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UBIQUITOUS NETWORK SOCIETIES:

THE CASE OF JAPAN

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1 Introduction

In recent years, the use of information and communication networks is being promoted in an increasingly diverse variety of ways, heralding a future in which networks will be everywhere. The rapid deployment of broadband and mobile services over the last few years has already changed lifestyles and business practices. With the parallel proliferation of personal communication devices, the path to a "ubiquitous network society" is being charted across the globe. In Japan, this path is being pursued with particular fervour.

1.1 Why study Japan?

Japan is a leader in the use and development of information and communication technologies. For instance, it boasts the highest percentage of mobile Internet users as a proportion of total mobile users. It was one of the first countries to launch third-generation mobile services in October 2001 and the first country to launch commercial services based on the W-CDMA standard. Japan also has the cheapest, fastest broadband access in the world (Table 1.1). Moreover, mobile phone handsets are now becoming comprehensive devices equipped with such functions as e-mail, photo management, and video on demand. Consumer electronics as a whole are expected to grow, with significant development in enabling sensor networks and RFID systems. Japan has a head-start with active R&D programmes already in place.

By capitalizing on these strengths, Japan is looking to realize significant advances in ubiquitous networks and computing. Its government has implemented a number of policy and strategy initiatives geared specifically towards this goal. As such, Japan presents an important case to study in more depth, with a view to gaining a better grasp of its vision of a future "ubiquitous network society".

Table 1.1: Comparative prices for broadband, top 15, July 2004, ranked by USD per 100 kbit/s

Economy	*Company*	*Technology*	*Speed (k bit/s)*	*Price per month (USD)*	*Price per 100 k bit/s*	*Change, 2003-04*
Japan	KDDI	DSL	47'000	25.85	0.06	-44.1%
Korea (Rep.)	Hanaro	DSL	20'000	47.86	0.24	-4.0%
Sweden	Bredbandsbolaget	FTTH/ DSL	24'000	58.63	0.24	-97.4%
Taiwan, China	Chunghwa	DSL	8'000	35.30	0.44	n.a.
Hong Kong, China	Netvigator	DSL	6'000	51.03	0.85	-33.2%
Canada	Bell	DSL	3'000	34.05	1.13	-66.6%
Belgium	Belgacom	DSL	3'300	48.40	1.47	19.6%
Singapore	StarHub	Cable	3'000	46.50	1.55	-31.3%
Switzerland	SwissCom	DSL	2'400	77.88	3.24	-73.3%
USA	Comcast	Cable	3'000	52.99	1.77	-50.0%
Netherlands	Wanadoo	DSL	1'120	42.35	3.78	5.5%
Finland	Sonera	DSL	2'048	82.28	4.02	-53.6%
Iceland	Vodafone	DSL	500	21.00	4.20	-37.1%
Denmark	Tele2	DSL	2'048	86.32	4.21	-32.1%
Norway	Tele2	DSL	1'024	62.95	6.15	-11.0%
Average			**8'429**	**51.56**	**2.22**	**-36.3%**
Best practice (top 20%)			**30'333**	**44.12**	**0.18**	**-48.5%**

Source: ITU World Telecommunication Indicators Database

1.2 Scope and outline of report

The present report aims to provide an outline of the Japanese vision of the future ubiquitous network society. It is based on a case study on mobile phones in Japan released in 2004 for the ITU New Initiatives Workshop on "Shaping the Future Mobile Information Society"[1]. The present case study forms part of the background material for the ITU Workshop on "Ubiquitous Network Societies" held in April 2005 in Geneva (Switzerland)[2].

This paper is structured as follows. Chapter two provides an introduction to the country, followed by an overview of the ICT sector and institutional framework. Chapter three looks at a first generation of ubiquitous technical devices in Japan – the mobile phone. Chapter four examines new ubiquitous devices and technologies, and national policies towards the realization of the ubiquitous network society. Finally, chapter five posits on the social and human context.

2 About Japan: An overview

2.1 Geography and demographics

Not far off the eastern coast of the world's largest continent, Asia, lies the relatively small Japanese archipelago – almost at shouting distance from the Korean peninsula. This chain of islands, of which four distinguish themselves as the main ones, is home to some 127 million people, equivalent to almost half the population of the United States. Its land mass is 377'835 square kilometres, 71 per cent of which is mountainous. It is half again the size of the United Kingdom, but only one-ninth the size of the Indian subcontinent. The national territory is divided into eight or nine geographical regions. These regions are categorized mainly by their economic and human characteristics. The Kanto region, Kinki region and Tokai account for over 60 per cent of the total population. Apart from fishing (Japan accounts for 15 per cent of the world's catch), the country is lacking in natural resources. This is in sharp contrast to its huge economy, which is among the world's largest. Its rate of urbanization is high, as 80 per cent of its population now lives in crowded urban areas, a factor not be neglected in accounting for the considerable success of mobile communications in Japan. The national currency is the Japanese Yen (JPY). One language is spoken throughout the land even though two systems of writing prevail. They are: *Kanji*, written in the manner of Chinese hieroglyphics (3'000 symbols are in daily use) and the phonetic *Kana* (each with a 46-character set). Standard Japanese word-processors recognize up to 6'000 *Kanji* characters.

Figure 2.1: Geographical regions and population distribution in Japan

Source: The Kinki region is also known as Kansai.
The Hokuriku region is the northern part of the Chubu region and Tokai region is the southern part of the Chubu region.

Table 2.1 Basic social and economic indicators for Japan

	1997	1998	1999	2000	2001	2002	2003
Population (thousands)	126'166	126'490	126'500	126920	127291	127435	127619
Urban population (in per cent)	78.42	79.00	79.00	78.70	79.00.	n.a.	n.a.
Gross Domestic Product (GDP) (JPY Billion)	509'645	498'499	511'837	513'534	503'594	500'529	n.a.
GDP Per Capita (US$)	34'203	31'179	35'478	37'544	32'553	31'324	31’324
Average Annual Exchange Rate Per US$	120.99	130.91	113.91	107.77	121.53	125.39	115.93

Source: ITU World Telecommunication Indicators Database, International Monetary Fund.

2.1.1 Human development

Japan ranks ninth among the 174 countries that make up the United Nations Development Programme[3] 2004 Human Development Index and is placed in the “high” human development group. In this respect, it ranks ahead of France, Switzerland and Hong Kong China, but behind Canada, the United States and the Netherlands. Table 2.1 provides some relevant social and economic indicators for the country.

2.2 Political economy

Japan is universally regarded as one of the world’s leading industrial nations. Significant government-industry collaboration, rapid technological innovation and a strong work ethic have sustained the economy at its present high level.

One of the most remarkable characteristics of the economic scene is the “*keiretsu*”, or tightly knit groups consisting of manufacturers, suppliers and distributors. Much of the labour force enjoys lifetime employment and in general there is a high degree of staff loyalty. The use of robotic technology and telecommunications are important factors contributing to its economic strength. In fact, Japan possesses 410,000 of the world's 720,000 “working robots”.

Historically, the economy suffered greatly as a result of the Second World War, particularly due to destruction of infrastructure, severe food shortages and high inflation. Various social reforms were carried out after the war in order to establish a basic framework for economic recovery and development. The process of liberalization began with the break-up of the “*zaibatsu*”, or large business trusts. For instance, postwar demilitarization and the prohibition of rearmament are written into a new constitution, and Japan now spends as little as 1 per cent of its total gross domestic product (GDP) on defense.

In the latter half of the twentieth century, overall economic growth in Japan was phenomenal. In the 1960s, for instance, the annual growth rate averaged close to 11 per cent. This was far above the growth rates for the Federal Republic of Germany at 4.6 per cent and for the United States at 4.3 per cent during the same period. This growth was spurred by large investments from the private sector in infrastructure and equipment, and by the increased capital spending and the introduction of new technology.

There was a significant slowdown between 1992-95, largely due to the after-effects of increased investment during the late 1980s, and constrictive domestic policies intended to wring out speculative excesses from the stock and real estate markets. Since then, periods of growth have been frequently interspersed with stagnation. Growth picked up in 1996 following the introduction of stimulating fiscal and monetary policies coupled with low inflation. Again, in 1997-98, Japan’s economy took a downward turn. After the bursting of the IT bubble in 2000, Japan has once again plunged into a severe recession. The slowdown in the economy has been partially attributed to high unemployment rates, and low consumer confidence. The economy picked up somewhat in second and third quarter of 2002, but lost this momentum near the end of the year. There was renewed hope in 2003 however, when GDP figures confirmed a brighter trend, with a rise in

investment and stock prices, and a slight decrease in unemployment. The year 2004 did not bring any significant improvement to the economy.

2.3 ICT sector overview

2.3.1 Basic indicators

Basic telecommunication indicators for Japan are set out in Table 2.2. Over the past few years, overall telephone density in Japan has been increasing at a rapid rate. However, like in many industrialized economies, the growth of fixed lines has been tapering off. In 2000, mobile lines outnumbered fixed lines in Japan. The penetration of PCs continues to rise, and the rate of 41.8 per cent at the end of 2002 had just about reached the average of high-income countries[4]. The Japanese information and communication industry expanded from JPY 79 trillion (USD 732 billion) to JPY 119 trillion (USD 1'141 billion) from 1995 to 2001. In 2002, there was a slight decrease (2.76 per cent) to 116 trillion yen.

