

# 7 Network Reliability

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Responding to a disaster

As a provider of telecommunications services, DOCOMO pursues its mission of providing a communication environment that enables customers to use their mobile phones anytime and anywhere, and it strives to enhance customer security, safety, and comfort. In 2017, we set up the Network Division to spearhead our initiatives to ensure a consistently reliable network for customers by constructing and operating a total network service that includes communication devices and applications as well as to secure communication during disasters and guarantee the safety of radio waves used by mobile phones.

## Provision of Network Services

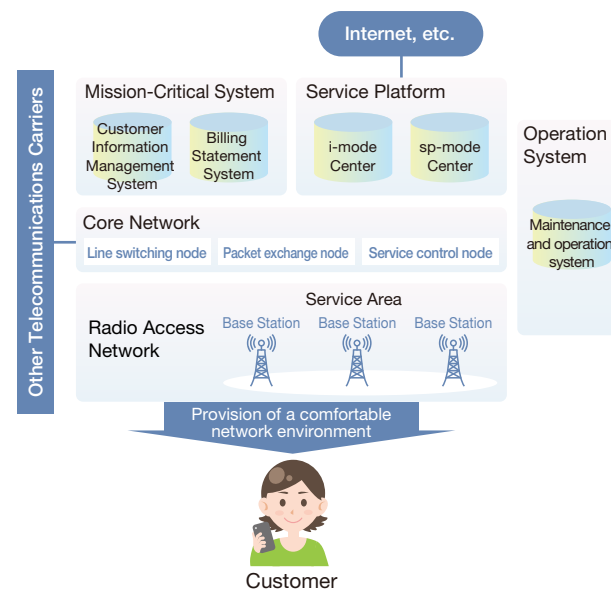
### Basic Policies and Philosophy

DOCOMO seeks to provide constantly improving network services that consistently satisfy customers. Building base stations to expand our service areas offers connectivity to our customers wherever they are, in the city, on the subway or in a remote location or relatively unpopulated area. We also work to maintain a system that ensures connectivity around the clock, all year round, regardless of any specific circumstances that may arise in the course of a normal day or special event. We are improving connectivity during spikes in service demand and raising the reliability of our telecommunications services during network failures by implementing the network functions virtualization technology. In addition to increasing communication speeds, we are constructing a robust lifeline based on DOCOMO's Three Principles of Disaster Preparedness, which we can rely on in times of disaster.

### Overall Layout of DOCOMO's Network

The DOCOMO network comprises the radio access network, core network, service platform, various mission-critical systems and the operation system.

DOCOMO's Network Layout



### Expansion of the Service Area

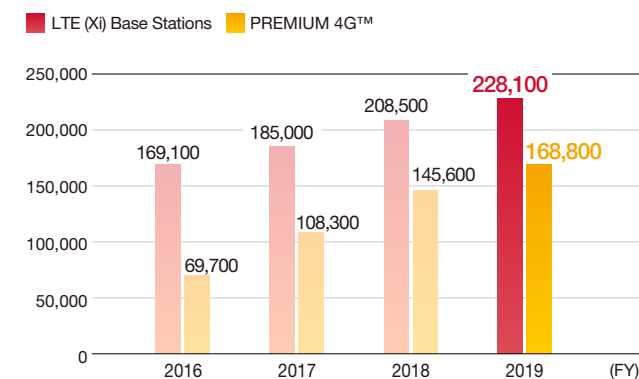
#### Building Base Stations

We are building base stations to enhance voice communication and data transmission as well as to expand our service area. We have been setting up new base stations every year for both LTE and FOMA. As for LTE, we are increasing the number of

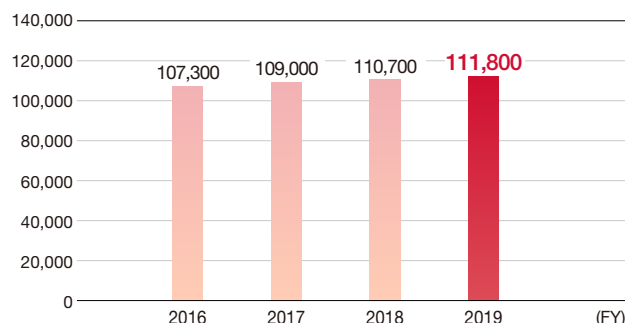
base stations capable of handling higher communication speeds offered by PREMIUM 4G, and we provided the service in 1,687 cities nationwide in fiscal 2019.

