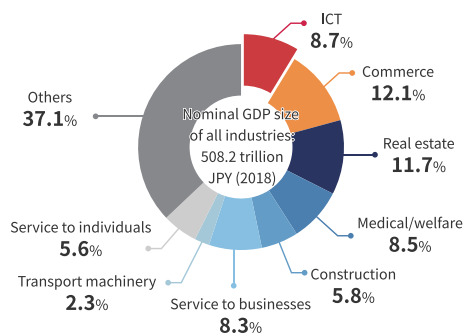# ICT

Information and Communication Technology

1. Overview

Digitalization of society brought about by 5G and Beyond 5G

To cope with the worldwide outbreak of the coronavirus from early 2020 onwards, the Japanese government has been calling on people to voluntarily refrain from going out unnecessarily or attending group events. This led to local governments and businesses introducing telework, implementing online learning, and relaxing regulations related to online medical care. In the manufacturing, infrastructure, and construction industries, which center on work on-site, production activities are being carried out through remote control of machine operations. In the field of education as well, there are ICT solutions to improve the efficiency of school work, and AI to provide the best learning according to the level of understanding of each student. In this way, digitalization has begun to progress in these areas that used to lag behind.

The role of the ICT market in promoting the digitalization of society as a whole is very important. The nominal GDP of Japan's ICT industry is 44.2 trillion JPY (8.7% of all industries), ranking next to the commercial (61.4 trillion JPY) and real estate (59.4 trillion JPY) industries (See Figure 1).
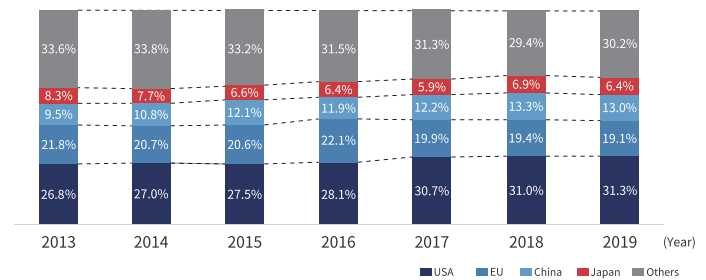
Figure 1 **Nominal GDP of Japan's major industries (2018)**

ICT **8.7**%
Commerce **12.1**%
Real estate **11.7**%
Medical/welfare **8.5**%
Construction **5.8**%
Service to businesses **8.3**%
Transport machinery **2.3**%
Service to individuals **5.6**%
Others **37.1**%
Nominal GDP size of all industries 508.2 trillion JPY (2018)

〔Source〕Created based on data from the Ministry of Internal Affairs and Communications

Japan's ICT market, which has developed through the spread of telecommunications services and the advancement of telecommunications networks, holds a 6.4% share of the global market. Excluding the EU, it is the world's third-largest market after the U.S. and China, and it is one of the major industries in the Japanese economy (See Figure 2).

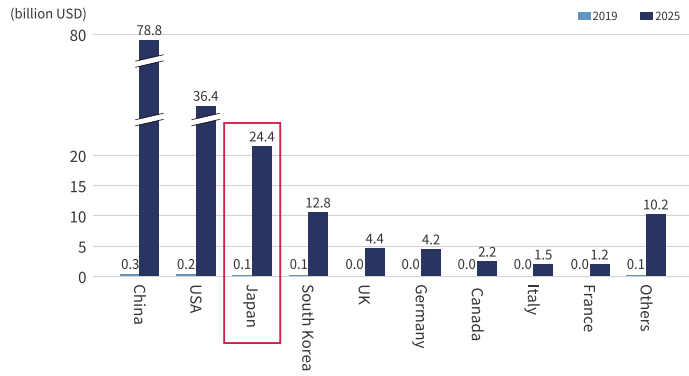Figure 2 **Worldwide share of ICT market (2013-2019)**

	2013	2014	2015	2016	2017	2018	2019
Others	33.6%	33.8%	33.2%	31.5%	31.3%	29.4%	30.2%
Japan	8.3%	7.7%	6.6%	6.4%	5.9%	6.9%	6.4%
China	9.5%	10.8%	12.1%	11.9%	12.2%	13.3%	13.0%
EU	21.8%	20.7%	20.6%	22.1%	19.9%	19.4%	19.1%
USA	26.8%	27.0%	27.5%	28.1%	30.7%	31.0%	31.3%

