Partner Program. NTT DOCOMO has concluded 5G-related collaboration agreements with the local governments listed in Table 6.

Table 5 Typical examples of creating 5G use cases

	Example	Partner
1	Remote medical examination by high-definition diagnostic images	Wakayama Prefecture / Wakayama Medical University
2	Future construction site	Komatsu Ltd.
3	12-channel MPEG Media Transport (MMT) transmission of 8K video	Sharp Corporation
4	5G FACTORY III	NS Solutions Corporation
5	Security area by face-authentication gate	Sohgo Security Services Co., Ltd. / NEC Corporation
6	Urban space security	Sohgo Security Services Co., Ltd. / NEC Corporation
7	New Concept Cart	Sony Corporation
8	5G transmission of 4K sports live relays	The Mainichi Newspapers Co., Ltd
9	Diorama Studio	Fuji Television Network, Inc.
10	360-degree 8K VR live streaming/viewing system	Niigata City
11	4K video transmission using wire-powered (tethered) drone	Aso City, Kumamoto Prefecture
12	Connected cars trials	Toyota Motor Corporation / Ericsson Japan / Intel Corporation
13	Trials on use of traffic data	Sumitomo Electric Industries, Ltd.
14	Remote monitoring system by self-driving vehicles	DeNA Co., Ltd.
15	360-degree virtual exhibition tour	Panasonic Corporation
16	Street museum 5G	Toppan Printing CO., LTD.
17	IoA Virtual Teleportation	Toppan Printing CO., LTD.
18	Free View Point Live II	Crescent, Inc.
19	Music jamming experience over 5G network	Yamaha Corporation
20	VR space generation by 3D CAD model × 5G transmission	DVERSE Inc.

Table 6 Collaboration agreements concluded with local governments

Date concluded	Name of agreement	Local government
May 10, 2018	Collaboration agreement on promotion of urban development using ICT	Maebashi City
May 23, 2018	Agreement on collaboration between Osaka Prefecture and NTT DOCOMO	Osaka Prefecture
Jun 5, 2018	Agreement on promotion of open innovation using 5G	Hiroshima Prefecture
July 10, 2018	Collaboration among NTT DOCOMO, Okinawa Prefecture, IT Innovation and Strategy Center Okinawa (ISCO), and Okinawa Open Laboratory toward industry promotion and social problem solving in Okinawa Prefecture by 5G	Okinawa Prefecture
September 28, 2018	Collaboration agreement between Matsuyama City and NTT DOCOMO on regional revitalization by 5G/IoT/AI	Matsuyama City
Nobember 5, 2018	Collaboration agreement on promoting the use of 5G/ICT in Sustainable Development Goals (SDGs) (Hakusan City, Kanazawa Institute of Technology)	Hakusan City
January 24, 2019	Collaboration agreement on urban development using Smart Mobility, etc. (Yokosuka City, Keikyu Corporation)	Yokosuka City

4. 5G Pre-commercial Service

NTT DOCOMO launched a 5G pre-commercial service on September 20, 2019 to provide sites for experiencing 5G in actual 5G coverage areas using 5G terminals.

The benefits provided by this service to partners participating in the DOCOMO 5G Open Partner Program can be broadly divided into (1) areas, (2) devices, (3) docomo Open Innovation Cloud™*6, and (4) solution packages as described below.

4.1 Areas

DOCOMO 5G Open Labs at NTT DOCOMO branches in Japan have been made into pre-commercial service 5G areas with the aim of providing sites where services can be tested with a variety of partners. Opportunities for experiencing 5G were also provided at Rugby World Cup venues reflecting the expansion of 5G testing to diverse fields.

4.2 Devices

NTT DOCOMO considers that expanding the range of user experiences such as “watching,” “listening,” and “shooting” by linking a 5G terminal with various types of devices can lead to new and innovative solutions for the 5G era.

