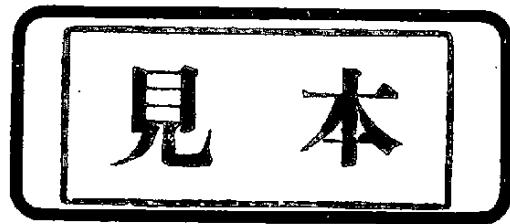


# JIPDEC

1995

## Informatization

## Quarterly



*Mobile Communications  
and All about PHS*

**JIQ No. 102**



# JIPDEC Informatization Quarterly

1995

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No. 102



## From the Editor

In August, 1995, the number of new cellular phone subscribers reached the 400,000 level. The total number of subscribers as of the end of August was 6,231,500, finally passing the 6 million level. According to DDI, the rapid growth of new subscribers is explained by a synergistic effect with PHS services which started in July of this year. The number of new PHS subscribers (in the number of sets in operation) in the Tokyo district was 23,000 in August, but the total number was already approaching 100,000 by the end of August.

PHS is a new micro digital cellular phone service that was developed as a personal cordless telephone for not only indoor use, but also outdoors. This service is unique to Japan. Short-distance communication fees for PHS, are far less than cellular phones, about one-fifth. PHS surely has some shortcomings. For example, its service area is small and it cannot be used during high-speed travel. However, PHS terminals can have many added functions even though they are ex-

tremely compact. PHS and cellular phones will have expanding applications in different areas where their unique characteristics can be taken advantage of.

In August 1994, the Ministry of Posts and Telecommunications (MPT) set up a "Study Group on Multimedia Mobile Communications" headed by the Director-General of the Telecommunications Bureau to respond to advancing and diversifying user needs for mobile communications. The group studied mobile communication systems for the multimedia age and summarized the results in a report at the final meeting held in April 1995.

The report says the market, including mobile communication services, equipment and multimedia services, amounted to about 1.7 trillion yen and employed about 40,000 people in 1994. It projects that the market will grow to about 15.7 trillion yen and about 520,000 employees by 2010. They predict two major directions for the future development of mobile communications.

One is wireless systems, providing multimedia services that would be available on B-ISDN and cable systems, and the other is services that take greater advantage of mobility and portability. It says that various improvements must be made and problems must be solved before realizing such services. For example, communication software and OS for mobile communications must be improved; environmental preparations, such as clarification of usable frequency bands, must be made for technological development; and internationally-agreed standards should be formulated from the development stage.

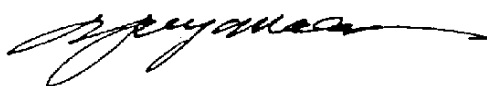
Rapid advances in information and communication technology are bringing about the multimedia age. Multimedia is about to exert major influence not only on industry and society, but also on individuals and their lifestyles. In other words, it will be possible for anybody to produce and send information. For example, new technology will supplement the existing media in supplying information in a time of a disaster such as the Great Hanshin Earthquake. PHS will mainly be a voice service for the immediate future, but its uses will be expanded to various directions because PHS terminals are most suitable for ex-

changing multimedia information such as images and characters in the digital mode. When cordless telephones were introduced to the market, communication equipment manufacturers suffered a severe blow due to aggressive activities of household electric appliance manufacturers. The same situation is about to take place with PHS terminals. In fact, many communication equipment manufacturers are taking a wait-and-see attitude toward production because "profitability cannot be expected due to intensive price competition." On the other hand, household electric appliance manufacturers say, "We are superior in price and commodity planning. PHS terminals are among the few commodities that prevent hollowing-out of industry." They have started active research for developing goods for various usages. Sharp, a representative PDA manufacturer, is promoting research on connecting PHS terminals to Zaurus and LCD Viewcam.

MPT's "Telecommunication Business Policy Study Group" estimates that 32 million PHS terminals will be installed by 2010. This means that one out of three people will own a PHS terminal. In other words, PHS is about to become the nucleus of personal communica-

tions. However, carriers must make positive equipment investments and improve service menus before PHS reaches the ideal state of personal communications—"Anytime, anywhere, with anybody". Also, appropriate actions must be considered for environmental and ethical problems related to PHS dissemination and institutional issues.

This issue focuses on PHS, which started in Japan in July of this year. We hope readers find the information useful.



Yuji Yamadori  
Director  
Research & International Affairs

# I. Mobile Communications Industry

The cellular phone market has expanded dramatically after cellular telephone terminals were liberalized in April 1994. Since then full-scale competition has started both in terms of fees and services. The cellular phone market is currently the most dynamic market in Japan.

## 1. Market

As of March 31, 1994, the number of subscribers was about 2.13 million. The number doubled to 4.33 million by the end of March 1995 (see Figure 1). About 3.6% of the population currently subscribe.

Service providers, who had been anxiously waiting for terminal liberalization as a trigger for the market, made large discounts aiming at the liberalization scheduled for April 1994. The monthly subscriber charge was reduced nearly in half, and the connection charge was reduced by nearly 30%.

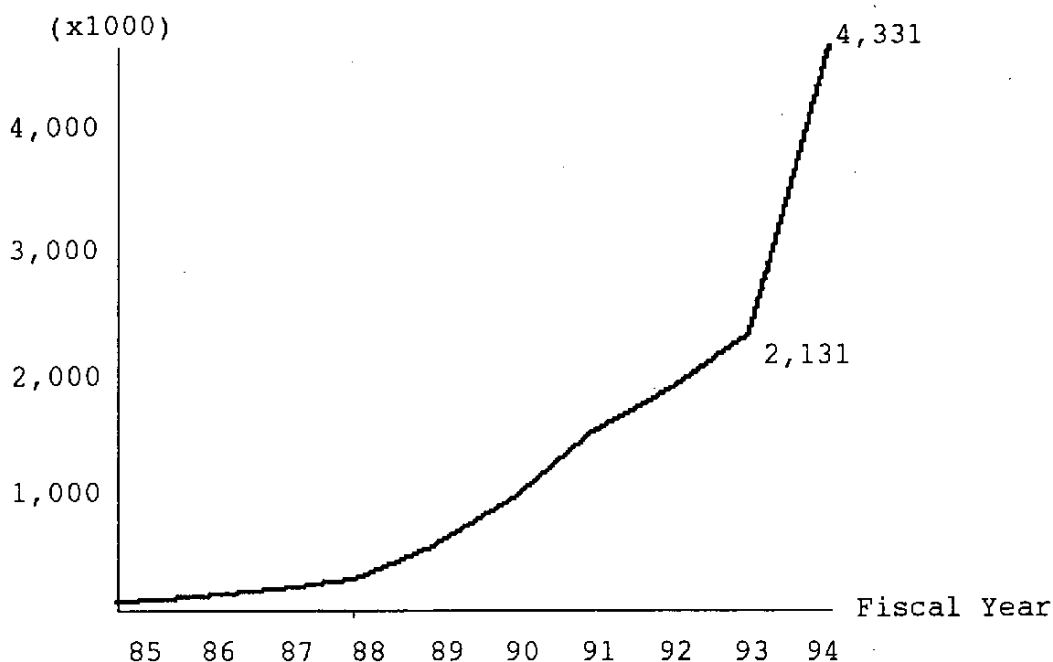
Price competition often started even before new phone products went on sale, and there were sales promo-

tions in which phones were provided almost free of charge. The increase in new subscribers was beyond even the projection of service providers. There were cases where subscribers waited for products in line because the products were sold out.

In December 1994, service providers reduced connection charges from 41.7% to 49.2%. They also reduced the monthly subscriber charge and toll charges in the early morning and late night hours, and introduced discount services. In January 1995, people recognized the effectiveness of cellular phones in the aftermath of the Great Hanshin Earthquake. As a result, the number of new cellular phone subscribers exceeded 2.2 million in fiscal 1994, exceeding the number of new fixed-line telephone subscribers of NTT for the first time. The number of NTT's fixed-line subscribers was about 1.2 million, nearly half the number of new cellular phone subscribers.

About 40% of the new subscribers are assumed to be digital cellular





**Figure 1. Number of Subscribers 1985 - 1994**

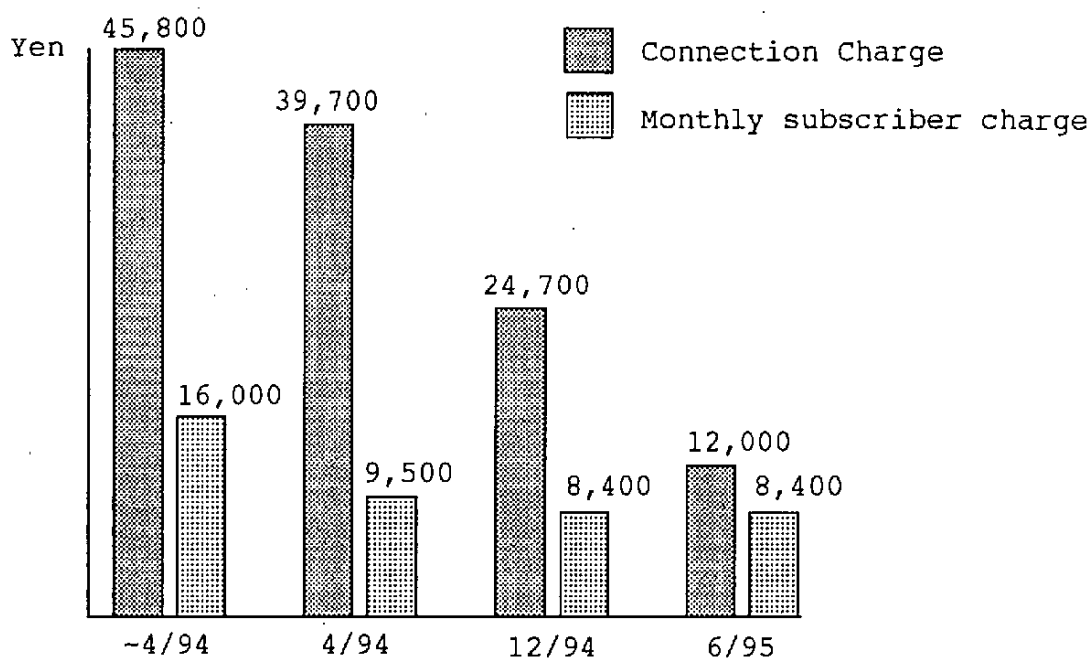
phone users. We estimate that more than half of the new subscribers will use digital phones in the future, from the standpoint of effective frequency utilization.