(Year)
■ USA ■ EU ■ China ■ Japan ■ Others

〔Source〕Created based on data from Statista

Industries in Japan are becoming more efficient and adding more value with the accelerating digital transformation enabled by the development of ICT infrastructure and digital technology. In this process, the integration of cyberspace and physical space is being facilitated. Going forward, people's activities are expected to move from physical space to cyberspace, and there are high expectations for the use of ICT infrastructures, such as the 5th generation mobile communication system (5G), and digital technologies such as cloud computing and quantum computing.

5G is expected to support digital transformation in a variety of industries and sectors. The government aims to realize this through policies such as "Society 5.0," a social system that highly integrates cyberspace and real space, and the "Beyond 5G Promotion Strategy", which drives the digital transformation facilitated by 5G. The increase of about 20% in the budget (MIC standards) for implementing 5G-related policies, from 128.4 billion JPY in 2019 to 157.1 billion JPY in 2020, is also part of this. As a result of these 5G technology initiatives, Japan is expected to rank third in the global 5G service market in 2025, after China and the U.S. (See Figure 3).

Figure 3

Worldwide 5G service market forecast (2019-2025)

(billion USD)

■2019 ■2025

Country	2019	2025
China	0.3	78.8
USA	0.2	36.4
Japan	0.1	24.4
South Korea	0.1	12.8
UK	0.0	4.4
Germany	0.0	4.2
Canada	0.0	2.2
Italy	0.0	1.5
France	0.0	1.2
Others	0.1	10.2

〔Source〕Created based on data from Mordor Intelligence

2. Government Initiatives

Promotion of digitalization due to the impact of the coronavirus pandemic

1 Beyond 5G

From 2019 to 2020, 5G commercial services were launched one after another in various countries worldwide, including Japan. In order to create new markets, Japan has been conducting 5G Comprehensive Demonstration Tests since FY 2017-18 with the cooperation of stakeholders in various related fields (See Figure 4). Since 2018, there has been lively academic debate on communications technologies that are considered promising for realizing Beyond 5G, and discussions on use cases and requirements have begun (See Figure 5).

Figure 4
Comprehensive 5G PoC conducted across Japan (FY 2019-20)

Business Overview	Location	Business Details
Ensuring crane operations safety with high-resolution images	Imabari City, Ehime Prefecture	■ 4K high-definition images of blind spots in crane slinging operations are transmitted to the operator's cab using 5G, making it possible for the operator to work safely while checking the images.
Remote control and integrated construction management system for construction equipment	Iga City, Mie Prefecture	■ Remote control and management of construction equipment, utilizing high capacity and ultra-low latency of 5G at construction sites.
Remote medical examinations enhancement	Wakayama City and Hidakagawa Town, Wakayama Prefecture	■ Doctors at a remote clinic send the patient's condition, vital signs, and echo video to a specialist at a university hospital via 5G and under a specialist's direction provide accurate diagnosis and treatment to patients.
Driving assistance in dense fog	Oita City, Oita Prefecture	■ The information from the 4K high-definition camera mounted on the vehicle is transmitted to the server using 5G. The images are analyzed and information such as white lines and vehicles in front are displayed on the head-up display in an easy-to-understand manner that ensures safe driving in dense fog.
Self-guided sightseeing using VR and body sharing technology	Naha City, Okinawa Prefecture	■ A service that utilizes VR and robots to allow users to virtually experience activities from remote locations as if they were sightseeing.
Support to ensure safety in underground railway sections	Osaka City, Osaka Prefecture	■ 4K high-definition video of the inside of a subway train is transmitted using 5G, and abnormalities in the train are automatically detected through video analysis and reported to station staff.
Truck platooning	Hamamatsu City, Shizuoka Prefecture (Shin Tomei Expressway), etc.	■ Actualizing convoy driving with 5G to provide ultra-low latency and highly-reliable operation control between multiple trucks, will help solve the labor shortage.
Improve the efficiency of dairy and livestock industries	Kamishihoro Town, Hokkaido	■ Saving time and labor by determining the location and identifying individual cows based on the high-definition images transmitted using 5G from multiple 4K cameras installed in the barn.
Safety management for workers in tunnels	Akaigawa Village, Hokkaido	■ In addition to detecting abnormalities in tunnels using various sensors, in the event of a disaster or accident, construction equipment can be operated remotely to check the surroundings and ensure the safety of workers.
Monitoring system for mountain climbers	Komagane City, Nagano Prefecture	■ High-precision aerial images from a drone equipped with a 4K camera are delivered to the search headquarters in real-time. Delivering images to the search headquarters in real-time makes it easier for them to assess the situation of the victims for rapid rescue operations.
Enhancement of emergency transportation	Maebashi City, Gunma Prefecture	■ Simultaneous sharing of 4K images of patients in ambulances or doctor cars to doctors of designated emergency hospitals and family doctors using 5G will shorten the time required to consider where and how to accept patients and enable early sharing of symptoms.