Table 2.2 Basic telecommunication indicators for Japan

	1996	1997	1998	1999	2000	2001	2002	2003
Main telephone lines (000s)*	64'037	65'735	62'413	62'054	61'957	61'326	60'772	60'218
Main lines per 100 inhabitants*	50.88	52.10	53.35	55.75	58.58	59.71	55.79	47.19
Internet users per 100 inhabitants	4.37	9.16	13.40	21.37	29.94	38.42	44.89	48.27
Mobile phone subscribers, cellular and PHS (000s)	26'906	38'254	47'308	56'846	66'784	74,819	79'081	86'655
Mobile phone subscribers per 100 inhabitants	21.38	30.32	37.43	44.88	52.62	58.76	63.61	67.90
Number of personal computers per 100 inhabitants	16.21	20.21	23.72	28.69	31.51	34.87	41.80	n.a

Source: ITU World Telecommunication Indicators Database.

2.3.2 Market structure and network deployment

In April 1985, Nippon Telegraph and Telephone (NTT), which had been a public corporation since 1952, was privatized. This marked the start of competition in Japan's telecommunication market. Statistics show that there were about 12'518 telecommunication carriers in Japan at the end of 2003, of which 1'562 were new entrants.

NTT was restructured to the holding company and its subsidiaries in 1999. This NTT group has two regional telecom subsidiaries, NTT East and West. They dominate the local voice-call market (over 90 per cent of market share). Another subsidiary, NTT Communications, owns long-distance and international networks. Some other subsidiaries, such as NTT-ME, also offer telecommunication services such as ISP service. Three operators — KDD (mainly international telecommunication), DDI group (long-distance and mobile) and IDO (mobile) — merged into KDDI in 1999. This is the second largest telecommunication group in Japan. The third largest is the Japan Telecom group. In 1999, Vodafone obtained over half of its stocks and since then, Ripplewood has controlled this group.

In the fixed line market, other than above-mentioned three groups, ten telecommunication subsidiaries of ten regional electric power companies own their nationwide networks. Their telecommunication networks are along electric power lines. In Japan, most CATV operators' service areas are only small areas. About 290 CATV operators offer telecom services. Most of their services are Internet access service. For the most part, Japan's Internet services market has been largely unregulated.

At the end of 2003, there were 77.3 million Internet users in Japan. Of these, there are 14.95 million subscribers enjoying a broadband service based on FTTH, DSL, cable Internet, or wireless (e.g. FWA). The take–up of DSL (11.20 million subscribers) is the most popular form of broadband. The number of cable Internet subscribers was 2.58 million at the end of fiscal 2003 and is growing steadily. In terms of broadband usage, the total number of broadband users at the end of 2003 was estimated at 26.07 million (a 33.4 per cent increase over the previous year). Broadband users in Japan now account for 33.7 per cent of the total population[5].

The first digital broadcasting (DB) services in Japan started in June 1996 with the launch of communication satellite DB. In July 1998, digital broadcasting became available in some areas with cable television. In December 2000, broadcasting satellite DB started. In December 2003, terrestrial digital television was launched in three major regions (Osaka, Tokyo and Nagoya). A complete shift from analog to digital broadcasting is planned for 2011, with the exception for terrestrial radio broadcasting.

In the mobile market, NTT's subsidiary NTT DoCoMo group owns about 60 per cent of the market share. KDDI (KDDI has Tu-Ka group that offer mobile service in three main regions) and J-Phone that is Vodafone's subsidiary are other players in this market. They offer nationwide mobile services. NTT DoCoMo, J-Phone and the Tu-Ka group adopted the Personal Digital Cellular (PDC) system—Japan's original 2G phone system. KDDI initially adopted this system too, but later replaced it by the cdmaOne system and terminated the PDC service in March 2003. These operators offer mobile Internet services based on these technologies, but with some differences (see details in the Annex A). In October 2001, DoCoMo launched its 3G service "FOMA (Freedom of Mobile Access)" based on W-CDMA system, on a fully commercialized basis. KDDI followed launching its 3G service in April 2002. It adopted cdma2000 1x that has upper-compatibility as its 3G system. J-Phone, which uses the W- CDMA system, launched 3G services in December 2002. J-phone officially changed its name to Vodafone in September 2003.

An alternative to PDC is the personal handy phone system (PHS) launched in 1995. NTT DoCoMo, DDI Pocket (a subsidiary of KDDI) and the ASTEL group offer nationwide PHS services. With the drop-off in the market share since 1997 due to competition from mobile, the operators have switched their attention to PHS data services. The PDC system allows for a much higher maximum transmission speed (128 kbit/s), compared with other 2G mobile systems.

Like in many other countries around the world, since early 2002, wireless LAN (WLAN) hotspots, primarily based on the IEEE 802.11 family of standards (e.g. Wireless Fidelity or 802.11b), have emerged in restaurants, cafés and convenience stores as well as airports and train stations all over large metropolitan cities in Japan.

2.4 ICT regulation and policy

2.4.1 History

A Ministry of Communications was established soon after the introduction of telephone services, in 1890. It remained in place until the end of the Second World War, when it was split into the Ministry of Telecommunications and the Ministry of Posts. In 1952, the Ministry of Telecommunications became a public corporation and Nippon Telegraph and Telephone (NTT) was born. It was to be the monopoly domestic operator. At the same time, the Ministry of Posts became the Ministry of Posts and Telecommunications (MPT) responsible for the regulation of the telecommunication market. In the same year, the KDD Corporation Law of 1952 was enacted, establishing Kokusai Denshin Denwa (KDD) as the international operator. NTT was the primary regulator, responsible for the setting of technical standards, the development of telecommunication regulation, and for policy-making in conjunction with the Japanese parliament (the Diet). NTT already controlled an R and D system in collaboration with the large equipment manufacturers, such as Fujitsu, NEC, Hitachi and Oki Electric.

While substantial network development had been achieved, NTT was nevertheless perceived as being out of touch with user needs. Consequently, in 1970, the MPT set up a number of study groups to consider reforms to telecommunication policy. These study groups, made up of about 100 younger MPT staff, examined the possibility of reorganizing the NTT, and openly questioning its monopoly status. The report, released in June 1971, recommended the "reorganization" of NTT and the liberalization of value-added services. These reforms were not adopted until 1985, fifteen years later. And despite NTT's role as primary regulator, the involvement of the MPT in regulatory reform in the 1970s sealed MPT's future role as the telecommunications regulatory authority for Japan.

With respect to value-added networks, by the end of the 1970s, the Ministry of International Trade and Industry (MITI) and the MPT were in competition with each other. As the regulator for the computer and IT industry, the MITI was pushing for the liberalization of value-added services, whereas the MPT was of the view that all new entrants, including value-added service providers, should be subject to MPT regulation (for the purposes of ensuring consumer protection). Finally it was decided to liberalize value-added networks for small and medium-sized enterprises under the MPT's framework. At the same time, telecommunication reform got under way in Japan.

Significant reform in telecommunications occurred in the 1980s, as the United States began liberalizing its telecommunications market and started the process leading to the break-up of AT&T. In Japan, the Second Provisional Council on Administrative Reform (*Rincho*) announced a proposal in 1982 to introduce competition in all sectors of telecommunication services, as well as to privatize and "reorganize" NTT. Approval was given to separate telecommunication services on the basis of installation of circuit-switched facilities, rather service types. Under this scheme, Type I service providers (those owning their own facilities or infrastructure) would require permits from the MPT. Special Type II service providers (those not owning infrastructure but with a large user base) would need to register with the Ministry. Basic Type II service providers (confined to operation in limited areas) need to merely register. The licensing regime in Japan is just under revision (see below).

On 1 April 1985, three reform laws came into effect: the Telecommunications Business Law, the NTT Law, and the Background Law for the Telecommunications Law. Open tendering for NTT stock began in October 1986, when the government issued the first block of 200'000 shares. Complete privatization did not take place and the government still holds a substantial share in NTT.

The reforms of 1985 placed regulatory power firmly in the hands of the MPT, e.g. the authority over price and service regulation (the Diet's original domain) and technical regulation (NTT's original domain). The MPT also increased its role in telecommunication policy, and research and development. It even began exerting its authority over competition issues, for instance selecting new entrants (new common carriers – NCCs) in the 1980s and 90s. A large number of companies entered the market, and by 1996, 124 Type 1 and 3134 Type II carriers were offering services.

In the 1990s, the MPT evolved its regulatory framework significantly to adapt to technological innovation and changing market dynamics. It started with the liberalization of the cable TV market in the early 1990s. In 1996, the MPT embarked upon a deregulation process, which included, *inter alia,* a new regime for end-to-end interconnection with NTT (known as "ko-sen-ko" interconnection) and a relaxation of foreign ownership restrictions. Once the privatization process had begun, the MPT was able to focus more effectively on developing policies for information and communications technologies (ICT) in Japan. The MPT and two other ministries were merged into the Ministry of Public Management, Home Affairs, Post and Telecommunications (MPHPT) in the administrative reform of central government in January 2001. In 2004, the Ministry changed its name to Ministry of Internal Affairs and Communications (MIC).

2.4.2 Legislative Framework

In April 1985, NTT (until then a public corporation) was privatized and the Japanese telecommunication market was opened to new entrants. This was a turning point for the Japanese telecommunications industry, as up until that point, NTT held an unchallenged monopoly. At the same time, the *Telecommunications Business Law* (hereinafter referred to as the "TBL") was established to regulate telecommunication companies. Businesses offer telecommunication services are required to either to obtain permission, or to register/to notify the Ministry of their intention, depending on their type of operation.

