

Section 2 Trends in the Telecommunication Sector

1. Trends of the domestic and overseas communications markets

Since 2000, the number of fixed-line broadband subscriptions¹⁰ has been increasing in major countries (**Figure 3-2-1-1**). By country, China rose to the top position overtaking the United States in 2008 and has been sharply increasing the number since 2015. Compound annual growth rate (CAGR) of China from 2000 to 2020 is 65%, which is by far higher than 15% of the United States and 22% of Japan.

The number of mobile phone subscriptions¹¹ has also

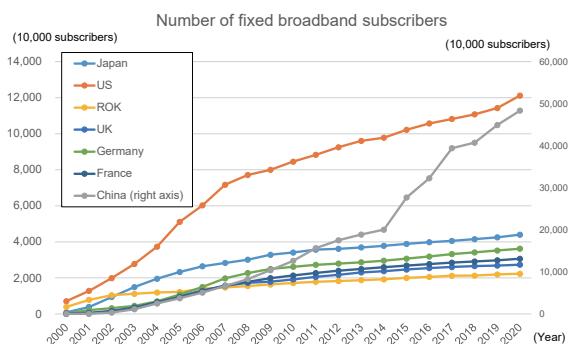
been on the increase in major countries. The number sharply increased especially in China (**Figure 3-2-1-2**). CAGR of China from 2000 to 2020 is 16%, which is higher than 6% of the United States and Japan. In 2020, the ratio of the number of mobile communication subscriptions to the population was 154.5% (57.4 point increase from 2010) in Japan, 106.0% (16.3 point increase from 2010) in the United States and 121.7% (53.8 point increase from 2010) in China.¹²

¹⁰ According to “fixed-broadband subscriptions” of ITU statistics. Fixed-broadband refers to high-speed lines providing communication speed over 256kbps either or both of uplink and downlink. High-speed lines include cable modem, DSL, optical fiber and satellite communications, fixed wireless access and WiMAX, but do not include subscriptions of data communication using mobile networks (cellular systems).

¹¹ According to “Mobile-cellular subscriptions” of ITU Statistics. The number includes deferred-payment subscriptions and prepaid subscriptions. Prepaid subscriptions are included only when the service was used for a fixed period of time (e.g., three months). Data card and USB modem subscriptions are not included.

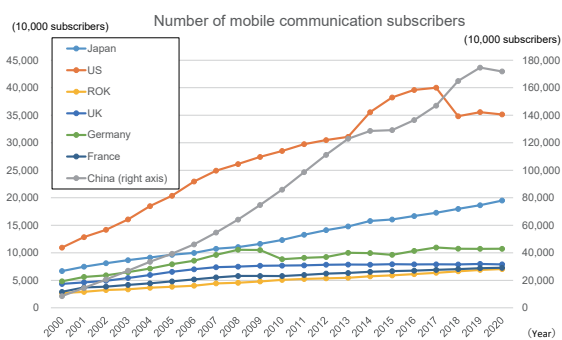
¹² Number of mobile subscriptions includes prepaid-based subscriptions.

Figure 3-2-1-1 Changes in the number of fixed-line broadband service subscriptions in major companies¹³



(Source) ITU¹⁴

Figure 3-2-1-2 Changes in the number of mobile communication subscriptions in major countries

