

Policy Focus Achieving Beyond 5G (6G)

1. Expectations and social implementation of Beyond 5G (6G)

(1) About Beyond 5G (6G)

The mobile communication system in Japan has undergone a generational change from the first generation (1G) to the fifth generation (5G) in about 10-year cycles. 4G is now widely used as a commercial service, while 5G commercial service was launched in 2020 and its use continues to spread. Beyond 5G (6G) is expected to

serve as the next generation of information and communications infrastructure for a wide range of industrial and social activities in the 2030s. Rather than being an extension of wireless communications, Beyond 5G (6G) is considered to be an entire network encompassing wired and wireless; and land, sea, air, and space.




Figure (related data) Beyond 5G (6G) features
 URL: https://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2023/data_collection.html#f00391
 (Data collection)

(2) Society in the 2030s

Beyond 5G (6G) is expected to become a reality in the 2030s, with the aim of creating a resilient and vibrant society in which citizen's lives and economic activities can be maintained smoothly. Specifically, this calls for (1) an inclusive society in which everyone can play an active role, (2) a sustainable society in which people can grow, and (3) a dependable society in which people can live and work with ease. In light of the government's na-

tional strategy and Japan's social issues, these social goals are illustrated in **Figure 1**.

In order to achieve such a society, **Figure 2** shows the issues and future vision for the 2030s in a wide range of industries, not limited to the information and communications field, and identifies and arranges a wide range of information and communications usage scenes involving many industries and uses.

Figure 1 Society of the 2030s realized through Beyond 5G (6G)

