II-3-1 Backbone networks

High-speed optical submarine cable networks at the speed of 80 Gbps are to be established around the Japanese archipelago.

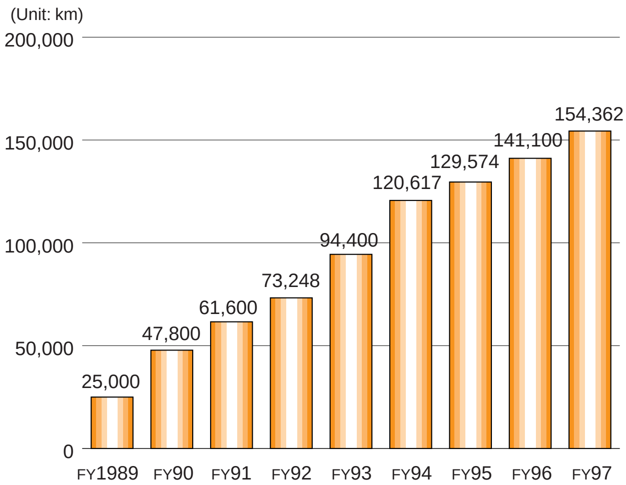
Domestic backbone networks have been growing year on year within Japan, in response to an explosive increase in traffic. In fiscal 1997, NTT's fiber-optic backbone lines grew 9.4% over the previous fiscal year, reaching a total cable length of 154,362 km (Fig. 1).

In April 1999, KDD Corp. began operation of a 100-Gbps "Japan Information Highway" (JIH) optical submarine cable network with 17 landing stations, which loops the Japanese archipelago (Fig. 2).

Thirty-five years have elapsed since 1964, when the first telecommunications cable to be laid below the Pacific Ocean, Trans-pacific Cable No. 1 (TPC-1). Such coaxial submarine cable systems have already replaced with fiber-optic ones, such as the Trans-pacific Cable No. 5 Cable Network (TPC-5CN) (Fig. 3).

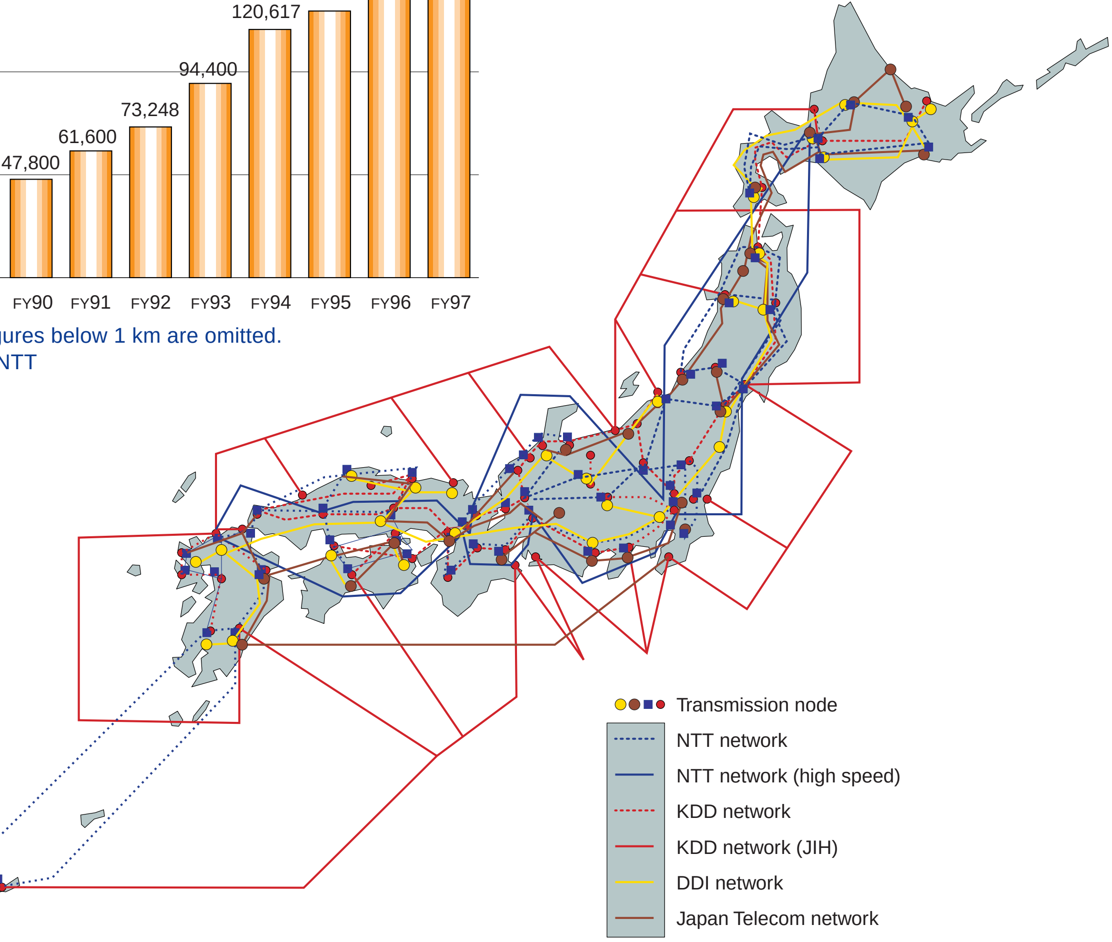
To deal with growing traffic, there are plans to lay new optical submarine cable networks with a larger transmission capacity than ever before. A new loop-shaped Japan-US Cable Network, with a capacity of 80-Gbps, connecting Japan, Hawaii and the mainland of the U.S., will go into operation at the beginning of 2000 and will be upgraded to 640-Gbps capacity in the future. Meanwhile, the China-US Cable Network, which will have landing stations in Japan, the U.S., China, Republic of Korea and Taiwan, will start operation at the end of 1999 (Table).