In research and development, we have maintained a workforce of between 900 and 1,100 researchers since the late 1990s and have spent around 80 billion yen to 100 billion yen annually since the year 2000. We continue to provide innovations that serve as the backbone of sustainable development as the leader in the global mobile communications business. Furthermore, we have built base stations for 5th generation (5G) mobile communications and began providing commercial service on March 25, 2020.

Number of LTE (Xi) Base Stations



Number of FOMA Base Stations



### ■ DOCOMO's Approach to Installing Base Stations

Before building a new base station, we provide detailed explanations to local residents in accordance with the rules stipulated by relevant laws and regulations as well as to those living in areas designated by DOCOMO's internal rules where such laws and regulations do not apply. Some residents are concerned about the effects of electromagnetic waves, while others are ambivalent about the construction of antenna towers. We make an earnest effort to explain and place top priority on the security and safety of local residents when conducting construction work.

### ■ Activities for Inspecting and Improving Reception Quality

In order to ensure coverage quality and expand our coverage area, DOCOMO widely solicits information from customers on reception quality.

We will continue to improve reception quality by using this feedback while building more base stations in an effort to ensure a more stable environment for our mobile phone users.

In fiscal 2019, we received about 57,000 customer inquiries, which we responded to sincerely, and we are striving

to make improvements by conducting reception quality tests on vehicles and on foot throughout Japan.

For customers who request better indoor reception quality, we offer them solutions by installing DOCOMO repeaters that amplify signals or compact femtocell base stations that transmit signals.

### ■ Ensuring the Quality of Communications Services during Large Events

Major events and exhibitions gather large numbers of customers in a single location. Local base stations may experience intermittent overloads causing spotty phone service when these customers use their mobile phones at the same time. We prepare for such potential problems by proactively implementing special measures. In addition, we are systematically expanding the facility capacity of our networks in response to the usage status of our customers.

#### Example 1 Events such as fireworks and concerts

- Disperse communication loads by installing mobile base stations and Wi-Fi Spots
- Secure communication capacity by setting up base station facilities to cover the venue and modifying the software that controls the facilities

#### Example 2 Concentration of greeting calls and mail during the New Year holiday

- Plan in advance to meet service demand
- Enhance telecommunications equipment monitoring system and control traffic

### ■ Enabling Communications in Remote or Relatively Unpopulated Areas

DOCOMO has drawn up its Basic Policy on Area Expansion to

strategically develop base stations in remote or relatively unpopulated areas. Our service coverage ratio in Japan for both 3G FOMA and 4G LTE has reached nearly 100%.

We also respond to temporary spikes at locations such as tourist spots that experience intermittent increases in demand from visitors. These measures have helped climbers make rescue calls when they are hurt or lost and has increased the number lives saved.

#### Example 1 During the Mt. Fuji climbing season

- Provide stable telecommunications services by installing a temporary base station at the summit

#### Example 2 Mountain trails where radio waves are blocked by the surrounding terrain or foliage

- Install special antennas along mountain trails or compact base stations on the roofs of mountain huts

### ■ Overseas Use of Mobile Phones

DOCOMO is enhancing its international roaming service so that customers can enjoy the convenience of their mobile phones overseas. Our WORLD WING service allows customers to continue using the DOCOMO mobile phones they use in Japan within the areas covered by our overseas carrier partners while retaining the same phone number and e-mail address. We have been expanding the number of countries and regions covered by our LTE-based, high-speed communication, LTE international roaming services, and our VoLTE international roaming services that offer high audio quality. As a result, DOCOMO's mobile phones can be used in over 220 countries and regions as of June 1, 2020.

### DOCOMO's Other Major International Services

- Packet Pack Kaigai Option

In 204 countries and regions, representing the largest coverage among Japanese telecommunications service providers, we offer a 24-hour flat-rate packet option for overseas use. In February 2019, we also started offering flat rate options for 1 hour, 3 days, 5 days, and 7 days in 62 countries and regions.

