Innovation

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DOCOMO’s R&D has been leading the mobile scenes not only in Japan but the world over. It has continuously created new technologies and new services by exercising its creativity and innovativeness. We strive each day in our R&D to overcome any stress factors that could strain communication or act as wall that hamper a smart life so as to achieve DOCOMO’s goals for the 2020s of providing new value to customers and bringing structural change to the industry.

Promoting R&D and Innovation

Basic Policies and Philosophy

Advances in the information and communications industry are being made rapidly with the potential of having a major social impact through new technologies and ideas. DOCOMO believes that in addition to the area of mobile communications central to our business, such as devices and networks, there is a need to nurture the ability to bring about innovation toward quickly delivering services that enhance customer convenience and industrial efficiency. DOCOMO has been bringing innovation to society ever since it began offering services. To realize our “Declaration beyond,” we are pursuing R&D of telecommunications networks, devices and services to provide 5th generation (5G) mobile communications and to develop businesses based on AI, IoT and drones. Also, we are deeply engaged in open innovation toward creating new value in collaboration with external corporate partners. We will seek further growth and solutions for social issues through services based on an open-ended pursuit of innovation.

R&D System

DOCOMO conducts R&D on mobile communications systems and new products and services primarily at the Yokosuka Research Park. The R&D Division leads our efforts, while the R&D Strategy Department is responsible for overall supervision. As part of our ongoing R&D activities and to further enhance the Group’s devices, networks and services, each R&D division collaborates with product development staff in other DOCOMO divisions. We also conduct joint development with major manufacturers toward realizing ideas for new services conceived by business divisions and promote an open innovation strategy that maximizes our diverse relationships with external entities. We publicize the results of our R&D efforts, such as new technologies, by making strategic announcements to the media and in other ways.

In response to technological innovations overseas, we established DOCOMO Innovations, Inc. in Beijing Communications Laboratories Co., Ltd. in China. These R&D bases particularly contribute to international standardization activities for 5th generation (5G) mobile communications and virtual network technology in collaboration with the R&D Division at the DOCOMO head office. Along with DOCOMO Innovations, Inc., we also collaborate with and invest in startups ventures in North America, with the objective of investing in startups possessing advanced, innovative technologies that can be applied to mobile communications services. In the NTT Group, R&D systems are maintained by the holding company and major operating companies (NTT East Japan, NTT West Japan, NTT Communications, NTT Data and NTT DOCOMO). The holding company is responsible for R&D on basic technologies commonly used by the operating companies, while each operating company undertakes R&D on applied technologies closely related to their respective services and business operations.
5. Innovation > Promoting R&D and Innovation

R&D Innovation Division

- R&D Strategy Department
  - Common planning and management related to R&D and technology innovation, global technology alliances and technical publications

- Innovation Management Department
  - Common planning and management related to R&D and technology innovation, global technology alliances and technical publications

- Research Laboratories
  - Management of business creation, strategic investment and corporate collaboration related to technology innovation

- 5G Laboratories
  - R&D and standardization of 5G and future mobile communications systems and co-creation of 5G service

- Communication Device Development Department
  - Development, installation support and technical support involving communication devices (mobile phones, etc.)

- Service Innovation Department
  - Development of methods and systems related to creating new services, installation support and technical support

- Core Network Development Department
  - Development, installation support and technical support for core network systems

- Radio Access Network Development Department
  - Development, installation support and technical support for radio access systems

- R&D General Affairs Department
  - General affairs, accounting and technology information management for the R&D Division

**DOCOMO Beijing Communications Laboratories Co., Ltd.**
- Established in November 2003

**DOCOMO Communications Laboratories Europe GmbH (Munich)**
- Established in November 2000

**DOCOMO R&D Center (YRP)**
- Established in March 1998

**DOCOMO Innovations, Inc. (Palo Alto)**
- Established in November 1999
  - (Name changed in October 2015)

Changes in R&D Expenses and Number of R&D Employees

Since the late 1990s, we have maintained a workforce of between 900 and 1,100 researchers for research and development and have spent around 80 billion yen to 100 billion yen annually from the year 2000. We continue to lead in the global mobile communications business and provide innovations that serve as the backbone of sustainable development.
5. Innovation > Promoting R&D and Innovation

**Innovation Chain**

- **Basic Research**
  We established our R&D system by comprehensively taking into account social conditions, trends in technological development, interaction with external research entities including universities, and the results of customer marketing. The Research Laboratories play a central role in undertaking basic research in collaboration with external institutions. As a major operating company of the NTT Group, DOCOMO supports NTT’s R&D system for basic technologies. The R&D divisions of NTT and DOCOMO maintain close cooperation in their research to ensure that DOCOMO’s business activities benefit from technological achievements made through these efforts. As an example of how we have applied such technological achievements, the laboratories of the holding company conducted basic research on voice recognition and intention interpretation technologies, which were then moved to the applied R&D phase at DOCOMO. This has led to the creation of various new services in recent years.

- **Applied Research and Development**
  In the area of infrastructure, we engage in technological exchanges with major overseas operators and formulate strategies in response to external trends. We are therefore contributing to the establishment of global standards and leading the industry in ecosystem-related efforts by conducting PoC (Proof of Concept) experiments with major manufacturers.

  Even as we play a role in the advancement of this industry, we also ensure that we enjoy competitive advantages in developing our own businesses. Furthermore, the Core Network Development Department and the Radio Access Network Development Department are heading up our involvement in joint development with major manufacturers to provide equipment and systems with internationally recognized functions.

  As for services, we are striving to create new offerings by establishing an agile development system to promptly respond to market needs. Service ideas created by the business divisions are taken up by the Service Design Department to develop system infrastructure, while the Communication Device Development Department develops applications installed on the device. The Innovation Management Department is responsible for creating businesses related to technological innovations, extending strategic investments and bolstering collaboration with other companies. The Service Innovation Department develops element technologies and systems related to the creation of new services. As we create services, we accelerate the pace of introducing them and their value to markets by incorporating element technologies developed by the holding company and the latest technologies developed elsewhere, in addition to DOCOMO’s own technologies. We are also striving to further expand into new markets for services based on DOCOMO technologies.