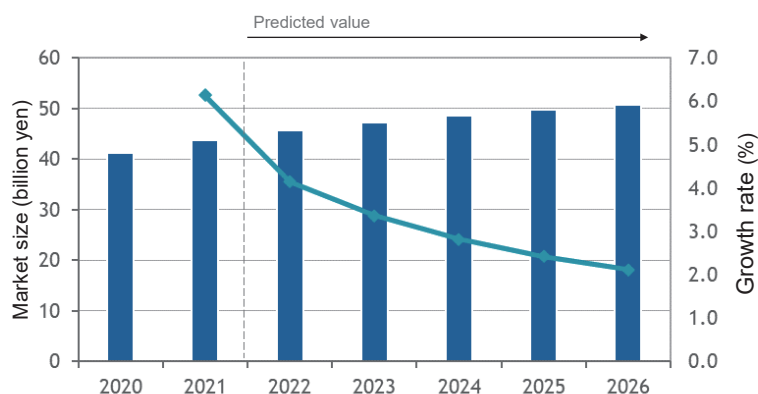


(Source) ITU¹⁵

In 2021, the market size of network virtualization was 2.8942 trillion yen (18.3% increase year-on-year) in the world. With the spread of server virtualization, reduction in cost of its ownership and flexible extensibility of networks, network virtualization technologies have been gradually introduced. The size of Japan's network virtualization/automation market (sum of the markets for data centers and corporate networks)¹⁶ was 43.8 bil-

lion yen in 2021 and expected to grow at a compound annual growth rate of 3.0% from 2021 to 2026 (**Figure 3-2-1-4**). Background factors of the gradual growth include: its establishment as the method for infrastructure construction and operation at data centers; and rising need for network construction in corporate LAN and for speeding up and efficient improvement of network operations.

Figure 3-2-1-4 Changes and forecasts of the size (in terms of sales) of Japan's network virtualization/automation market



(Source) IDC Japan¹⁷

Regarding RAN (Radio Access Network) of carriers, progress is being made in Open RAN¹⁸ to realize multi-vendors and vRAN¹⁹ to realize virtualization and other initiatives to innovate the composition of network equipment. Regarding virtualization of core networks, for example, it is AT&T's policy to transfer the core network

for mobile communication services operated by the company to Microsoft Azure that is a public cloud of Microsoft and to develop 5G network.²⁰ In Japan, Rakuten Mobile adopted the world's first open and fully virtualized architecture albeit on 4G network, procured equipment from multiple vendors and implemented a virtual-

¹³ In addition to the subscriptions with FTTH, DSL, CATV and FWA, subscriptions with VPN and broad area Ethernet services, which are provided mainly for businesses are also included.

¹⁴ <https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>

¹⁵ <https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>

¹⁶ Total of the network virtualization/automation markets of datacenter networks and corporate networks. Network virtualization and automation refer to the function to virtualize and automate networks by using software and hardware. The market consists of network infrastructure and network automation/virtualization platforms.

¹⁷ <https://www.idc.com/getdoc.jsp?containerId=prJPJ49092722>

¹⁸ Open Radio Access Network. Mobile Front Haul that is interface between Distributed Unit (DU) and Radio Unit (RU) is standardized as O-RAN Front Haul by the O-RAN Alliance. The standardization is expected to facilitate provision of communication network equipment by various vendors and at the same time facilitate area building and lower equipment procurement costs.

¹⁹ Virtual Radio Access Network. Virtualization technology deploys communication software on virtualization layers installed on general hardware and activates the software independent of hardware characteristics.

²⁰ businessnetwork.jp, "The plan to 'Move 5G networks to Azure' started to gather momentum: what will carriers gain from move to cloud?" (May 23, 2022) <https://businessnetwork.jp/Detail/tabid/65/artid/9133/Default.aspx>

ized network.²¹

Regarding the development of NTN (Non-Terrestrial Network), Internet connectivity services using outer space have begun in earnest overseas. For example, the US Space X is providing Starlink that is a broadband Internet service using satellite constellation.²² In Japan, mobile operators are leading initiatives to construct NTN.²³ For example, SoftBank and its affiliate HAPS Mobile Inc. participate in “HAPS Alliance,” an industry group aiming to construct High Altitude Platform Station, and take the initiative in earnest. For implementation of satellite constellation using low-orbit satellites, KDDI signed a contract with Space X to use Starlink as backhaul line of au base stations in September 2021.

