Chapter 1

Progress in data flows

Due to progress in digitalization, advancement of networks, and the miniaturization and cost reduction of smartphones and IoT-related devices, such as sensors, a huge amount of data, such as information on people's locations, activity histories, and internet viewing and consumption activities, are distributed via networks, and various digital services that utilize and share such data have emerged.

This chapter provides an overview of advances in telecommunications infrastructure and progress in the distribution and utilization of data over networks.

Section 1 Advances in telecommunications infrastructure to support data flows

1. Fixed communications

In the late 1980s and early 1990s, before the spread of the Internet, many people used personal computer communications in which their computer connected to a telecom provider's computer via a telephone line or ISDN to send and receive information[1]. Personal computer communications paved the way for data communications in addition to the existing voice informationcommunications, and although such data communications were mainly text-based services, such as e-mail, message boards, and chats, they steadily became popular.

After that, commercial use of the Internet also started in Japan, and the spread of the Internet to ordinary households rapidly progressed with the release of Windows 95 in 1995.

In the late 1990s, when the Internet began to spread, the mainstream telecommunication environment was dial-up connections via telephone lines, and there were problems such as insufficient communication speeds, pay-as-you-go services, and the inability to make telephone calls while connected to the Internet.

In 1999, a commercial ADSL service was launched. Because ADSL used a different bandwidth for data communications than for telephone calls, it was possible to make telephone calls and connect to the Internet at the same time. It was also provided for a flat fee, and it had a constant connection. In 2001, new providers of low-cost ADSL services, such as Yahoo! BB, led to increased competition among providers and reduced prices, including NTT EAST, which had been offering the service since its inception. In addition, the number of subscribers expanded rapidly as the line speed increased from a maximum of 1.5 Mbps download speed at the beginning to 50 Mbps in 2004.[2]

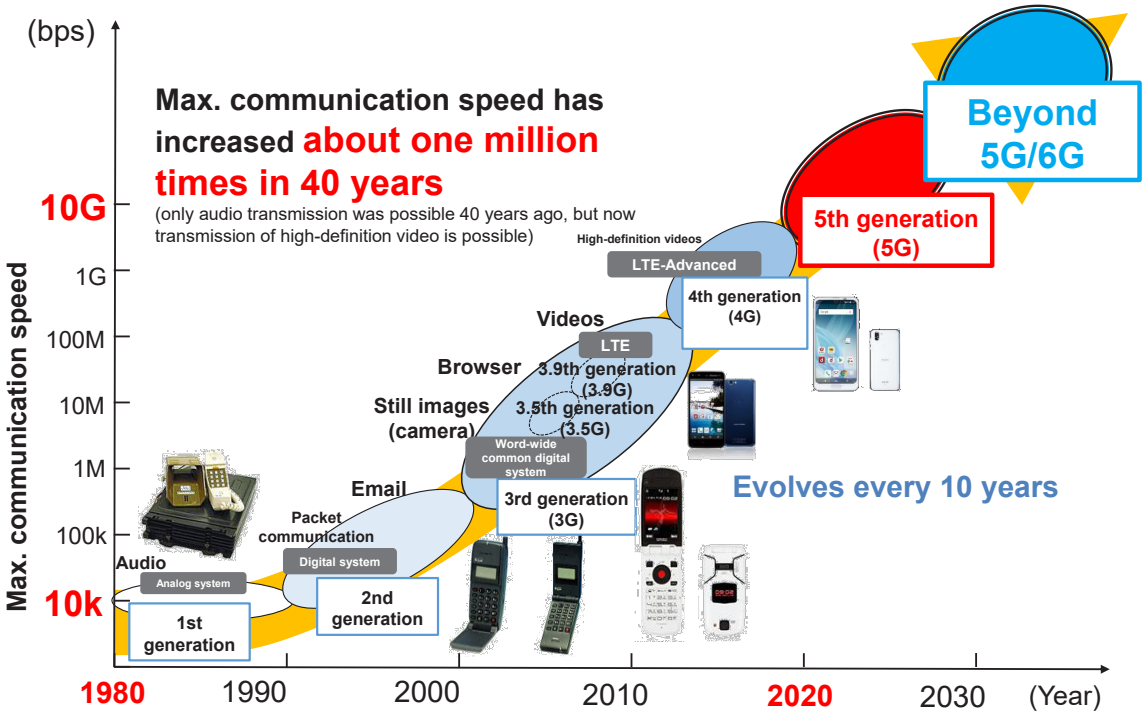
While the price of ADSL continued to decline and its speed increase, in 2001, fiber to the home (FTTH) services that utilized optical fiber were launched for general users, and in the late 2000s, people started switching from ADSL to higher-speed FTTH. FTTH surpassed DSL in terms of total subscriptions in 2008, and FTTH still form the bulk of broadband services.