- **Sales and Service**
  Relevant divisions at DOCOMO actively present proposals that reflect social conditions, trends in technological development and circumstances at shops as well as ideas for improvement from shops and the results of exchanges with external companies and customer marketing activities.

  We convene screening meetings as part of our deliberations to launch new services. This cross-sectional meeting structure and an ongoing, comprehensive assessment process allow us to make decisions quickly.

- **Post-sales and Post-service**
  Each business promotion division regularly monitors the situation to inform decisions, including those related to the formulation of revival plans for services that appear unlikely to meet their initial targets.
### Promoting Open Innovation

DOCOMO is seeking to make the transition from a conventional mobile communications company to a “Value Co-Creation Company.” Through collaboration with partners in various areas, including local governments, companies and research institutions, we will offer greater convenience for the daily lives of our customers and engage in initiatives aimed at revitalizing regional communities and resolving social issues. Specifically, we are pursuing “+d” initiatives in the areas of 5G, AI and IoT. DOCOMO possesses diverse business assets such as its mobile networks and customer base, secure settlement systems and customer referrals. We believe that we can create new businesses by making these assets available to partners with expertise and knowledge, and this in turn will lead to the co-creation of new social values.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Project Description</th>
<th>Alliance Partner</th>
<th>Objective</th>
<th>URL (in Japanese only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5G</td>
<td>5G-based remote control system for construction and mining equipment</td>
<td>Komatsu Ltd.</td>
<td>Conduct verification tests for the development of a 5G-based remote control system for construction and mining equipment.</td>
<td><a href="https://www.nttdocomo.co.jp/info/news_release/2017/05/23_00.html">https://www.nttdocomo.co.jp/info/news_release/2017/05/23_00.html</a></td>
</tr>
<tr>
<td>5G</td>
<td>5G-based remote medical service</td>
<td>Wakayama Prefecture, Wakayama Medical University</td>
<td>Conduct verification trials for eliminating regional differences in medical services through remote diagnosis using high-resolution diagnostic images.</td>
<td><a href="https://www.nttdocomo.co.jp/library/pdf/info/news_release/topics_180326_03.pdf">https://www.nttdocomo.co.jp/library/pdf/info/news_release/topics_180326_03.pdf</a></td>
</tr>
<tr>
<td>AI</td>
<td>AI traffic jam prediction</td>
<td>East Nippon Expressway Company Limited</td>
<td>Start field trials on traffic jam prediction through “AI traffic jam prediction” based on demographic statistics using our mobile phone network system and historic congestion records held by East Nippon Expressway.</td>
<td><a href="https://www.nttdocomo.co.jp/info/news_release/2017/11/30_01.html">https://www.nttdocomo.co.jp/info/news_release/2017/11/30_01.html</a></td>
</tr>
<tr>
<td>Autonomous bus</td>
<td>National University Corporation Kyushu University, DaNA Co., Ltd., Fukuoka City</td>
<td>Start verification tests by the Smart Mobility Promotion Consortium for the autonomous bus project at the Kyushu University's 10-Campus.</td>
<td><a href="https://www.nttdocomo.co.jp/info/news_release/2016/12/13_00.html">https://www.nttdocomo.co.jp/info/news_release/2016/12/13_00.html</a></td>
<td></td>
</tr>
<tr>
<td>IoT</td>
<td>Mirai noie Project</td>
<td>Yokohama City, and factory, Inc.</td>
<td>Start the “Mirai noie Project” to visualize and thereby raise public awareness of the living conditions of residents and to consider and promote the creation of comfortable indoor environments.</td>
<td><a href="https://www.nttdocomo.co.jp/info/news_release/2017/06/22_00.html">https://www.nttdocomo.co.jp/info/news_release/2017/06/22_00.html</a></td>
</tr>
<tr>
<td>IoT</td>
<td>docomo Smart Parking System</td>
<td>Prestige International Inc., Premier Mobile Solution Inc.</td>
<td>-Provide a solution for parking lot operators utilizing IoT and ICT technologies to ease the chronic shortage of parking spaces in urban areas by using small lots and other land not facing main streets. -Continue providing the commercial service started in the second half of fiscal 2017 following verification tests.</td>
<td><a href="https://www.nttdocomo.co.jp/info/news_release/2017/07/21_00.html">https://www.nttdocomo.co.jp/info/news_release/2017/07/21_00.html</a></td>
</tr>
</tbody>
</table>
Co-creation with Ventures

Considering future social environments and industry trends, DOCOMO is supporting the growth of venture companies and promoting co-creation with them through investments via DOCOMO Ventures, Inc., a DOCOMO subsidiary, and DOCOMO Innovation Village activities.

As for investment activities, we focus on the business domains stated in our “Declaration beyond” Medium-Term Strategy 2020 and are making strategic investments in anticipation of generating synergies with our business.

In terms of DOCOMO Innovation Village activities, we support ventures mainly through three programs (Village Alliance, Village Community, and Village Social Entrepreneurs). Specifically, we match our businesses with those of ventures, promote exchanges between our employees and entrepreneurs, and support entrepreneurs who take on social issues.

Example of Co-creation with VR Business Partners

DOCOMO is promoting the use of virtual reality (VR) as a new service.

The VR business requires the development of an optimal system by integrating various aspects, such as content and devices. Therefore, the creation of a better VR service is vitally dependent on co-creating with business partners. We hope to forge a partnership that enables us to effectively disseminate venture assets through our infrastructure.

