Chapter 2

Challenges Brought about by Advancing Digital Technologies

As outlined in Chapter 1, as digital technology becomes increasingly prevalent in socio-economic activities and its presence as a part of social infrastructure grows, there is a growing risk that its negative impacts will become even greater.

For example, as the use of advancing digital technologies such as AI progresses, there is a need to secure a digital infrastructure that can respond to increasing demand for communications, computing resources, and electricity. However, against the backdrop of the current increasingly unstable global situation and intensifying disasters, there is a risk that the use and access of important digital infrastructure will become more difficult, and that security will be compromised, which could increase in the future. In addition, several risks are expected to become more serious. These include: the risks posed by the advancement of AI; problems related to dis-/mis-information on the Internet, including social media platforms that are becoming increasingly important as a basis for information gathering and communication; and cybersecurity threats, which are intensifying due to both the destabilization of the global situation and the advancement of AI. Addressing these challenges in the digital field is essential to fully enjoy the benefits of advancing digital technologies while minimizing their risks.

This chapter provides an overview of the major challenges facing the digital field, brought about by the advancement of digital technologies and their growing influence as social infrastructure, coupled with the current global situation, changes in the natural environment, and society[1].

Section 1 Securing a Reliable Digital Infrastructure that Supports a Digital Society

In Japan, where the population is aging and the economy continues to stagnate, there is a need to use advancing digital technologies, including AI, to advance solutions to social issues. With the growing use of digital technologies and the expansion of the digital ecosystem as a foundation of society, there is an increasing need to develop digital infrastructure capable of supporting a digital society and responding to rising demand for communications, computing resources, electricity, and disaster risks. Furthermore, given the current destabilizing global situation and the increasing dependence on overseas countries in the digital field, concerns have been raised about excessive dependence on overseas countries from the perspective of maintaining stable economic and social activities and ensuring security.

From this perspective, it is becoming increasingly important to secure a strong digital infrastructure for supporting a digital society in response to the further increase in demand for communications due to advances in digital technologies such as AI, and to ensure and improve Japan's autonomy by improving its international competitiveness in the digital field.

1. Overview of key challenges

As digital technologies are used to solve social issues in Japan and the digital ecosystem expands as social infrastructure, there is a growing need to develop a digital infrastructure to support a digital society in response to increasing demand for communications, computing resources, electricity, etc., as well as disaster risks.

For example, data centers have become one of the most important digital infrastructures that support today's digital society, and securing data centers within Japan has become an important issue. However, the location of domestic data centers and new investments are concentrated in the Kanto and Kansai regions, and as of 2023, approximately 90% (in terms of area) of data centers across Japan are located in the Kanto and Kansai regions. On the other hand, from the perspective of wide-area disaster prevention, it is important to ensure that backup databases are geographically dispersed.

Furthermore, while submarine cables are an important digital infrastructure for transporting large volumes of international communication traffic, submarine cable landing stations are concentrated in a few locations, such as the Boso Peninsula in Chiba Prefecture and the Shima Peninsula in Mie Prefecture, and there is a need for regional decentralization and multiple routes, similarly to data centers.

Moreover, for the advancement of AI use in various

[1] Note that this chapter does not comprehensively describe the content and responses to each challenge, but rather provides examples to promote understanding of individual issues, and the challenges are not limited to those described here. Refer also to Chapter 2 of Part II for the MIC's related policies regarding individual challenges.

fields and future services, there is a need for computing capabilities to process large amounts of data. Demand for the infrastructure necessary for the development and use of generative AI is expanding significantly worldwide[2]. In order to maintain and strengthen competitiveness in various industries, it is essential to secure further computing capabilities, and securing computing resources in Japan is an important challenge.

In addition, concerns are growing about the increasing amount of electricity consumed in the ICT sector, including networks and data centers, as a new challenge arising from the expansion of generative AI and communication traffic. For example, the Japan Science and Technology Agency (JST) forecasts the amount of power consumed by data center networks depending on the level of improvement in energy efficiency, and predicts that if current technologies remain unchanged and no energy-saving measures are implemented, power consumption will increase significantly in the future.

Additionally, as discussed in Chapter 1, foreign businesses operators hold a large share of many digital markets today. It is not realistic to expect all digital services and infrastructure to be provided by business operators with business bases in Japan. However, in light of the instability of the current global situation and Japan's national and economic security, it is becoming increasingly important to ensure a stable and secure supply chain network through collaboration with trustworthy domestic and foreign business operators, as well as to ensure and enhance Japan's autonomy, particularly when it comes to important digital services and infrastructure.

2. Direction of response

(1) Securing a strong digital infrastructure for supporting a digital society

Advances in technologies such as AI are expected to further increase demand for communications. In order to minimize the impact of unforeseen events such as disasters on our social lives, which depend on digital infrastructure, it will be important to take steps to ensure that digital infrastructure can respond to the sudden increase in demand for computing resources, communications, and electricity, and is easy to access, resilient, and redundant[3].