- Overseas Packet Suspension Service

Packet communication is automatically cut off once the volume of communication not covered by the fixed-rate packet plan exceeds a certain amount in order to prevent communication charges from becoming too expensive.

- DOCOMO World Counter

Support desks are available for customers preparing for a departure or on an overseas trip. Counters have also been set up at airports in Japan and overseas (in Hawaii) to provide complimentary phone charging services and explanations for mobile phone fees and usage.

### Seeking Even Faster Speeds

#### Faster PREMIUM 4G

We continue to increase transmission speeds to realize comfortable communication for our customers. The maximum downlink transmission speed of PREMIUM 4G, a communication service using LTE-Advanced that began in December 2015, reached 1.7 Gbps as of March 2020, following the introduction of high-speed technologies such as carrier aggregation, 256 QAM and 4×4 MIMO.

Additionally, we are monitoring customer traffic volume and

expanding our service areas in major cities in Japan where traffic is concentrated.

DOCOMO will aim to provide networks that can be used to enjoy various types of content, such as video, music and SNS, by meeting the needs of each individual customer.



Download speed (median speed) **229Mbps**

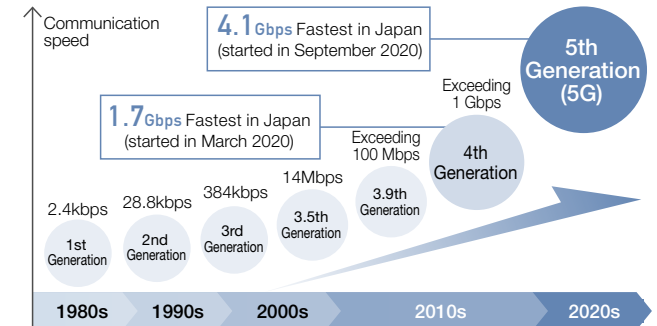
Upload speed (median speed) **33Mbps**

Note: These are median speeds of Android and iOS as of the end of March 2020, measured by NTT DOCOMO in accordance with the guidelines on effective speeds by the Ministry of Internal Affairs and Communications.

### Higher Speed after Launch of 5G Services

DOCOMO started 5G commercial service on March 25, 2020 and has achieved high-speed communication of up to 3.4 Gbps receiving, and up to 182 Mbps transmitting. The Company has been researching 5G since about 2010 and has steadily accumulated results by participating in a leading role in global research organizations and demonstration experiments with the world's major vendors.

DOCOMO will continue to lead global innovation toward realizing ever higher speeds by leveraging its network operations know-how and leading-edge technical development capabilities cultivated for more than 20 years.



### Ensuring a Stable Network

#### Network Surveillance and Response to Network Failures

DOCOMO strives to construct mechanisms for minimizing the impact on its service when a problem arises in order to provide a reliable network that customers can use anytime, anywhere.

#### Providing Year-round Surveillance and Response for Network Facilities

DOCOMO maintains network operation centers in Tokyo and Osaka that ensure connectivity by conducting surveillance of our network facilities and equipment, such as base stations, as well as monitoring the status of our service to customers nationwide on a 24-hour, 365-day basis. When informed of an abnormality, operators promptly respond by remotely controlling network facility and traffic routes to prevent any disruption in service. They also investigate the cause of the problem, and when the facility requires repairs due to physical or other damage, maintenance staffs are dispatched to the site to replace and repair the network equipment quickly.

## Preventing Service Interruptions Caused by Network Facility Failures

DOCOMO seeks to maintain mechanisms for taking preemptive action against potential failures in network facility that could cause interruptions in our service to customers.

For example, we have been operating commercial network communication that uses network functions virtualization technology since March 2016. Through it we are making improvements in terms of connectivity during network congestion caused by disasters and are better ensuring continued connectivity during facility failures.

Every day, we collect data on network facilities under normal operating conditions. When an anomaly is detected, we can conduct an analysis to determine whether or not it is a warning sign of an impending failure, and we respond through measures such as replacing faulty equipment in advance. In March 2019, we began deploying a remote-controlled surveillance system equipped with AI with the aim of identifying failures that had been difficult to detect and creating new value.