We have worked with a local municipality as well as a venture company proficient with VR. Moreover, we have successfully drawn out the potential of VR by, for example, providing opportunities for attendees at tourism events to try out a head-mounted display to watch a VR clip on sightseeing spots and also distributing a VR video to the world online.

docomo Developer Support—Collaboration Based on Technology Licensing

docomo Developer support is a collaborative platform that provides various assets, owned by DOCOMO and its partner companies, in the form of generalized APIs (Application Programming Interfaces). These resources can be used by developers of new services with the aim of supporting the creation of unprecedented businesses. Our Web-based, open architecture enables users to pursue commercialization in a way that is self-contained, thus reducing the time spent on designing the service or considering how to develop it and efficiently undertaking operations. Also, it facilitates access to a broad range of resources, including human and technological. Our platform not only makes creating businesses easier; it also helps add significant value to the new business by offering the opportunity to increase the number of registered users and collaborative projects. Moreover, since there are apps that have been developed using thousands of APIs, dramatically cutting business costs is possible by combining them.
Collaborating with Startup Companies—39works

In addition to the conventional methods of joint research and licensing, DOCOMO is quickly seeking to provide new services closely linked to social issues by promoting an open innovation strategy. Based on this strategy, the 39works program for “co-creative business development” organizes joint projects with external partners and together engages in BizDevOps, which encompasses the entire process, from planning and development to operations and maintenance. The program aims for a quick start of small businesses and nurturing them by repeating improvements of their service quality in accordance with market response through a high-speed PDCA approach.

The program is inclusive and creates products and services that are better and more useful for people by continuously determining whether they fit the needs of markets and society. In fiscal 2017, we launched five new businesses, and we are now considering the launch of eight more in fiscal 2018.

Mirai Translate

Going forward, machine translation technology is expected to mature, more tourists will visit Japan, and a larger number of Japanese companies will expand their business overseas. Given these trends, we established Mirai Translate, Inc. in October 2014, and we are currently providing machine translation solutions, leveraging ongoing tuning by professional engineers, and our mobile terminal development capabilities and sales network, as well as a large volume of translation corpus in which NTT DOCOMO, SYSTRAN INTERNATIONAL Co., Ltd., Panasonic Corporation, Honyaku Center Inc. and NTT Communications Corporation all maintain strengths.

We developed a neural machine translation (NMT) engine that is capable of writing a level of English higher than a TOEIC score of 900, in June 2017. Then, in December 2017, we launched Mirai Translator™ as a cloud machine translation service equipped with the NMT engine. We provide other services as well, including Hanashite Hon’yaku (Japaki) (in 11 languages), Hanashite Hon’yaku for Biz (in 10 languages), “Taimen-hoonyaku,” a multilingual voice translation service (Panasonic), Hikari Cloud cototoba (NTT East), and Cotoha Translator (NTT Communications).

Through sales of Mirai Translator™, our machine translation engine, and speech translation solutions, as well as the provision of machine translation platform services and their related consulting services, we expect to achieve 1 billion yen in operating revenues in fiscal 2019.

Mirai Translator™, a web browser-based cloud machine translation service translates text data as well as Microsoft Office format files (Power Point, Word, Excel), or PDF format, while keeping the layout unchanged, by a simple drag-and-drop operation.

To realize stress-free communication between different languages in various business settings, including daily conversations and documents with many technical terms, such as agreements and internal documents, we are promoting our machine translation platform service, which is safe and scalable and can be customized for the business domains of our customers. With this service, we are helping to globalize Japan.
5. Innovation > Promoting R&D and Innovation

● Collaboration with External Partners

Evolved the conversation mode of the “Kokokuma” Teddy Bear Communication Robot, following an addition from partners.

As part of the 39works program for co-creative business development, DOCOMO collaborated with Iwaya Corporation, VITEC Global Electronics Co., Ltd. and Mooredoll Inc. to develop “Kokokuma,” a communication robot in the form of a stuffed animal. The robot is designed to support communication between families living at some distance from their elderly members and incorporates functions such as recording, voice messaging linked with smartphone apps, conversation mode and a human sensor that ensures safety.

Since their release on January 25, 2017, talk conversation scenarios have been added every day through a built-in LTE module. In October 10, 2017, five companies—Cocolomi, Techfim, BCC, FueTek, HOYA—joined us in helping deliver smoother dialogues to elderly users, thereby making them feel more closely connected to the dialogues. In November 28, 2017, we won the AI & Robotics Committee Special Award in the Service & Solution category of the “MCPC award 2017” hosted by the MCPC (Mobile Computing Promotion Consortium).

Promoting Process Innovation

In October 2017, DOCOMO began its “Top Gun” initiative, in which the R&D and Corporate Sales and Marketing departments have formed an elite team and work as one with customers to address challenges. This involves a swift process that encompasses identifying issues and needs, creating solutions, developing business projects and monetizing them. We also established a maintenance and operation system for our solutions, which are sold nationwide as a packaged product for corporate customers. Ten months after the initiative’s launch, we are pursuing ten projects, as of July 2018.

“Top Gun” collaborations between R&D and Corporate Sales and Marketing are not limited to the departments at the head office. Corporate Sales and Marketing staff at DOCOMO’s regional offices and branches in Japan can voluntarily join the initiative to solve issues faced by companies and governments, and the number of participants is rising. We set up a system so that the head office can share information about “Top Gun” with the regional offices and branches, and at the head office we provide space where staff working at that location can meet for discussions with colleagues from regional offices and branches. The “Top Gun” initiative has encouraged greater interaction and collaboration between the R&D departments and corporate sales departments at our regional offices and branches nationwide.

We will create solutions at a much faster pace by having R&D members responsible for developing the technology visit customers to make on-the-spot decisions as to whether or not it will be useful for resolving a particular issue and to present even better solutions. In fiscal 2017, we began work on eight projects, and we plan to start ten more in fiscal 2018. Moreover, R&D and Corporate Sales and Marketing staff together visit customer worksites in order to connect needs with potential solutions. This allows us to verify and resolve issues simultaneously and with speed, and to turn technological possibilities into value for customers while making full use of the cutting-edge technologies we provide them with solutions. We will pursue this initiative to accelerate the pace of “+d” co-creation toward achieving Declaration 4: Industry creation and Declaration 5: Solution co-creation under our “Declaration beyond” Medium-Term Strategy to 2020.
Since ICT services have a major impact on consumers, we believe that we must always consider their effects on society in general as we pursue our business. DOCOMO is actively promoting businesses that provide new value and enjoyment to society and contribute to providing solutions to social issues by further enhancing its products and services and continuously taking on the challenge of “smart innovation” to provide ever-improving value.