Fig. 1 Growth of NTT's fiber-optic backbone network



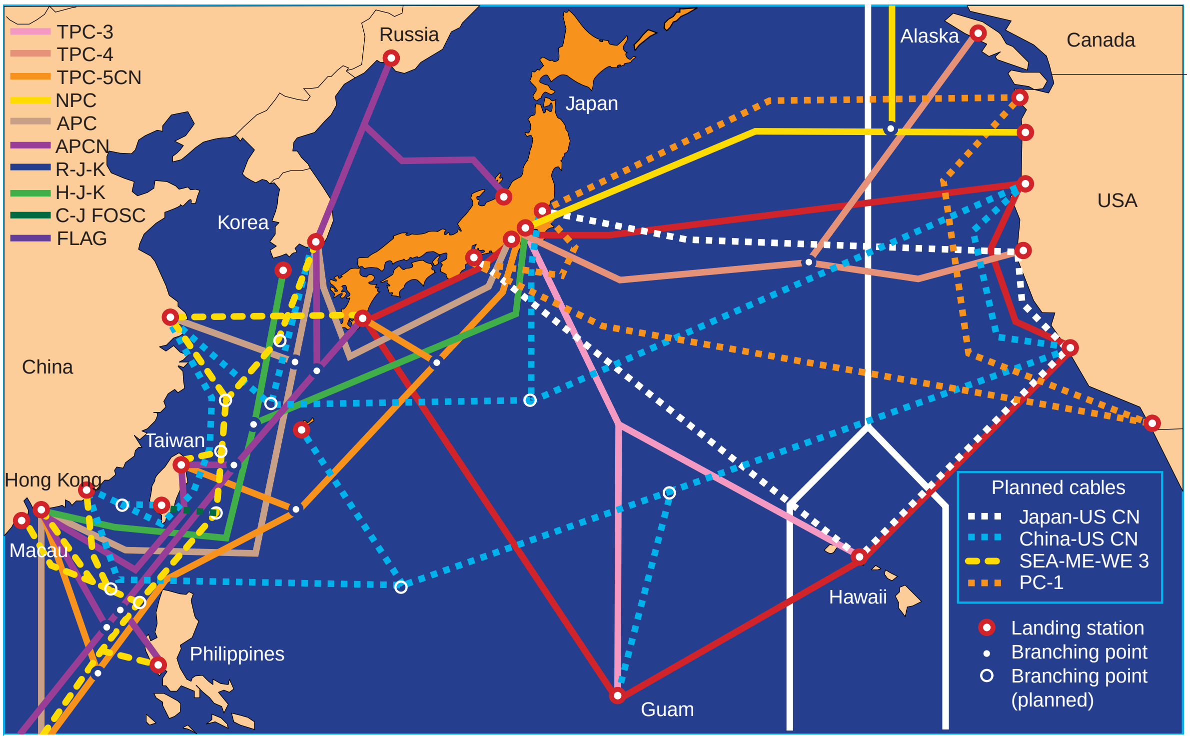
Note: Figures below 1 km are omitted.
Source: NTT

Fig. 2 Domestic backbone networks



Sources: NTT, KDD, DDI and Japan Telecom

Fig. 3 Japan's connection to international submarine cable systems (February 1999)



Name	Transmission capacity (bps)	Distance (km)	Start of operation (year)	Landing point
TPC-3	840M	9,070	1989	Japan (Chikura), USA (Guam, Hawaii)
TPC-4	1.12G	9,850	1992	Japan (Chikura), USA (Point Arena), Canada (Port Alberni)
TPC-5CN	10G	25,000	1995, 1996	Japan (Miyazaki, Ninomiya), USA (Bandon, San Luis Obispo, Hawaii, Guam)
NPC	420M	30,000	1990	Japan (Miura), USA (Pacific City, Seward)
APC	1.68G	7,500	1993	Japan (Miyazaki, Miura), Taiwan (Toucheng), Hong Kong, Malaysia, Singapore
APCN	10G	15,000	1996, 1997	Japan (Miyazaki), Korea (Pusan), Taiwan (Toucheng), Hong Kong, Philippines, Malaysia, Singapore, Thailand, Indonesia, Australia
R-J-K	1.12G	1,715	1995	Japan (Naoetsu), Russia (Nakhodka), Korea (Pusan)
H-J-K	560M	4,600	1990	Japan (Chikura), Korea (Chejudo), Hong Kong
C-J FOSC	560M	1,250	1993	Japan (Miyazaki), China (Nanhui)
FLAG	10G	27,000	1998	Japan (Ninomiya), Korea (Kojedo), China (Nanhui), Hong Kong, Thailand, Malaysia, India, UAE, Jordan, Egypt, Italy, Spain, UK

Sources: Various

Table Major Pacific Ocean submarine cable networks (February 1999)

Name	Transmission capacity (bps)	Distance (km)	Start of operation (year)	Landing point
Japan-US CN	80G	21,000	2000	Japan (Minami-Shima, Maruyama, Kita-Ibaraki), USA (Manchester, Morro Bay, Makaha)
China-US CN	80G	30,000	1999	Japan (Chikura, Okinawa), China (Chongming, Swatow), Korea (Pusan), Taiwan (Fangshan), USA (Bandon, San Luis Obispo, Guam)
SEA-ME-WE 3	20G	38,000	1999	Japan (Okinawa), Korea (Kojedo), China (Shanghai, Swatow), Taiwan (Toucheng, Fangshan), Hong Kong, Macao, the Philippines, Brunei Darussalam, Vietnam, Singapore, Malaysia, Indonesia, Australia, Thailand, Myanmar, Sri Lanka, India, Pakistan, UAE, Oman, Djibouti, Saudi Arabia, Egypt, Turkey, Cyprus, Greece, Italy, Morocco, Portugal, France, UK, Belgium, Germany
PC-1	160G	20,900	1999, 2000	Japan (Ajigaura, Shima), USA (Norma Beach, Toro Creek)