NTT DoCoMo discounted toll charges in April 1995. In May 1995, other cellular phone service providers discounted fees. In June 1995, all the service providers reduced connection charges. Fee discount competition has become more and more intense (see Figure 2).

services has become a driving force to significantly increase the number of subscribers. In the fixed-line telephone market, there are various regulations to restrain NTT's monopoly. Therefore, we cannot say that new services can be provided immediately. In the cellular phone business, new services can be provided relatively easily since all service providers have their own facilities. In Japan, cellular telephone market is the most competitive of all the telecommunication markets.

In the meantime, diversification of

The services that particularly at-



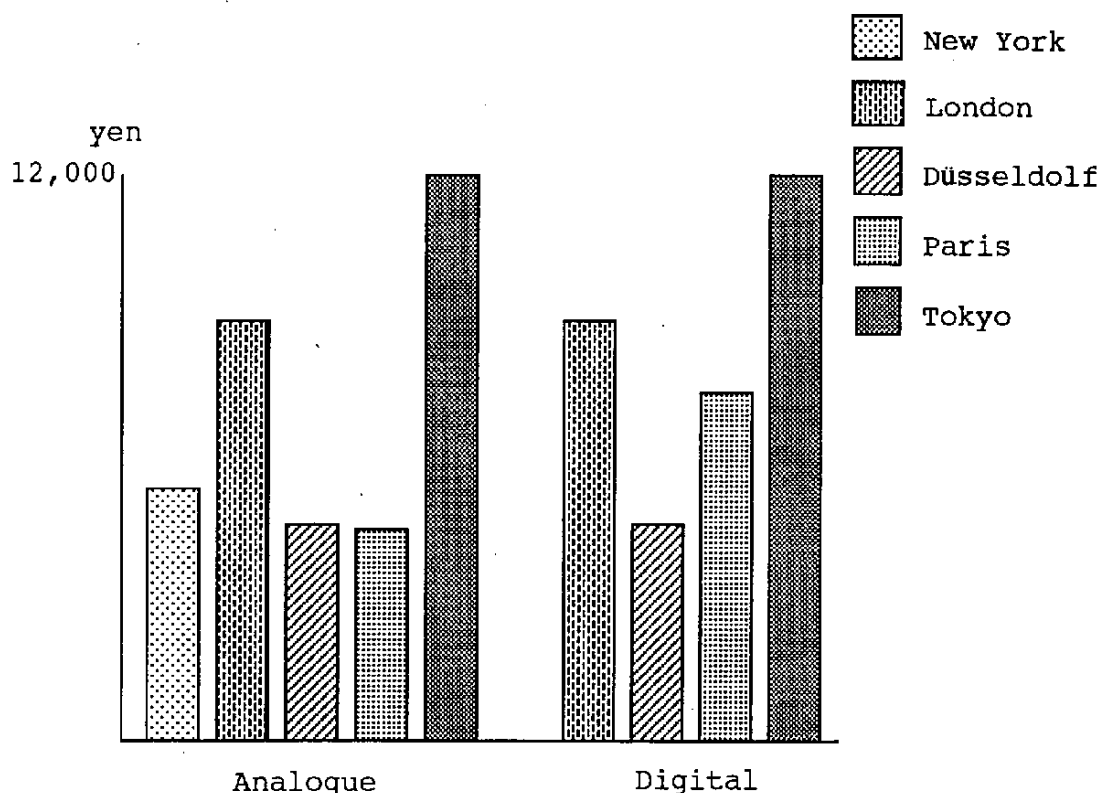
**Figure 2. Decline of Charges (NTT DoCoMo)**

tract subscribers are optional calling plans such as low call service, under which the monthly subscription charge is reduced by about half and toll charges raised by about half. A new type of service called "Doni-cho" (meaning Saturday, Sunday and late night), that gives subscribers access only on Saturdays, Sundays and late at night, and reducing the connection charge and monthly subscriber charge to about a third (1/3) of the general price, has created a new demand.

Japan's cellular phone toll charges are said to be relatively high inter-

nationally. According to the "Price Survey on Cellular/Automobile Telephone Services in Japan and the Rest of the World" released by the Ministry of Posts and Telecommunications in June 1995, Japan is competitive with the rest of the world insofar as service charges are concerned (see Figure 5). However, when it comes to connection charge and monthly subscriber charge, fees in Japan are obviously high (see Figures 3 and 4).

The cellular phone service business is the most liberalized market of all the telecommunications markets in



Source: MPT

**Figure 3. Comparison of Connection Charge**

Japan, and we do not believe that the regulation is a factor in the high cost.

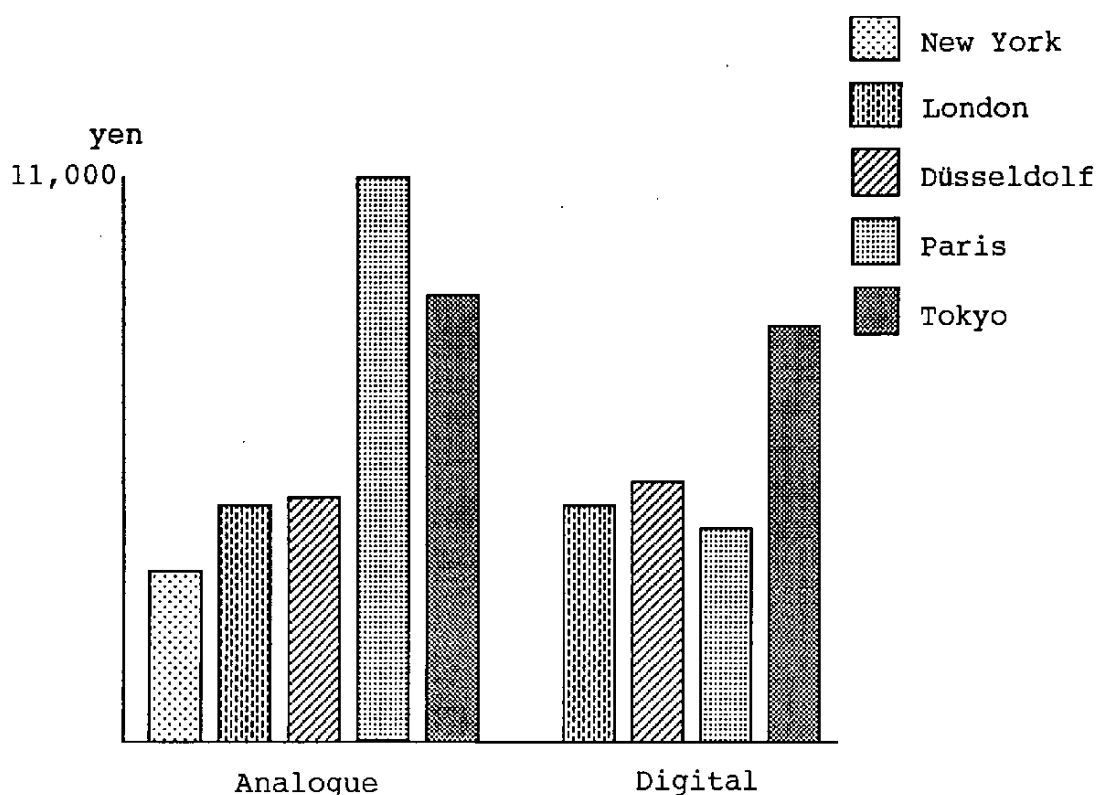
In short, prices in general are high in Japan, and we believe that land price and construction expenses for network construction, labor costs, high rents, etc. heavily affect connection charge and monthly subscriber charge. If the number of subscribers increase, relative cost

will decline due to economies of scale.

## 2. Service Providers

Cellular phone service providers in Japan are NTT's subsidiary group NTT DoCoMo, DDI's cellular subsidiary group (Cellular Group), IDO, Digital Phone and Tu-Ka.