Creation of New Services Using the “5G Trial Site”

The “5G trial site” was constructed by DOCOMO ahead of the scheduled launch of commercial 5G services in 2020. The site serves as a means for collaborating with corporate partners across a broad range of industries in creating new services and content based on 5G’s unique properties, including super high-speed, large-capacity communications, lower latency and connection to a super large number of terminals. The site is located in the Tokyo Waterfront City (Odaiba and Aomi district) and Tokyo Sky Tree Town.

In May 2017, DOCOMO worked with the Tobu Railway Group on transmitting the world’s first 8K live video using experimental 5G signals, successfully reproducing a video transmitted from the observation deck of the Tokyo Sky Tree. Combined with AR/VR technologies, 8K video transmission can meet the needs of customers seeking a greater sense of reality and enjoyment from live videos of sports and music and has the potential to change the way we enjoy them.

In December 2017, we successfully implemented a long-distance transmission of over 1 km from the observation deck of the Tokyo Sky Tree to Asakusa, and thus demonstrated super high-speed communication achieving up to 4.52 Gbps downlink and 1.55 Gbps uplink when receiving. This established that our technology can utilize high-frequency radio waves, which are difficult to transmit at a distance due to strong attenuation, in more diverse environments, including urban settings as well as rural, suburban and mountainous areas. In addition, we field-tested a new communication service using MR (mixed reality) technology between the Sky Tree and Asakusa Station, successfully facilitating a realistic, real-time conversation. Furthermore, we demonstrated a VR (virtual reality) entertainment system using 5G transmission of images taken by a 4K, 360-degree high-definition livestream camera, and the demonstration was well received.

In March 2018, we conducted various 5G field trials initiated by the Ministry of Internal Affairs and Communications. In a 5G wireless transmission test conducted in the area around the 5G trial site, we observed a maximum 10.2 Gbps throughput when two users connected simultaneously in an outdoor environment, confirming that super high-speed, high-capacity communications can be achieved in the field. Moreover, we verified that quality can be kept stable during the transmission of 8K/4K high-resolution images via 5G. Therefore, 5G is expected to be applied to public viewing, digital signage and similar applications.

Development of the 5G-based Remote Control System for Construction and Mining Equipment

The Japanese construction industry is undergoing a period of technological change, as construction projects are increasingly reliant on electronic data using ICT construction equipment, which gathers information on machinery and vehicles as well as on soil and personnel at the site. Companies are seeking to enhance productivity by shifting to ICT-based construction and production processes, which include surveying, construction work and inspections. Wireless access to ICT construction machinery has become a key factor for optimizing centralized control of the entire construction and production process.

In May 2017, DOCOMO began collaborating with Komatsu Ltd. on a verification trial aimed at developing a 5G-based remote control system for construction and mining equipment (hereafter “construction equipment”). We have conducted verification trials in which we remotely controlled construction equipment by sending onsite videos taken by several cameras mounted on the equipment and control signals to the equipment through 5G. We will continue to conduct verifications for the actual environments of users. The use of 5G networks will enable us to provide site construction and management services that facilitate accurate, efficient construction using real-time information about the onsite status from a remote office. This is expected to address the issue of labor shortage at construction sites.
Expanding into the Drone Business

DOCOMO has developed the “docomo sky™” drone operation platform for corporate partners that provide drone services. The platform consists of four components: cloud connect, operation support base, business support base, and analysis support base. DOCOMO specifically focuses on the business support base and analysis support base, and it will further seek ways to utilize the data obtained in real time while increasing its base of knowledge by engaging with a variety of companies.

In May 2018, we began “Drone Starter Support™” to provide comprehensive support for companies and municipalities in their initial introduction of drones, including sales and rental of drone units and cameras, offering communication terminals, and measuring relay images, as well as support for flight applications to the Ministry of Land, Infrastructure, Transport and Tourism, dispatch of pilots, and safety sessions. We expect the use of drones will enhance future social infrastructures.

Field Demonstrations of Drone Services in Japan

In September 2016, DOCOMO obtained a license to operate experimental commercial stations for mobile phone use in combination with unmanned aerial vehicles in designated regions in Kanagawa, Chiba and Fukuoka prefectures. In October of that year, we launched the “docomo Drone Project” in various locations across Japan to verify the commercialization of services based on cellular drones using our mobile phone network.

We conduct field demonstrations toward providing a variety of solutions using drones while also seeking to create an environment for flying drones without creating problems by verifying the drone’s connection quality in flight as well as its impact on above-ground mobile phone networks.

Overview of the docomo sky Concept™

<table>
<thead>
<tr>
<th>Project</th>
<th>Alliance Partner</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport of packages using a drone port system for distribution</td>
<td>Blue Innovation Co., Ltd., The University of Tokyo, JAPAN POST Co., Ltd., Autonomous Control Systems Laboratory Ltd., Ina City in Nagano Prefecture</td>
<td>Comprehensive verification test on the distribution of unmanned aircraft using a drone port system for distribution</td>
</tr>
<tr>
<td>Prevention inspection of railroad infrastructure using cellular drones</td>
<td>TOBU RAILWAY CO., LTD.</td>
<td>Verification of an inspection method for railroad-related equipment using safer, more efficient cellular drones instead of the current visual inspection</td>
</tr>
<tr>
<td>Development of the world’s first* floating spherical drone display</td>
<td>DOCOMO Developed a floating spherical drone display capable of displaying images in all directions while in flight, as a solution for event venues such as stadiums and concert halls (theater production, advertising, guidance, etc.)</td>
<td></td>
</tr>
<tr>
<td>Covering mobile phone communications service areas through a drone relay station</td>
<td>DOCOMO Considered introducing a drone relay station to restore communications services for mobile phones in areas where disasters have interrupted service; conducted a field trial in Gunma Prefecture, which successfully provided service for these areas</td>
<td></td>
</tr>
</tbody>
</table>
Proxy Shopping Service Using Cellular Drones

In November 2016, DOCOMO conducted verification trials using cellular drones to test a product delivery service requested by phone to homes on a remote island of Fukuoka City, which has been designated as a national strategic special zone. The project tested the feasibility of the service through the long-distance BVLOS (Beyond Visual Line of Sight) operations of cellular drones using our mobile phone network. It also tested the connection quality of the drone and its impact on above-ground mobile phone networks. The service is intended to solve community-based social issues toward realizing a society in which all citizens, from children to the elderly, can lead safe and prosperous lives.