KDDI plans sequential introduction starting from around 1,200 sites across Japan in 2022.²⁴ NTT and SKY Perfect JSAT announced a plan to establish the Space Compass Corporation in July 2022. The joint venture is expected to play a central role in the space satellite projects including a space data center project to deploy satellites with data center functions on a geostationary satellite orbit and the space RAN²⁵ project.²⁶ Furthermore, Rakuten Mobile together with AST SpaceMobile of the United States is working on “Rakuten Mobile Space Project” to build a mobile broadband network for transmission from outer space by using low-orbit satellites and thereby expand the area of its mobile communication service on Earth.²⁷

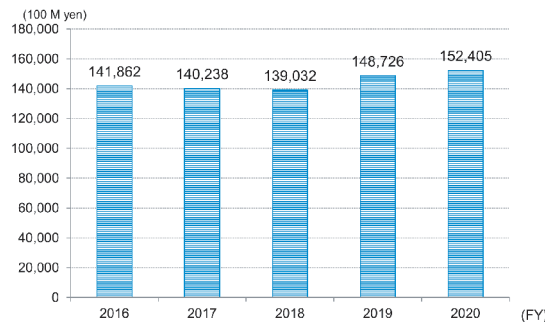
2. Current status of telecommunications in Japan

(1) Market size

In fiscal 2020, sales in the telecommunication sector

continued to grow to 15.2405 trillion yen (2.5% increase year-on-year) (**Figure 3-2-2-1**).

Figure 3-2-2-1 Changes in telecommunications sector sales



*Sales are total of the sales of all responding business operators. Comparison must be made carefully because the number of respondents varies depending on the year.

(Source) Prepared from MIC / METI “Basic Survey on the Information and Communications Industry” <https://www.soumu.go.jp/johotsusintokei/statistics/statistics07.html>

(2) Number of carriers

The number of telecommunication carriers at the end of fiscal 2021 was 23,111 (330 registered carriers and

22,781 notified carriers). The number continued to increase following the previous fiscal year (**Figure 3-2-2-2**).

Figure 3-2-2-2 Changes in the number of telecommunication carriers

End of FY	2013	2014	2015	2016	2017	2018	2019	2020	2021
Number of telecommunication carriers	16,321	16,723	17,519	18,177	19,079	19,818	20,947	21,913	23,111

(Source) Information & Communications Statistics Database <https://www.soumu.go.jp/johotsusintokei/field/tsuushin04.html>

²¹ Nikkei XTECH, “Qualcomm and others challenge the unchallenged position of Intel for leadership in virtualization base station vRAN” (April 1, 2022) <https://xtech.nikkei.com/atcl/nxt/column/18/01273/00028/>

²² As of March 2022, beta tests were conducted in 29 countries including Ukraine. Nikkei XTECH, “Satellite network covering the globe delivers videos from Ukraine” (May 9, 2022) <https://xtech.nikkei.com/atcl/nxt/column/18/02040/00002/>

²³ R&D to realize NTN (Non-Terrestrial Network) is advanced. NICT, for example, is working on R&D on “generic technologies of satellite flexible network”.

²⁴ KDDI, “Agreed to sign a contract of business alliance with SpaceX to adopt its satellite broadband Starlink to au communication network” (September 13, 2021) <https://news.kddi.com/kddi/corporate/newsrelease/2021/09/13/5392.html>

²⁵ Radio Access Network

²⁶ Nippon Telegraph and Telephone and SKY Perfect JSAT, “NTT and SKY Perfect JSAT agreed to establish Space Compass Corporation – toward a new space computing network business for realization of a sustainable society” (April 26, 2022) <https://group.ntt.jp/newsrelease/2022/04/26/220426a.html>