2. Mobile communications

Since the launch of the first generation of Japan's mobile communications network in 1979, the network has undergone a generational change approximately every 10 years up to the fifth generation, which was launched in 2020, and it has continued to evolve in the direction of increasing speed and volume. Accordingly, mobile communication services have diversified and become more sophisticated **(Figure 1-1-2-1)**.

[1] The number of users of personal computer communications increased from 1.15 million in 1991 to 5.73 million in 1996.
[2] In 2003, the number of subscribers exceeded 10 million.

Figure 1-1-2-1 Evolution of mobile communications systems



(Source) Material created by MIC

In 1979, Nippon Telegraph and Telephone Public Corporation began offering the first generation analog automobile telephone service. In 1985, shoulder-type terminals were introduced that could make calls from outside automobiles. In 1987, NTT began a mobile phone service using smaller and lighter terminals.

From 1993, the second generation mobile communication system 2G, which was a digital system, was launched to replace the analog system. With the realization of communications using 2G packet switching technology, data communications services started to be launched in earnest in addition to the transmission of voice calls, and internet connection services for mobile phones were launched by all companies. [3]

In 2001, the world's first service using the third generation mobile communication system 3G was launched. The feature of 3G was the use of code-division multiple access (CDMA) as its access method. With this, users were identified by a code called a spreading code, making it possible for many users to share the same frequency at the same time. Furthermore, the adoption of CDMA, which is a type of frequency spreading technology, enabled wide-band communications, thus realizing high-speed and high-volume communications when compared to 2G. In addition, around the time of the introduction of 3G, the multifunctionality of mobile phone devices progressed further, and full-fledged services that enabled users to access sites dedicated to mobile phones began to appear, enabling users to enjoy a variety of content, such as games and music on mobile phone terminals.

As the need to use various types of content on mobile phone devices increased, the communication speed of 3G became inadequate. In 2003, services using the 3.5th generation mobile communication system (3.5G),[4] which was evolved 3G that specialized in high-speed data communications, were launched.

When Apple introduced the iPhone in the U.S. in 2007, its design and ease of use resulted in it gaining popularity, and the shift from feature phones to smartphones began worldwide.

The fourth generation mobile communication system (4G) was launched commercially under these circumstances. Initially, services using the 3.9th generation mobile communications system (3.9G) (Long Term Evolution (LTE)) were launched in 2010. With the arrival of the smartphone era, the need for high-speed, high-volume communications grew even more, and LTE achieved even higher speeds by increasing the efficiency of spectrum use to enable a much wider bandwidth than 3G. In 2015, the fourth generation mobile communications system (4G, LTE-Advanced), which made LTE

[3] NTT DOCOMO launched the DoPa and i-mode Internet connection services for mobile phones in 1997 and 1999, respectively. The Cellular Group and IDO launched EZweb and EZaccess in 1999, and J-Phone (the company name changed from Digital Phone and Digital Tu-Ka companies) launched J-SKY in 1999.

[4] While it took 27 to 30 hours to download a single DVD with 3G, it took 45 minutes to 1 hour with 3.5G. This improved speed allowed users to smoothly browse websites and videos, including images, and it enriched the user experience of the Internet on mobile phones.

even faster, was launched and the communication speed evolved from mega-level to giga-level.

In March 2020, about 10 years after the commercial launch of 4G,[5] commercial services of the fifth generation mobile communication system (5G) were launched. 5G is expected to become the foundation of life, the economy, and society in Japan, not only because of its ultra-high speed, which is more than 100 times faster than 4G, but also because it provides features such as ultra-low latency, which enables operation of robots etc. to be performed smoothly even in remote areas, and because it allows many simultaneous connections, enabling many devices to a network simultaneously. Initiatives to achieve wide-area coverage with 5G quickly and accelerate the utilization of 5G in various industries are being carried out actively,[6] and as of the end of March 2022, the national 5G-population coverage rate exceeded 93.2% while the prefectural 5G-population coverage rate exceeded 70% in all prefectures.

[5] The collective name of the 3.9th generation mobile communication system (LTE) and the 4th generation mobile communications system (LTE-Advanced)
[6] For details, see Section 3. "Radio Policy Trends" in Chapter 5 of Part 2.