DOCOMO R&D Open House

We hold a DOCOMO R&D Open House every year to showcase the DOCOMO Group’s latest R&D efforts and promote our +d initiatives. The event’s main purpose lies in its broad appeal to stakeholders related to DOCOMO’s efforts to deliver added value to customers and create social value through our mid- to long-term R&D initiatives in order to co-create value with our corporate clients.

In fiscal 2017, we exhibited 110 technologies, categorized into the distinct zones of Living, Traveling, Learning, Exciting, 5G Experience, AI Platforms, IoT Platforms, Device and Interaction, Networks, Innovation Challenge, and Solutions, under the overall theme of “docomo R&D Open House 2017; Starting to See the Near Future.” We received about 8,406 visitors, about three times the number we welcomed in fiscal 2016. The Open House is a key opportunity to inform a broad audience about DOCOMO’s initiatives on creating social value through R&D and to strengthen our collaboration with diverse partners.
Examples of Innovation

DOCOMO has leveraged the unlimited potential of ICT to develop innovative solutions that address issues facing society.

Education & Learning × ICT

Promoting Agricultural IoT through a Water Management Support System for Wet-rice Agriculture: PaddyWatch and Agri-note

DOCOMO sells PaddyWatch, a water management support system for wet-rice agriculture, to rice farmers across Japan. This product of vegetalia, inc. contains our communication module. The system gathers four data points representing water level, water temperature, air temperature and humidity every ten minutes from a device equipped with a sensor and communication functions installed in the rice paddy. It then transmits the information every hour to the cloud via our network. Centrally managing the status of these communication functions on the IoT platform service enables us to provide stable service for agricultural IoT.

In addition, DOCOMO’s “Business Plus” business services include “agri-note,” an application provided by Water Cell inc., which uses aerial photos of farmers’ fields, enabling them to record their daily field work on a smartphone or another device.

Going forward, we plan to connect PaddyWatch and agri-note as elements of an agricultural IoT. Specifically, we will enable the automatic recording of information obtained from the sensor into agri-note toward increasing the efficiency of farm management.

Furthermore, in Niigata City we are providing food education to elementary school children by using the educational Kyoikuden rice paddies with the support of farmers. The schools are working with local farmers to educate children about food while receiving their support. The use of PaddyWatch and agri-note have helped to visualize field work and specific indexes, enabling farmers to review their work on a daily basis.

Approx. 75% reduction

Labor cost for rice paddy management
Health & Medical Care × ICT

Mother and Child Health Handbook App

The Mother and Child Health Handbook has been issued for over half a century to pregnant women in Japan. This has helped reduce the child mortality rate and improve the health of pregnant and prenatal women. The utility of this unique system has been globally recognized and introduced in more than 30 countries. DOCOMO further advanced the potential of this handbook by partnering in the development of the web application "Mother and Child Health Handbook App" as a way to contribute to good health.

The Mother and Child Health Handbook App can digitize information about the health status of a mother and child entered on a smartphone. Moreover, it can receive information about the system and procedures of the mother’s municipality at the right time according to the development of her child. The app user can also choose her own doctor from approximately 300 medical institutions in partnership with DOCOMO (as of the end of fiscal 2017), allowing the user to receive highly reliable medical information.

In February 2018, the app launched a service for low-weight babies of less than 2,500 g at birth. It includes a modified chart of age by month to show the expected growth and development status of the baby counting back from the expected date of birth, not from the actual date, and thereby helps the mother raise her baby with peace of mind.

Going forward, we will increase our partner municipalities to 500 by the end of fiscal 2018, work to enhance app functions and promote the distribution of the app to realize a sustainable society that leaves no one behind.

500

Target partner municipalities

*DOCOMO and Hakuhodo DY Media Partners Inc. jointly plan, develop and operate the app, sponsored by the specified non-profit corporation Himawari-no-kai.
5. Innovation > Examples of Innovation

Mobile Gyuonkei

In collaboration* with the National Federation of Agricultural Cooperative Associations (ZEN-NOH) and REMOTE, Inc., DOCOMO developed “Mobile Gyuonkei,” which notifies the birth of a calf in advance to prevent delivery accidents.

Due mainly to the epidemic of foot-and-mouth disease in 2010, the bankruptcy of major ranches, and the retirement of cattle farmers with the aging of cattle farmers, the number of farmers and cows has been declining, which is an issue that cannot be overlooked. Under these circumstances, approximately 30,000 calves die annually during delivery, which inflicts immeasurable damage on cattle farmers.

Mobile Gyuonkei uses its temperature sensor to monitor the body temperature of the cow and transmits an email when the time for delivery is approaching, thus increasing the probability of assisted delivery being available. ZEN-NOH estimates that the use of this technology can reduce the rate of delivery accidents from around 5% to 0.4%. In addition, although cattle farmers used to sleep in the cowshed during the prebirth period, they can now sleep without worry at home, thereby improving working conditions. Farmers used to have difficulty making other commitments, even for important family events, but Mobile Gyuonkei has improved their personal lives as well.

DOCOMO pays attention to the safety and price of the product so that cattle farmers can adopt it easily. We will work on broadening the use of Mobile Gyuonkei to help the cattle industry leap to a new level toward becoming a sustainable growth industry.

*The call center is operated by DOCOMO and REMOTE, while product communications are handled by DOCOMO and sales are handled by DOCOMO and ZEN-NOH.

99%

Delivery accident prevention rate
In 2011, DOCOMO started the community cycle (bicycle sharing) service “baybike” in Yokohama City. Since 2011 we have been working to realize a circulating society by integrating bicycles and mobile phones to develop environmentally sound bicycle sharing services. Bicycle sharing is a service in which the user can rent and return a bicycle from/to any of the cycle ports within a service area, and this service is expanding as a new urban transit option in Japan and many other countries.