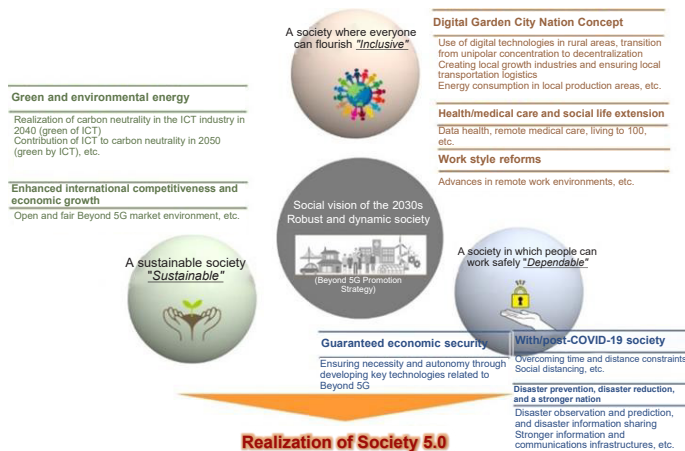


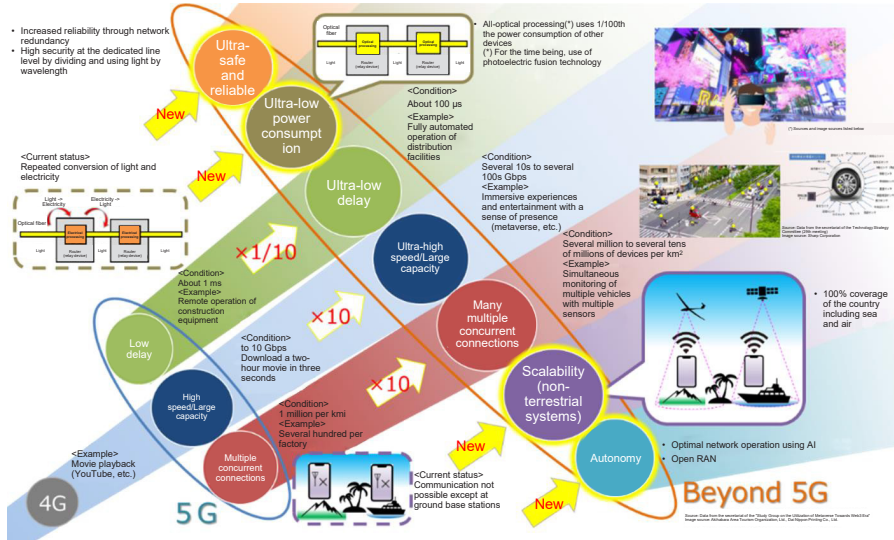
Figure 2 Beyond 5G (6G) use cases

Finance	Construction, real estate	Logistics, transportation	ICT	Media	Energy, resources
<ul style="list-style-type: none"> More services going online and cashless, digital conversion of contact points with all customers Cooperation and accommodation with high-value-added businesses and other industries through the use of AI and transaction data 	<ul style="list-style-type: none"> Remote collaboration and robot remote control using VR technology Maintenance management and monitoring through IoT and wireless sensing 	<ul style="list-style-type: none"> Tracking and managing packages in warehouses and logistics, and autonomous and drone operations for machinery and robots Logistics support including maritime routes using satellites and HAPS Seamless flight and railway transfers, automatic operation, etc. 	<ul style="list-style-type: none"> Digital technologies that leave no one behind Real experiences using avatars, etc., and high-precision demand forecasting and supply optimization using AI Autonomous and resilient networks using AI 	<ul style="list-style-type: none"> Immersive media experiences, including body ownership experiences Personalization of individual viewing environments, etc. 	<ul style="list-style-type: none"> Immersive remote control and automation for safe on-site resource extraction and processing Infrastructures for common use of recycled data, etc.
Beyond 5G serving as the foundation for all industrial and social activities in the 2030s					
<ul style="list-style-type: none"> Support of safe driving through use of high-precision vehicle detection and prediction Creation of dynamic maps using real-time images of road and traffic conditions 	<ul style="list-style-type: none"> Ultra-fast large-capacity services Services requiring ultra-low latency Services where many IoT sensors are connected simultaneously Freedom from time and place constraints Stable and secure provision of quality of service required by users 				<ul style="list-style-type: none"> Unmanned factories using IoT and robots High-precision remote control of machinery using XR, etc. Smart farming through use of automation, advanced functions, and remote control of farming equipment
Food, agriculture	Distribution, retail, wholesale	Medical	Public, government, education	Disaster prevention, local communities	Space, HAPS
<ul style="list-style-type: none"> Automatic operation of unmanned tractors and control and remote monitoring of agricultural chemical spraying devices Remote monitoring of crops and livestock by sensors, cameras, etc. 	<ul style="list-style-type: none"> Advances in transportation and delivery to ensure convenience in all regions Acquisition, linking, and distribution infrastructures of data throughout supply chains 	<ul style="list-style-type: none"> Remote surgery using high-resolution video and communications technology Real-time acquisition of biometric information using sensors, and health management using AI diagnosis 	<ul style="list-style-type: none"> One-stop administrative systems with Uls to allow users access to procedures from anywhere Remote education with a sense of presence using XR, etc. 	<ul style="list-style-type: none"> Disaster prediction systems, rescue and evacuation training support systems, and evacuation guidance systems Use of HAPS, etc. to ensure communications in the event of disasters 	<ul style="list-style-type: none"> Development of smart cities and the elimination of the digital divide through the use of communications infrastructures that use HAPS, etc. to cover land, sea, and air Remote control of activities in outer space from the ground, etc.

In order to realize these use cases, solve various social problems, and realize a vibrant society, it is essential to develop technology for Beyond 5G (6G), which is expected to become the foundation of all industries and societies in the future. In addition to further upgrading

5G features (high speed and high capacity, low latency, and multiple simultaneous connections) new features such as ultra-low power consumption, scalability of communications coverage, autonomy, and high safety and reliability are expected (Figure 3).

Figure 3 Features and use scenes realized by Beyond 5G (6G)



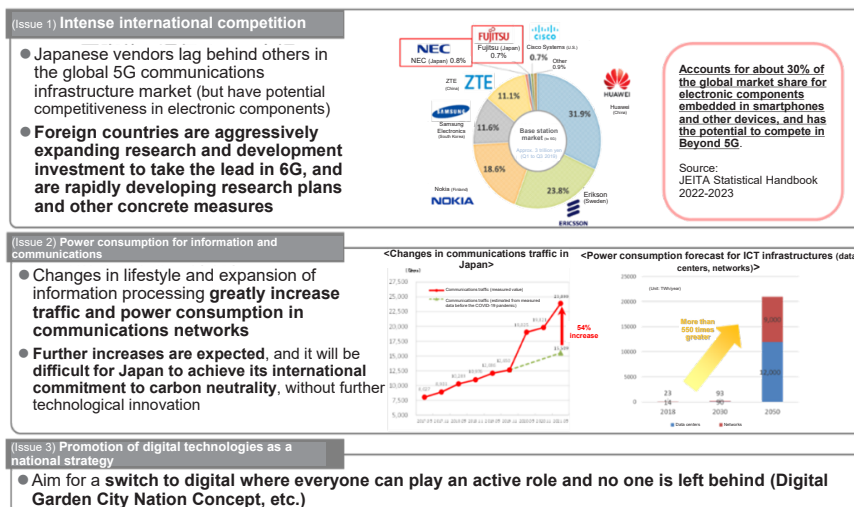
2. Challenges for Beyond 5G (6G)

Major overseas companies now account for a high proportion of the international market share of 5G base stations, and the international competitiveness of Japanese companies is low. Large-scale government research and development investments and research and development plans have been announced in countries outside of Japan, and global development competition is intensifying in order to secure technological superiority in Beyond 5G (6G).