Sources: Various

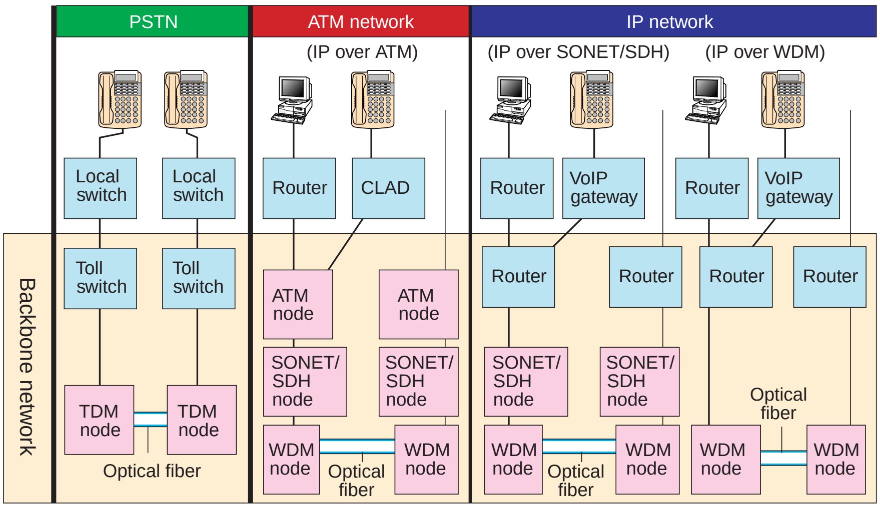
II-3-2 Internet Protocol networks

To keep pace with growing demand, voice signals will be processed as part of data traffic.

Services based on Internet Protocol (IP) networks, including Internet telephony (Refer to I-2-5-(8)), are already in use in Japan. To accommodate growing data traffic, major telecommunications carriers are planning to build backbone IP networks, in addition to the existing public switched telephone networks (PSTNs) based on the circuit switching system (Table). IP-based backbone networks use high-speed routers based on the packet switching system, by converting voice signals into IP packets to process as part of data traffic.

At the same time, some carriers are constructing asynchronous transfer mode (ATM)-based backbone networks. The ATM network has two advantages: it has circuit switching functions that maintain transmission speed and service quality regardless of traffic density, and packet switching functions that use circuits efficiently and cut communications costs (Fig.).

Fig. Examples of PSTN and future backbone networks



SONET: synchronous optical network, SDH: synchronous digital hierarchy,
TDM: time division multiplexer, WDM: wavelength division multiplexer,
VoIP: voice over Internet protocol, CLAD: cell assembly and disassembly

Table Major carriers' backbone network plans

Carriers		Plans
U.S. and others	AT&T, British Telecom	By establishing a joint venture, AT&T Corp. and British Telecommunications plc plan to construct 200-Gbps IP networks combining voice and data, in the next phase, Tbps-class routers will be installed and connect 100 cities.
	Level 3 Communications, Inc., Qwest Communications International Inc., IXC Communications, Inc. and others	By constructing their own fiber-optic networks for IP over SONET with routers, connect corporate customers in larger cities
	Sprint Corp. (ION: Integrated On-demand Network), Bell Atlantic Corp. and others	IP over ATM combining voice and data
Japan	NTT	For the time being, 2 backbone networks will coexist: ATM networks integrating data, and a synchronous transfer mode (STM) circuit switching network for voice.
	Japan Telecom (PRISM)	Backbone networks will be improved by using IP over SONET (and IP over WDM in the future), scheduled to be in operation from the beginning of 2000. The existing telephone network will be gradually replaced with IP over SONET within 10-20 years.
	KDD (KTH21)	High-speed routers with optical fiber will be introduced in the domestic backbone networks by 2005 and international backbone networks by 2010.
	Power Nets Japan (PIN)	Ten electric power companies will construct IP over WDM backbone networks by 2000.
	DDI	IP over WDM backbone networks, integrating data communications using cellular and PHS terminals, are scheduled to start operation in 2002.
	Cross Wave Communications Inc.	In operation from April 1999, the carrier offers data communications services using WDM and SONET/SDH technologies; line facilities are leased from KDD.

Note: Acronyms in parentheses indicate names of new networks.
Sources: Relevant carriers

II-3-3 Subscriber local loop

New access methods are entering the communications market.

Subscriber local loops connected to public switched networks, which have up to now consisted mainly of fixed telephones, have been diversifying with the growing use of radio waves for mobile communications and rising demand for high-speed data communications.