Cellular phone service is provided



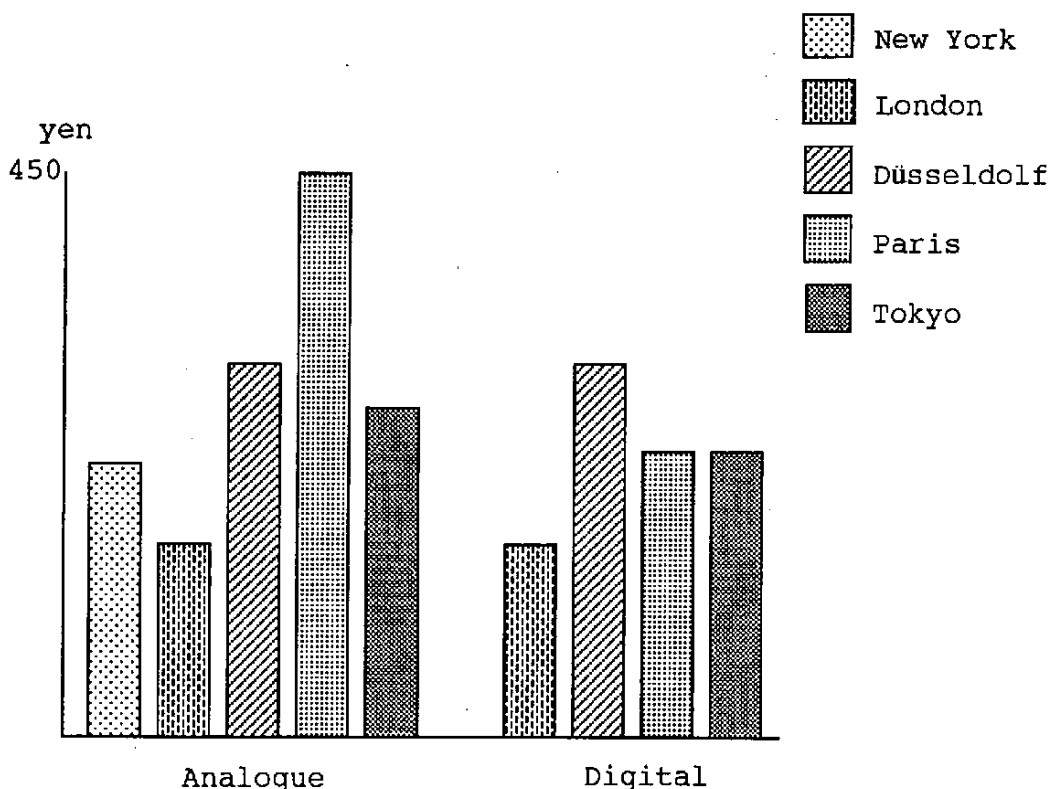
Source: MPT

**Figure 4. Comparison of Monthly Subscriber Charge**

by regional companies of each group in about 9 districts across Japan. Not all groups operate in all the districts. Only NTT's DoCoMo Group and the Cellular Group currently operate nationwide.

The Ministry of Posts and Telecommunications policy prohibits one service provider from servicing the whole country.

NTT DoCoMo was established in July 1992, having been divested from NTT. Before that time, NTT itself had provided the service. In 1987 that service providers other than NTT DoCoMo began to enter the market. The market share of NTT DoCoMo had been stable at about 60%, having lost market share to the new competitors. NTT DoCoMo has lost about 10% of the market in the year after the liberaliza-



Source: MPT

**Figure 5. Comparison of Service Charge (three-minute talking)**

tion of cellular phone terminals (see Figures 6 and 7).

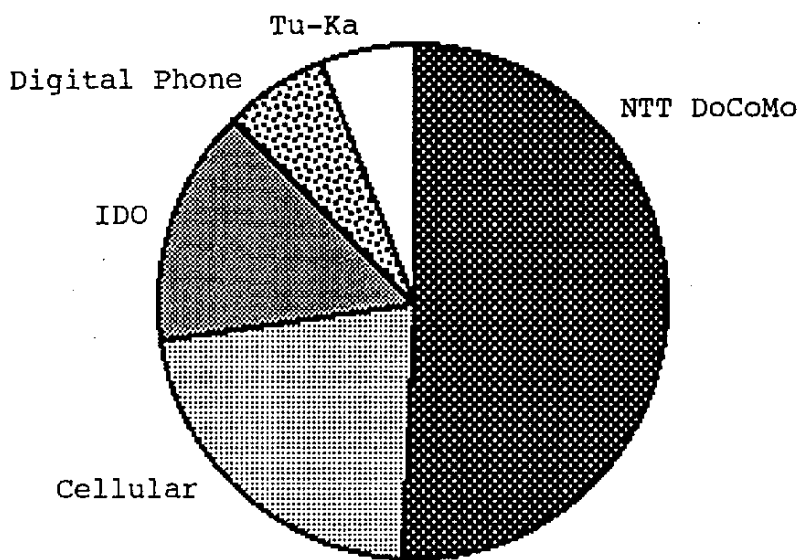
Systems provided by operators are given in Table 1. Latecomers such as Digital Phone Group and Tu-Ka Group provide only digital systems.

### 3. Threat of PHS

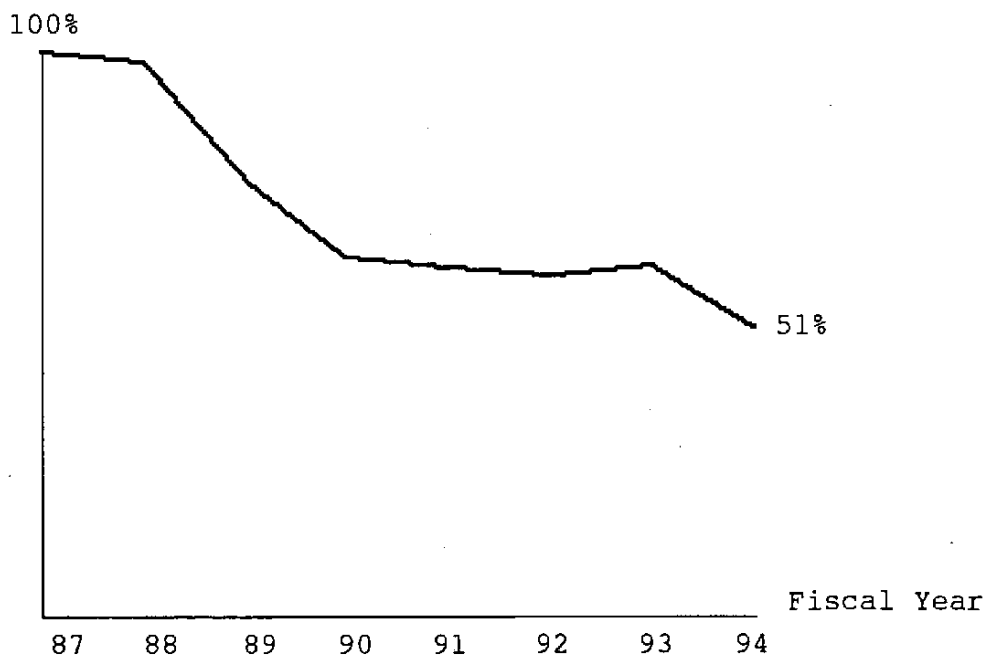
The market has been rapidly expanding, and the sales of service

providers are growing. However, there are service providers such as IDO that experienced loss in fiscal 1994.

In this way, the cellular phone market has entered uncertain times, which alone is a big burden for each service provider. However, PHS was introduced in July 1995 as service to compete with the existing cellular phone service.



**Figure 6. Share by Service Provider**



**Figure 7. Decline of Market Share of NTT DoCoMo 1987-1994**

**Table 1. Cellular Phone Systems of Carriers**

Carrier	Analogue	Digital	
		800MHz	1.5GHz
NTT DoCoMo	NTT	800MHz	1.5GHz
Cellular	TACS	1.5GHz	
IDO	TACS/HICAP	800MHz	
Digital Phone	-	1.5GHz	
Tu-Ka	-	1.5GHz	

In June 1995, all the cellular phone service providers reduced connection charges in order to counter the PHS service to start in July 1995, and the fee was set at about double the PHS connection charge.

PHS (Personal Handyphone System) phones themselves are inferior to cellular phones, but the fees are lower. PHS became a menace to cellular phone service even before the service was provided. Consumers took a "wait and see" attitude, and hesitated to purchase cellular telephones.

However, the number of new cellular phone subscribers has returned to its earlier pace, probably due to the perception of the limited ser-

vice area of PHS among consumers. The number of new units rose by 423,700 units, a record high net increase, in June 1995 when connection charges were reduced. The monthly net increase passed 400,000 units for the first time. After that, pace of increase in the number of subscribers has further heightened. The assumption in industry circles is that a synergy effect with PHS has worked favorably on cellular phones.

Cellular phone service providers are now facing competition with not only their fellow competitors in the same service, but also with PHS service providers. Japan's mobile communications business has been thrown into a state of competitive chaos.

## II. What is PHS?

### 1. Development of PHS

PHS (Personal Handyphone System) was originally modeled on the Telepoint service of the UK. Telepoint was a system which used a cordless telephone handset, related to a telephone inside a house, outdoors for the purpose of sending messages in place of a pay telephone. In 1989, Telepoint became operational, but it did not take root. By 1993, all the service providers withdrew from the business and Telepoint services in the UK ceased to exist.

In the meantime, commercialization of digital micro cellular mobile communication was attempted, such as PCN (Personal Communications Network) in Europe and PCS (Personal Communications Service) in the US.

It took a long time to decide which method would be actually adopted for PHS. We were doubtful about the future of the Telepoint method which featured dedicated use for sending and ended in failure. The Telepoint service was originally con-

ceived because of the high number of out of order pay telephones in the UK. The situation is different in Japan where pay telephones are well maintained. Therefore, PHS came to be positioned as the Japanese version of PCN and PCS. In October 1993, a development test was performed both in Sapporo and Tokyo, with the participation of many service providers.