In February 2015, DOCOMO BIKESHARE, INC. was established, and in February 2016, a wide-area experiment of bicycling across administrative districts was launched in Tokyo, and we are striving to enhance service content with greater convenience. As of the end of June 2018, more than 7,700 bicycles are available at about 760 cycle ports nationwide.

Moreover, in July 2017 we began providing a docomo Smart Parking System solution to parking lot operators. Urban and residential areas have suffered a chronic shortage of parking spaces, but at the same time lands suitable for metered parking have been under-utilized, mainly because investments in building and operating metered parking spaces would not pay for themselves.

The “docomo Smart Parking System,” developed by DOCOMO, makes it possible to build and operate metered parking spaces in even previously unprofitable small locations, in a short construction period and at a reasonable cost, thereby enabling the temporary use of vacant lots as metered parking areas. The system consists of a “smart parking sensor,” an IoT device equipped with a function that detects entering and exiting vehicles, a gateway mounted with a communications module and a cloud-based parking space management server.

The special smartphone app enables drivers to check for vacant spots and reserve one in advance, thus saving the trouble of finding a space to park after arriving at the destination.

These services are offered to any mobile phone user regardless of their carrier. The widespread use of these Sharing Mobility services will help improve customer convenience and also reduce the greenhouse gas emissions of society at large while vitalizing regional communities and tourism and encouraging healthier lifestyles.

Furthermore, in November 2017 we launched a new service “d car sharing,” which allows the customer to choose their favorite car from those owned by a car sharing operator, rental car operator, or individual, based on purpose, location and date of use. “d car sharing” offers three kinds of services on its platform: “Car Share,” provided by car sharing operators, “My Car Share,” car sharing between individual drivers, and “Rental Car,” provided by major rental car operators in Japan. The customer enters details about their trip, such as location and date of use, and can then browse all vehicles from these three services, and make a booking and even payment (excluding “Rental Car”) on their smartphone or another mobile device.

Climate Change × ICT

Providing Sharing Mobility Services (DOCOMO BIKESHARE, docomo Smart Parking System, d car sharing)
5. Innovation > Examples of Innovation

**Mobility × ICT**

**Started Operation of AI Taxi that Forecasts Taxi User Demand**

In February 2018, DOCOMO launched “AI Taxi,” a service that uses AI to predict demand for taxi rides. Demand for taxis has been increasing as more tourists visit Japan. However, the country has been facing such social issues as a driver shortage and lower driver productivity owing to a declining population and super-aging society. To solve these issues, DOCOMO has conducted a number of field trials in Tokyo and Nagoya City since fiscal 2016.

AI Taxi uses various types of data including taxi operation, weather, surrounding facilities (Point of Interest, or POI), as well as a real-time version of DOCOMO’s mobile spatial statistics® (“demographic data”) to analyze all of the data required for AI, understanding demographic changes by attributes such as gender and age group associated with the shifts in population distribution across Japan. Based on this analysis, AI Taxi forecasts taxi demand every 10 minutes for up to 30 minutes. This is the world’s first taxi demand forecasting service that leverages AI and demographic data that can provide real-time changes made by the movements of population distribution across a wide area.

The service is expected to help improve convenience by shortening the waiting time of taxi riders, enhance the productivity of taxi drivers through more efficient operations, and also mitigate traffic congestion caused by unnecessary waits for customers. In addition, the service’s core transportation demand forecasting technology can be used to optimize other means of transportation, thereby improving the efficiency of the entire traffic system.

**Work Style Reform × ICT**

**Launching the Work Style Innovation Package**

As part of work style promotion included in its medium-term strategy 2020 “Declaration beyond,” DOCOMO started providing the “Work Style Innovation Package” as a solution for realizing a work style that offers flexible choices of time and location by combining the “Share Office” co-working space, which allows employees to work outside the office, with a telework ICT that supports telework, such as the FMC cloud phonebook service “Office Link +,” cloud web conference service “sMeeting,” and virtual desktop service “s-WorkSquare” in June 2017.

“Share Office” provides WORKSTYLING of Mitsui Fudosan Co., Ltd. and “Business-Airport” of TOKYU LAND CORPORATION as the options of DOCOMO’s business service lineup “Business Plus.” It allows sales employees out on business to use the nearest “Share Office” to work, which can reduce travel time and overtime work hours.

DOCOMO has been incorporating a telework, work-from-home system since April 2010. Before offering this service, we implemented telework targeting our Corporate Sales and Marketing Division using the “Work Style Innovation Package.” As a result, overtime work hours decreased by about 15%*. Through the service, we will propose better work styles of various types with a range of conditions for different industries to our customers by realizing a telework environment using ICT and the practical know-how we have acquired through our Work Style Reform.

*As a result of a year-on-year comparison between April and October 2017 and April and October 2016
5. Innovation

Examples of Innovation

Promoting R&D and Innovation
Smart Innovation
DOCOMO R&D Open House
Examples of Innovation
Awards for Innovation

Education & Learning × ICT

Providing the Tuition-free College Course “gacco” Service

DOCOMO provides “gacco,” a web service that allows anyone to take or view lectures by college professors without tuition fees. We have been offering learning opportunities to a wide range of generations by creating new learning models, including online lectures, attending classes via smartphone or tablet during spare time while away from home, scoring other students’ work, face-to-face learning, and meet-ups. As of August 2018, this service has attracted over 450,000 members.

Health & Medical Care × ICT

Estimating Stress with Smartphones

To address the annual rise in the number of mental health patients, DOCOMO jointly developed a technology for estimating one’s own stress level with The University of Tokyo (UT) and Keio University (KU) in March 2018. DOCOMO’s big data analysis and AI technology is combined with UT’s data processing technology for behavior recognition and KU’s expertise in the area of psychiatric medicine and psychology, including behavior under stress, to classify distinctive stress behaviors into 130 types and quantify the results based on data for daily smartphone use, such as power on-off, location information and number of calls, as well as the smartphone owner’s heart rate data.