〔Source〕Created based on data from the Ministry of Internal Affairs and Communications

Figure 5
Status of Beyond 5G initiatives

Entity	FY	Details
NICT	2018-19	■ Started R&D in terahertz end-to-end wireless systems in collaboration with the EU and promoted R&D in wireless, networks, and devices in preparation for Beyond 5G
NTT	2019-20	■ Launched the 6G network concept "IOWN". Announced an alliance between NTT, Intel Corp., and Sony Corp. in October 2019
NTT Docomo	2020-21	■ Released a 6G technology white paper aiming to launch the service around 2030]

〔Source〕Created based on materials from the Ministry of Internal Affairs and Communications

At the same time, Japan is looking towards the next 5G standards for the 2030s. In January 2020, the Government of Japan held the Roundtable Meeting on Beyond 5G Promotion Strategy to formulate a comprehensive strategy for Beyond 5G. Japanese corporations and their partners aim to acquire about 30% of the Beyond 5G infrastructure (hardware and software) market by the 2030s and ensure a consistent presence in the device and application fields.

To this end, the government is planning to create a Beyond 5G R&D Platform (tentative name) where various domestic and international players can collaborate on R&D. It will also support private sector investment in R&D, such as by easing regulations on the use of radio waves for R&D purposes, and will also discover and nurture ideas and human resources that can bring about innovation.

In order to achieve a "Beyond 5G ready" climate by 2030, the government is expanding its 5G network through a tax system that promotes 5G investment and the development of 5G areas, systems such as spectrum security, and the promotion of infrastructure sharing. At the same time, the Beyond 5G Promotion Consortium will be established to aggressively develop the Beyond 5G Promotion Strategy through industry-academia-government collaboration. In addition to sharing specific initiatives based on each strategy amongst industries, academia, and the government, the Consortium will also support the launch of new demonstration projects by companies and universities in Japan and overseas.

2 Laying the foundation for structural economic reforms to achieve Society 5.0

Today, digital platformers (who operate and provide digital platforms) are driving innovation, helping businesses to access markets, and improving consumer benefits. On the other hand, they have been criticized in Japan and around the world for their opaque and unfair trading conditions, data oligopoly, leakage of personal information, and illegal or inappropriate activities on the platforms.

Keeping this in mind, the Ministry of Internal Affairs and Communications (MIC), the Ministry of Economy, Trade and Industry (METI), and the Fair Trade Commission established basic principles for developing rules in response to the rise of the platform business model in the "Future Investment Strategy 2018", which was approved by the Cabinet in June 2018.

Furthermore, the Digital Market Competition Headquarters was established in the Cabinet Secretariat based on the "Action Plan of the Growth Strategy" adopted by the Cabinet in 2018. It holds meetings to research and discuss important matters related to the digital market. The meetings also discuss the development of rules for the digital market, and the "Bill on Improving Transparency and Fairness of Specified Digital Platforms" was passed in the 2020 Ordinary Diet Session.

In addition to the above, it also deliberates on the rules of the Antimonopoly Act, including evaluating the value of data, the establishment of a framework for regulating abuse of a dominant position in transactions between digital platform providers and consumers who provide personal information, and the evaluation of competitors in the digital advertising market.