Communications traffic in Japan is on the rise, and there are concerns that the power consumption of information and communications networks will increase significantly unless technological innovations are made.

It will be important as a part of national strategy to deliver the benefits of Beyond 5G (6G) to citizens in order to switch to digital technologies in a manner where everyone can play an active role and no one is left behind (Figure 4).

Figure 4 Major challenges for Beyond 5G (6G)



3. The ideal Beyond 5G (6G) network

Beyond 5G (6G) should not be regarded as an extension of current mobile communications (wireless communications) technologies and systems, but as an inte-

grated network that includes data centers, devices, and terminals, and that encompasses wired and wireless; optical and radio wave; and land, sea, air, and space.

Innovative next-generation communications infrastructures that offer high speed, high capacity, low latency, high reliability, and low power consumption will be realized by tightly coupling fully-optical networks (fixed networks) with mobile networks, while making broad use of photoelectric fusion technology. It would also be seamlessly coupled with non-terrestrial networks such as satellites and HAPS to greatly expand communication coverage. Integrated networks capable of securely and optimally controlling these will be created by utilizing virtualization technology and other relat-

ed technologies.

By aiming for such a Beyond 5G (6G) network, Japan will lead the global market, contribute to carbon neutrality by reducing the power consumption of entire communications networks, and realize a Digital Garden City Nation infrastructure that can cover a wide area of the country, including land, sea, and air. Strategic efforts are therefore needed to ensure that Japan remains a game-changer and winner in the global communications infrastructure market.




Figure (related data) The ideal Beyond 5G (6G) network
 Source: Information and Communications Council, Summary of the interim report on the “Information and Communications Technology Strategy for Beyond 5G”
 URL: https://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2023/data_collection.html#f00396
 (Data collection)

4. Initiatives to realize Beyond 5G (6G)

(1) Technology strategies to focus on research and development, social implementation, and overseas implementation of Beyond 5G (6G)

In order to promote initiatives to implement Beyond 5G (6G), MIC consulted with the Information and Communications Council in September 2021 on the “Information and Communications Technology Strategy for Beyond 5G,” and an interim report was compiled in June

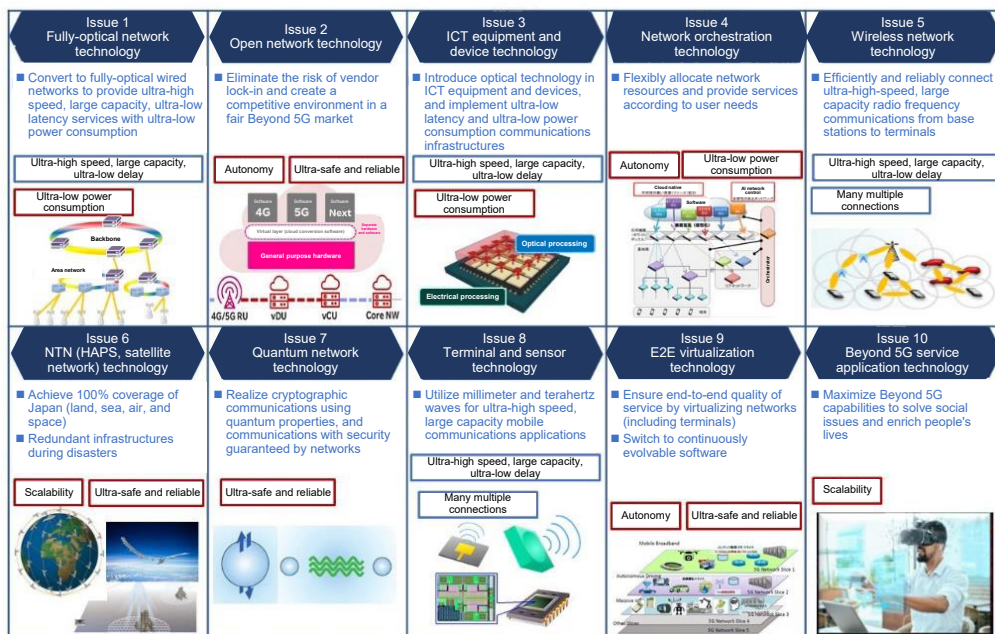
2022. The report presents four strategies: a research and development strategy, social implementation strategy, intellectual property and standardization strategy, and overseas implementation strategy.