The TBL classifies telecommunications businesses into Type I and Type II businesses. The latter are divided into General Type II and Special Type II businesses. Operators that install their own circuit facilities are classified as Type I businesses and others as Type II businesses. The rationale behind this classification stems from the important role played by Type I operators, typically large telephone companies, who are responsible for providing basic infrastructure indispensable to people's lives and overall socio-economic activity. They are therefore subject to more stringent regulations. On the other hand, Type II operators, that do not install their own circuit facilities, are small value-added service providers with less direct influence on socio-economic activities. The "mobile virtual network operator" model stems from this distinction. MVNOs in Japan include Japan Communications Inc, NTT Communications, as well manufacturers Sony and Fujitsu.

However, over the last few years, the market has evolved. There are a number of small operators in the Type I category, such as CATV, W-LAN and CBD (central business district). Similarly, large-scale Type II enterprises have emerged, such as Internet, IP-telephony, and ADSL providers. These operators compete in the same market. If an operator owns circuit facilities, no matter how small, it is classified as Type I and is subject to more stringent regulation. The Government deemed that the distinction between Type I and Type II businesses was therefore in need of revision. In March 2003, the Cabinet submitted a bill to the Parliament (Diet) to amend the TBL. The main amendments, which have been in force since 24 July 2004, were as follows:

1. Abolition of the distinction between Type I and Type II telecommunications business;
2. Abolition of permission system for market entry with regard to Type I telecommunications business;
3. Abolition of permission system for suspension and discontinuance of business with regard to Type I telecommunications business;
4. Abolition of tariff regulations for non-dominant operators;
5. Abolition of ex-ante regulations with regard to interconnection such as prior notification of interconnection agreement for non-dominant operators;
6. Maintenance of asymmetrical regulations for dominant operators.

2.4.3 The e-Japan strategy I

Like many other industrialized countries, Japan is facing a number of challenges, including environmental concerns, a rapidly ageing population, falling birthrates, and expanded urban development. The introduction and rapid diffusion of information and communication technology is seen to be an essential factor in overcoming these challenges. However, up until 2000, there was no national policy on IT, in contrast to other countries in Europe and Asia. In this context, in January 2001, the government put forward "e-Japan Strategy", with the main objective of making Japan the most advanced IT nation in the world within five years (2005). The Strategy consists primarily the "e-Japan Priority Policy Programs" and "FY2002 Programs". In order to enable a rapid and focused policy implementation related to establishing advanced information society, a Cabinet-level IT Strategy Headquarters [6] (led by the Japanese Prime Minister) was established, to enforce the Basic Law on the Formation of an Advanced Information and Telecommunications Network Society (commonly referred to as "IT Basic Law") of January 2001[7]. The Headquarters announced the "e-Japan Strategy" in January 2001[8] and revealed in March 2001 the "e-Japan Priority Policy Programme"[9] with a view to clarify specific action plans. This programme, to be reviewed every year, sets out five policy areas for the country to concentrate on:

(1) Infrastructure;

(2) Human resources;

(3) E-commerce;

(4) E-government;

(5) Network security.

In terms of infrastructure development, the programme clearly states that, "the private sector is to play a leading role in the area of IT". Although initiative was to be taken by the private sector, the government was

to take concrete action in promoting an environment conducive to innovation and investment, through mechanisms such as effective IT policies, tax incentives and deregulation.

2.4.4 The e-Japan strategy II

In line with the e-Japan strategy, the goal of providing always-on high-speed Internet connections to 30 million households and ultra high-speed connections to 10 million households is well on its way to being realized. Furthermore, as mentioned earlier, the country's monthly broadband consumer prices are the lowest in the world[10]. In July 2003, the IT Strategy Headquarters adopted the second phase of the IT strategy, "e-Japan Strategy II", to ensure that Japan stays on course and maintains its position as an ICT Leader in 2006 and beyond. The second stage shifts its focus from infrastructure to the use of ICTs. In this respect, the main aim is to create a "vigorous, safe, impressive and convenient society[11]". The strategy cites four strategic ideas for realizing such a society: structural reform, new value creation, individual perspective and new international relationships. On this basis, seven areas were designated for the promotion of ICTs: medical care, food, living, small business financing, intellectuality, employment/work, and government services. The e-Japan strategy II also includes specific infrastructure targets for the development of infrastructure, as a follow up to the first phase.

3 Mobile Japan: A first step to ubiquitous networks

3.1 The growth of mobile in Japan

Japan's mobile journey began, like in many other countries, with car phones, which were introduced by the NTT in 1979. In April 1987, NTT (privatized in 1985) began offering portable mobile phone services under an analogue "HiCap" system that it had developed. At the same time, NCC (New Common Carriers), IDO and Cellular Phone Group were established. IDO was a subsidiary of the long-distance fixed line operator Nihon Kosoku Tushin, and Cellular Phone Group was a subsidiary of long-distance fixed line operator DDI. IDO started its service from December 1988 in Kanto and Tokai region. Cellular Phone Group operators launched their service in other regions. At that time, two mobile operators (NTT and IDO or Cellular Phone Group operator) offered mobile services in each region. Roaming between operators was not an obligation and depended on negotiations between them. In August 1991, with a view to ensuring fair competition in the mobile market, NTT separated its mobile phone business, and NTT DoCoMo was established as a subsidiary.

Digital mobile phone services in the 800 MHz frequency band were launched in 1993. Operators adopted the PDC (Personal Digital Cellular) system developed by NTT DoCoMo. In April 1994, the 1.5GHz frequency band was also opened up for mobile services. DoCoMo now uses this band in the Kanto, Tokai and Kinki regions, where population density is very high. In these areas, two additional mobile operators (Digital Phone Group of Japan Telecom and Tu-ka Group of Nissan) also entered the market in April 1994. In other regions, Japan Telecom and Nissan Motors jointly established one operator (Digital Tu-ka Group).

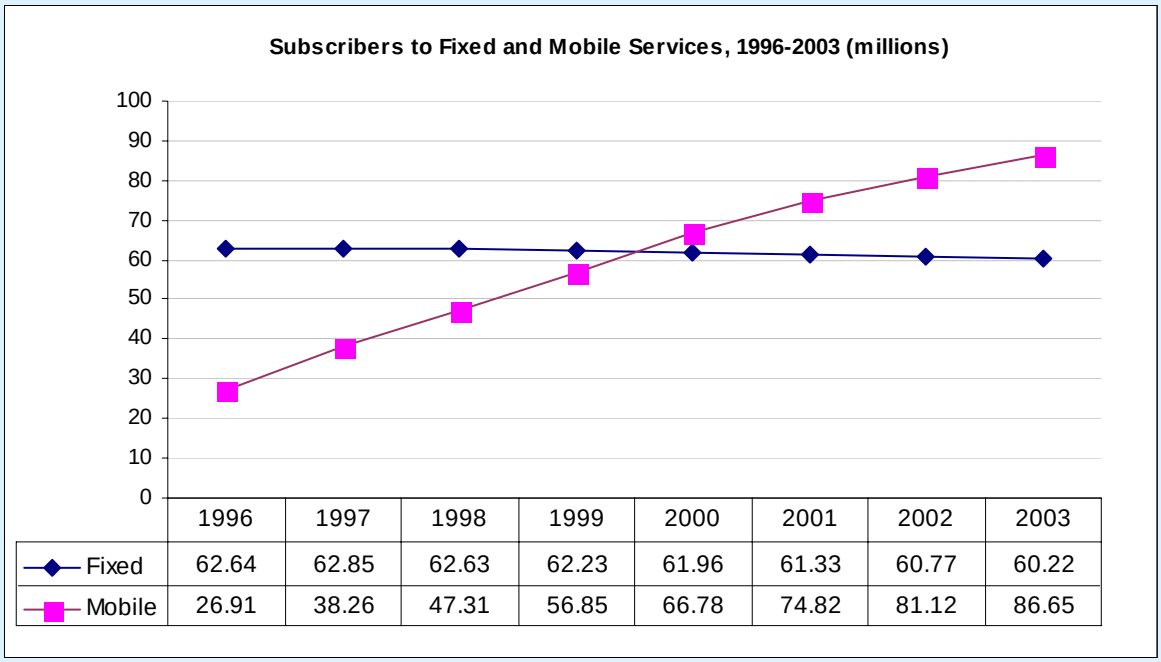
In July 1995, a new mobile phone system by the name of personal handy phone system (PHS) was launched. Three groups of PHS operators (NTT Personal, DDI Pocket, and ASTEL Group) launched their services simultaneously in each region. PHS had the advantage of low cost, long battery life and relatively fast data transmission rate (64 kbit/s compared to PDC's 9.6 kbit/s). However, it was primarily a cordless phone and thus had limited coverage. Although the early adoption rate for PHS was higher than for cellular mobile or PDC, its subscriptions declined, and now account for a fraction of the total mobile market. Over the last few years, the strategy of PHS operators has shifted to focusing on wireless PC data access (see Section 3.2.1).

The mid-1990s were crucial for the development of mobile communications in Japan. Take the example of the pager. At first its only function was to alert the user to a to a transmission with a ringing bell. Not unlike the mobile phone, its first use was limited to businesses. This situation was radically altered, however, with the introduction of the "display pager". This pager displayed the caller's number. This was quickly adopted as an important means of communication between high school students, who then used the pager code to exchange messages. Although the number of mobile phone subscribers in 1992 was about 1 million, the number of pager subscribers was 7 million. PHS was then developed and these three products competed fiercely for market share.