#### 1) Outline of Final Report on PHS System Development Test Evaluation & Research Association

The PHS System Development Test Evaluation and Research Association of the Ministry of Posts and Telecommunications released its final report in October 1994, a year after the start of the test.

According to the report, the combined total of the responses of "I would like to use it very much" and "I would like to use it if possible" from monitors reached about 90% and it became clear that people were very willing to use PHS.



The functional restriction of being unable to use PHS during high speed travel was not a problem. The monitors evaluated services for easy communication using their own terminals in locations close to daily activities in life.

As a result, many people wanted to use PHS in underground shopping areas and inside buildings, in addition to "on the road" and "on the premises of stations."

However, no matter how good services may get, the number of people who would like to use will decline if service charges are expensive. Many respondents said that fees would be reasonable if connection charge is no more than 5,000 yen, monthly subscriber charge is no more than 3,000 yen, and a three-minute local call costs about 30 to 50 yen.

## **2) Ministry of Posts and Telecommunications Directives for PHS Introduction**

In June 1994, the Ministry of Posts and Telecommunications announced the following basic directives for PHS introduction.

- ① Japan shall be divided into 10 blocks, and participation of three

service providers shall be authorized in each block.

- ② NTT itself shall not be authorized to enter the market.
- ③ Monthly subscriber charge shall be held down to 1/3 that of the current cellular phone service fee.

In November 1994, the Ministry of Posts and Telecommunications announced the following final directives for PHS introduction based on the foregoing final report.

- ① Services shall be provided in a wide area at low cost with a variety of fee schedules.
- ② Interconnectivity with public switched telephone network (PSTN) shall be stipulated properly and firmly by agreement.
- ③ Service identifier number shall be "050."
- ④ External roaming shall be made possible at an earliest date.

Following the Ministry's final directives, NTT also firmly specified the following:

- NTT shall not discriminate be-

tween NTT Personal Communications Network Group, an NTT subsidiary, and other service provider groups.

- NTT shall regularly disclose information on facilities provided by NTT's PSTN to PHS service providers and shall enhance PSTN after reaching agreement with the PHS providers.

With these arrangements completed, in December 1994 three service providers groups including NTT Personal Communications Network, DDI Pocket Telephone (a DDI subsidiary) and Astel applied for authorization, and the three groups were authorized at the end of January 1995.

In April 1995, the Ministry approved the PHS tariff of the three service providers. As the basic direction No. 1 of the Ministry says, "Japan shall be divided into 10 blocks and participation of three service providers shall be authorized in each block." Actually, all three groups provide services in each block by forming regional companies. Service providers do not apply for business authorization or for their tariff as a group, but we handle them collectively for convenience's sake.

In Japan, holding companies are prohibited. In the case of NTT Personal Communications Network group, NTT Central Personal Communications Network, with sales area in Tokyo, functions as the head office, while DDI Tokyo Pocket Telephone is the head office of the DDI Pocket Telephone group.

The NTT Personal Communications Network group and the DDI Pocket Telephone Group began operation on July 1, 1995, starting with the Kanto and Hokkaido blocks. They plan to expand nationwide beginning with major cities. Meanwhile, the Astel group plans to begin services in October in the Kanto and Kansai blocks.

### **3) Service Provider Groups**

#### **(1) NTT Personal Communications Network**

This company was founded as a joint venture between NTT and NTT DoCoMo, NTT's subsidiary for cellular phone and paging services.

NTT DoCoMo was formed after the Mobile Communications Division was divested from NTT, but the unit for PHS-related business was retained within the parent company, NTT. From the standpoint of main-

taining fair competition, the Ministry of Posts and Telecommunications prohibited NTT itself from entering the PHS business. Therefore, NTT formed NTT Personal Communications Network Group as a subsidiary for its PHS business.

Cable & Wireless (C & W), a telecommunications service provider in the British Commonwealth, and Nextel of the US, which has an alliance relationship with NTT, have also invested in the group. C & W has a 5% equity in all the companies of the group. Nextel has a 0.3% equity in NTT Central Personal Communications Network responsible for services in the Kanto block, and has a 1% equity in NTT Hokkaido Personal Communications Network operating as a service company in the Hokkaido area.

## **(2) DDI Pocket Telephone**

This company is a wholly-owned subsidiary of DDI, an interexchange carrier. DDI also has a cellular group engaged in the cellular phone service business all over Japan.

## **(3) Astel**

Astel was jointly formed by Japan Telecom (an interexchange carrier), TTNNet (a regional telecommunica-

tions service provider owned by Tokyo Electric Power Co., Ltd.), KDD (an international telecommunications service), two trading companies, Mitsui & Co., Ltd. and Mitsubishi Corp., etc. At present, regional electric power companies other than Tokyo Electric Power Co. also have equity in Astel.

A regional network owned by electric power company related telecommunications services has a significant impact on the PHS service business, though it is not comparable to NTT.

This group has adopted the public switched telephone network (PSTN) connection type in the system configuration of PHS as described in the following section.

## **2. System Configuration of PHS**

PHS systems are configured by connecting PHS base stations in each area owned by PHS service providers with the exchange networks of public carriers.

For connections, there are two types, PSTN dependence type and PSTN connection type. The PSTN dependence type services partially own functions such as customer infor-

mation data base, account information data base, etc., and depend on PSTN for the rest of the functions. Therefore, construction costs are low.

The PSTN connection type service providers own not only customer information data base and account information data base, but also control information necessary for services such as location information, and the service system is connected with PSTN. As the dependence on PSTN is low, the leeway for service development will increase.

At present, service providers have no choice but to depend on NTT's PSTN. At first, the system is structured by connecting NTT's local network and the PHS base station using ISDN circuits. If CATV operators start regional telephone services, there can be cases where CATV networks can be connected to PHS, and CATV network (i.e. local telephone network) and the NTT network can be interconnected. It will result in reducing PHS's dependency on NTT's local network.

In this way, it may be correct to say that PHS is an extension of local networks rather than a kind of mobile communication. The Ministry

of Posts and Telecommunications also positions PHS as a second local network, expecting it to be a stimulant for competition in the stagnant local area telephone business. DDI, an interexchange carrier, is also planning to construct regional networks for PHS.

### 3. Specifications of PHS

The concept of PHS is that it can be easily used by anybody in any place.

The technical specifications of PHS in comparison with digital cellular are given in Table 2.

Access method is TDMA for both types. While PHS uses 1.9 GHz band, digital cellular uses 800 MHz band and 1.5 GHz band. Latecomer cellular phone operators such as Digital Phone Group and Tu-Ka Group use 1.5 GHz band digital telephones only.

As for mobility, a cellular phone can be used even while riding the Shinkansen (about 300 km/hour), but the maximum speed limit of PHS is at best 30 km/hour because the machine was designed assuming use at walking speed. PHS may be used while riding a bicycle but not on an expressway.

**Table 2. Specifications of PHS**

Spec.	PHS	cf. Digital Cellular
Access	TDMA	TDMA
Frequency band	1.9GHz	800MHz/1.5GHz
Bit rate	32kb/s	11.2kb/s
Moving speed	30km/h(max)	300km/h available
Reach	100~500m	1.5km
Power of a terminal	10mW	0.6~1W
Weight of a terminal	150~200g	200~250g

PHS voice transmission uses a digital ADPCM (adaptive differential pulse code modulation) technique, and the data rate is 32 K bits per second. On the other hand, digital cellular telephones use a VSELP (vector sum excited linear prediction) technique with a data rate of 11.2 K bits per second.

Furthermore, the output power of PHS is weak as compared with a cellular telephone at less than 10 mW, and its signal can reach only 100 to 500 meters. This will make it necessary to construct many base stations. However, the life of the battery is significantly longer than that of a cellular phone.

Service providers are installing base stations so that PHS can be used in locations such as underground shopping areas where cellular phones cannot be used. PHS has an advantage in ease of use in the sense it is

closer to people's daily life. Moreover, you can use PHS as a walkie-talkie through a dedicated parent phone within an area the signal can reach. In that case, communication is free of charge as a matter of course because the carrier's lines are not used.

Data transmission is also possible by connecting PDA (Personal Digital Assistants), PCs, etc. When communicating with a subscribers' network, a data rate of 9,600 bps is possible using a modem. If transmission is made via ISDN or between two PHSs, high speed data transmission at 32 K bits per second is possible. There is a plan to use 2 channels of PHS bundled as 64 K bits per second for data transmission. This is possible because PHS uses ISDN as a relay circuit, and has affinity with ISDN at 64 K bps per channel.

The standard method of this high-speed data transmission is currently being formulated to be completed in September 1995. It is a significant decision whether to authorize the bundled method to achieve 64 K

bps. In other words, we must check whether demand for such high data communication speed (or data rate demand for a user to occupy two channels) is really necessary.

### III. PHS Charges and Services

As we have seen in the results of the PHS development test, fee levels service providers set is an important factor in determining success or failure of the service.

As mentioned earlier, the Ministry of Posts and Telecommunications has directed the PHS service business as follows:

- Monthly subscriber charge shall be held to 1/3 that of the current cellular phone service fee.
- Service shall be provided in a wide service area at low cost with a variety of fee schedules.

Therefore, the business was planned on the condition that services be provided at a low cost from the beginning.

#### **1. Problems of Charges for Interconnection with NTT's Public Switched Telephone Network (PSTN)**

The biggest problem in making low cost PHS services a reality was with

reference to charges for interconnection between PHS service providers and NTT's PSTN. How much PHS service providers would pay for interconnection with NTT's PSTN would have a large impact on PHS service charges.