AI learns these figures and behavior characteristics and provides periodic feedback on stress level to the smartphone user. This raises their awareness of stress management, enabling them to maintain their physical and mental health in ways suitable for anyone. With the technology, DOCOMO is striving to accelerate the practical use of an application that helps users better understand their personal mental self-care status.

Productivity Improvement × ICT

ICT Buoy

The fisheries industry has recently been facing social issues such as the declining number and aging of workers and changes in the marine environment due to global warming and earthquakes.

ICT Buoy is a solution that implements various sensors for water temperature, salinity and so forth in order to obtain marine data via DOCOMO’s network through smartphones or mobile phones. Smartphones are capable of displaying current marine data as well as data trends from the past in tables and graphs. This enables users to monitor in-depth data remotely transmitted from a place closer to the fishing grounds so that they can more effectively manage current needs.

ICT Buoy offers the following four benefits.

- Stabilized yield: Reduce risk by making up for inconsistent experience, guesswork and unstable marine environments with hard data.
- Improved quality: Realize data-backed planned production.
- Reduced costs: Reduce fuel costs and onsite work needed to review the status of fishing grounds.
- Handing on to the next generations: Provide a new communication style by utilizing message boards and diary features.

This solution for resolving fishery issues has been introduced and verified at 16 locations across Japan as of June 2018.
5. Innovation > Examples of Innovation

Smart City × ICT

Providing an Environment for Realizing “SDGs Future Cities” and “Smart Satoyama Cities”

DOCOMO is working on a service to create a new life style in “Satoyama Cities (rural cities)” through the use of IoT, big data, AI and other technologies. As a means to collect data for the service, DOCOMO is building an environment for verification trials using an LPWA network that enables multiple connections with low power consumption.

DOCOMO has been building this environment in collaboration with the Kanazawa Institute of Technology (KIT) as one of the initiatives of “Hakusan City IoT Acceleration Lab” – a joint effort by industry, public/private sectors, and academia to create new rural cities through the use of IoT and other technologies. We are providing a LoRa®-based environment to consortium members who are working to realize a new IoT service using the environment. The LoRa® service allows for the connection of multiple devices to one gateway, enabling communications with devices located in mountainous areas with poor reception. The service is also suitable for communications through one gateway in places such as plastic greenhouses and factories where devices are concentrated in wide premises.

The service is expected to achieve higher efficiency through monitoring of the status of farm and other equipment used by residents, with sensors mounted on the equipment, and to mitigate damage by detecting signs of potential river flooding or a landslide with environmental sensors. To address the population decline in Satoyama (rural areas), we will work to help residents lead more efficient and convenient lives by making predictions using AI functions based on the analysis of data gathered and accumulated through sensors mounted on devices and equipment in the verification environment. We will also promote the development of applications and services that help attract tourists.

Hakusan City was selected for the “Sustainable Development Goals (SDGs) Future Cities” in June 2018. DOCOMO will work with KIT and others on this city’s efforts to promote “SDGs Future Cities.”

1: Concept of the Kanazawa Institute of Technology for creating a city for a new era in Satoyama, including foundations for livelihoods using IoT and AI, in collaboration with industry, public/private sectors, and academia.

2: Hakusan City, Kanazawa Institute of Technology, NTT DOCOMO, I-O DATA DEVICE, INC., Kanazawa Research Institute, goowa inc., and MULTISOUP CO., LTD. jointly applied for the “Local IoT Acceleration Labs” project promoted by the Ministry of Economy, Trade and Industry, and obtained certification in March 2017.

Inbound Tourism × ICT

Started Providing a Japanese Cultural Experience Program on “WOW! JAPAN,” a Portal Site for Foreign Visitors in Japan

The goal of welcoming 40 million foreign tourists in Japan annually by 2020 will require arranging community-based tours, such as those led by individuals and others by communities, as well as tours sponsored by major travel agencies encompassing urban areas and tourist sites.

DOCOMO began providing “WOW! JAPAN,” a portal site that provides Japanese sightseeing information to foreign tourists, and in August 2017 “WOW! JAPAN Experience+,” a program providing Japanese cultural experiences.

DOCOMO offers the service in collaboration with Gaiax Co., Ltd., and municipalities to involve communities with the goal of deepening the experience of foreign tourists about life in Japan through interaction with local people. The program offers participants five categories of first-hand experience: nature, farming, culture and crafts, cooking, and town walks. In line with the start of the service, DOCOMO recruited hosts for these categories of the program and further expanded it. We will also help municipalities promote local tourism.
Awards for Innovation

NTT DOCOMO has received the following awards for innovation in fiscal 2017 and 2018.

<table>
<thead>
<tr>
<th>Host</th>
<th>Award</th>
<th>Award-winning Project and Reason (affiliations are as of the time of winning the awards)</th>
<th>Date</th>
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</thead>
</table>
| Cabinet Office | Medal with Purple Ribbon | “Development of radio access control technology for the 3rd and 4th generation mobile phone system”
Seizou Onoe (R&D Innovation Division)
Recognized for developing radio access control technology for the 3rd and 4th generation mobile phone system, thereby helping to realize and expand of 3G and 4G in and outside of Japan and achieving more comfortable communication using smartphones, which helped improve the convenience of daily life. | April 26, 2018 |
| Institute of Electronic, Information and Communication Engineers (IEICE) | Distinguished Achievement and Contributions Award | Seizou Onoe (R&D Innovation Division)
Recognized for devoting many years to R&D in ICT and bringing innovations to mobile communication services by developing a number of novel schemes and technologies and by promoting their use, thereby helping to create a productive ICT society. | June 1, 2017 |
| Institute of Electronic, Information and Communication Engineers (IEICE) | Achievement Award | “Commercial deployment of 3.5 GHz band TD-LTE service”
Toshiro Kawahara (Radio Access Network Development Department)
Yasuyuki Watanabe (Radio Access Network Development Department)
Toshiyuki Futakata (Communication Device Development Department)
Recognized for devising a new method for efficiently and effectively deploying the higher frequency TD-LTE method in mobile communications.