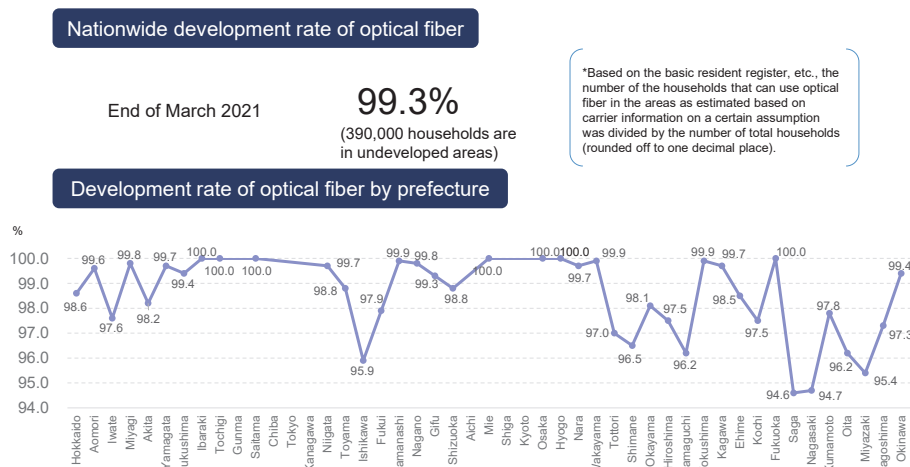
²⁷ Rakuten, “Rakuten invests in AST & Science of the U.S. and signed a strategic partnership” (March 3, 2020) https://corp.rakuten.co.jp/news/press/2020/0303_02.html

(3) State of infrastructure development

The Development rate of optical fiber (household cov-

erage) was 99.3% in Japan at the end of fiscal 2020 (**Figure 3-2-2-3**).

Figure 3-2-2-3 State of optical fiber development (estimation) at the end of March 2021



As of the end of fiscal 2020, 5G infrastructure deployment rate²⁸ was 16.5% and the number of 5G base stations was approximately 21,000.²⁹ There are regional differences in the development. For example, the number of 5G base stations per 10km² in November 2021 was 1.0 in national aver-

age but around 41.3 in Tokyo (**Figure 3-2-2-4**).

According to OECD, Japan is at the world's top level in terms of the ratio of optical fiber to the fixed broadband. Spread of digital infrastructure in Japan is advanced in international comparison.

Figure 3-2-2-4 The number of 5G base stations per 10km² in November 2021

National average	Approx. 1.0 stations
Tokyo	Approx. 41.3 stations
Osaka prefecture	Approx. 16.2 stations
Kanagawa Prefecture	Approx. 6.6 stations
Hiroshima Prefecture	Approx. 1.1 stations

(3.7GHz band, 4.5GHz band, 28GHz band)

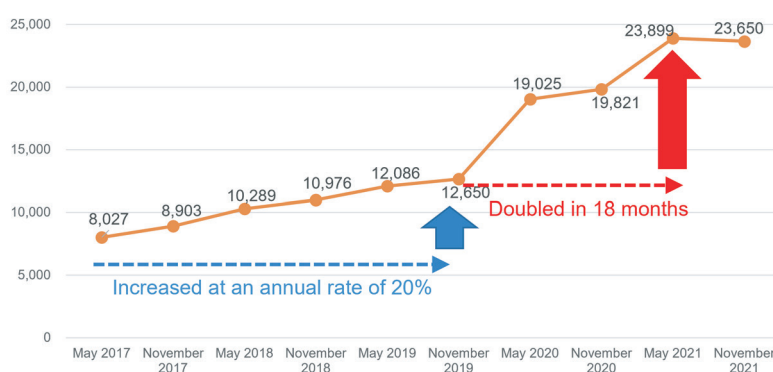
(Source) Excerpt from MIC (2021) "Special Commission on Digital Administrative Reform (2nd session)" Material 3

(4) State of traffic

The download traffic of fixed-line broadband in Japan increased rapidly after COVID-19 began to spread (**Figure 3-2-2-5**).

(**Figure 3-2-2-5**).