Since PHS services are dependent on NTT's PSTN, control facilities (dedicated switching equipment, data base, etc.) will be required on the side of NTT's PSTN to meet the needs of PHS service. Interconnection charges that PHS service providers pay to NTT are made up of cost for the PHS dedicated control facility owned by NTT and line charges.

Of the two items, the two parties could not easily agree on the price of the PHS dedicated control equipment to be installed by NTT. NTT had to make a large investment in the installation of the PHS dedicated equipment, and it was natural for NTT to request PHS service providers to pay an appropriate portion of the facility cost.

However, it was a major premise

that the monthly subscriber charge and a three-minute local call should be held down to about 3,000 yen and 30 to 50 yen, respectively. The discussions of the two parties focused on how services could be provided at that fee level. NTT did not agree to the plan initially, but finally agreed to a fee about 30% lower for the dedicated PHS equipment by obtaining a reduction in the equipment procurement price and simplifying the system equipment configuration.

As a result, service providers were able to start operation within the price range specified by the final report of the development test, and a local call was set at 40 yen. This was the lowest feasible price to obtain customers, and interconnection charges to be paid to NTT has been a great burden to PHS service providers.

## **2. Tariffs of PHS Service Providers**

The following four providers began service in July 1995:

NTT Central Personal Communications Network, NTT Hokkaido Personal Communications Network, DDI Tokyo Pocket Telephone and DDI Hokkaido Pocket Telephone.

The Astel Group will start service in October 1995, but to make up for the delayed start, they started airing TV commercials together with the other two groups.

### **1) Comparison of Tariffs between PHS Service Providers**

Tables 3, 4 and 5 show the tariffs of the three groups. When the tariffs of NTT Personal Communications Network Group, DDI Pocket Telephone Group and Astel Group are compared, we see that the Astel Group has divided the short distance charges more specifically, and set lower charges. Price comparison is based on a three-minute call because in Japan a local call is 10 yen (1 unit) for three minutes. This standard will be used for price comparison from now on.

All service providers charge 40 yen for three minutes within MA (10 yen for 60 seconds). If the call charge is excluded the 10 yen per minute toll is the same as pay telephones. The same toll as a pay telephone has become a reality. However, all the service providers charge the same tariff when a call is made from a pay telephone to a PHS (Table 6).



**Table 3. Tariff of NTT Personal Communications Network Group**

Connection charge	7,200
Monthly subscriber charge	2,700

- Usage charge of three-minute talking -

(yen)

Distance	8:00 - 19:00	19:00 - 23:00	23:00 - 8:00
within MA	30		
~20km	50		
~30km	90	70	60
~100km	130	90	80
100km~	190	130	110
call charge*	10 (per call)		

\* call charge is not applicable when a call is made from pay-telephone to PHS.

**Table 4. Tariff of DDI Pocket Telephone Group**

Connection charge	7,200
Monthly subscriber charge	2,700

- Usage charge of three-minute talking -

(yen)

Distance	8:00 - 19:00	19:00 - 23:00	23:00 - 8:00
within MA	30*		30**
~30km	40		30*
~60km	70	60	40
~100km	100	70	50
~160km	150	90	70
160km~	190	110	90
call charge	10 (per call)		

\* call duration of one unit (10 yen) is 60 seconds.

\*\* call duration of one unit (10 yen) is 70 seconds.

**Table 5. Tariff of NTT Astel Group**

Connection charge	7,200
Monthly subscriber charge	2,700

- Usage charge of three-minute talking -

(yen)			
Distance	8:00 - 19:00	19:00 - 23:00	23:00 - 8:00
within MA	30		20
~30km	40		30
~60km	70	60	40
~100km	100	70	50
~160km	150	90	70
160km~	190	110	90
call charge	10 (per call)		

\* call duration of one unit (10 yen) is 60 seconds.

\*\* call duration of one unit (10 yen) is 90 seconds.

**Table 6. Tariff of DDI Pay-telephone to PHS**

- Usage charge of three-minute talking -

(yen)			
Distance	8:00 - 19:00	19:00 - 23:00	23:00 - 8:00
within MA	60		
~20km	120	100	
~30km	140	130	120
~60km	180		
~100km	210		
~160km	240	170	160
160km~	260		

## 2) Comparison between PHS and Cellular Phone

Comparison of standard charges between the cellular phone of NTT DoCoMo Group and the PHS of NTT Personal Communications Network Group is shown in Table 7. The cellular phone charges are those in the case where a call is made from a cellular phone to a fixed NTT subscriber's phone. This case is used for charge comparison because the cellular phone is most frequently used in that way and the most common use of PHS was assumed to be the same.

As the table shows, the cellular phone charge is considerably higher than PHS, though the charges have been reduced more than once. In the case of the furthest location, PHS costs 200 yen and cellular phone costs 280 yen, 40% higher than PHS. In the case of the nearest location, PHS costs 40 yen, while cellular phone costs 200 yen. PHS is definitely less expensive. However, if you take into account the advantages of the cellular phone, including high-speed usability, and a wider service area, we believe it can compete with PHS in the case of short talks such as one minute.

**Table 7. Comparison of PHS and Cellular Phone**

	PHS	Cellular
Connection charge	7,200	12,000
Monthly subscriber charge	2,700	8,400

- Usage charge of three-minute talking (8:00-19:00) -

(yen)

Distance	PHS	Cellular
within MA	30	200
~20km	50	
~30km	90	
~100km	130	
~160km	190	230
160km~		280
call charge*	10 (per call)	-

\* call charge is not applicable when a call is made from a pay-telephone to PHS.

However, the service area of PHS is expected to expand to nationwide scope in the future. Following the expansion of the PHS service area, it is possible that the cellular phone charge will have to be further reduced.

### **3. Service Area**

As of July 1995, the service areas of NTT Personal Group and DDI Pocket Group were Kanto and Sapporo and surrounding vicinities. As the output power of DDI Pocket Group base stations is greater, the service area of DDI Pocket Group is much wider. However, if they plan to cover their area with a smaller number of large output power base stations, there will inevitably be more cases where signals are cut off. Utilization in underground shopping centers, one of PHS advantages, will be impossible. We can say that DDI Pocket Group is a step ahead in the beginning, but the service areas will be roughly the same by March 31, 1996.

### **4. PHS Terminal**

In preparation for starting service in July, service providers began taking reservations for PHS terminals in the middle of May. Since terminal makers had the bitter experi-

ence of rapid price fall of cellular terminals one year earlier, we do not believe the same price fall will occur in the case of PHS terminals.

There are four different cellular phone systems being used, Two methods each for analog and digital types. It is a disadvantage in lowering cost by volume production of terminals. PHS has an advantage in this regard because it uses only one unified method.

However, as in the case of Japan's cellular phones, PHS is Japan's unique standard. Should de facto international standard terminals such as PCS and PCN enter the Japanese market in the future, it is possible PHS might not be able to compete with them in price.

If no other countries adopt the PHS standard, and if de facto international standard systems cannot enter the Japanese market, it is highly likely that a new trade barrier issue will surface in the future.

In that sense, it is to Japan's great advantage that Hong Kong has decided to name Japan's PHS as one of the next generation cordless telephones and that Hutchison, one of the common carriers in Hong Kong, has selected PHS after making a

comparison check with Europe's DECT and a US system.

The world's large wireless terminal makers such as Motorola of the US and Nokia of Finland have not taken part in the sales of PHS terminals, and seem to be taking a wait-and-see attitude to fully examine the future of PHS. If PHS utilization spreads in Asia, they will form positive strategies.

### 1) $\alpha$ -PHS

DDI signed an agreement with 10 electronics manufacturers to make PHS dedicated LSI and communications software to be mounted on the LSIs (developed by DDI) common standards for PHS terminals. The dedicated LSI called " $\alpha$ -PHS" is a set made up of 5 chips. This dedicated LSI set had been developed for four years jointly with PCSI Inc., an American venture business.

The  $\alpha$ -PHS has all the necessary functions for communications control. The electronics manufacturers which made the agreement with DDI are household electrical appliance makers, and they are relatively weak in wireless communications technology. These makers can easily enter the PHS market by adopting  $\alpha$ -PHS.

### 2) Household Electrical Appliance Makers' Turn

When subscribers telephones were liberalized, existing telephone makers that sold equipment to only NTT were completely defeated by household electrical appliance makers that offered fashionable telephones with a variety of added value to attract consumers. The traditional telephone makers failed, because they did not think of the telephone as one of a consumers' products used in the home and they did not have the strong sales channels that household electrical appliance makers had.

PHS is positioned as extension of the so-called home telephone as a handset of an in-home cordless phone to be used outdoors. Because most in-home telephones are products of household electrical appliance makers, we are not sure that wireless communication makers which have supplied cellular phones will have a large market share in PHS.