A Regional decentralization of data centers and submarine cables

Regarding the regional decentralization of data centers and submarine cables, the MIC has established a "Digital infrastructure development fund" under the FY2021 supplementary budget "Digital infrastructure resilience project through regional decentralization of data centers, submarine cables, etc." in order to support the development of data centers and submarine cables, etc., and promote "decentralization of data centers concentrated in the Tokyo area, etc.," "construction of submarine cables circling Japan," and "Project for Strengthening Digital Infrastructure through Multi-Routing of International Submarine Cables." The fund is providing support to private businesses that locate data centers, submarine cables, etc. in regional areas.

Moreover, the "Meetings of the Expert Group on the Development of Digital Infrastructures (Data Centers (DCs), etc.)" hosted by the MIC and the METI compiled the "Interim Report 3.0" in September 2024. In addition to continuing to promote the decentralization of data centers, the report recommended promoting the decentralization of landing stations for international submarine cables, with an eye toward international cooperation on all photonics network, in order to develop digital infrastructure that will support the AI society of the 2030s. Since March 2025, the MIC and the METI have been examining the development of data centers, primarily from the perspective of electricity and communications infrastructure, with the aim of accelerating digital transformation through the use of AI and simultaneously achieving growth and decarbonization. They have also been holding the "Summary 1.0 of Public-Private Advisory Council on Watt-Bit Collaboration" to promote collaboration and cooperation between public and private sector stakeholders.

Figure (related data) "Vision for Japan's digital infrastructure in the 2030s" (from the overview of MIC/METI "Expert Group Meetings on Development of Digital Infrastructures (eg, DCs) Interim Report 3.0")
Source: MIC/METI "Expert Group Meetings on Development of Digital Infrastructures (eg, DCs) Interim Report 3.0"
URL: https://www.soumu.go.jp/johotsusintokei/whitepaper/ja/r07/html/datashu.html#f00072
(Data collection)

[2] For example, according to the METI's "1st Industrial Structure Council Commerce, Distribution and Information Committee Information Economy Subcommittee" (December 25, 2024) document (https://www.meti.go.jp/shingikai/sankoshin/shomu_ryutsu/next_generation_semiconductor/pdf/001_03_00.pdf), the outlook for demand for AI infrastructure is that demand for servers and storage alone in Japan in the single year of 2030 is expected to reach approximately 1 trillion yen, approximately three times the amount in 2023.

[3] Taking into account the challenges and circumstances described here and with a view toward the end of FY2030, the MIC has formulated the "Digital Infrastructure Development Plan 2030" in June 2025 to clarify its policy on the development of essential digital infrastructure and specific promotion measures, thereby facilitating the integrated and efficient advancement of Japan's digital infrastructure (see Chapter 2 of Part II for details).

B Utilization of NTN

NTN (Non-Terrestrial Network) efficiently covers areas where it is geographically and economically difficult to develop communications infrastructure, such as remote islands, oceans, and mountainous regions, enabling the provision of communications services in those areas. It can also function as a temporary means of communication when existing communications infrastructure is damaged by natural disasters, etc., and as such, it is attracting growing interest from both the public and private sectors, and its utilization is increasing. In fact, following the earthquake that occurred in the Noto region of Ishikawa Prefecture in January 2024, the U.S. company SpaceX's satellite communications system "Starlink" was widely used to ensure emergency restoration of communications infrastructure and communications environments in evacuation centers and other locations.

Telecommunications carriers are actively promoting the use of NTN, and in addition to providing high-speed, high-capacity satellite communications services using low-orbit satellites, they are also working on developing solutions businesses that utilize satellites and drones, and on developing technology to realize HAPS[4]. Furthermore, in April 2025, KDDI and Okinawa Cellular Telephone Company began offering "au Starlink Direct," a service that uses Starlink to enable smartphones to communicate directly with satellites (satellite direct communication), making communication possible even in areas outside mobile phone coverage as long as the sky is visible.

Taking these trends into consideration, the MIC is conducting research and development on the establishment of the systems necessary for the domestic introduction of HAPS through technological demonstrations and on increasing the speed and capacity of HAPS communications, based on the "Strategy for Realizing Next-Generation Information and Communication Infrastructure to Support AI Society - Beyond 5G Promotion Strategy 2.0" compiled in August 2024. In addition, with regard to satellite communications services, the MIC is supporting the development of technologies related to direct communications services between satellites and mobile phones, satellite optical communications, and the advancement of radio wave utilization, and is implementing the necessary institutional arrangements.

C Addressing decarbonization in digital infrastructure

As addressing global warming becomes an urgent issue, there is a need for power-saving and decarbonization in communication equipment, data centers, cloud services, AI use, etc.