Figure 3-2-2-5 Changes in internet traffic (fixed-line broadband download traffic)



(Source) MIC (2022), "Aggregate results of Internet traffic in Japan (in November 2021)"³⁰

²⁸ Development rate of master station (advanced specified base station) in 10km-square area (around 4500 areas nationwide)

²⁹ https://www.soumu.go.jp/main_content/000803507.pdf

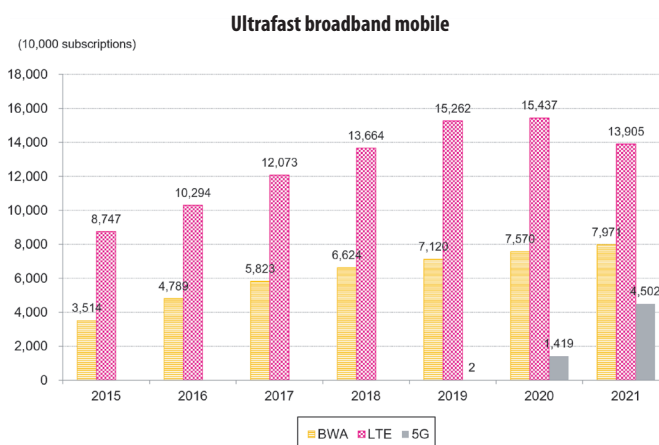
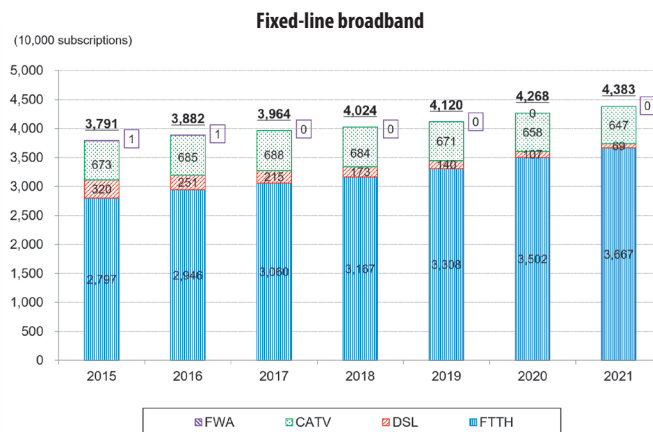
³⁰ https://www.soumu.go.jp/joho_tsusin/eidsystem/market01_05_03.html

(5) State of broadband utilization

At the end of fiscal 2021, the number of fixed-line broadband subscriptions³¹ reached 43.83 million (2.7% increase from the previous fiscal year). The breakdown of the number of ultrafast mobile broadband subscrip-

tions is: 139.05 million (9.9% decrease) for 3.9/4G mobile phones (LTE); 45.02 million (by 30.83 million from the year before) for 5G mobile phones; and 79.71 million (5.3% increase) for BWA (Figure 3-2-2-6).

Figure 3-2-2-6 Changes in the number of fixed-line broadband subscriptions³²



(Source) MIC, "Quarterly data on the number of subscribers and the market share of telecommunications services (the 4th quarter of fiscal 2021 (at the end of March))" https://www.soumu.go.jp/menu_news/s-news/01kiban04_02000206.html

(6) State of the number of subscriptions with voice communication services

In recent years, while the number of fixed communication subscriptions (NTT East/West subscribed telephone, chokushu (dedicated line) telephone³³ and CATV telephone, excluding 0ABJ IP telephone) has been declining, the number of subscriptions with mobile com-