### Incidents of Serious Facility Failures

FY2016	FY2017	FY2018	FY2019
1	0	0	0

## DOCOMO's Disaster Preparedness

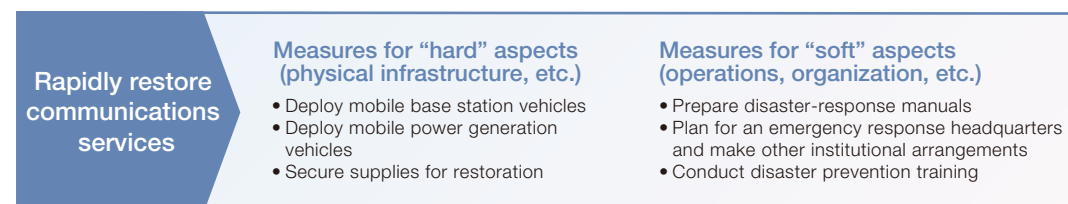
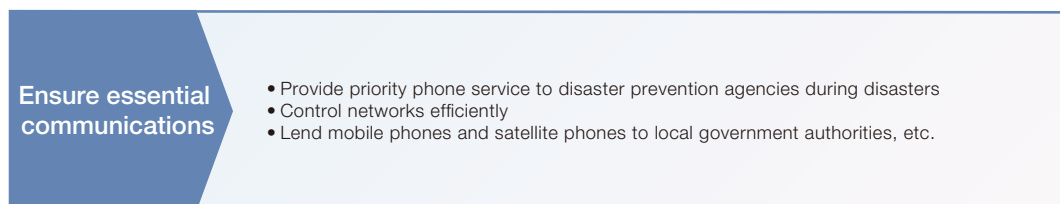
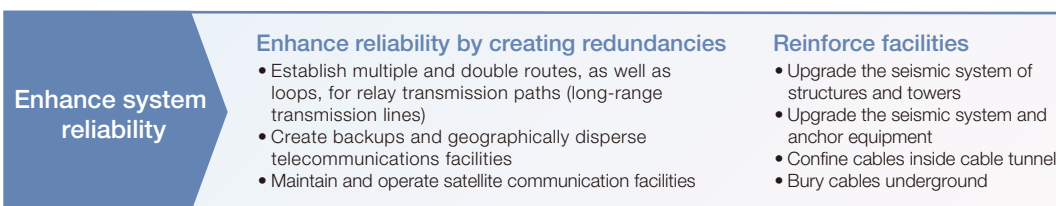
### Striving to Secure Communications in Times of Disaster Based on the Three Principles of Disaster Preparedness

Mobile phones play a critical role in rescue operations, reconstruction and confirmation of personal safety during disasters and emergencies. Since its founding, DOCOMO has been continuously working to secure communications during disasters in accordance with its Three Principles of Disaster Preparedness: enhance system reliability, ensure essential communications, and rapidly restore communications services.

Applying lessons learned from the Great East Japan

Earthquake, which occurred in 2011, we formulated new measures for disaster preparedness and implemented them by the end of February 2012. In view of subsequent developments in the internal and external environment, such as advances made to our networks and changes in customer usage, we announced additional measures amounting to 20 billion yen in fiscal 2018 to bolster preparedness against frequent natural disasters.

### Three Principles of Disaster Preparedness



### Disaster Countermeasures for the Next Two Years (Announced in October 2018)

#### Preparation for wide-area, hours-long power outage

- Install storage batteries and solar power generation systems at docomo Shops
- Reinforce emergency power supply for base stations and buildings

#### Securing important communication and reliability enhancement

- Expand roll-out of medium-zone base stations
- Enhance reliability by employing flood disaster prevention and other measures at key base stations
- Promote use of multiple transmission routes

#### Early restoration of communications services

- Increase deployment of emergency base stations (portable satellite equipment, etc.)
- Expand bandwidth of satellite links

#### Strengthen support for disaster-stricken areas

- Improve the level of sophistication of restoration area map
- Increase no. of rental smartphones/tablet devices