For example, the use of VR/AR devices in the trial conducted in Okinawa described above has expanded the act of “watching” and enabled an immersive experience at Nakijin Castle.

4.3 docomo Open Innovation Cloud

A cloud environment*7 for use by business partners as a 5G co-creation platform was launched in September 2019 as “docomo Open Innovation Cloud” (hereinafter referred to as “dOIC”). This is a cloud environment featuring secure transmission with low latency by virtue of being connected to

*6 docomo Open Innovation Cloud™: A trademark of NTT DOCOMO.

*7 Cloud environment: A virtual computing environment created on a network for use at the required time and in the required amount.

the NTT DOCOMO network (**Figure 9**). The 5G feature of low latency is 1 ms as a target value, but this applies only to the wireless interval, so from the viewpoint of the user experience, end-to-end latency that includes the wired interval must be considered. NTT DOCOMO considers that dOIC can reduce latency on the wired interval by directly connecting the cloud to the NTT DOCOMO network.

In addition, loading not just NTT DOCOMO applications but also partner applications on dOIC means that partner matching can be performed between solution providers and solution users thereby promoting solution co-creation for the 5G era. The loading of multiple solutions on dOIC has already begun and partners are being recruited to make use of them simultaneously.

The dOIC, moreover, has been developed to enable connection from LTE in addition to 5G pre-commercial service areas. The aim here is to secure a fixed level of quality even on the LTE network and thereby accelerate the rollout of business solutions.

4.4 Solution Packages

NTT DOCOMO is moving forward on the packaging of devices, terminals, cloud computing, and applications to provide solutions that can be applied to the solving of diverse problems.

Solutions can be used or applied in various ways depending on the target industry or problem. With this in mind, NTT DOCOMO seeks to connect solutions to problem solving by listening to partners describe their problems and having them try out solutions via the 5G pre-commercial service.

NTT DOCOMO also wants to actively market those packages that can use these solutions via LTE and to connect them to solving social problems by refining the solutions using 5G (**Figure 10**).