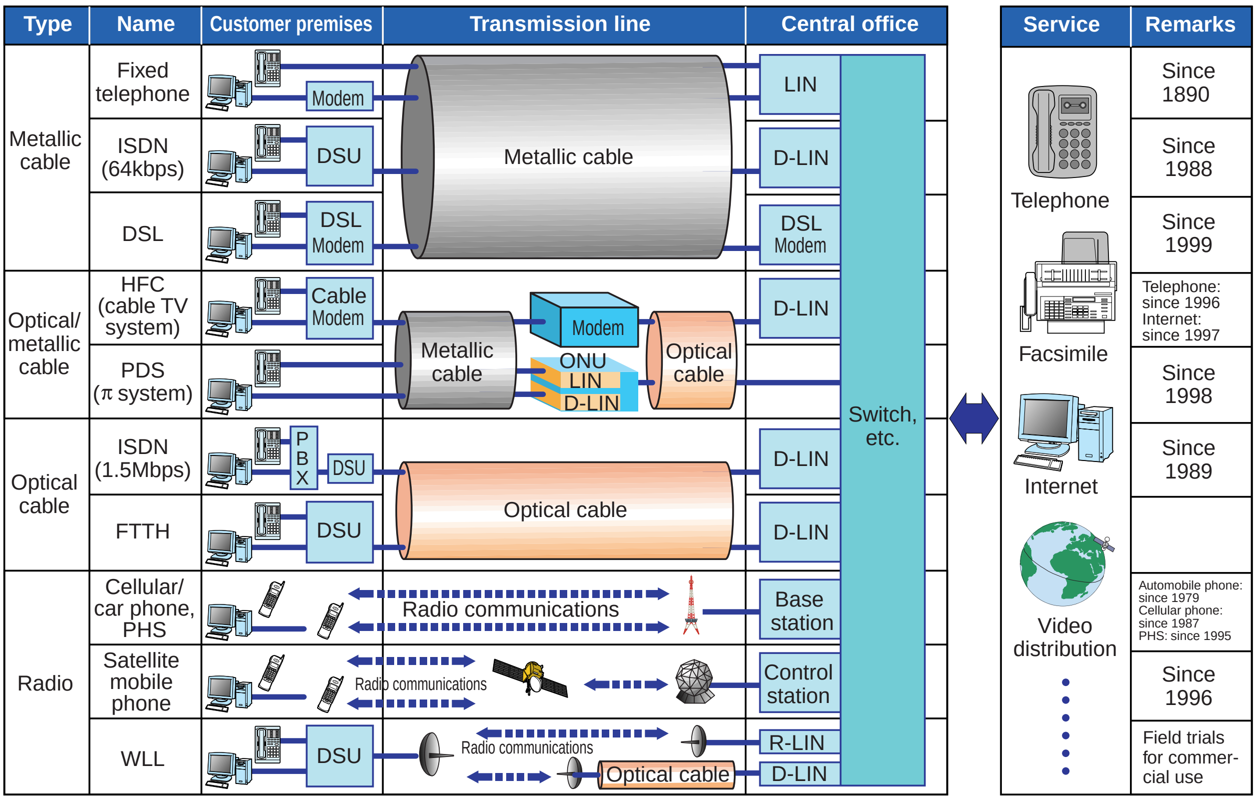
For metallic subscriber local loops, the new "digital subscriber line (DSL)," technology now in commercial use enables existing subscriber line cables to carry high-speed transmissions. There are several types of DSL, such as asynchronous DSL (ADSL), which is asymmetric, with different data rates for upstream transmissions to the customer and downstream ones (at 6 Mbps); symmetric DSL (SDSL), and others.

For hybrid metallic/fiber-optic subscriber local loops, NTT has a π system for existing low bit-rate services, including telephony and a basic rate interface ISDN service called "INS Net 64." The π system shares a single optical fiber for multiple customers from the central office to an optical network unit (ONU) installed on a nearby utility pole, from which a metallic subscriber local loop connects to each customer. This system was introduced in Kobe's Nagata Ward in March 1998 for the first time in Japan. With fiber-optic cable installed near customers' premises, the π system can cope with demand for broadband communications.

Meanwhile, cable television networks are increasingly being used for high-speed Internet access at a relatively low connection charge for unlimited transmissions, through the construction of a LAN between a cable television server and subscribers.

The wireless local loop (WLL) system is also attracting attention. It is expected to encourage competition in local markets and expand broadband communications. With WLL, since outside equipment such as fiber-optic or metallic subscriber loops can be replaced with radio communications, network construction costs are reduced. The system enables, for example, the collective construction of a subscriber local loop in a village and is thus especially well suited to rural or remote areas.

Fig. Subscriber local loop networks



D-LIN: Digital Subscriber Circuit R-LIN: Radio Subscriber Circuit DSU: Digital Service Unit PDS: Passive Double Star
DSL: Digital Subscriber Line WLL: Wireless Local Loop FTTH: Fiber-To-The-Home ONU: Optical Network Unit HFC: Hybrid Fiber/Coax

II-3-4 Mobile communications

Tokyo has the highest density of cellular telephones in Japan, while Miyagi Prefecture has the highest percentage of PHS subscribers.

By the end of fiscal 1997, about 25% of people in Japan subscribed to cellular telephone services, and 5.3% to Personal Handyphone System (PHS) services.

By prefecture, the highest penetration rate for cellular telephones was achieved by Tokyo, which had more than 40 terminals per 100 people (Fig. 1).

For PHS terminals, Miyagi Prefecture had the highest penetration rate, at more than 10 terminals per 100 people (Fig. 2).

Fig. 1 Density of cellular telephones by prefecture (end of fiscal 1997)