a Research and development strategy

As shown in **Figure 5**, this report summarizes 10 Beyond 5G (6G) research and development issues to be addressed by industry, academia, and government, based on the ideal Beyond 5G (6G) network and Japan's strengths. Technologies related to fully-optical networks, non-terrestrial networks, and secure virtualization and integrated networks have also been set as priority technology areas from the perspectives of Japan's

strengths, technological difficulties, autonomy assurance, national strategic positioning, and the need for acceleration based on prior investment. Research and development will be promoted strategically by concentrating national funds around these priority technology areas and working together to create a framework that allows for budgets spanning multiple fiscal years.

Figure 5 10 Beyond 5G (6G) research and development issues for industry, academia, and government



b Social implementation strategy

Our social implementation strategy is to apply what is learned in these priority technology areas in domestic networks and to bring these to market beginning in

c Intellectual property and standardization strategy

MIC will promote international standardization and intellectual property acquisition through an open and closed strategy, focusing on priority technology areas. In the open (cooperative) area, we will promote the international standardization of network architecture and key

d Overseas implementation strategy

MIC will define results in priority technology areas as global Beyond 5G key technologies, promote the implementation of these technologies in domestic society at an early stage, and communicate the usefulness of these technologies to the world as quickly as possible in order

Together, these four strategies will serve to accelerate the research and development and social implementa-

2025. Realize the Beyond 5G (6G) migration scenario, share the results globally with industry, academia and government, including the Osaka and Kansai Expo.

technologies in cooperation with willing countries based on the promotion of open architectures that lead to the creation of diverse businesses. In the closed (competitive) area, we will promote rights and secrecy of core technologies as a source of Japan's competitiveness.

to promote the creation of global de facto standards. By working strategically with major global vendors, MIC will also encourage the adoption of these standards among global communications carriers.

tion of Beyond 5G (6G).



Figure (related data) Strategy to accelerate research and development and social implementation of Beyond 5G (6G)

URL: https://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2023/data_collection.html#f00398

(Data collection)

(2) Establishment of promotion system by industry, academia, and government

Established in December 2020 by industry, academia, and government, the “Beyond 5G Promotion Consortium” continues to work on various initiatives. The consortium is working to develop white papers by examining use cases, concepts, and technical challenges for Beyond 5G (6G), and is working to strengthen international cooperation and dissemination through international conferences.

The “Beyond 5G New Business Strategy Center” was established in December 2020 as a framework to pro-

mote intellectual property and standardization strategies by industry, academia, and government. Based on a report released by the center, the report of the Information and Communications Council incorporated an international standardization roadmap and IP landscape for Beyond 5G. The center also holds seminars to disseminate information and conducts workshops to develop human resources to lead efforts in acquiring intellectual property, and setting standards.

(3) Sharing of an international vision (G7 Digital and Tech Ministers' Meeting)

In developing technology for Beyond 5G (6G), MC will focus on supporting research and development aimed at social implementation and overseas implementation. As for the latter, it will be important to create an environment in which technologies developed by Japan are widely accepted internationally.

MIC has therefore been working to disseminate Japan's vision of Beyond 5G (6G) through intergovernmental dialogue with countries such as the U.S., the EU, Germany, and Singapore in order to gain the understanding and approval of the international community. Japan has been pursuing dialogue with the aim of securing a leading position in the world in areas such as extremely energy-efficient photoelectric fusion technology that contributes to the realization of both DX and GX, and the promotion of open and interoperable networks.

“The G7 Digital and Tech Ministers' Declaration” was adopted during the “G7 Digital and Tech Ministers' Meeting in Takasaki, Gunma” chaired by Japan, held in April 2023, with the understanding and support of each participating country following discussions on building secure and resilient network infrastructures. Based on Japan's vision for Beyond 5G (6G), this declaration formulated a vision for the future of next-generation wireless and wired networks, and represents an agreement reached on the G7 Action Plan for Building a Secure and Resilient Digital Infrastructure.

MIC will steadily take measures in such way that the government and the private sector work together to develop Beyond 5G (6G), and then to implement it throughout society and overseas.