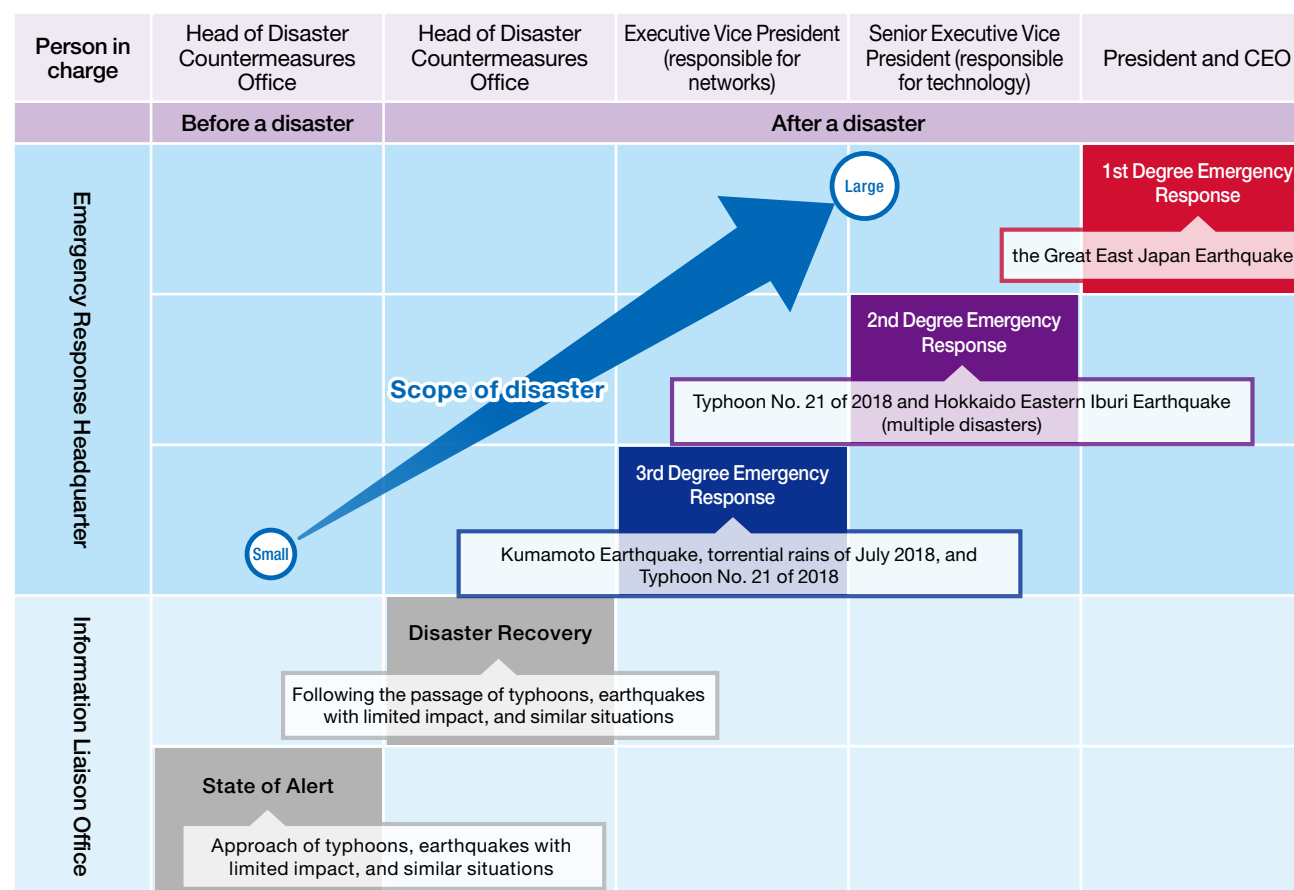
Monetary amount of additional disaster countermeasures for the two-year period:

**20** billion yen

### Disaster Management System

Under the NTT Group Disaster Preparedness Plan, we stand ready with a system that enables us to efficiently conduct initial operations in accordance with the scope of the disaster and recovery efforts. Our system is organized across departments to facilitate response to disasters even in times of uncertainty.

#### Internal System at the Time of a Disaster

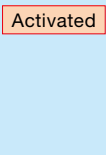
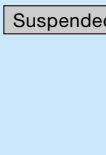
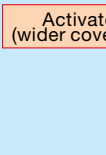
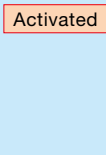




## Use of Emergency Base Stations in Response to the Magnitude of a Disaster

DOCOMO maintains emergency base stations to secure its networks in the event of a disaster. Depending on the level of damage incurred, we implement measures such as setting up temporary base stations and remotely adjusting the transmission angle of radio waves from base stations.