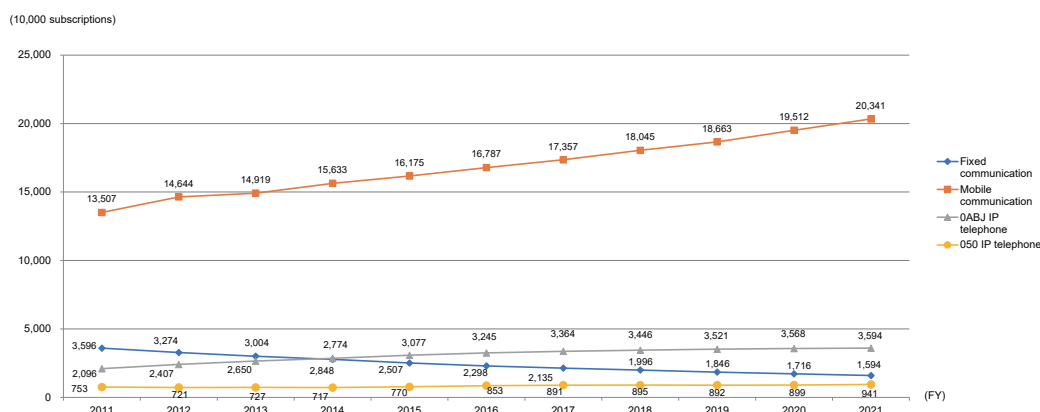
munication (mobile phone, PHS and BWA) and 0ABJ IP telephones has been steadily increasing. The number of mobile communication subscriptions was about 12.8 times the number of fixed communication subscriptions in fiscal 2021. The number of subscriptions of 050 IP telephone has been almost unchanged in recent years (Figure 3-2-2-7).

³¹ The number of fixed-line broadband subscriptions is the sum of the subscriptions of FTTH, DSL, CATV (coaxial, JFC) and FWA.

³² This is the number of subscriptions with 5G, LTE and BWA and does not include subscriptions with 3G or PHS.

³³ Chokushu telephone is subscribed telephone service by telecommunications carriers other than NTT East/West and includes choku subscription, choku subscription ISDN, new-type chokushu and new-type chokushu ISDN.

Figure 3-2-2-7 Changes in the number of subscriptions with voice communication services



*1 Mobile communication is the sum of mobile phones, PHS and BWA.

*2 Values of mobile communication since fiscal 2013 are "after adjustment of intra-group transactions," namely, when an MNO as MVNO received a mobile-phone or BWA service from other MNO of the group and provided the service combined with its own service through one mobile phone, etc., this is counted as one subscription.

(Source) MIC, "Quarterly data on the number of subscribers and the market share of telecommunications services (the 4th quarter of fiscal 2021 (at the end of March))" https://www.soumu.go.jp/menu_news/s-news/01kiban04_02000206.html

(7) International comparison of telecommunication charge

In comparison of the communication charge of six cities—Tokyo (Japan), New York (US), London (UK), Paris (France), Düsseldorf (Germany) and Seoul (Korea)—, smartphone bills in Tokyo (new 4G contracts with the top MNO share operator) are at a medium level

for plans with a monthly data volume of 2GB and 5GB, and at a low level for plans with 20GB.

Regarding fixed-telephone bills, the basic rate and local-call rate for three minutes at 12:00 on weekday are at a medium level.



Related data

International comparison of fixed telephone charge based on individual charge (FY2021)

International comparison of mobile phone bill based on model

Source: MIC, "FY2021 Survey on domestic-overseas price difference of telecommunication service"

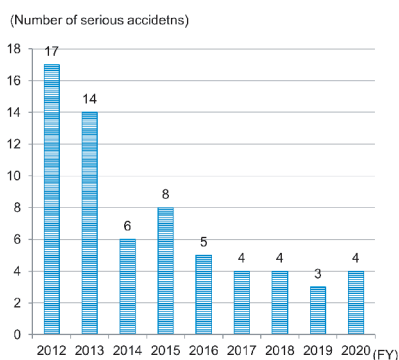
URL: https://www.soumu.go.jp/menu_news/s-news/01kiban03_02000789.html

(8) Occurrences of telecommunication service accidents

The number of reported accidents that require quarterly reporting was 6,610 in fiscal 2020. Among them,

four were serious accidents.³⁴ The number has been almost unchanged since fiscal 2017 (Figure 3-2-2-8).