Deregulation accelerated the growth of mobile services in the 1990s. In April 1994, customer ownership of handsets was introduced. Within this system, handsets could be sold to individual customers, rather than making them available on a rental basis. In December 1996, MPT deregulated its procedure for amending mobile phone call charges from permission to simple notification. As a result, mobile operators could reduce their call charges more easily and efficiently. As a result, PDC operators abolished the use of connection fees and reduced their per-minute tariffs. They also introduced attractive handsets and customized tariff packages. This further led to phenomenal growth in new mobile subscriptions[12]. When the cellular mobile phone (known as "keitai" in Japanese) was first launched, its main users were business professionals, and it was considered a luxury item.[13] Today, however, the number of mobile subscribers (both cellular subscribers and PHS) has outnumbered the number of fixed-line subscribers (including ISDN) in 2000 (See Figure 3.1). Cellular mobile subscribers overtook fixed line subscribers in 2002. In terms of overall mobile subscribers, Japan has the third largest mobile population, and ranks only after China and the United States (Figure 3.2). The country also ranks in the top 10 in terms of mobile subscribers per capita. There are currently three main operators on the market providing mobile services: KDDI, NTT DoCoMo and Vodafone (previously J-Phone).

Figure 3.1: Mobile overtakes fixed in Japan (1996-2003)

Transitions in the number of subscribers to fixed and mobile communications from 1996 to 2003

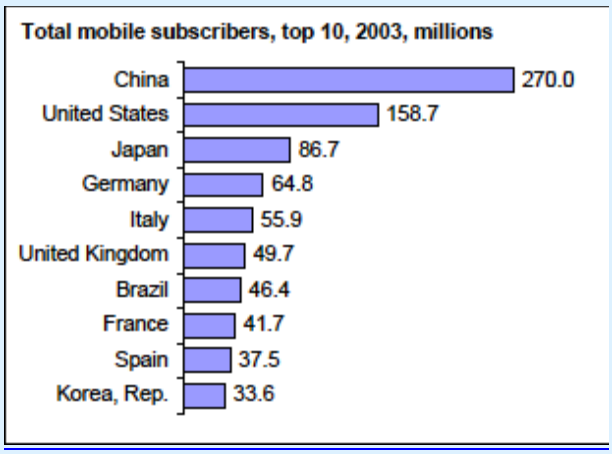


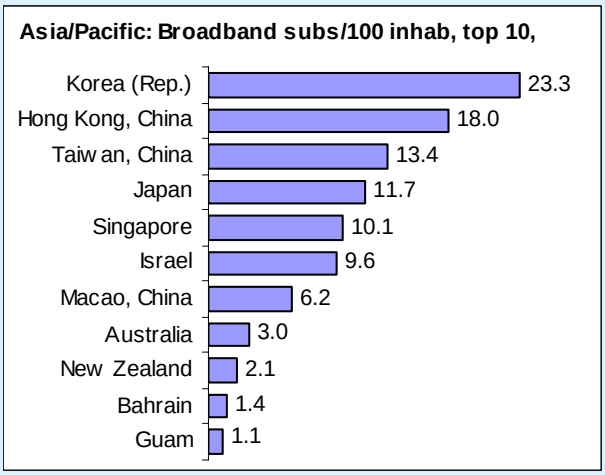
	1996	1997	1998	1999	2000	2001	2002	2003
Fixed	62.64	62.85	62.63	62.23	61.96	61.33	60.77	60.22
Mobile	26.91	38.26	47.31	56.85	66.78	74.82	81.12	86.65

Note: The data above refers to the end of the fiscal year (i.e. 2002 refers to March 2003), and mobile subscribers include subscribers to the PHS system.
Source: MIC

Figure 3.2: Japan in Top 10 (2003)

Leader countries in terms of total mobile subscribers and Asia-Pacific leaders in mobile penetration





Source: ITU World Telecommunication Indicators Database.

3.2 Third generation mobile (IMT-2000)

The policies on the introduction of higher-speed third-generation IMT-2000 services were finalized by the MIC in March 2000. They fixed the number of operators to three per region. New as well as incumbent operators were eligible for the licenses, with the exception of fixed regional operators. The main reason behind the limitation on the numbers of licenses was the shortage of frequencies. The regulator had a total of 60 MHz available for 3G services (uplink and downlink). This meant that in order to allocate a minimum of 2X20 MHz blocks of spectrum, only 3 licenses could be awarded. Owing to the shortage of frequencies experienced due to the unexpected growth in the number of 2G subscribers, the regulator was cautious in the allocation of 3G spectrum.

Operators were required to cover 50 per cent of the population in the first five years. The policies favored applicants with know-how of IMT-2000 technologies and systems. 3G operators were chosen through a comparative selection process, and operators were free to decide on the radio interface they wished to use, between Wideband CDMA and CDMA 2000. The 40-day application period began in April 2000 and licenses were allocated in June 2000. Only the three incumbent operators, i.e. NTT DoCoMo Group, IDO and Cellular Group (KDDI), and J-Phone Group, applied, and obtained, the three available licenses in each region.

NTT DoCoMo was the first operator to launch 3G services in Japan, under the brand name “FOMA”, or “Freedom of Mobile Multimedia Access”, and based on the ITU standard W-CDMA (Wideband CDMA). The full-scale commercial launch of FOMA was initially scheduled for 30 May 2001. However, DoCOMo had to postpone the launch until 1 October 2001. In the first days of FOMA, DoCoMo was hoping to sign up 150,000 users by the end of 2001. However, due to the limited service coverage at the time of launch, the fact that the W-CDMA system does not have backward compatibility with its 2G service based on the personal digital cellular (PDC) system, relatively short battery life and lack of killer applications (the highly publicized video-phone capability was not a resounding success), it took another year to reach 152’000 subscribers (by the end of 2002). In early 2003, DoCoMo introduced new W-CDMA handsets, which have a battery life three times longer than previous handsets. In addition, through further expansion of the service area, introduction of flat-rate pricing, and the emergence of advanced handsets equipped with multimedia functions such as the videophone (900i series), DoCoMo’s 3G services have become more widespread. Moreover, efforts to integrate HSDPA (High Speed Downlink Packet Access) technology, which will significantly reduce throughput speed compared to the current W-CDMA technology, are ongoing (Table 3.1).

DoCoMo was not the only operator to suffer delays. Vodafone initially announced a delay of six months to June 2002, and full commercial deployment of its W-CDMA network occurred as late as December 2002. KDDI launched its CDMA 20001x service in April 2002, and introduced its packet service CDMA 2000 1x EV-DO on 28 November 2003, under the brand name "WIN".[14] WIN will enable data transmission rates of up to 2.4 Mbit/s, and enhance delivery times for traditional mobile Internet services (e.g. Ezweb, EZMovie and EZ Chaku Uta). KDDI also plans to introduce a new series of services for the EV-DO network, including EZChannel, which will automatically distribute various multimedia programmes, and Live Camera, which will allow for the delivery of video content in real-time. In order to encourage take-up and allow for the increased data traffic, the operator will be introducing a flat-rate fee (EZ Flat), the first of its kind in Japan. Users will be able to benefit from unlimited use of EZWeb services, including e-mail, for a fixed monthly charge of 4'200 yen (USD 39.10).

Table 3.1 High-speed mobile systems in Japan: 3G and beyond 3G

		CDMA 2000 1x EV-DO	CDMA2000 1x	W-CDMA	HSDPA
Spectrum occupancy		1.25 MHz	1.25 MHz	5 MHz	5MHz
Services		Data only	Voice and Data	Voice and Data	Data only
Connection Mode		Packet only	Circuit and Packet	Circuit and Packet	Packet Only
Maximum Data Rate per User	**F/L**	2.4 Mbit/s	153.6 kbit/s	384 kbit/s and up to 2 Mbit/s	14.4Mbit/s
	R/L	153.6 kbit/s	64 kbit/s (153.6 kbit/s)	64 kbit/s and up to 384 kbit/s	2Mbit/s
Sector Throughput (F/L)		Approx. 600 Kbit/s	Approx 220 kbit/s	Approx 1000 kbit/s	Approx 3000-4000kbit/s

Source: MIC and operator data.

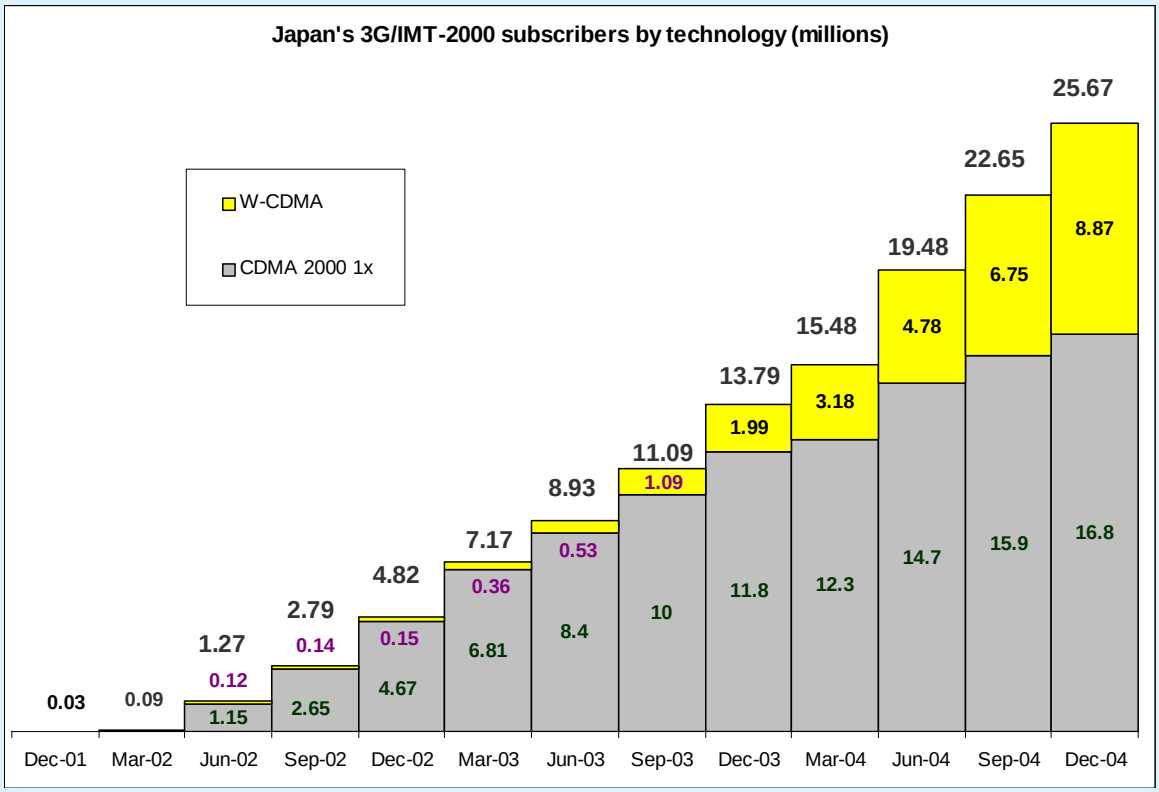
At the end of 2004, there were over 25 million 3G subscribers in Japan. KDDI boasts the highest number of 3G subscribers, at 16.8 million, and discontinued the sale of its 2G handsets in March 2003. As of December 2004, NTT DoCoMo had 8.5 million W-CDMA subscribers, while Vodafone had 370,000 W-CDMA subscribers as of December 2004. The figures mean that subscribers to 3G mobile phones in Japan account for 30 % of all mobile phone subscribers, which indicates a steady transition from 2G to 3G (see Figure 3.3).