3   New IT Strategy and the creation of the Digital Agency

On July 17, 2020, the Japanese government approved the "Declaration to be the World's Most Advanced IT Nation: Basic Plan for the Advancement of Public and Private Sector Data Utilization (New IT Strategy)". With the coronavirus pandemic radically transforming Japanese society and values in many areas such as the economy, lifestyle, work style, education, administration, healthcare, and disaster prevention, the New IT Strategy calls for a "new normal" perspective. In addition to focusing on the transformation of both the social structures and people's behaviors with the use of IT and strengthening digital resilience, the strategy also states that the construction of ICT infrastructure by national and local governments is a matter requiring urgent attention.

Of particular interest in the New IT Strategy is the Digital Agency, which the government aims to establish in September 2021. This agency is intended to be the command center for the creation of a digital society, with strong coordination capabilities to promote digital transformation of the government. Currently, ministries and agencies separately procure and manage their respective IT system, resulting in inefficiencies such as duplication of work and wasteful expense. In response to this, the government is setting up the Digital Agency to centralize IT operations and improve the efficiency and speed of administrative processes.

The Digital Agency is expected to unify the IT systems of the national and local governments, promote the use of My Number cards, and bring administrative procedures online. Apart from this, its projects will also affect industries. In order to avoid the "three Cs" (Closed spaces, Crowded places, Close-contact settings) as recommended by the government during the pandemic, the demand for online healthcare and online education is growing. The digital agency will oversee the relaxation of restrictions in these fields and ensure smooth access to online healthcare and education. In addition to the "IT Introduction Subsidy" (project to support the introduction of IT to improve productivity in services and other areas) developed by METI (See Figure 6), the Digital Agency will take the initiative in promoting digitalization, which will lead to IT adoption among small- and medium-sized businesses. This will help increase their productivity and improve profitability through the creation of new IT-based products and

services.

Figure 6   **IT Introduction Subsidy Project (2017-2020)**

Eligible businesses	■ Small and medium-sized enterprises, small businesses (including food and beverage, accommodation, retail and wholesale, transport, medical, nursing and child care services, as well as manufacturing and construction)
Eligible tools	■ Software, cloud usage, professional fees, etc.

Subsidy amount	Type	Subsidy rate	Tool requirements (objectives)
Between 300,000 – 4.5 million JPY	Regular	1/2	-
	Special	2/3, 3/4	■ Only "A: Addressing damage to the supply chain" is introduced ■ One of "B: Shift to a non-face-to-face business model" or "C: Facilities for teleworking" is introduced

〔Source〕Created based on materials from the Ministry of Economy, Trade and Industry

3. Attractive Markets

In this report, we focus on the following four attractive markets in the ICT industry:

1 5G market   **2** Cloud market   **3** Quantum computer
**4** Edge computing

1 5G market

As 5G services became fully commercialized in the spring of 2020, expectations for the expansion of 5G and related markets in Japan are rising. Investment in network infrastructure for 5G services in Japan is expected to grow rapidly from 2020 onwards, with forecasted market size of approximately 200 billion JPY in 2020 expanding at a compound annual growth rate of 54.6% between 2019 to 2024. Furthermore, 5G mobile lines are expected to account for a good share of the market, with the number of lines for IoT growing rapidly as the use of smartphones, tablets, and other devices continue to increase. Hence, the 5G market is expected to develop as an essential system for the future.

① Smart City × 5G

5G is positioned to be a new social infrastructure that will expand the possibilities of smart cities by processing large amounts of data from IoT devices in real-time. The spread of 5G will broaden both the quantity and quality of information that can be collected. The market for smart city platforms in total is forecast to be worth 1.23 trillion JPY in FY 2025-26, of which the 5G-related portion will be around 300 billion JPY, or approximately 25% (See Figure 7).