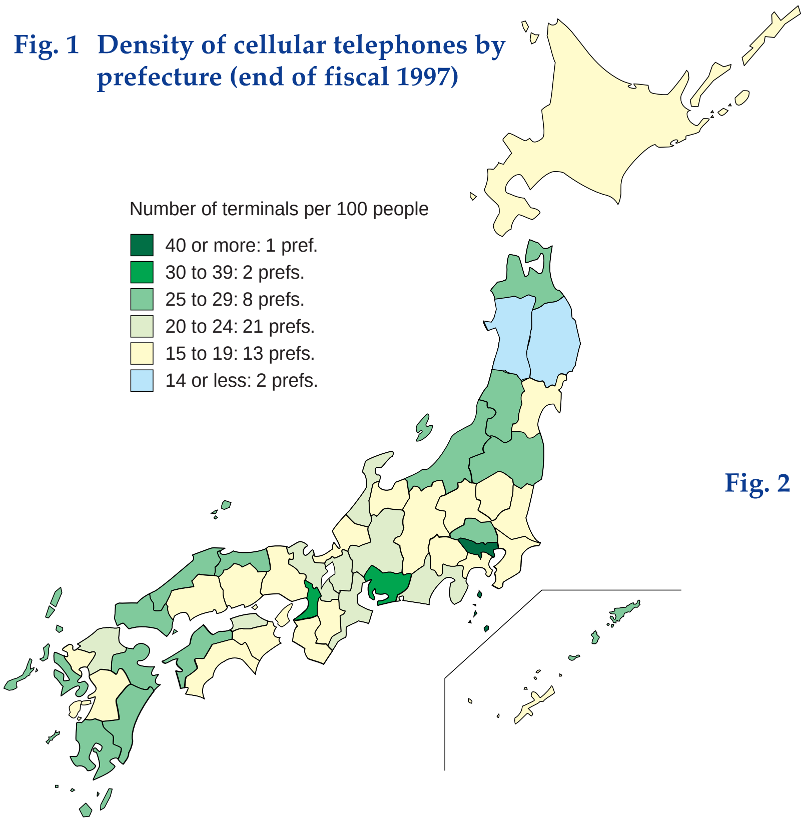
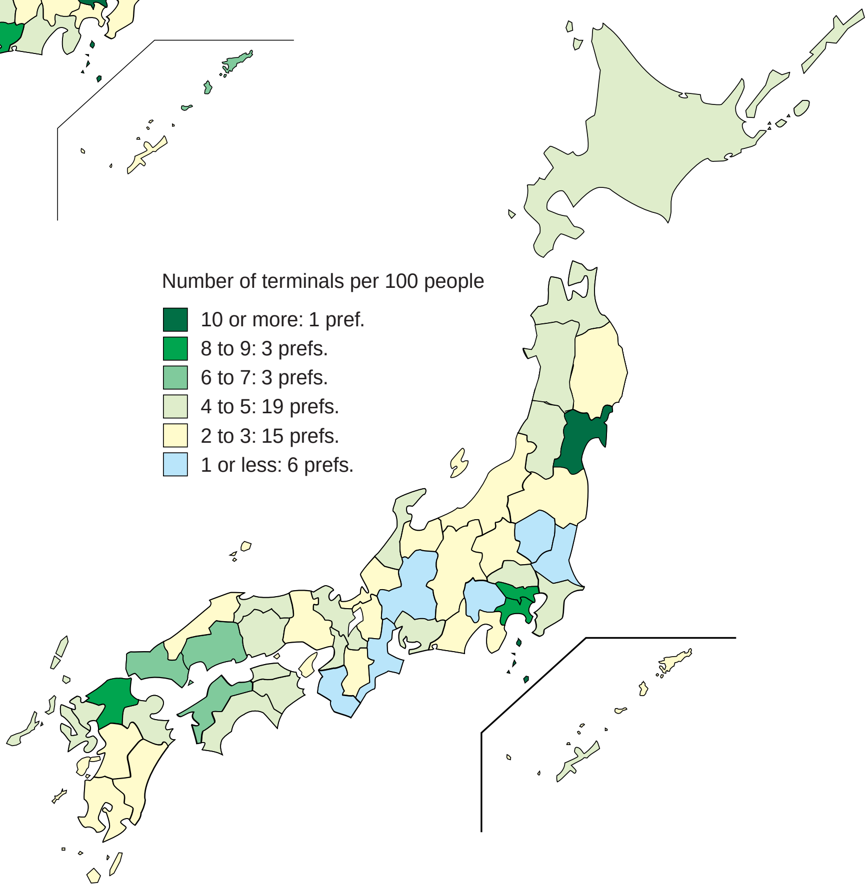


Fig. 2 Density of PHS terminals by prefecture (end of fiscal 1997)



Sources: Relevant carriers

II-3-5 Satellite

Satellite businesses are increasing along with the lifting of restrictions on foreign capital investment and expansion of communications and broadcasting services.

1. Domestic services

Ten geostationary satellites were in use by Type I telecommunications carriers for domestic services in Japan, as well as 304 transponders, at the end of fiscal 1998 (Table).

Following the removal in February 1998 of all limitations on foreign capital investment in Type I telecommunications business (except for NTT and KDD), PanAmSat International Systems Inc. entered Japan's domestic satellite communications market in April 1998. This brought to four the number of Type I telecommunications carriers offering domestic satellite communications services via their own satellites: Japan Satellite Systems Inc. (JSAT), Space Communications Corp. (SCC), NTT and PanAmSat.

Three of these companies' satellites (JSAT's "JCSAT," SCC's "SUPERBIRD" and the PanAmSat satellite) are mainly used for intracompany communications, distribution of cable television programs, CS digital broadcasting and satellite Internet access services. NTT's satellite "N-STAR" is mainly used for satellite mobile communications and for alternative routing in the case of a natural disaster.

Meanwhile, three broadcasting satellites were in use by the end of fiscal 1998 (Table). The BSAT-1a satellite is used for television broadcasting, including Hi-Vision broadcasting; BSAT-1b and BS-3N are back-ups to BSAT-1a.

2. International services

At the end of fiscal 1998, at total of 22 geostationary satellites were in use by Type I telecommunications carriers in Japan to provide international telecommunications services, and the number of transponders totaled 717 (Table; Refer to Appendix 10). These satellites are owned by foreign operators, except for those used for both domestic and international services owned by JSAT and SCC.