3.3 Fixed wireless and converged services

High-speed Internet access services, such as wireless LAN (local area network) were launched in 2002 in Japan. However, it seemed challenging task to develop a sound business model, attracting a large number of paying users. Much media attention was paid to the launch of the first commercial wireless LAN service called Mobile Internet Services (MIS) in April 2002, but service was suspended in December after only garnering around 1'300 subscribers in eight months.

Figure 3.3: IMT-2000 in Japan

Proportion of IMT-2000 subscribers by technology

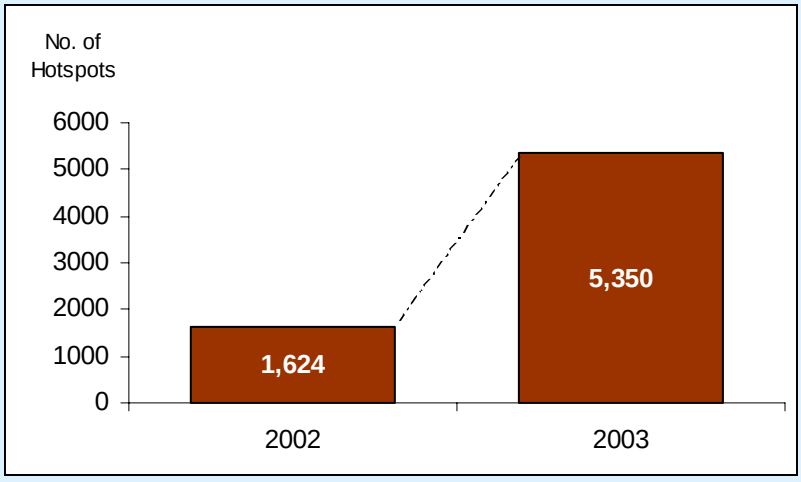


Source: MIC.

NTT Communications launched in May 2002 its commercial wireless LAN service, branded "hotspot", and based on a combination of IEEE 802.11a and IEEE 802.11b specifications. There are also several wireless LAN access points offered free of charge by a number of providers. Still, "Freespot", which offers access points free of charge, has the largest number of access points in Japan. Overall, the number of high-speed wireless access points in public places increased from 1'624 in 2002 to 5'350 in 2003 (Figure 3.4). A survey by the MIC reveals that the use of WLAN access points by Internet users increased to 9.5 per cent at the end of 2003, up 0.7 percentage points from the end of 2002[15].

Figure 3.4: The growth of Wireless LAN Hotspots in Japan

Hotspots in Japan in 2002 and 2003



Source: MIC White Paper 2004, "Survey of the Current Status and Issues of Networks".

Still, other types of fixed wireless access services continue to be launched. And given the possible transmission speed of up to 11 Mbit/s, they are seen by some to threaten third-generation mobile services, which have a theoretical maximum speed of 2.4Mbit/s. Table 3.2 shows the various fixed wireless access systems in Japan.

Table 3.2: Wireless access in Japan

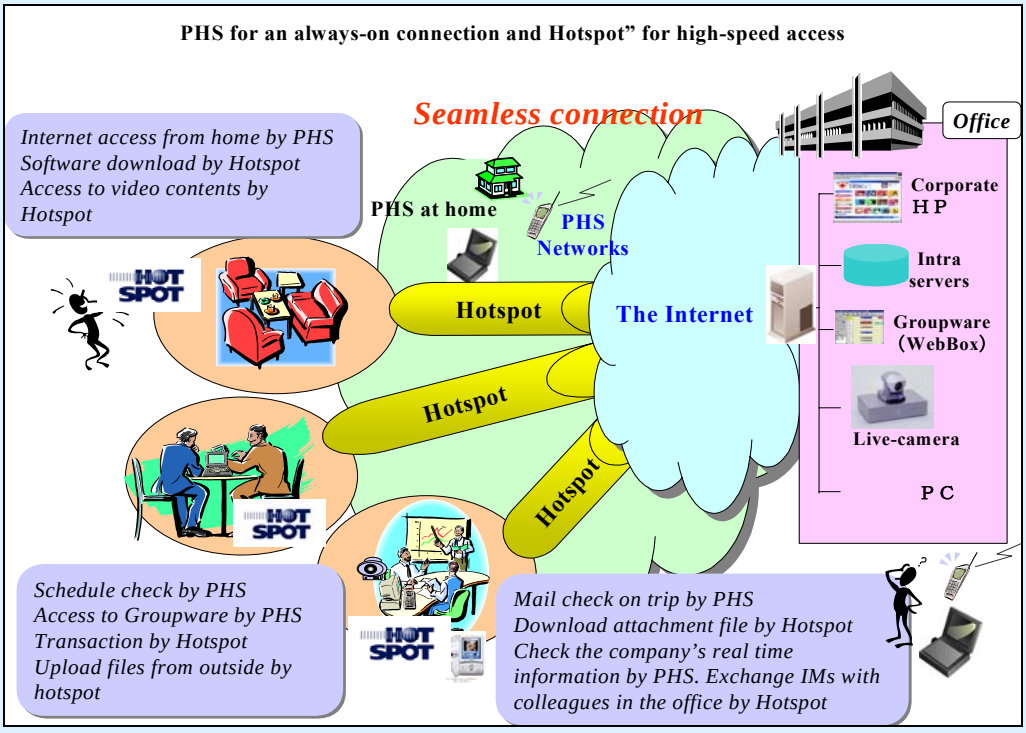
Frequency band	Examples of use	Transmission distance	Maximum Transmission speed	Licence for radio station
2.4GHz	(1) Wireless LAN in the office (2) FWA (in hot spots and to buildings) (3) Home Network	Around 5km	54 Mbit/s	Not necessary
5GHz	FWA (in hot spots and to buildings)	Around 3km	54 Mbit/s	Necessary
5.2GHz (Indoor only)	(1) Wireless LAN in the office (2) FWA (indoor hot spots) (3) Home network	Around 300m	54 Mbit/s	Not necessary
18GHz	FWA(for public use)	Around 5km	156Mbit/s	Necessary
22/26/38GHz	FWA (for businesses)	Around 4km	10Mbit/s (P-MP) 156Mbit/s (P-P)	Necessary
25/27GHz	(1) FWA (in hot spots and to buildings) (2) Relay line to access points (3) Wireless LAN in the office (4) Home network	Around 100m	100Mbit/s 400Mbit/s (Short distance)	Not necessary

Note: P-P: refers to a system in which one radio station communicates with another radio subscriber station. P-MP: refers to a system in which one base station communicates with more than one subscriber station.

Source: MIC.

Figure 3.5 PHS and WLAN nomadic Internet access

PHS and WLAN service provided by NTT Communications



Source: NTT Communications.

The lack of profitability of WLAN services is likely to persist for some time to come, and for this reason, a number of providers are exploring options to combine or integrate WLAN services with other types of services, notably NTT Communications and NTT DoCoMo. Since July 2002, NTT DoCoMo has been offering "Mzone"[16], a public wireless LAN service (11 Mbit/s). More recently, it has offered it in combination with its 3G or FOMA service, which typically provides speeds of 384 kbit/s. Users can benefit from 3G data transmission rates when away from wireless LAN access points, through the 3G network. Transmission at a much higher speed of 14.4 Mbit/s is being planned for the first half of 2005[17]. A service known as "Nomadic Internet Access" is now being provided by NTT Communications – it combines PHS and WLAN as set out in Figure 3.5. This system enables the use of PHS for always-on data connection and WLAN for high-speed stationary access.