Research and development is being conducted on various power-saving technologies and decarbonization promotion technologies as a technological response to the increasing power consumption in digital infrastructure such as data centers and communication infrastructure. One of such power-saving technologies is photonics-electronics convergence technology. Photonics-electronics convergence technology is a technology that combines circuits that handle electrical signals with circuits that handle optical signals, achieving low power consumption and low latency.

For example, in 2019, NTT launched the next-generation optical communications infrastructure concept "IOWN"[5] and is conducting research into photonics-electronics convergence technology, drawing up a roadmap for applying photonics-electronics convergence technology to connections between data centers, connections between boards within data centers, and even data transmission between or within semiconductor packages. Commercial use of IOWN 1.0 began in March 2023, and it is expected that data centers will be able to reduce their power consumption from FY2025.

The MIC is also conducting research and development aimed at the social implementation of all photonics network technology that utilizes photonics-electronics convergence technology, based on the "Strategy for Realizing Next-Generation Information and Communication Infrastructure to Support AI Society—Beyond 5G Promotion Strategy 2.0-" (announced by the MIC in August 2024).

In addition, at the aforementioned "Summary 1.0 of Public-Private Advisory Council on Watt-Bit Collaboration," the MIC has been examining the development of data centers, primarily from the perspective of electricity and communications infrastructure, with the aim of accelerating digital transformation through the use of AI and simultaneously achieving growth and decarbonization to promote collaboration and cooperation between public and private sector stakeholders.

(2) Ensuring and enhancing Japan's autonomy in key digital fields

While the presence of foreign business operators is increasing in many important digital services and infrastructure, in light of the instability of the current global situation, it is becoming important to ensure a stable and secure supply chain network through collaboration with trustworthy domestic and foreign business operators, as well as to ensure and enhance Japan's autonomy, particularly when it comes to important digital services and infrastructure.

[4] Acronym of High Altitude Platform Station

[5] Agency for Natural Resources and Energy, Advisory Committee for Natural Resources and Energy, Strategic Policy Committee (56th meeting) (June 6, 2024) Document 4 Hearing materials (Nippon Telegraph and Telephone Corporation) "The future of the electric power business from the perspective of the IOWN concept" < https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/2024/056/056_008.pdf> (Reference March 27, 2025)

A Measures to ensure stable supply under the Act on the Promotion of Ensuring National Security through Integrated Implementation of Economic Measures, etc.

The Act on the Promotion of Ensuring National Security through Integrated Implementation of Economic Measures[6] aims to strengthen supply chains by designating as specified critical products those that are essential for the survival of the people or upon which the people's daily lives and economic activities depend widely, and by supporting private businesses and others working to ensure a stable supply of these materials. Programs used in systems that make computers (including input/output devices; the same applies hereinafter) available for information processing by others via the Internet or other advanced information and communications networks (hereinafter referred to as [7]"cloud programs") are elements that determine the functionality of cloud services. In particular, from the perspective of economic security and the balance of payments, it is important that fundamental cloud services, which are expected to expand into important areas such as corporate core systems, government services, and the control of social infrastructure, be provided by business operators with business bases in Japan. For this reason, cloud programs are designated as specified critical products, and plans to ensure a stable supply for efforts such as developing important technologies for highly competitive cloud services or introducing advanced computers required for basic cloud programs have been approved, and support for the plans' efforts has been provided. As of April 2025, a total of 11 plans for ensuring stable supply have been approved.

B Strengthening Japan's competitiveness in the digital field

Strengthening Japan's competitiveness in important digital infrastructures will contribute to enhancing Japan's autonomy in these digital infrastructures.

For example, Open RAN, an open radio access network that realizes interconnection among equipment and systems from different vendors, reduces supply chain risk by enabling the adoption of products from various vendors, enables the construction of flexible and scalable radio access networks, in addition to price optimization by revitalizing the base station market. It is also expected to contribute to the international expansion of Japanese telecommunications carriers and vendors by leveraging their strengths. In the overall base station market, Japan's share of the global market is only a few percent, but Open RAN is an area in which Japan has a relatively high share [8]and is expected to grow in the future.

As a policy response to open RAN, the MIC is taking into account the "Strategy for Realizing Next-Generation Information and Communication Infrastructure to Support AI Society—Beyond 5G Promotion Strategy 2.0 -" compiled in August 2024 and the "Comprehensive Strategy for Digital Overseas Promotion 2030" formulated in June 2025. The ministry is implementing measures such as enhancing the interconnection and operational test environment for base station equipment using open standards, conducting research and development on improving the efficiency of RAN control using AI, and supporting the overseas expansion of Open RAN through the "Overseas Expansion Support Project for Digital Infrastructure Ensuring Safety and Reliability."

[6] Act on the Promotion of Ensuring National Security through Integrated Implementation of Economic Measures (Act No. 43 of 2022)
[7] Cloud programs are divided into application software for realizing individual functions and software (basic cloud programs) for realizing functions commonly required to run applications.
[8] Refer to "Global market share and trends" in Section 3, 2 (1) (i), Chapter 1, Part I