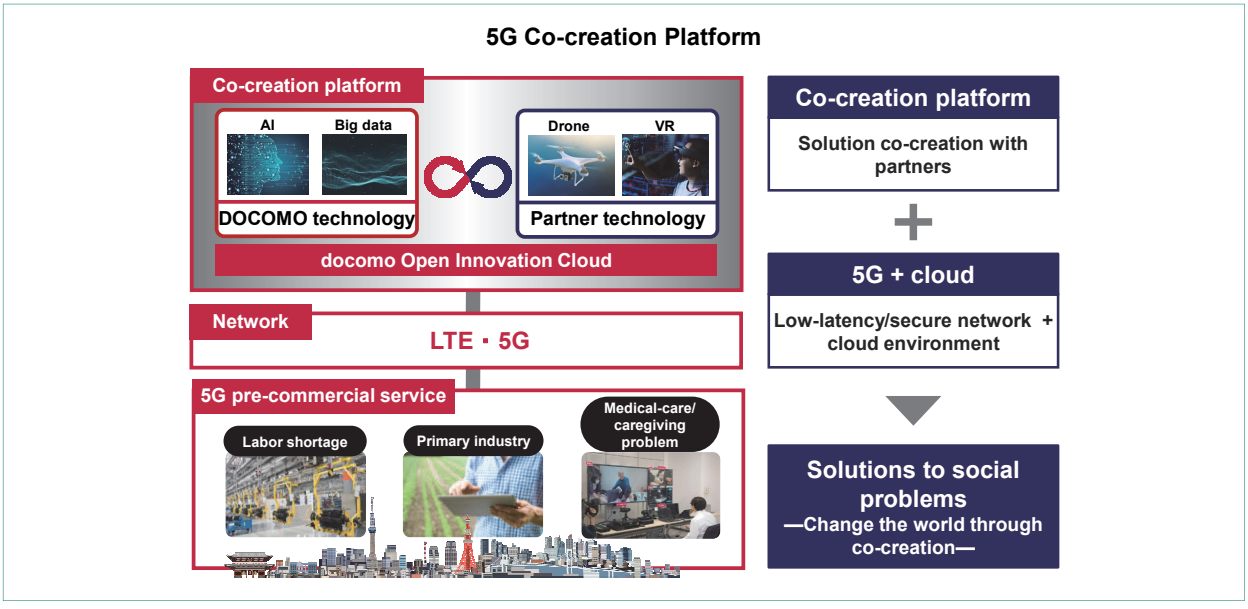

Figure 9 Concept of docomo Open Innovation Cloud

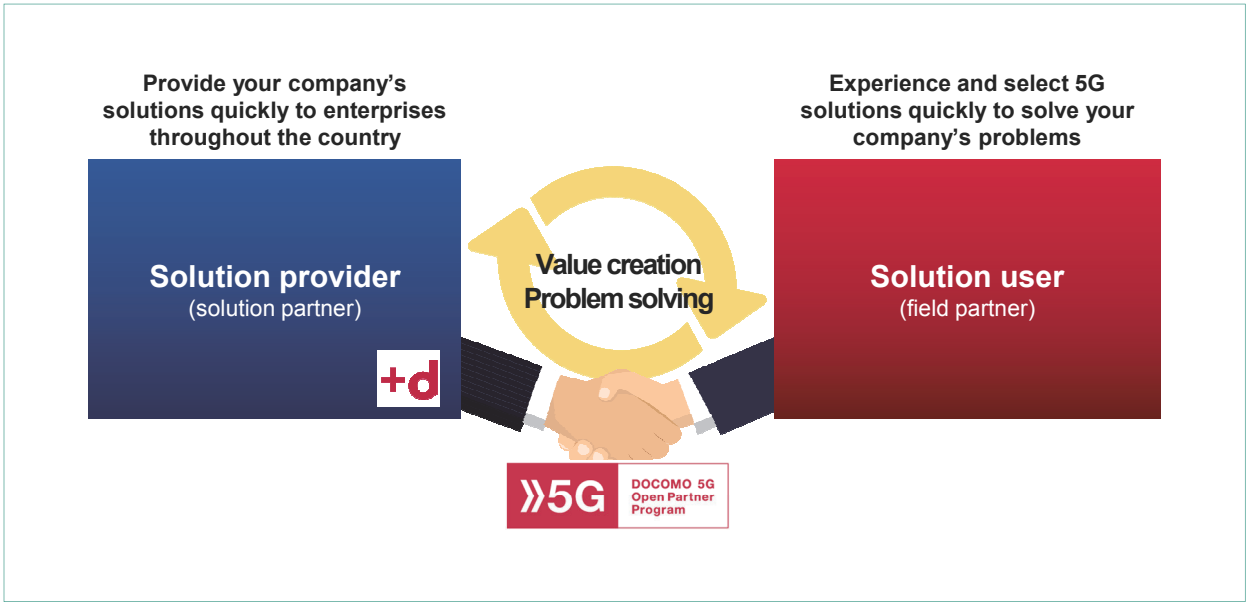

Figure 10 Matching of solution partners and field partners

5. Conclusion

Focusing on solution co-creation with business partners, this article provided an overview of the DOCOMO 5G Open Partner Program, introduced examples of solutions undertaken through this program, and described solution packages provided to business partners in NTT DOCOMO's 5G pre-commercial service.

Japan is a developed country facing a number of unprecedented problems such as a labor shortage. How Japan intends to solve these problems is attracting worldwide attention. If solutions arising out of the DOCOMO 5G Open Partner Program can be used to help solve these problems, we can expect them to find application throughout the world.

Co-creating solutions through the wonders of 5G can invigorate Japan and change the world. NTT DOCOMO seeks to achieve this in collaboration with many partners.