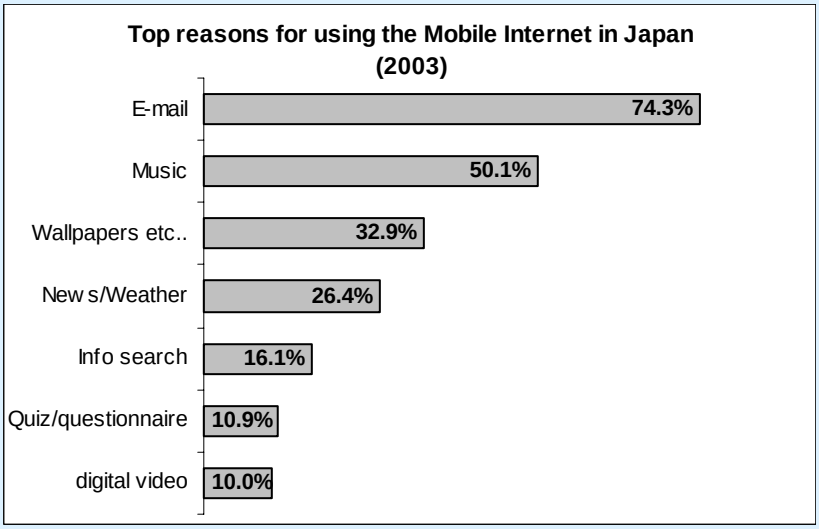
3.4 Mobile Internet services

In the 2G world, very few countries have been successful with the "mobile Internet" thus far. WAP in Europe suffered from low transmission speeds, paucity of content and disenchanted users. Japan, on the other hand, introduced a wide array of mobile Internet services, and witnessed phenomenal growth in usage and subscribers. In fact, Japan made mobile Internet services an integral part of mobile phone ownership, and even made charging for Internet content a reality. The country boasts the highest total number (and percentage) of mobile Internet users in the world: over 89 per cent of mobile users enjoy some form of Internet access (Figure 3.7). In terms of devices connected to the Internet, mobile phones now outnumber personal computers.

NTT DoCoMo launched its famous Internet connection service for mobile phones, 'i-mode', as far back as February 1999. The main services are e-mail, information services and applications such as Internet banking and ticket reservation. Other mobile operators also have competitive Internet connection services in 1999 (KDDI group launched Ezweb and the J-Phone group launched "J-Sky"). But, by far, the most popular service remains NTT DoCoMo's i-mode.

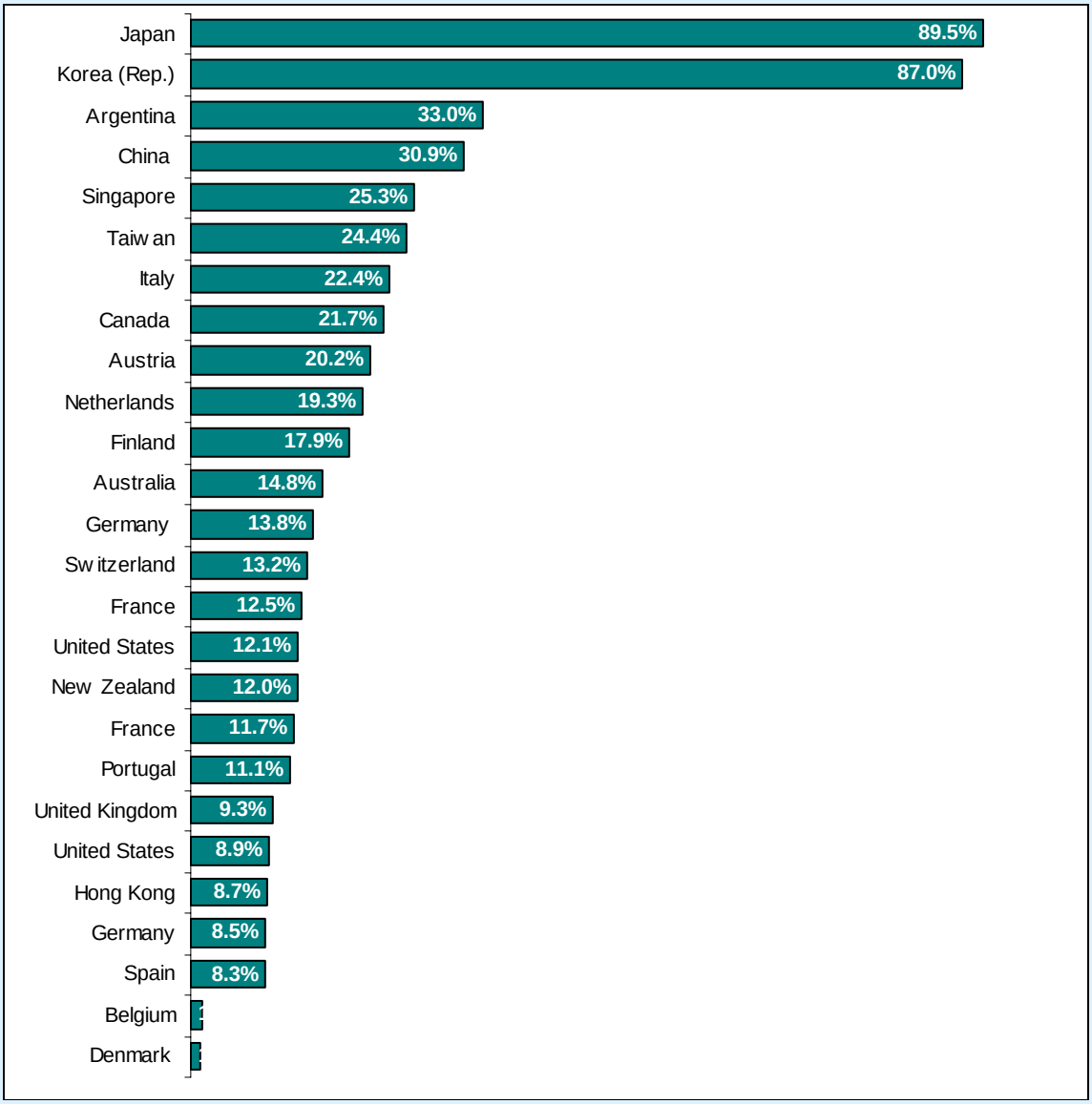
There are several factors contributing to the success of mobile networks for Internet access in Japan - low PC and Internet penetration are the most important ones. Some analysts point to the large number of long-distance commuters using public transport as a stimulus for growth. Early adopters of mobile services are usually young users, who account for the largest proportion of data traffic. It seems that the Internet and electronic services market in Japan will be spurred by the mobile industry. In fact, the demand for browsing services has been responsible for transforming NTT DoCoMo into the world's largest ISP almost overnight.[18] In 2003, the average annual revenue per i-mode user was USD 236[19] most of which stems from packet transmission charges. The introduction of colour handset in 1999 and of java-enabled handsets 2001 ("i-appli" service), were also driving forces. Though mobile Internet services are being used for a variety of reasons in Japan, the primary use remains email (Figure 3.6)

Figure 3.6 Top Reasons for using Internet services over mobile or PHS networks



Source: MIC (formerly MPHPT) Communications Usage Trend Survey

Figure 3.7: Mobile Internet users in selected countries
Mobile Internet subscribers as a percentage of total mobile subscribers (2003)



Note: For Japan, the figure includes paying subscribers, whereas in other cases (e.g. Korea), numbers may actually be lower, as those with Internet-enabled handsets may not necessary be subscribed to a particular service or using particular service.
Source: MIC compiled from *3G Mobile.*

3.5 Market peculiarities

One of the most distinguishing aspects of the Japanese mobile industry is that it is operator-led. Equipment manufacturers and operators work in closely-knit groups and supply the market with handsets and portable devices in a coordinated effort. The mobile operator retains ownership of the handset. As such, the operator's brand is dominant rather than that of the manufacturer. The Japanese subscriber must first select the service provider and then choose his or her mobile device. The subscriber's choice of handset is thus limited to those on offer and branded by the service provider selected. This differs remarkably from the European case, where the handset brand rests firmly with manufacturers such as Nokia and Ericsson, as does the responsibility for research and development.[20] By contrast, Japanese mobile operators play a leading role in research and development activities. The Yokosuka Research Park (YRP), just outside Tokyo, is well-renowned and houses one of the largest R&D centers in the world for 3G technologies. The close relationship between manufacturers and operators in Japan accounts in part for the sophistication and

availability of handset technology and the take-up of value-added services. This relationship must be fostered in order to ensure further innovation and service take-up.

Another peculiarity of the Japanese mobile market is the agreement that was struck early on between content providers and operators. In principle, the mobile operator bills for content, retains a commission, and passes on the majority of the content fees to the content provider, which amounts to about 90 per cent. However, none of the revenues from the traffic that content sites generate is passed on the content providers. In addition, in many cases, a price cap has been introduced for content subscription charges. Many content providers and analysts argue that call charges should be included in any revenue-sharing for mobile content. One mechanism to address the perceived imbalance is to introduce flat-rate billing for data traffic charges. If operators bring down connectivity costs for data traffic, users will most likely increase their use of content sites. Thus, proportionately, in such a case, there will be a drop in traffic charges but a corresponding increase in content charges. However, such a system is more feasible for packet-based services. KDDI introduced flat-rate billing in November 2003, for all users subscribed to its CDMA 2000 1x EV-DO (WIN). It remains to be seen whether the issue of revenue sharing between mobile operators and content providers will be subject to renewed negotiation.

4 Realizing the "ubiquitous network society" in Japan

There are different ways to characterize the "ubiquitous" information society. At its origins, the word "ubiquitous" is derived from the Latin "ubique", meaning that which exists everywhere. In the context of information and communication technologies, ubiquitous "networks" are those networks that can be accessed by anyone and anything via a wide variety of mechanisms or access methods, and this without limitations of time or space. However, there can be different approaches to fostering such a society, the concept of "ubiquity" being a relatively broad one. For Sony, ubiquity manifests itself through integrated circuit cards communicating with all kinds of devices. On the other hand, for Toyota, ubiquity may come in the shape of car navigation services. The Ubiquitous Networking Laboratory may consider that ubiquity can be achieved through the use of tiny chips and special communicators. But on a national level, the Japanese approach is a unified one, while still covering a number of different areas. This chapter describes that vision, outlines current research and development (R&D) initiatives, some current applications, and governmental policy and strategy.