Figure 7   **Smart city platform size forecast (Japan)**
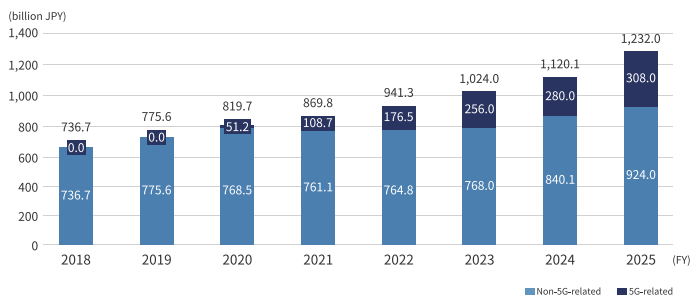
〔Source〕Created based on data from Nomura Research Institute

Along with the spread of 5G, governments and companies are also working to develop smart cities. To resolve the myriad issues cities face, they have been promoting "Data-driven smart cities" since 2017. This project seeks to build an open data collaboration platform that enables a diverse range of entities, including large companies and venture companies, to participate. Local governments and companies are collaborating to conduct demonstration tests, and projects by 14 local governments and organizations have been supported up to 2019. In 2017, Accenture (Ireland) made it easier to access AI chatbots and common portals providing information on categories such as maternal and child health, for people in

Aizuwakamatsu City. In 2019, Aflac Life Insurance (U.S.) leveraged lifestyle and environmental data in Chofu City to promote health and is collaborating with local universities to improve the educational environment. Thus, the collaboration between foreign-affiliated companies and local governments is also noteworthy.

In 2019, the Japanese government established the "Smart City Public-Private Partnership Platform" to encourage collaboration between businesses and sectors concerning public and private smart cities. As of January 2021, this platform includes 412 companies, universities and research institutions, 135 local public entities, and 11 government-related ministries and agencies. Members receive assistance with activities such as hands-on business support, subcommittees, partner matching, and promotional activities.

② SporTech × 5G

SporTech is expected to be one of the earliest of 5G application markets to take off. Even pre-commercialization of 5G services, sports has been a focus of companies such as SoftBank (professional basketball) and NTT Docomo (Rugby World Cup Japan 2019). However, they have also set their sights on the Tokyo Olympic and Paralympic Games, which are scheduled to be held immediately after full-scale commercialization. There are many areas where the features of 5G can be effectively advertised, such as virtual reality (VR) viewing, multi-perspective viewing using multiple cameras, and virtual watching from a remote location. The future potential is very high in this field.

The Japanese market for SporTech is projected to be worth 155 billion JPY in FY 2025-26, of which 16.4 billion JPY, or approximately 11%, will be related to 5G. SporTech × 5G can also be applied at concerts and other live events (See Figure 8).

Figure 8   **SporTech market size forecast (Japan)**
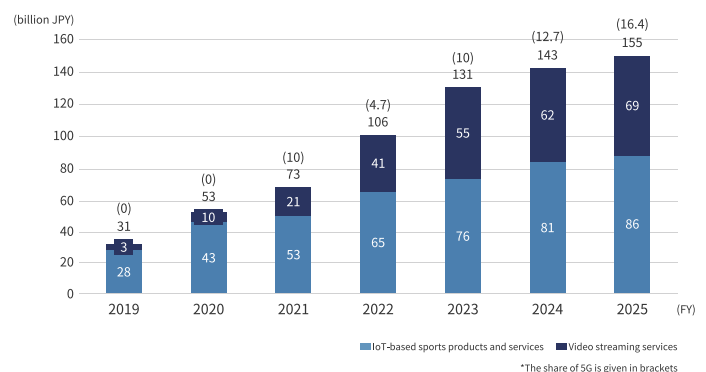
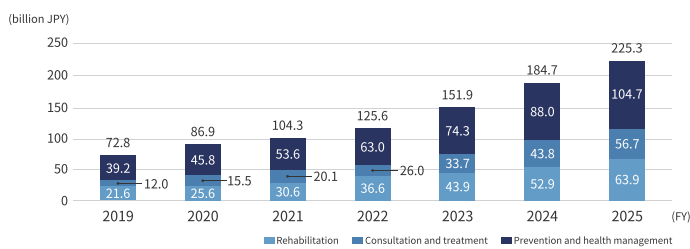〔Source〕Created based on data from Nomura Research Institute

③ HealthTech × 5G

One of the major social issues in Japan is the burgeoning social security cost that comes with the decreasing birthrate and aging population. One of the most effective ways to stem this is to extend people's healthy lifespans, or in other words,

to focus on disease prevention. 5G is expected to be widely applied in the field of HealthTech to improve quality of life by collecting and analyzing information on users' daily activities and vital signs (such as body temperature and pulse rate).