Voice transmission and video transmission are among the major international services offered by KDD Corp., International Digital Communications Inc. (IDC) and Japan Telecom Co., Ltd. (JT) via INTELSAT or other C-band satellites owned by private operators. These satellites are also used for overseas broadcasting by foreign broadcasters (Refer to Appendix 10).

3. Others

In January 1999, Nippon Iridium Corp. started a worldwide, low Earth orbit (LEO) satellite mobile telephone service, using 66 satellites.

Table Satellites for domestic services

Type	Operator	Name	Number of transponders: C-band	Ku-band	Others
Communications satellite	Japan Satellite Systems, Inc. (JSAT)	JCSAT-2 (I, C) JCSAT-3 (C) JCSAT-4 (C) JCSAT-5	-- 12 12 --	32 28 28 32	-- -- -- --
	Space Communications Corp. (SCC)	SUPERBIRD-A (I) SUPERBIRD-B (I) SUPERBIRD-C (C)	-- -- --	23 23 24	Ka (3) Ka (3) --
	NTT	N-STARa N-STARb	6 6	8 8	S (1), Ka (11) S (1), Ka (11)
	PanAmSat	PAS-2	16	16	--
Broadcasting satellite	Broadcasting satellite system (B-SAT)	BSAT-1a BSAT-1b BS-3N	-- -- --	4 4 3	-- -- --

Note: I (including international services), C (including CS broadcasting)

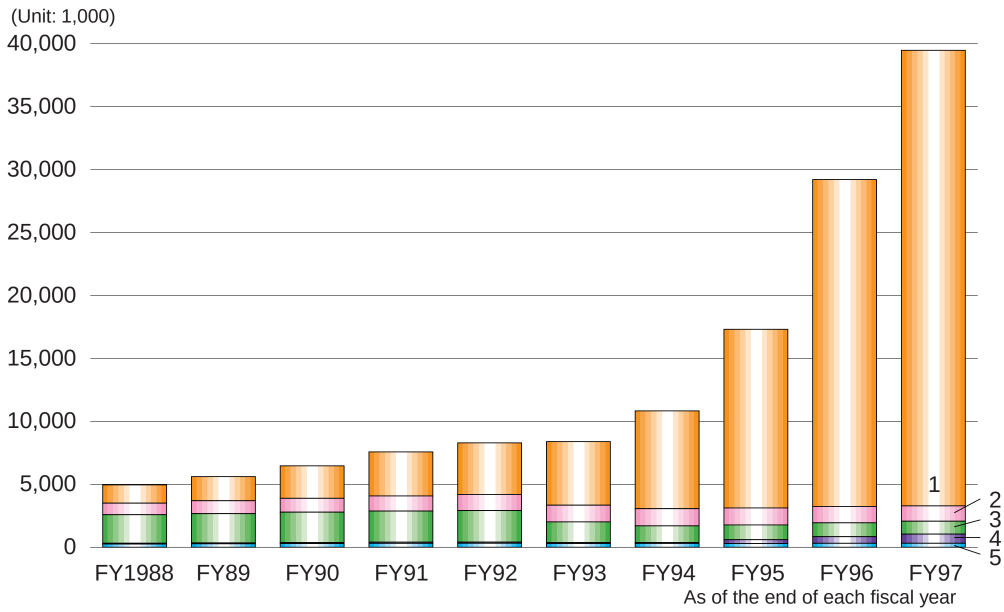
II-3-6 Radio stations

There were some 40 million radio stations as of the end of fiscal 1997, up by about 10 million over fiscal 1996.

There were 39,478,889 radio stations operating in Japan at the end of fiscal 1997 (excluding PHS and cordless telephones requiring no license), up by 10,267,406, or 35.1%, from fiscal 1996. Over the three fiscal 1995, 1996 and 1997, the number of radio stations almost quadrupled.

This explosive growth was caused mainly by increases in land mobile stations, such as cellular phones, which by the end of fiscal 1997 surpassed 90% of all radio stations. In addition, the number of base cell stations rose sharply along with expanding service areas for cellular and PHS phones, recording a 20% increase to 202,160 stations compared with the previous fiscal year (Fig.; Refer to Appendices 11 and 12).

Fig. Number of radio stations



	FY1988	FY89	FY90	FY91	FY92	FY93	FY94	FY95	FY96	FY97
Land mobile stations 1	1,452	1,916	2,581	3,497	4,098	5,051	7,770	14,192	25,975	36,192
Amateur radio stations 2	917	1,027	1,101	1,203	1,283	1,326	1,364	1,350	1,296	1,220
Simple radio stations 3	2,268	2,321	2,410	2,473	2,506	1,641	1,325	1,173	1,102	1,024
Base stations 4	64	73	84	91	90	78	77	303	527	729
Others 5	253	274	292	310	316	296	298	297	312	314
Total	4,955	5,611	6,468	7,574	8,293	8,392	10,834	17,316	29,211	39,479
Growth rate (%)	10.6%	13.3%	15.3%	17.1%	9.5%	1.2%	29.1%	59.8%	68.7%	35.1%

Notes:
1. Land mobile stations: Radio stations operated while moving or when posting at an unspecified site (e.g., cellular phones)
2. Simple radio stations: Radio stations for simple radio communications service (e.g., personal radio)
3. Base stations: Fixed radio stations opened on the ground for communications with land mobile stations (e.g., PHS cell stations)