As of now, wireless communication makers have the lead but they cannot afford to sit idle if household electrical appliance makers enter the market, because of their strong selling power and product develop-

**Table 8. PHS Terminals**

NTT Personal				
model	supplier	weight	life of battery (call/stand-by)	Display (chars.)
PALDIO 101S	Sharp	160g	4h / 135h	12
PALDIO 102S	Sharp	95g	5h / 400h	10
PALDIO 101P	Panasonic	115g	4h / 95h	11
PALDIO 101Y	Sony	190g	5h / 85h	12
PALDIO 101N	NEC	120g	3.2h / 80h	10

DDI Pocket				
model	supplier	weight	life of battery (call/stand-by)	Display (chars.)
PS-501	Kyocera	145g	5h / 200h	11
PHS-P101	Sanyo	180g	4h / 120h	10
ISD-P7	Kenwood	200g	4h / 70h	12
KX-PH10SZ	Panasonic	149g	3h / 75h	10
PH-100	Casio	190g	3.5h / 100h	12
DL-S20P	Toshiba	215g	5h / 130h	10
TL-PH7	Mitsubishi	139g	5h / 130h	10
PT-H50	Aiwa	168g	7h / 120h	12
TN-PZ1	Victor Japan	140g	4.5h / 100h	10

ment capability.

### **3) PHS Terminals Currently on the Market**

Table 8 shows major PHS terminals being sold on the market. They are sold for about 40,000 yen. The PALDIO Series is sold under the label of NTT Personal, while DDI Pocket products is sold under the label of each supplier with the "α-PHS" logo.

Since service started on July 1, there

have been cases where product supply could not meet demand.

These are chiefly the case with PHS dedicated terminals. In some cases, you may use the handset as a cordless home-use telephone if you purchase the dedicated base unit. Total price for a base unit and a handset combined is about 100,000 yen, which is still expensive.

Generally, PHS is assumed to be "a low-cost version of a cellular phone". For the present, the PHS dedicated

terminal fully meets the requirements of consumers. If the price of a cordless home-use telephone with PHS functions falls, that type of machine will become the mainstream.

At present, there is no compatibility between these PHS dedicated terminals and existing cordless home-use telephones. In fiscal 1993, about 65 % of telephones produced in Japan were cordless telephones. About

half of general households are presumed to own cordless telephones.

The most widely used cordless telephones are analog type, with very few digital telephones installed in the home. That may be the reason why compatibility was neglected and product development was done based on different specifications. It is regrettable from the standpoint of service expansion.

## **IV. Future Prospects of Mobile Communication**

PHS has been accepted favorably by consumers for the time being. We now look over the mobile communications market, including PHS, in the future based on various market projections.

### **1. Trends in Demand**

#### **1) Prime Minister's Office Survey**

According to the "Public Opinion Survey on Living and Information Communications" released in January 1995 by the Public Relations Office, Prime Minister's Secretariat within Prime Minister's Office, 25% of the respondents cited "cellular phone/PHS" as information communications media they want to use, though multiple responses were allowed. Cellular phone/PHS was the first choice, followed by facsimile machine at 21.8%.

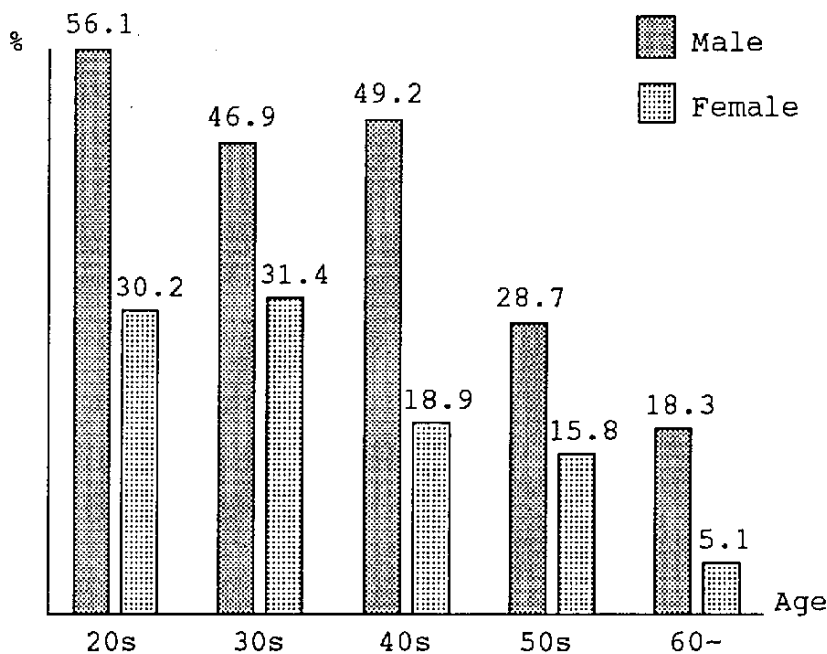
In terms of demographics, 56.1% of men aged 20 to 29 said they wanted a cellular. The phone or PHS, the highest rate, followed by 46.9% of men aged 30 to 39 and 49.2% of men

aged 40 to 49. It follows that about half of men from 20 to 49 want to use cellular phones or PHS. As for women, 31.4% aged 30 to 39 responded that they want to use cellular phones or PHS. That age bracket is followed by women aged 20 to 29 (30.2%). About 30% of women aged 20 to 39 want to use cellular phones or PHS (see Figure 8).

#### **2) Ministry of Posts and Telecommunications "Communications Utilization Trend Survey"**

The Ministry of Posts and Telecommunications conducts a "Communications Utilization Trend Survey" every year. According to the fiscal year 1994 survey results, household ownership rate of cellular phones was 5.8%, which was 1.8 times the previous fiscal year. Also, 26.3% of respondents said that they want to have the phone in the future. It was the second choice after fax, which 33 % of the respondents selected.





Source: Office of the Prime Minister

**Figure 8. Potential Users of Cellular Phone or PHS**

Meanwhile, the business cellular phone ownership rate is 24.7% for portable phones and 7.5% for car-mounted phones. Of businesses without cellular phones, 7.8% responded that they "want to use in the near future", 31.4% said they "want to use if conditions are met". Therefore, a combined total of 39.2% have a forward-looking attitude toward using cellular phones. More than half of the respondents cited fee reduction as a condition for purchasing equipment, but it is nota-

ble that 15.7% of the respondents said that they would rather wait for the start of PHS than buying existing cellular telephones.

Cordless telephones employing PHS technology for use inside the office had been commercialized prior to the start of PHS service operations. It would be very convenient for companies if that cord-less telephone terminal could be taken outside the office.

In this way, there is a strong demand for mobile communication.

There are young people who make phone calls for several hours as part of their daily life now, and they support an increase in demand. They have a cordless handset of their own in the home, and have long drawn-out telephone conversations in their rooms. They frequently have contact with their friends and tend to have a strong desire to talk on the phone any time, anywhere. They are very fond of telephones, in a way older people are unable to understand.

## **2. Competition between Cellular Phones and PHS**

The number of new subscribers for cellular phones has been continuously on the rise. As of June 30, 1995, the number of subscribers was as high as 5.35 million, and in the three months from April to June the number of new subscribers surpassed 1 million. In July 1995, when PHS service was inaugurated, a record number of new subscribers, about 475 thousand, was recorded, following the monthly record in June. It has become more difficult to get popular models of cellular phones, and some buyers have to

wait two or three months after making a reservation. In some areas, subscription has had to be restricted. To cope with the rapid increase, service providers plan to accelerate installation plans for switching systems and base stations.

On the other hand, the combined total of subscribers to the NTT Personal Group and the NTT Pocket Group was about 87,000 in the month of July, the month PHS service started.

The willingness to purchase mobile communications equipment was heightened with the start of PHS service. Potential demand for mobile communications immediately became reality in synergy with PHS, as people purchased cellular phones after comparison with the insufficient service area of PHS, and also people were attracted anew to cellular phones due to large reductions in monthly subscriber charge and toll charges, and, fee schedules with diversified options.

There are changes in positioning PHS and cellular phone service. While PHS is an extension of a local network, cellular phone services are provided by independent mobile networks. In reality, there are no differences from the consumer's stand-

point, since both types are nothing but mobile communication equipment. In short, the keys are functions, service areas and charges.

Cellular phone service providers have so far installed communications service equipment individually, according to their strategic requirements. However, they have decided to embark on equipment upgrade by joint funding in order to make phone use in underground shopping centers and tunnels possible. Up to now, the service providers have had a negative attitude toward investing in most underground areas because equipment would be costly. However, in order to cope with PHS and also to comply with the request of cellular phone users, all the service providers have decided to jointly promote use in underground areas. The construction work will be undertaken by the Road and Tunnel Information Communications Infrastructure Maintenance Association, which is organized by cellular phone and paging service providers. All regional service companies will make investments. Pager as well as cellular phone use will be possible.

Comparison of standard charges is shown in Table 7. Cellular phone service costs are considerably high-

er than PHS, but there are cases where cellular phone services are less expensive than PHS, such as service limited to Saturday and Sunday.

As explained above, cellular phone service providers have made positive efforts to improve weak points when compared with PHS. On the other hand, the PHS companies are struggling to expand their service areas as a top priority plan. The goal of the two groups is almost the same. Furthermore, the parent company of the NTT DoCoMo Group and the NTT Personal Group is NTT, while DDI is the parent company of the Cellular Group and the DDI Pocket Group. In this relationship, one company exercises control over both the cellular phone service and the PHS service. The two groups seem to be aiming at the expansion of mobile communications market together rather than fermenting an intensive rivalry between cellular phones and PHS.

In the future, it is plausible that PHS terminals with cellular phone functions may be introduced. In the long run, it is probable that the two system may be integrated into a single system. For the time being, we believe that significant competition will take place to uncover

trends in users' needs and to incorporate them in the next generation of mobile communication systems.