In addition to the above measures to extend healthy lifespans, the government is promoting workstyle reforms and health management. As a result, the overall Japanese market for HealthTech is expected to be worth 225.3 billion JPY in FY 2025-26, of which about 26%, or 58 billion JPY, will be related to 5G (See Figure 9).

Figure 9

HealthTech market size forecast (Japan)

(Source) Created based on data from Nomura Research Institute

2   Cloud market

As companies "Lift and Shift" their existing applications to the cloud and retrofit or rebuild them cloud-natively, the workstyle innovations prompted by the coronavirus pandemic is driving the growth of the cloud market. The domestic cloud services market in FY 2019-20 was worth 2.36 trillion JPY and is expected to grow to 5.4 trillion JPY by 2024 (See Figure 10).

Figure 10

Domestic Cloud Market Performance and Forecasts
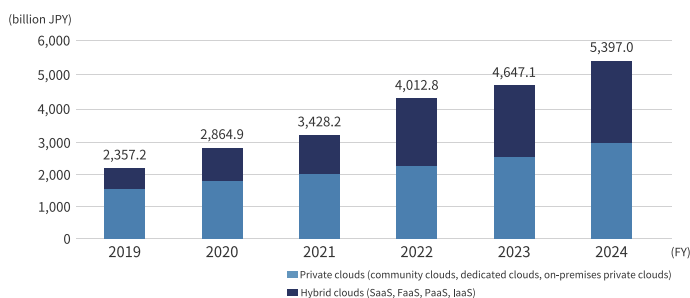
(Source) Created based on data from MMRI

As the shift from on-premises to cloud computing progresses, the environment is becoming more conducive to developing systems for cloud use, thereby advancing the cloud shift further. As a result, the share of the three major cloud companies (Amazon Web Services, Microsoft Azure, and Google Cloud Platform) in the Japanese cloud market in 2020 is expanding, and the second-ranked Azure is close behind the leader, AWS. Generally speaking, in the PaaS marketplace, which is the chosen infrastructure for the development of new cloud-native systems, users of all three companies are increasing. In the IaaS marketplace, which is used as a site of transition from an on-premises environment, the usage rate of top-ranked AWS reached 51.9%, and more than half of the companies in Japan that have introduced IaaS have installed AWS. Moreover, Oracle (U.S.) and IBM (U.S.) are seeing a

steady increase in the number of users, while Tencent (China) has also announced its expansion in Japan in anticipation of the growth of the market.

Web conferencing was the most common SaaS that companies introduced or encouraged due to the effects of the pandemic, followed by groupware/business chat, virtual desktops, and emergency contact/safety check. As people are asked to refrain from leaving home, SaaS is being used to secure communication channels.

3   Quantum computer

The progress of AI and IoT in recent years has meant that the amount of data generated and disseminated worldwide is increasing, but this is testing the performance limits of conventional computers. In recent years, while the amount of data generated and distributed around the world has been increasing due to advances in AI and IoT, the performance limitations of conventional classical computers are being speculated.

In order to process these vast amounts of data, "quantum computers", which use quantum mechanics for computation and are claimed to have an unparalleled processing power, are drawing attention. In fact, the field of healthcare has already found applications for quantum computers in demonstration tests such as those simulating the spread of the coronavirus. Also, the development of innovative treatment methods and other such initiatives that are expected to have a significant impact on society has been progressing. They are expected to begin moving from the demonstration phase to commercialized production in the leading fields of finance and chemistry in FY 2025-26. The focus is particularly on using "Ising Machines", which are computers specialized in solving combinatorial optimization problems. Apart from this, quantum computers are expected to be used in various other fields, including the energy sector and the development of batteries for electric vehicles.

Coming to the quantum computer-related activities in Japan, the Cabinet Office in January 2020 formulated the Quantum Technology Innovation Strategy and is actively promoting R&D in this field. Waseda University, Keio University, Tohoku University, and others are leading joint industry-academia research, and are fast approaching the world's first practical application of this technology. Several Japanese companies such as NEC and Fujitsu are also moving towards the commercialization of quantum computers. Demonstration experiments in the fields of finance, chemistry, e-commerce, manufacturing (especially simulation), logistics, and academic applications, have been gaining momentum, and applications such as material calculations and simulations have already started to appear.