Source: MPT

II-3-7 Terrestrial broadcasting

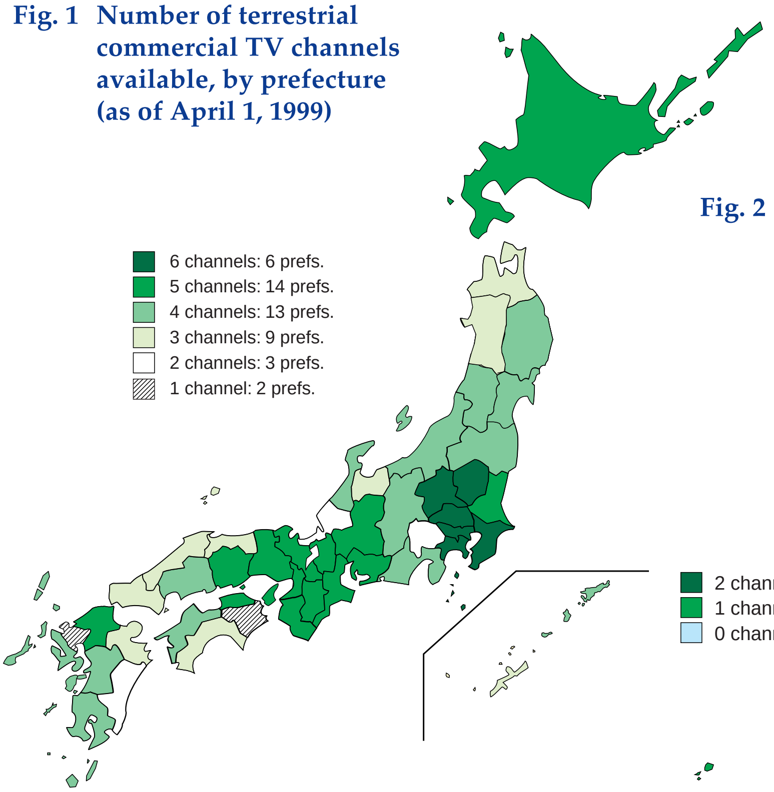
About 90% of households in Japan can receive more than six terrestrial TV channels.

In addition to NHK's two terrestrial TV channels and one terrestrial FM radio channel, MPT's basic policy is to allocate four TV channels for terrestrial commercial broadcasters in each prefecture and more than five channels for major districts, as well as one FM radio channel for terrestrial commercial broadcasters in each prefecture and two channels for major districts.

As a result, by April 1, 1999, of Japan's 47 prefectures, 33 had surpassed MPT's target number for TV channels, representing 89.0% of all Japanese households. (This figure was calculated using data from the Residents Registration Ledger of March 31, 1998.) Meanwhile, the target for commercial FM radio broadcasting was met in 43 prefectures, representing 94.6% of all Japanese households (as for commercial AM broadcasters, refer to Appendix 13).

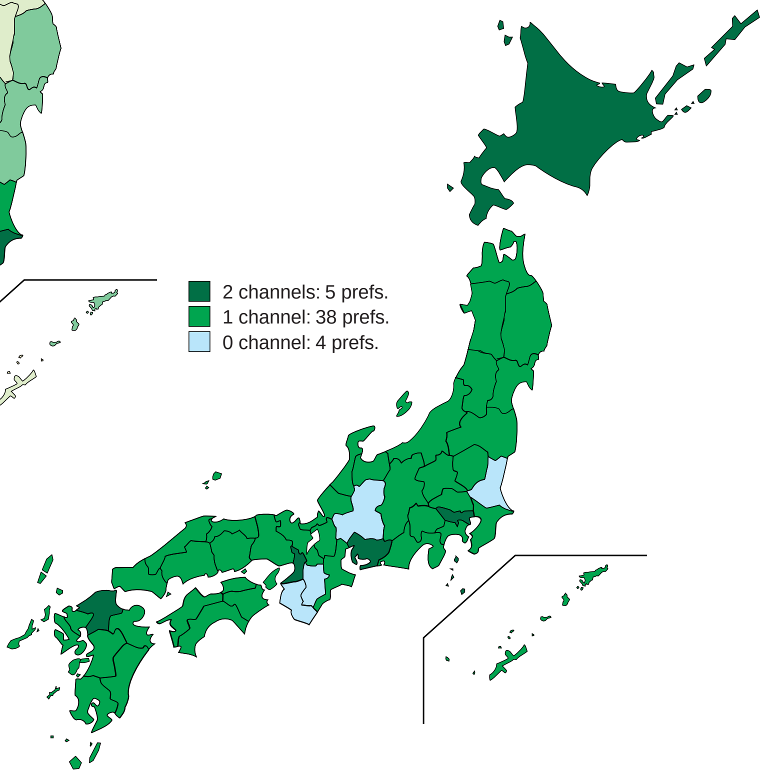
With the expansion of broadcasting, the number of community FM radio stations reached 118 in fiscal 1998, while there were three foreign language FM radio stations: one each in Tokyo, Osaka and Fukuoka (Refer to Appendix 14; as for the number of terrestrial broadcasting stations, refer to Appendix 15).

Fig. 1 Number of terrestrial commercial TV channels available, by prefecture (as of April 1, 1999)



Note: As of April 1, 1999, there were no stations with provisional licenses.

Fig. 2 Number of terrestrial commercial FM radio channels available, by prefecture (as of April 1, 1999)



Notes: 1. Community FM stations and foreign language FM stations are excluded.
2. As of April 1, 1999, there were no stations with provisional licenses.

Source: MPT

II-3-8 Cable Television

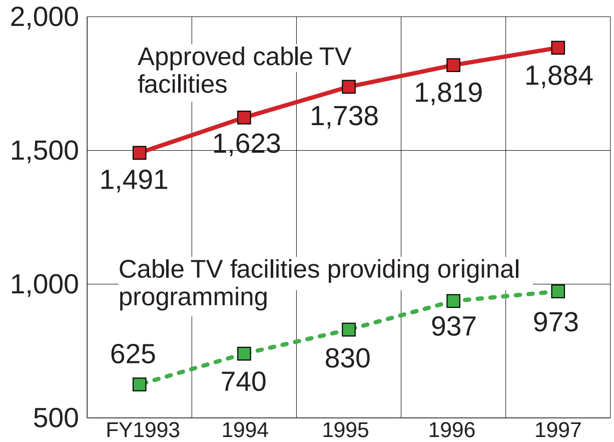
The number of cable TV facilities has been on the rise.