## 2. Projection of the Mobile Communications Market

The projections that had been announced before the mobile phone terminal liberalization and charge reductions of 1994 are now known to be completely inaccurate. The projected numbers announced by all institutions were significantly lower than the actual figures as of the end of fiscal year 1994, and all the

projections are no longer of value. This market may be said to be a difficult one to project, but here we would like to pick up on relatively new projection figures released by the Ministry of Posts and Telecommunications.

The Ministry projects that the market size of cellular phone services, which was 800 billion yen as of 1994, will grow to 2.6 trillion yen by 2000 and to 5.9 trillion yen by 2010. On the other hand, the Ministry projects the PHS service market will grow to 400 billion yen by 2000 and to 1 trillion yen by 2010 (see Figure 9).

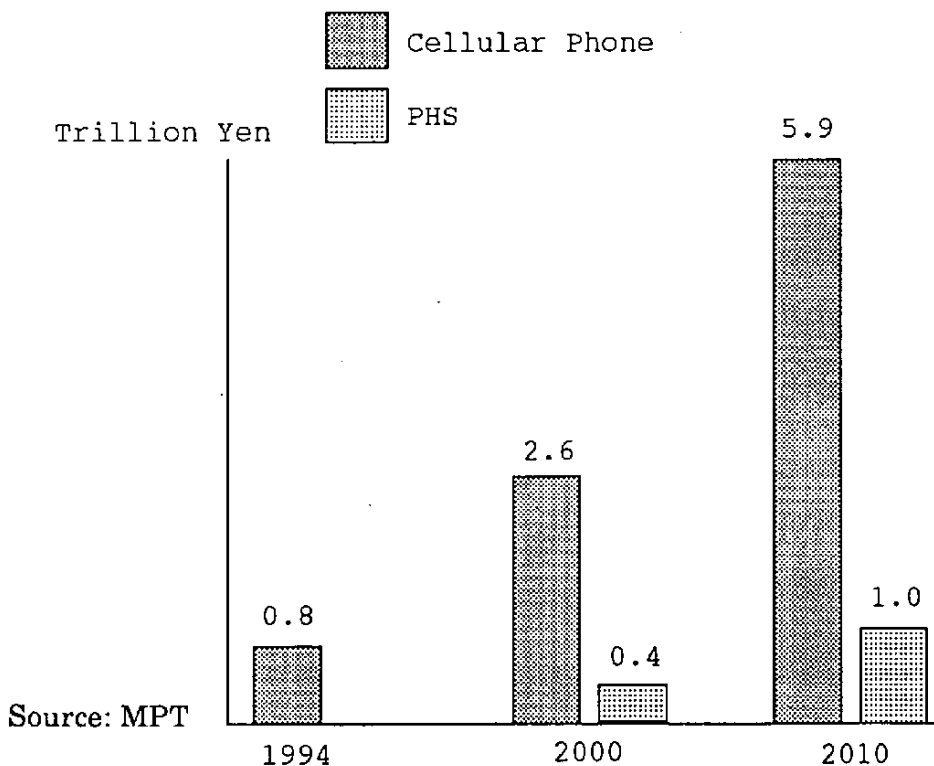
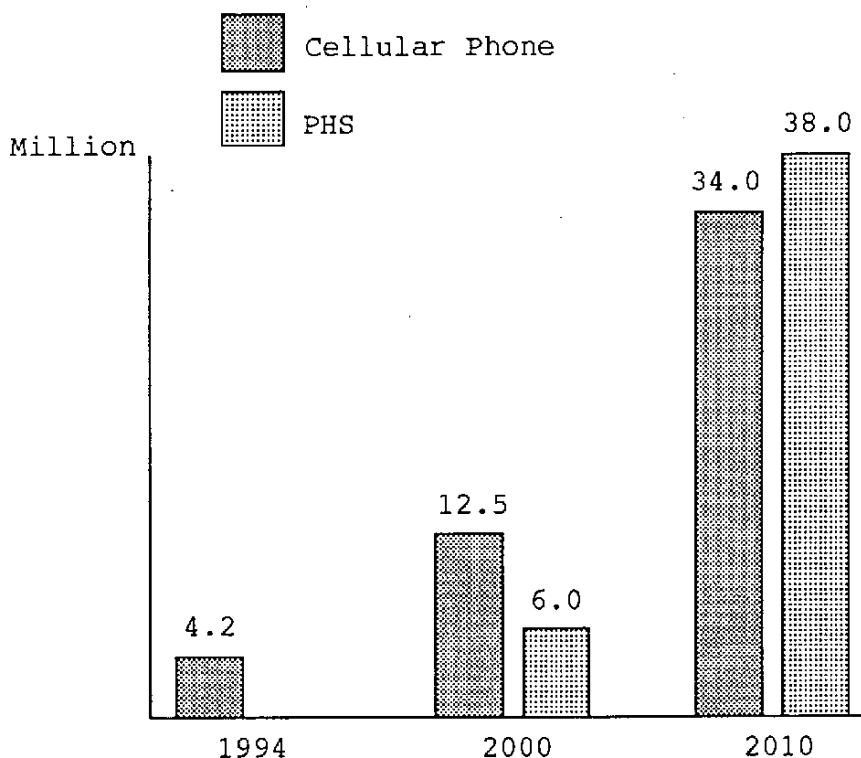


Figure 9. Market Forecast for Cellular Phone and PHS Services



Source: MPT

**Figure 10. Subscribers Forecast for Cellular Phone and PHS**

As for the number of subscribers, the Ministry projects that the number of cellular phones subscribers will grow to 12.5 million by 2000, and to 34 million by 2010. Meanwhile, the Ministry projects the number of PHS subscribers will grow to 6 million by 2000, and to 38 million by 2010 (Figure 10).

When Figures 9 and 10 are compared, the service sales size growth

of PHS is lower than the growth rate of the subscribers. It is because PHS service is positioned as a low-cost service for extension of a local telephone, and the service rate will become close to that of fixed subscriber telephones.

Cellular phones are still chiefly used for business, because charges for short-distance talk are expensive. As for the new subscribers who ap-

plied for PHS in July, it was reported that there were more individuals than business people. It may be quite natural. However, the gap must be closed sooner or later if a rapid increase is made in the number of new subscribers. The propagation rate of cellular phones is still much lower in Japan than the US and Europe. From now on the mobile communication market will expand further in Japan, with utilization by individuals as the driving force for increased demand.

The Ministry of Posts and Telecommunications projects that the mobile communications market including hardware in the multimedia age will grow from 1.7 trillion yen by 1994 to 5.3 trillion yen by 2000 and 15.7 trillion yen in 2010.

If the method to bundle two PHS transmission channels for 64 K bps transmission is adopted as the standard, affinity with multimedia communication will be enhanced, and many applications will become a reality irrespective of place.

# Current Topics

## Japan's Engagement in NII

The basic policy announced by the Advanced Information and Telecommunications Society Promotion Headquarters is the nucleus for NII related activities in Japan. The issue was discussed actively by various public and private organizations such as MITI, MPT and Ad Hoc Commission on Administrative Reform until the announcement of the above policy.

MITI announced "Program for Advanced Informatization Infrastructure" in May 1994. This program presents specific short-term and medium-term outlooks in the industry, home, and public fields and showed the desirable forms of networks. It proposes to positively promote five public areas (administration, education, research, medical care/welfare, and library) as the trigger for future development.

"Program for Advanced Industrial Information Infrastructure" (draft) prepared in November of the same year focuses especially on the in-

dustrial field among the areas selected in the Program announced in May and projects a future image of an industrial information system. It presents the following three keywords for implementing an advanced industrial information network: ① Digitalization, ② Open network, and ③ information sharing. The specific images that are taken up are EC (Electronic Commerce) and CALS (Production/Procurement/Operation Support Integrated Information Systems), which exchange all business process information electronically via an open network. MITI has set force various information related measures interlocked with these two programs such as ① informatization promotion in the public field, ② informatization promotion in industry (CALS, EDI, etc.), and ④ infrastructure development for information industry (such as "Multimedia Support Center").

"Reforms toward the Intellectually Creative Society of the 21st Century (Program for the Establishment of High-Performance Info-Communications Infrastructure)" an-

nounced by the Telecommunications Council in May 1994 proposes to construct an optical fiber network covering the whole country by 2010 as the first step for constructing an information and telecommunication infrastructure for the multimedia age. According to the specific schedule presented in the program, the network will cover major areas (population coverage: 20%) in the prefectural seats by 2000, cities with population over 100,000 (60%) by 2005, and the whole country (100%) by 2010. As for public use facilities, it proposes to extend optical fiber cables to schools, libraries, hospitals, public halls, and welfare facilities throughout the country by 2000 in parallel with development and installation of public applications.

### **[1] Japanese NII**

In the "Basic Policy" announced by the Advanced Information and Telecommunications Society Promotion Headquarters in February 1995, information infrastructure is interpreted in a wide sense of the term. In other words, "an advanced information and telecommunications society has a multi-layer structure consisting of a network infrastructure made up of optical fiber and satellite communications, etc.; system equipment; software, informa-

tion resources (contents) stored in databases; engineers, users; various systems regulating uses of the above resources." All of them are included in "information and telecommunications infrastructure" and must be developed. The Basic Policy presents basic ideas and measures for developing and realizing each of them.

It says that infrastructure development is essential for accelerating and promoting an advanced information and telecommunications society directed towards the 21st century. At the same time, it points out that infrastructure development will expand the market of information and telecommunication industry, strengthen its role as a leading industry, and create many new businesses.