“Commercialization of network virtualization technology capable of running the EPC software of multiple vendors”
Hiroyuki Oto (R&D Strategy Department)
Yasuyuki Uchiyama (Core Network Development Department)
Kazuaki Obana (NTT Network Innovation Laboratories)
Recognized for their extraordinary contribution to the mobile communication industry through this commercialization, the world’s leading example in network virtualization, and for their distinguished achievement. | June 7, 2018 |
| Ministry of Education, Culture, Sports, Science and Technology | The Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology | Prize for Science and Technology (Development Category)
“Development and commercialization of world leading VoLTE with high-quality sound and high efficiency”
Kazuaki Sugiyama (Core Network Development Department)
Akihiro Maebara (Radio Access Network Development Department)
Toshiyuki Futakata (Communication Device Development Department)
Recognized for their outstanding achievements in their project in terms of R&D and understanding the enhancement of science and technology. | April 17, 2018 |
| International Electrotechnical Commission | Industrial Standardization Awards | IEC1906 Award
Teruo Onishi (Research Laboratories)
Recognized for his outstanding achievement in the standardization of electric and electronic technologies and related activities. | October 23, 2017 |
## Awards for Innovation

**Promoting R&D and Innovation**

<table>
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<tr>
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<th>Date</th>
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<tbody>
<tr>
<td>Tsushinbunka Association</td>
<td>Hisoka Maejima Award</td>
<td>“Commercialization of Advanced C-RAN for the effective rollout of LTE-Advanced” Sadayuki Abeta (Radio Access Network Development Department), Yosuaki Watanabe (Radio Access Network Development Department), Yoshihisa Shinzau (Radio Access Network Development Department), Norihiro Tokihito (Communication Device Development Department) Recognized for commercializing the advanced C-RAN that led to the effective deployment of LTE-Advanced, thereby contributing to the expansion of a new market, including the promotion of the use of rich content through the mobile network.</td>
<td>April 11, 2017</td>
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<td>“Contribution to the international standardization of a ground-based radio communication system through ITU-R” Akira Hashimoto (Network Department) Recognized for being active on the front lines of international standardization in the radio communication field by participating in ITU radio communication department meetings as a Japanese representative as well as for significantly contributing to the improvement of Japan’s global competitiveness.</td>
<td>April 10, 2018</td>
</tr>
<tr>
<td>ITU Association of Japan</td>
<td>ITU-AJ Accomplishment Award</td>
<td>Sadayuki Abeta (Radio Access Network Development Department) Masaomi Suntita (R&amp;D Strategy Department) Recognized for contributing to activities to standardize LTE/LTE-Advanced, ATM transmission of highly compressed voice, etc., within 3GPP and ARIB.</td>
<td>May 17, 2017</td>
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<td>ITU-AJ Encouragement Award</td>
<td>Arif Umezoki (Radio Access Network Development Department) Kazuaki Takada (3G Laboratory, Research Laboratories) Mereko Otsuki (Carrier &amp; Regulatory Affairs Office, Corporate Strategy and Planning Department) Recognized for their contributions to standardizing HSUPA, LTE/LTE-Advanced, 5G, etc., within 3GPP and ITU.</td>
<td>May 17, 2018</td>
</tr>
<tr>
<td></td>
<td>ITU-AJ Accomplishment Award</td>
<td>Kozo Sakai (Core Network Development Department) Lan Chen (R&amp;D Strategy Department, Beijing Labs) Recognized for their contributions to more efficient management of virtualized networks, higher functionalization, and standardization of 5G etc., within 3GPP and ETIS.</td>
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<td></td>
<td>ITU-AJ Encouragement Award</td>
<td>Hiroki Harada (Communication Device Development Department) Taro Uehiro (Radio Access Network Development Department) Motohiro Abi (Core Network Development Department) Recognized for their contributions to standardizing LTE/LTE-Advanced, IoT, 5G VOLTE roaming, etc., within 3GPP and ITU.</td>
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</table>
## Awards for Innovation

**Host** | **Award** | **Award-winning Project and Reason (affiliations are as of the time of winning the awards)** | **Date**
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**Association of Radio Industries and Businesses (ARIB)** | The Meritorious Award on Radio | "Commercialization of a super high-speed, high-capacity LTE-Advanced system using FDD/TDD carrier aggregation technology" Toshiro Kawahara (3.5 G HzLTE Development Group) Recognized for his effort to realize higher speed and capacity using carrier aggregation technology. | June 15, 2017

**Association of Radio Industries and Businesses (ARIB)** | The Award of the Representative of the Board of ARIB | "The world-first commercialization of VoLTE roaming through the establishment of a new method" Kazuo Sugiyama (VoLTE Roaming Development Team) Recognized for reducing the time required for development and testing compared to the previous method and developing a new method that can reduce service fees, as well as pursuing international standardization. | June 27, 2018

**Association of Radio Industries and Businesses (ARIB)** | The Award of the Minister of Internal Affairs and Communications | "Commercialization of the power-saving technology eDRX for IoT communication equipment" Toshiyuki Futakata (Power-saving Technology eDRX Commercialization Team) Recognized for providing eDRX technology in LTE areas throughout Japan by promoting the commercialization and standardization of technology that can significantly extend the intervals of intermittent sending and receiving by connecting a core network to a wireless network and also for extending battery life by about 10 times by developing a low power consumption UIM in combination with the above. | June 27, 2018

**Red Hat K.K.** | Red Hat Innovation Awards APAC 2017 IT optimization | "Commercialization of Network Functions Virtualization (NFV), which enables the running of multiple vendor software" Kazuo Sugiyama (Network Virtualization Base Development Team) Recognized for the world’s first commercialization in March 2016 of network virtualization technology that improves usability through the integrated and flexible control of various vendor products as well as for his active contribution to international standardization. | October 20, 2017

**Japan Institute of Design Promotion** | FY2017 Good Design Award | "docomo Smart Parking System" Innovation Management Department (7 members) Highly regarded for bold innovation of the solution’s idea, its level of achievement in product design, and economic efficiency by realizing the prior reservation of empty space in parking lots and cashless settlement using mobile ICT and IoT technologies. | October 4, November 2, 2017