The number of cable TV facilities in Japan totaled 68,234 at the end of fiscal 1997, up 3.0% over the previous fiscal year.

By scale, the number of approved cable TV facilities was 1,884 (up 3.6% over the previous fiscal year); the number of cable TV facilities that submit notice was 35,474 (up 2.1%); and the number of small-scale cable TV facilities that submit notice was 30,876 (up 3.9%).

By service, 973 facilities provide original programming, up 3.8% from the previous fiscal year, and 67,261 providing retransmission programming only (up 2.9%).

Fig. Number of cable TV facilities



Classification		FY1993	1994	1995	1996	1997
Approved facilities:	1	416	484	538	614	640
	2	1,075	1,139	1,200	1,205	1,244
	Total	1,491	1,623	1,738	1,819	1,884
Facilities with notification:	3	209	256	292	323	333
	4	31,390	32,491	33,490	34,413	35,141
	Total	31,599	32,747	33,782	34,736	35,474
Small-scale cable TV facilities with notification:	5	25,860	27,236	28,443	29,717	30,876
	6	625	740	830	937	973
Total	7	58,325	60,866	63,133	65,335	67,261
Grand total		58,950	61,606	63,963	66,272	68,234

1. Facilities providing original programming
2. Facilities providing retransmission programming only
3. Facilities providing original programming
4. Facilities providing retransmission programming only
5. Facilities providing retransmission programming only
6. **Facilities providing original programming**
7. Facilities providing retransmission programming only

Notes: 1. Approved facilities: Facilities with 501 or more drop terminals
2. Facilities with notification: Facilities with 51 to 500 drop terminals
3. Small-scale cable TV facilities with notification: Facilities with 50 or less drop terminals and providing retransmission programming only
4. “Facilities providing original programming” include facilities broadcasting original programming by leasing unused channels from other cable TV operators.

Source: MPT

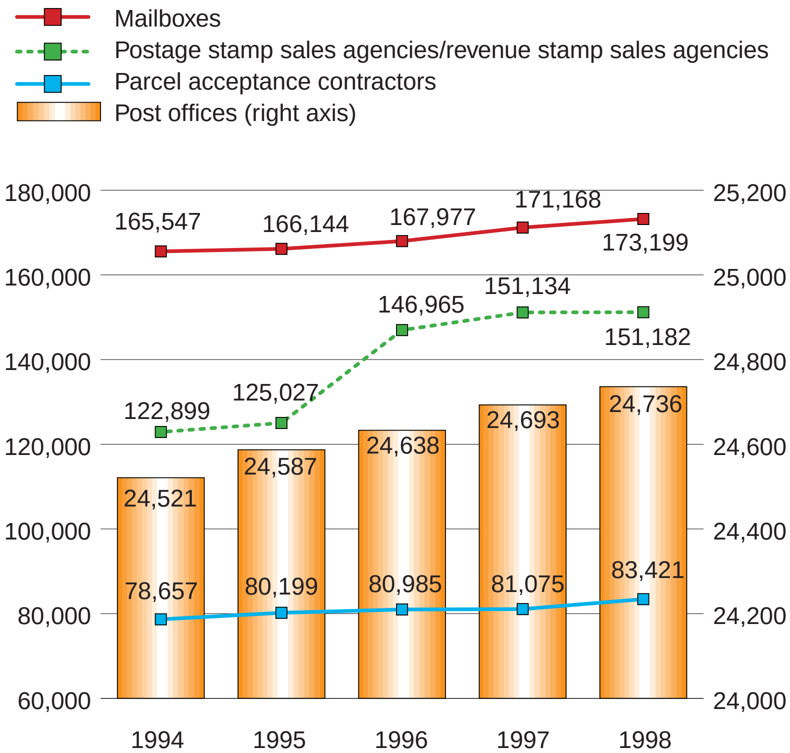
II-3-9 The postal network

Further strengthening of the nationwide postal network of postal facilities

At the end of fiscal 1998, there were 24,736 post offices in Japan, 173,199 mailboxes (the preliminary report), 151,182 postage stamp sales agencies/revenue stamp sales agencies and 83,421 parcel acceptance contractors (the preliminary report), all of which have been increasing (Fig. and Table).

In June 1998, in cooperation with MPT, commercial carriers started using Japan's postal network to handle some of their parcels (mainly chilled goods) as mail items. For this purpose, MPT had concluded business tie-up agreements with 12 commercial carriers as of the end of March 1999.

Fig. Number of postal facilities



Note: Figures for mailboxes, postage stamp sales agencies and parcel acceptance contractors are based on the preliminary report.

Table Number of post offices

Classification	FY1994	FY1995	FY1996	FY1997	FY1998
Ordinary post offices	1,327	1,319	1,321	1,324	1,315
Collection and delivery post offices	1,267	1,260	1,262	1,265	1,257
Non-collection-delivery post offices	60	59	59	59	58
Special post offices	18,575	18,654	18,711	18,764	18,832
Collection and delivery post offices	3,697	3,692	3,682	3,655	3,656
Non-collection-delivery post offices	14,878	14,962	15,029	15,109	15,176
Postal agencies	4,619	4,614	4,606	4,605	4,589
Total	24,521	24,587	24,638	24,693	24,736

Note: Figures are as of the end of each fiscal year.

Sources: MPT