Furthermore, in recent years, a string of foreign-affiliated companies have announced their further business expansion within Japan. In December 2019, Cambridge Quantum Computing Japan (U.K.), a venture company from the University of Cambridge, announced its full-scale entry into the Japanese market following Japan's substantial investment in research and projects aimed at commercializing quantum computers. Around the same time, the University of Tokyo and IBM (U.S.)

established the "Japan-IBM Quantum Partnership". This is a broad partnership framework involving a wide range of other universities, public research institutions, and industries. They also plan to install the "IBM Q System One", a quantum computer owned and managed by IBM, at IBM offices across the country. The world's first quantum computer based on quantum annealing technology was commercialized by D-Wave Systems Inc. (Canada) in 2011. In June 2019, it established a Japanese subsidiary to advance research into the application of quantum annealing and further promote its use in society. The company has announced that it will work together with NEC to carry out development, marketing, and sales activities in this field.

In this way, backed by domestic and overseas industry, government, and academia, the quantum computing market in Japan is expected to be worth 6.2 billion JPY in FY 2020-21, and reach 43 billion JPY in FY 2025-26 and 230 billion JPY in FY 2030-31 (See Figure 11).

Figure 11

Quantum computer market size and trends forecast (Japan)

(billion JPY)

*Estimates for FY 2020-21, forecasts for FY 2021-22 and beyond
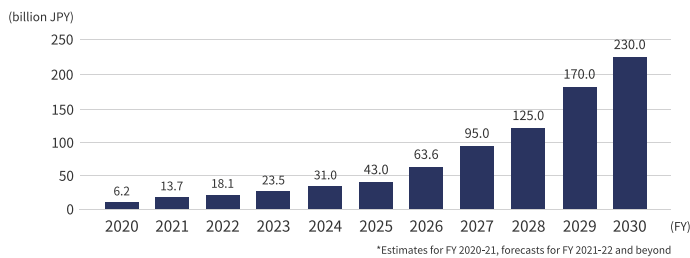
〔Source〕Created based on data from Yano Research Institute

4 Edge computing

With the rising popularity of cloud systems and IoT, "edge computing", where the processing is done at the terminal, has become the focus of attention in order to achieve efficient network operation, low latency, and to prevent information leaks due to unauthorized access. Japan is highly competitive in the automotive and industrial robots industries, which will be the focus of edge computing in the future. Hence, the government is also paying attention to its potential impacts.

The domestic market for edge computing is gradually gaining momentum with the entry of domestic and foreign companies. In April 2017, Fujitsu Network Solutions announced that it would adopt Relay2's (U.S.) Next-Generation Cloud Wi-Fi Integrated Edge Computing Platform to expand its business in the growing edge computing market. In response to the growing trend of shifting from cloud-based to edge-based computing to protect personal information and resolve communications issues, Lenovo Japan (Hong Kong) started to sell two new types of edge-based ultra-compact personal computers in July 2019. In addition, in January 2019, Gorilla Technology Group (Taiwan) allied with Asteria Corporation, a Japanese software company that offers "Gravio" (an edge computing middleware for IoT and AI), to jointly drive the global spread of edge computing required for AI and IoT.

Under these circumstances, the development of IoT infrastructure for edge computing is steadily progressing. The domestic IoT edge infrastructure market grew by 25.1% (33.1

billion JPY) in 2019 and is expected to reach 74.2 billion JPY by 2023 (See Figure 12).

Figure 12   **Domestic IoT edge infrastructure market trends**

(billion JPY)
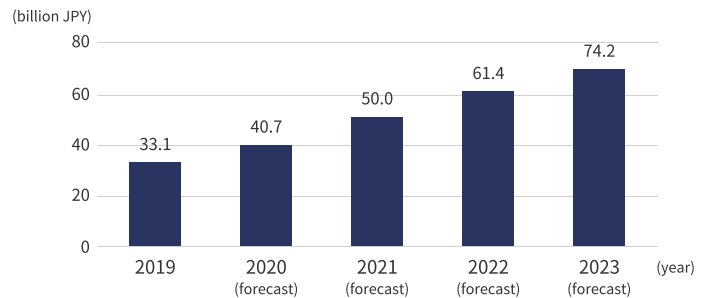
〔Source〕Created based on data from IDC Japan

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