The Basic Policy presents the following seven points as the behavior principle for realizing an advanced information oriented society:

- ① Society in which everyone can enjoy conveniences and merits of advanced telecommunication services without any worry
- ② Considerations for the socially weak



- ③ Contribution to form energetic regional society
- ④ Unrestricted distribution of information
- ⑤ Relative development of telecommunications infrastructure
- ⑥ Flexible review of various systems
- ⑦ Realization of global advanced information and telecommunications society

Based on the experience of the Great Hanshin Awaji Earthquake, the Basic Policy declares "to positively promote infrastructure development using the cutting edge information and telecommunications technology to assure quick information transmission for anti-disaster activities" and includes the development of an anti-disaster information system of high mobility among the targets.

## **[2] Informatization of Administration and Deregulation**

Informatization of administration and deregulation should be taken up as a part of general movements for information infrastructure de-

velopment. Concerning the former, "Basic Plan for Promoting Administrative Informatization," which is a 5-year plan starting in fiscal 1995, was approved by the Cabinet meeting in December 1994. The major objectives of this plan are ① electronification and sophisticated use of administrative information (such as LANs within governmental organizations), ② smooth distribution of administrative information (including Kasumigaseki WAN), ③ advanced information providing services, and ④ more speedy administrative procedures. Based on this basic plan and the "Common Implementation Plan" (announced in March 1995), individual ministers and agents are to prepare and promote plans.

Deregulation has been discussed and deliberated actively since the release of the so-called Hiraiwa Report (in December 1993). In June 1994, the Administrative Reform Promotion Headquarters announced deregulation for 279 items (including 49 items in information and telecommunication field). In March 1995, the deregulation promotion plan was announced. It covers 1,091 items in total, consisting of 367 previous items and 724 new items. Information and telecommunication field is among the high priority

fields along with housing/land, distribution, transportation, finance/securities/insurance, standards/certification/import, etc. Fifty three items in the information and telecommunications field are taken up.

The major items include the following: ① Introduction of preliminary notification system for type I telecommunication charges except for basic charges, ② phased permission of connection of public and leased lines for voice service, ③ phased permission of basic voice service in international VAN service, and ④ sharing of frequency bandwidth between telecommunications and broadcasting.

The above deregulation plan is a 5-year plan from fiscal 1995 until fiscal 1999. Economic regulations are to be reviewed under the basic idea of free in principle and exceptional regulations and limiting social regulations to the minimum essential. Meanwhile, the industrial world complains that their demands are not necessarily reflected. We must keep our eye on movements related to deregulation.

### **[3] Comparison of Japan and U.S. in Information Infrastructure**

We compared Japan and the U.S. in the state of a wide range of information infrastructure including information equipment (hardware), networks, and contents. It is found that the U.S. is above Japan in almost all the items (See Table 1). Since the data is not necessarily based on internationally consistent criteria, it should be regarded as reference information. However, the difference between the two countries is obvious even if the data is corrected by the ratio of population (The U.S. has about twice as large population as Japan.)

The U.S. has great accumulation of information infrastructure because of historically long activities for infrastructure development. Ideas of personalization and networking were presented at an early stage in the long history of informatization. In addition, downsizing has rapidly promoted uses of computers and networks by individuals. The American environment is favorable for nurturing venture business because of large venture capital availability and National Association of Securities Dealers Automated Quotations (NASDAQ). For this reason, influential venture enterprises have appeared in rapid succession in the general trends toward the multimedia age and introduced epoch-

making services and products.

The American information infrastructure is the result accumulated over the long history and the de-

gree of its integration will be sharply raised by recent NII activities. Japan will have to make more and more efforts.

**Table 1. Comparison of Japanese and**

	Comparison items		U.S.	Japan
Hardware related infrastructure	Value of computer shipments (1993, 1 million dollar)		62,500	28,909
	Number of PCs shipped (1994, 1,000 units)		18,605	3,005
	Accumulated number of PCs installed (1993, 10,000 units)		6,653	942
	Number of PCs installed per employee (1994, unit/1,000 persons)		551.4	146.5
	Computer hardware expenditure (1992, %)	General-purpose machines	45	60
		PC, WS	55	40
	Share in global semiconductor market by enterprise HQ location (1993, %)		41.9	41.4
Network related infrastructure	Number of PC communications subscribers (1994, 10,000 persons)		619.7	196.4
	Number of subscribers for top 2 PC communication companies (1994, 1,000 persons)		4,660	1,430
	Number of systems connected to Internet (Jan. 1995)		3,179,170	96,632
	Number of Internet WWW servers (Mar. 1995)		8,798	306
	Number of mobile telephone subscriptions (1994, 10,000 units)		1,928	213
	Number of subscriber's telephones (1993, 10,000 units)		14,866	5,883
	Charge for leased lines (1994, yen)		420,515	2,738,000
	Number of CATV subscriber households (1993, 1,000 households)		57,000	1,629
	Percentage of CATV subscribers (1993, %)		61.5	4.7
	Number of subscribers for top CATV company (1993, 1,000 persons)		12,000	99

## American Information Infrastructures

U.S./Japan	Data source and comment
2.2	U.S.: Estimates by Department of Commerce ITA; Japan: MITI's survey on computer deliveries (1 dollar = 111.18 yen)
6.2	U.S.: Data Quest Japan; Japan: JEIDA (domestic shipments only)
7.1	International Data Corp. (Shipments and Installed Base of Vendors in the U.S. 1993)
3.8	Estimates based on the above data on assumption that the U.S. and Japan have 120.66 million employees and 64.32 million employees, respectively, as of the end of 1993.
—	OECD IT Outlook * Japan lags behind in downsizing due to priority on general-purpose machines.
—	Quick data from Data Quest Japan's "News Release." * Japan and the U.S. were reversed again since 1986.
3.2	U.S.: As of end of Dec. '94, SIMBA Information Inc.; Japan: Jun. '94, New Media Development Association (commercial networks only)
3.3	In the U.S., CompuServe and Prodigy have the same number of subscribers, 2.3 million, as of Sep. '94. In Japan, PC-VAN and Niftyserve have 760,000 and 670,000 subscribers, respectively. (Same data source as above)
32.9	Internet Society (ISOC) * The growth rate from previous year is 215% in the U.S. and 226% in Japan.
28.8	<a href="http://www.netgen.com">http://www.netgen.com</a> data (as of Mar. 9, '95). * The number of servers is an indicator of information transmission power.
9.1	U.S.: As of Jun. '94, CTIA (Cellular Telecommunications Industry Association) Data Survey; Japan: As of Mar. '94, MPT
2.5	U.S.: Dec. '93, USTA yearly statistics; Japan: Mar. '94, MPT
—	Monthly rental charge for a 500 km line of 1.5 M bit (1 dollar = 100 yen) * NTT applied for 26% reduction on average for medium and long-distance leased lines in Mar. '95.
35.0	U.S.: Dec. '93, NCTA (National Cable Television Association); Japan: Mar. '94, MPT (Limited to urban type CATV)
—	Same data source as above. (Japan: Urban CATV subscribing households/Number of NHK contract households)
121.2	U.S.: TCI; Japan: Number of Nippon Network Service subscribers

	Comparison items		U.S.	Japan
Contents and others	Sales of software packages (1992, 100 million yen)		42,200	6,600
	Share of software packages in sales of information services industry (1992, %)		34	9.3
	Sales of databases (1993, 100 million yen)		11,800	2,100
	Number of database producers (1993, company)		1,500	130
	Number of domestic databases (1993, number of DB)		5,100	1,000
	Number of CD-ROM titles (1994, number of title)		13,000	2,600
	Percentage of schools using computers for education (Figure in parentheses: Percentage of students having no experience of using a computer) (1992, %)	Primary school	100 (1)	36 (42)
		Secondary school	100 (3)	71 (44)
		High school	100 (3)	93 (35)
	Computers installed per school (1992, number of students per computer)		24.1	53.6
	Informatization budget per Central Government employee (1991, 10,000 yen)		146	68
	Percentage of government in sales of information services (1993, %)		17	9
	Use of computers by business managers (1994, %)		64	8

U.S./Japan	Data source and comment
6.4	U.S.: INPUT; Japan: MITI's Survey (1 dollar = 100 yen)
-	Same data source as above. * The Japanese package market has not matured.
5.6	U.S.: LINK Resources; Japan: MITI's Survey. DPC "Database White Paper 1995"
11.5	U.S.: Gale Directory of Databases; Japan: MITI "Database Directory"
5.1	Same data source as above. DPC "Database White Paper 1995"
5.0	"World CD-ROM Directory 1995" (Penlog Co., Ltd.) (Estimated number of commercial CD-ROMs only)
-	IEA (International Associations for the Evaluation of Educational Achievement)/National Institute for Educational Research * In Japan, the percentage of primary schools is especially low. * In Japan, the percentage of students with experience of using a computer is low for the percentage of schools using computers probably because the number of computers installed per school is small.
-	U.S.: 1991, Statistical Abstract of the U.S.; Japan: Ministry of Education
2.1	U.S.: Quantum Electronic Database (QED); Japan: Management and Coordination Agency (1 dollar = 120 yen)
-	U.S.: Percentage of vertical industries based on INPUT; Japan: MITI's Survey (Central Government and local government organizations included)
-	Percentage of responses of "Essential for work", Fujitsu Research Institute for Advanced Information Systems and Economics's "Questionnaire Survey on Effective Utilization of Information for Business Management" (Nov. '94)





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- No. 97: The Computer System and Patent Information at the Japanese Patent Office
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