4.1 Ubiquitous Net Japan (u-Japan)

As it approaches the target year for the e-Japan strategy, and in the present economic climate, Japan has begun creating a new vision for future generations of users of information and communications technology.

Given current technological trends, ubiquitous network technologies have now taken centre stage. It is expected that such technologies will create a society in which it is possible to connect to the network "anytime" (24 hours day or night), "anywhere" (at work, at home, in the city, in the country, or on the move), with "anything" (home appliances, individual items, cars, food products), and by "anyone" (adults or children, elderly or handicapped). This "ubiquitous network society" that Japan is aiming to achieve is known as "Ubiquitous Net Japan (u-Japan)".

It must be noted that the u-Japan vision cannot be realized in a short space of time, as a number of important challenges need to be overcome. The necessary policies to respond to these challenges have been grouped under the heading of the "u-Japan" policy. The basic concept of this u-Japan policy is based on the e-Japan strategy and e-Japan strategy I. It is made up of the following 3 axes, and represents a mid-term vision for the period beyond 2005.

1. *From broadband to ubiquitous networks*

   First, infrastructure deployment is crucial. Japan's main objective is the transition from existing networks (consisting mainly of wireline) to ubiquitous networks, thereby enabling the seamless connection between wireline and wireless networks and services. Rather than being limited to the geographical areas served by broadband, the country is working towards the development of a network environment facilitating seamless networks connections from any location, through organic linkages between wireline and

wireless, networks and terminals, identification and data exchange. The end result will be the creation of a grassroots ICT environment in which networks merge with every facet of daily life.

2. *From the promotion of informatization to the resolution of issues*

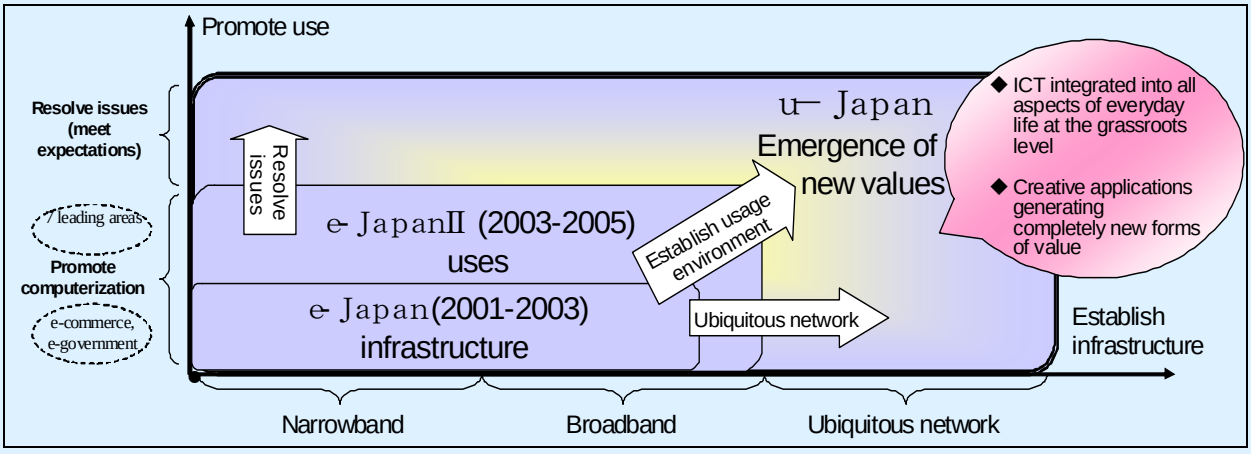
The second aspect relates to the user side, namely the shift from the "promotion of informatization" to the actual resolution of issues. Until now, the use of ICTs included measures to promote "informatization" and to accelerate the transition to "informatization" in those fields that are lagging behind. Japan is beginning to work on the positive utilization of ICTs in order to resolve the social problems of the 21st century. The power of ICTs as a tool for aiding society is being increasingly explored.

3. *Radical strengthening of the usage environment*

The third aspect relates to safety and security, in the context of the usage environment. With the growing role of ICT in private and public life, there is an increasing awareness of the need for enhanced privacy and information security. In order to surmount these unresolved problems (a thorn in the side of ICTs), it is vital to take radical steps for strengthening the usage environment, including the creation of concrete and all-encompassing policies.

The u-Japan policy has been progressing steadily in terms of the points outlined above. It must be noted that the u-Japan policy is not intended to be a mere extension of the e-Japan strategy. Rather, it represents a paradigm shift to a world in which ICTs become as natural as air or water. The positioning of the u-Japan policy described above is illustrated in Figure 4.1.

Figure 4.1 U-Japan policies - progressing from "e" to "u"



Source: MIC.

4.2 Research and Development (R&D)

The vision of Japan's ubiquitous network society is one where optical communications, mobile and consumer electronics, are connected to one network. For this, international involvement is indispensable. In order to realize this vision, MIC is focusing on key research and development areas. These are quite diverse. Since 2003, MIC has been focusing particularly on foundational, high risk, high wave-effect technologies. Working closely with industry and academia, it has created joint research and development structure for the three technology areas outlined below:

- *Microchip Network Technology*

  Network technology that enables connection control of the large volume of microchips, which enable all devices to connect to the network.

- *Ubiquitous Network Authentication and Agent Technology*

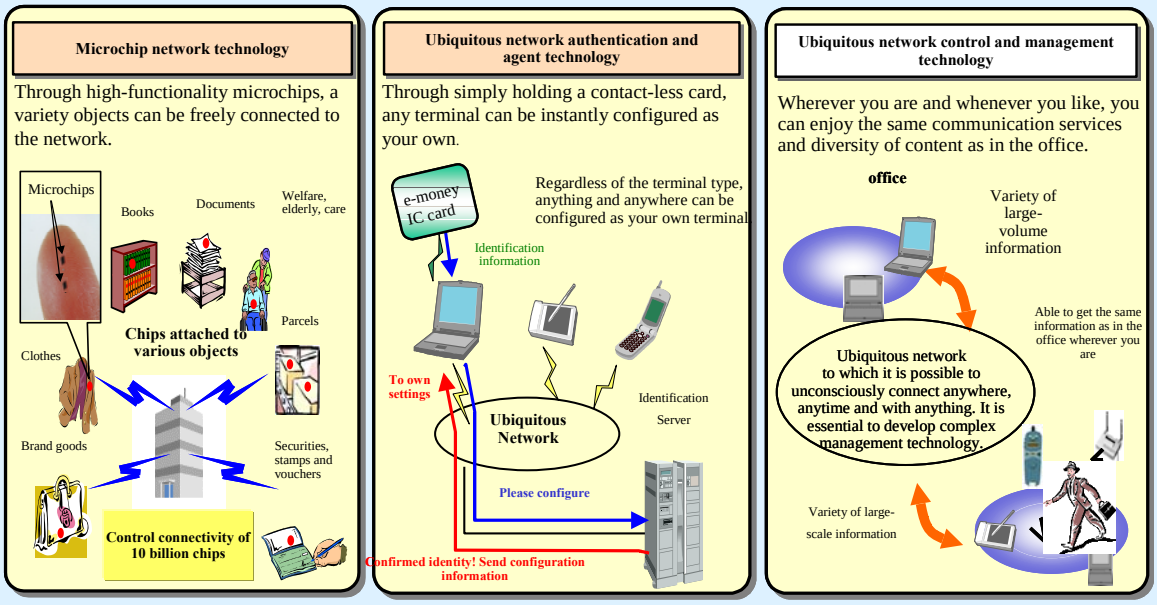
Authentication and agent technology makes it possible, through the use of contactless cards, to instantly identify individuals. In turn, it allows individuals to use any terminal anywhere, and for that terminal to have the same configuration as their own terminal.

- *Ubiquitous network control and management technology*

Technology to control and manage the network, allowing the user to connect to the network anywhere, anytime. An optimal communication environment is provided based on the situation of each specific user.

These three development areas are illustrated schematically in Figure 4.2.

Figure 4.2: Outline of Research and Development on Ubiquitous Network Technologies

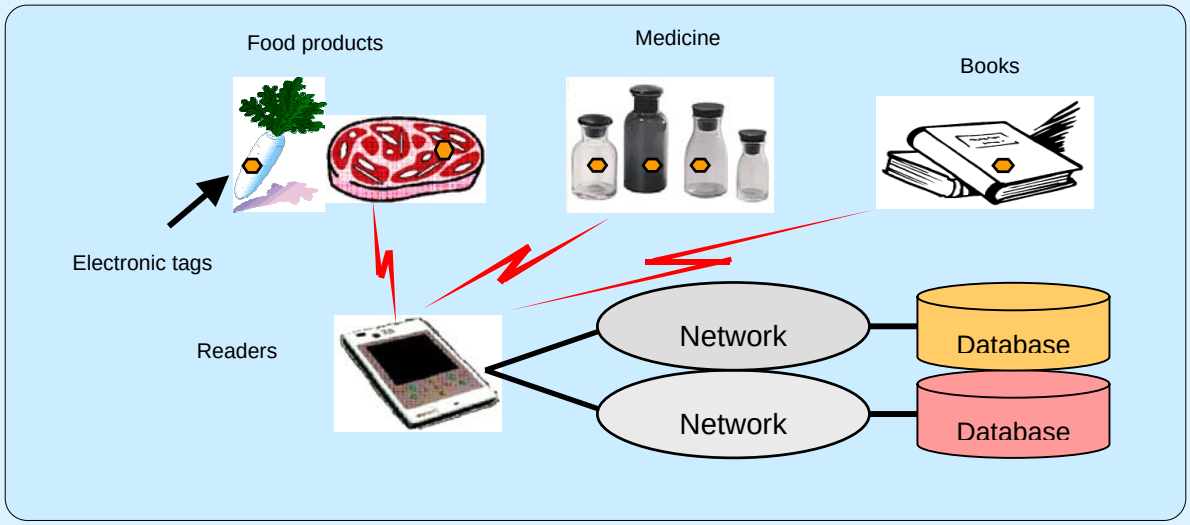


Source: MIC

4.1.1 Radio-frequency identification (RFID)

The MIC has embarked on a research and development programme as part of the 4-year "Research and Development for Utilization of RFID" plan, to realize sophisticated utilization of RFID in a variety of fields, such as food products, distribution, medical treatment and environment (Figure 4.3).