### DOCOMO's Emergency Base Stations

	Mobile base station vehicles and portable base station devices	Medium-zone base stations		Large-zone base stations
Key feature	<b>Respond to diverse natural disasters</b> Mobile base stations (vehicles and portable devices) that provide pinpoint relief for specific areas	<b>Respond to diverse natural disasters</b> Base stations that boost the capacity of existing stations to provide coverage for surrounding areas during a disaster		<b>Dedicated to major disasters</b> Provides wide-area coverage only when operations at most other base stations in the vicinity have been disrupted
Operation Overview	Normal state			
	Emergency			
Area size (radius)	<b>Small</b> (up to about 1 km)	<b>Small</b> (about 1 km)	<b>Medium</b> (between 3 km to 5 km)	<b>Large</b> (about 7 km)
Emergency operation	Requires time to transport and install	Instantly activated by remote control		Instantly activated by remote control

### Large-Zone Base Stations

Large-zone base stations are specialized for use in times of disaster to secure communications in heavily populated areas during widespread disasters and power outages. It provides 360-degree coverage across a seven kilometer radius, which is wider than a standard base station. Since 2011, DOCOMO has installed large-zone base stations at 106 locations around Japan. All are compatible with LTE, which boosts capacity by about three times. During the Hokkaido Eastern Iburi Earthquake, which struck in September 2018, we activated a large-zone base station for the first time, helping to restore communication to a wide area of Kushiro City.



Large-zone base station that secures communications in densely populated areas in times of disaster

### Medium-Zone Base Stations

Apart from large-zone base stations that provide coverage for urban areas such as prefectural capital cities, we also promote nationwide deployment of medium-zone base stations to secure a means of communication in the suburbs of medium-size cities, disaster base hospitals, and coastal and mountainous regions.

We installed more than 2,000 base stations by March 2020.

#### Definition of a Medium-Zone Base Station

- Built with foundations that are more robust compared to those of standard base stations and used as standard base stations under normal circumstances.
- Capable of remotely adjusting the antenna angle to expand its service area in the event that a disaster interrupts service at neighboring base stations.
- Equipped against power outages to continue operating for over 24 hours after losing the power source.
- Transmission paths are doubled to ensure communication even in the event that one path is interrupted.

#### Target Areas for Installing Medium-Zone Base Stations

- Standard base stations capable of covering areas expected to incur damage based on hazard maps.

#### Shipboard Base Stations

To diversify emergency recovery options in times of a disaster, DOCOMO is developing the use of shipboard base stations. This involves installing temporary base stations on vessels anchored offshore to enable the construction of a temporary service area on land. DOCOMO will utilize shipboard base stations to recover the lifeline quickly and provide support to the victims.

#### Major Initiatives for the Use of Shipboard Base Stations in Recent Years

- November 2016: DOCOMO became the first carrier in Japan to obtain a license for mobile communication base stations from the Ministry of Internal Affairs and Communications' Kyushu Bureau of Communications, and it is conducting drills under this license.

- April 2018: We concluded the Mutual Cooperation Agreement Regarding Disaster Prevention and Disaster Response Activities with Shinnihonkai Ferry Co., Ltd. to enable prompt service recovery and support victims at times of disaster. This was the first attempt in Japan to operate a shipboard base station on a passenger ship. The Shinnihonkai Ferry operates regular routes between major ports in Hokkaido, Tohoku, Hokuriku, and Kansai. Under our agreement, we will further strengthen the framework of cooperation for disaster response activities.

### Overview of DOCOMO's Response to Disasters

The large typhoon No. 19 that occurred in 2019 was certified as the first specified disaster for a typhoon, and DOCOMO promptly set up an emergency response headquarters. A total of 91 municipalities in its service area were impacted by prolonged power outages caused by river flooding and submerged facilities. About 2,000 employees a day worked to secure and restore communications services in a united effort of the DOCOMO Group.