Figure 3-2-2-8 Changes in the number of serious accidents



(Source) MIC, "Occurrences of telecommunication service accidents (Fiscal 2020)" https://www.soumu.go.jp/menu_news/s-news/01kiban05_02000229.html

³⁴ Accidents falling under "if -snip - any other serious accident specified by Order of the Ministry of Internal Affairs and Communications has occurred with respect to its telecommunications operations, it must report without delay to the Minister for Internal Affairs and Communications to that effect including its reason or cause" of Article 28 of the Telecommunications Business Act

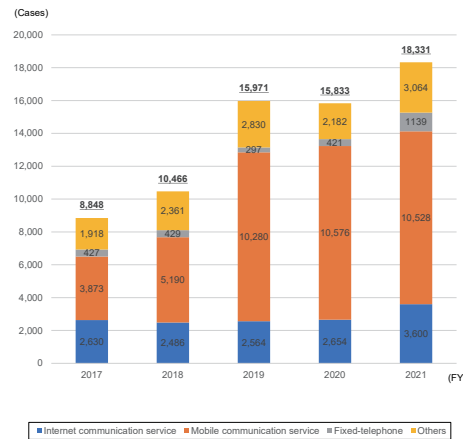
(9) Complaints/requests for consultation on telecommunication service, and requests for consultation on illegal/harmful information

i Complaints/requests for consultation on telecommunication service

The number of complaints/requests for consultation

on telecommunication service sent to MIC increased to 18,331 in fiscal 2021 from the previous year (**Figure 3-2-2-9**).

Figure 3-2-2-9 Changes in the number of complaints/requests for consultation sent to MIC



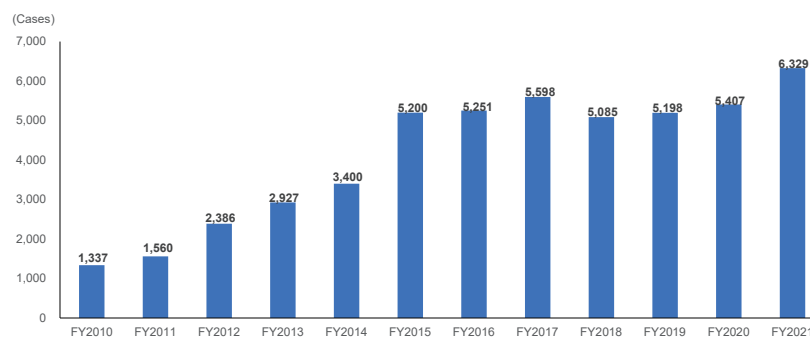
(Source) Prepared by MIC

ii Request for consultation on illegal/harmful information

The number of consultations provided at the Illegal Harmful Hotline operated by MIC increased about five-

fold to 6,329 from fiscal 2010, when consultation started (**Figure 3-2-2-10**). The top five operators involved were Twitter, Google, Meta, 5 Channel and LINE.

Figure 3-2-2-10 Changes in the number of requests for consultation on illegal/harmful information



Related data

Breakdown of the number of consultations provided at the Illegal Harmful Hotline by business operator

Source: MIC, "2021 Report on consultations on illegal harmful information on the internet and other contract operations (summary)" p8
URL: https://www.soumu.go.jp/main_content/000814645.pdf

3. New technology development

(1) IOWN (Innovative Optical and Wireless Network) Concept

NTT is leading an initiative toward technical innovation by introducing optical technologies to all networks, computing and semiconductors. It is expected to bring about a paradigm shift and become a game changer in the near future.³⁵

(2) IoT network using low earth orbit satellites

Rakuten Mobile and the University of Tokyo began

joint research and development into "IoT ultra-coverage utilizing low Earth orbit (LEO) satellites" in November 2021.³⁶ The project aims at IoT ultra-coverage by using communication satellites to expand the area coverage to 100% of the national land and to realize long-distance communication with the existing narrowband IoT (telecommunications standard for IoT equipment with advanced narrowband and low power consumption) and IoT terminals.

³⁵ https://www.soumu.go.jp/main_content/000781800.pdf

³⁶ https://corp.mobile.rakuten.co.jp/news/press/2021/1129_01/