We provided relief to the disaster-stricken area using satellite-linked mobile base stations. As part of helping to secure communications, we not only installed multi-chargers and Wi-Fi at emergency shelters but also provided rental services for equipment such as smartphones and tablets. In addition, DOCOMO dispatches liaison staff to the national and local governments upon request to share details on communication restoration status and other matters to carry out disaster response efficiently with related organizations.



Responding to a disaster

### Working with National and Local Governments

The NTT Group Disaster Preparedness Plan was established to facilitate the appropriate implementation of preparedness and response measures as a designated public body under Japan's Disaster Measures Basic Law. Under the plan, we prepare for disasters during normal circumstances and offer emergency response in the event of a disaster. During a disaster, we cooperate with government institutions through measures such as loaning mobile phones to local governments to maintain essential communication. In addition, DOCOMO has signed agreements with Japan's Ministry of Defense, the Ground Self-Defense Forces and the Japan Coast Guard to allow for quick recovery and relief activities during natural disasters.

Under these agreements, DOCOMO lends satellite phones and mobile phones used in disaster recovery activities, and its emergency response equipment and personnel are quickly transported to affected areas by the Ground Self-Defense Forces and other public institutions. Apart from offering



cooperation based on the agreements, DOCOMO also supports local governments and national government institutions by lending mobile phones and satellite phones in times of disaster.

In July 2019, the Cabinet Office and DOCOMO signed the Collaborative Agreement on Disaster Response, under which we mainly provide communication equipment necessary for disaster response activities by dispatching staff from the Cabinet Office and sharing map information for the early restoration of communications services in disrupted areas. We will continue to enhance our response capabilities in the event of a disaster through these efforts.

## Radio Wave Safety

### Basic Policies and Philosophy

DOCOMO complies with related laws and regulations and ensures that the level of radio wave emissions from base stations and mobile phones remains below the limits specified in the Radio-Radiation Protection Guidelines. Emissions below these levels are recognized around the world as having no adverse effect on human health, so users need not be concerned.

### Consideration for Radio Wave Safety

#### Radio-Radiation Protection Guidelines

The health effects of radio waves from mobile devices have been researched for over 60 years in Japan and abroad. As a safety standard for the effect of radio waves on the human body, the World Health Organization has published its recommended guidelines, while the Radio-Radiation Protection Guidelines serves as their equivalent in Japan. DOCOMO is fully committed to complying with the relevant laws and regulations and has ensured that the level of radio waves emitted by its base stations and mobile phones meets the requirements indicated in the guidelines. Furthermore, DOCOMO discloses the Specific Absorption Rate (SAR), the rate at which energy emitted by radio waves is absorbed by the human body, and incident power density for each mobile phone on its corporate website, and it strives to make mobile phones safe for customers to use.

[!\[\]\(faf942dc3e59ce8eb64b4ac481eca7e0\_img.jpg\) Compatibility with mobile phone radio wave protection](#)

#### Collaborative Research on Radio Wave Safety

Since 2002, DOCOMO has conducted experiments in collaboration with KDDI Corporation and SoftBank Corp. related to the possible impacts of radio waves on the human body at the cellular and genetic levels. Following an interim report issued in 2005, we released a final report in 2007 stating that the research had identified no impact. This report provided scientific evidence against the argument that radio frequency radiation has an impact on cell structure and function, which may cause cancer, and reconfirmed the safety of radio waves from mobile phones.

Currently, the Electromagnetic Environment Committee of the Association of Radio Industries and Businesses (ARIB) is engaged in surveys and research concerning the safety of mobile phone radio waves in an effort to enhance public welfare associated with the use of radio waves. In support of the ARIB, DOCOMO is actively involved in these initiatives as a regular member. We will continue to pursue initiatives related to radio wave safety, which we recognize as an important social responsibility for mobile phone operators.

[!\[\]\(95b425611cbd2b8716a140cf67c81822\_img.jpg\) Radio Wave Safety \(in Japanese only\)](#)

#### Effect on Medical Electronic Devices and Ongoing Measures

Japan's Ministry of Internal Affairs and Communications and the Electromagnetic Compatibility Conference have confirmed the effects of mobile phones and other wireless devices on the movement of medical electronic devices, including heart pacemakers, and have widely published their safety guidelines. Accordingly, the DOCOMO Group seeks to develop user awareness of the required care by providing information in the mobile phone users' manual and via the DOCOMO website.