Figure 4.3: Schematic representation of RFID use



Source: MIC

The main technologies that are being explored under this R&D programme are the following:

- *Mutual exchange gateway technology*

Research and development on technology to link RFID, network addresses and attribute information of objects on the network, and search and reverse probe information on IDs and attribute data.

- *Security adaptability control information*

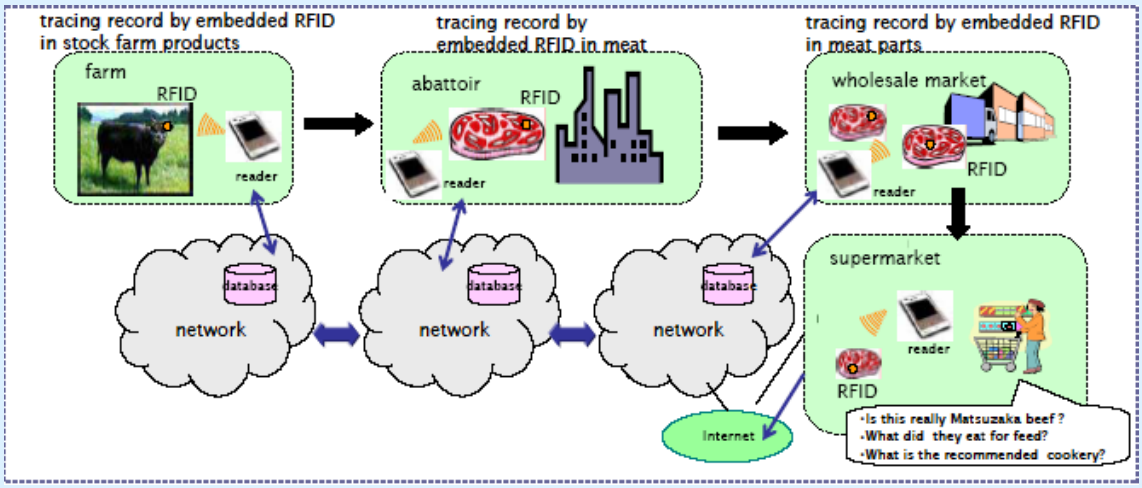
For the exchange of information between RFID and the network, research and development on the prevention of forgery and illegal access of data stored on RFID or Database, and the flexible control the disclosure of privacy information.

- *Seamless tag information management technology*

Research and development on technologies for the exchange of information contained in RFID systems between different platforms, as well as the seamless management of this information in line with any environmental changes.

In addition, as part of its research and development initiatives in the field of RFID, the MIC is undertaking a range of trials focused on users. A good example is the use of RFID tags in stock farm products to ensure that these products can be traced during the whole distribution process, from farms to the supermarket shelves (Figure 4.4).

Figure 4.4: RFID Research and Development



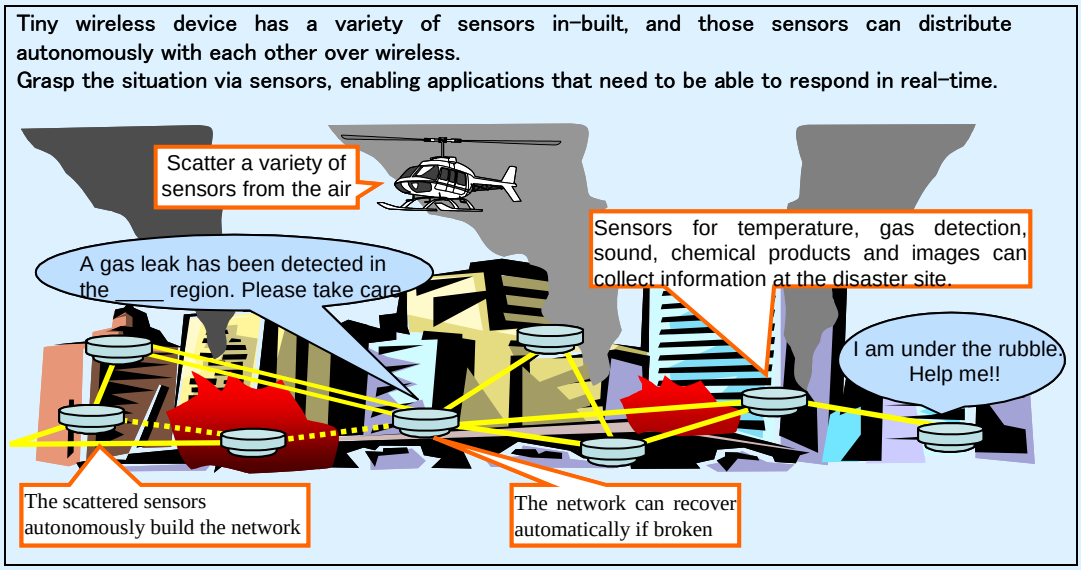
Source: MIC

The aim is that, through the linkage of RFID over the network, it will be possible to promote utilization of RFID that transcends corporations and industries and move from limited use of corporate and industry to further diffusion.

4.1.2 Ubiquitous Sensor Network technology

Ubiquitous sensor networks enable sensors to detect the status of people and objects and their surrounding environment, dealing with them in real-time through autonomous circulation of information between sensors. Through the development of this technology, it is expected that ICT support be strengthened in a wide range of social and economic activities, such as medical care, welfare, crime prevention, security, disaster management and environmental risks (Figure 4.5). The MIC plans to undertake research and development in this area as of 2005, thereby contributing to the creation of diverse applications and new services.

Figure 4.5: Ubiquitous sensor network technology



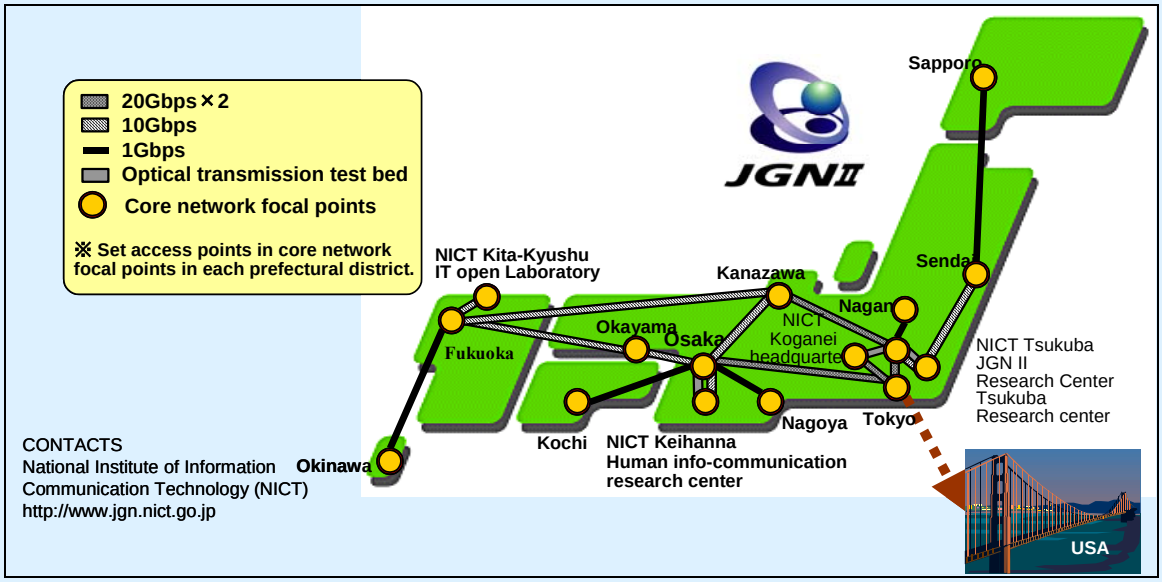
Source: MIC

4.1.3 Advanced Testbed Network (JGNII)

The research and development test bed network, with a leading approach to a variety of technologies through research and development and verification testing, is bringing about wide-ranging wave effects, such as in improving Japan's technological competitiveness, strengthening links between industry, academia and government, stimulating regional activities and nurturing human resources.

It has been verified that with the gigabit network (JGN: Japan Gigabit Network) operated from 1999 to 2004 as well, through its use by 650 institutions and 2000 researchers, large-scale benefits were brought about in the fields of broadband, stimulation of regional areas and nurturing of human resources.

Figure 4.6: Outline of R&D Testbed Network (JGN II)



Source: MIC

As the successor of the JGN, JGNII which began operation from April 2004 has leading optical equipment to enable high speed traffic of up to 10Gbps ×2, and by cutting-edge functionality for research and development, such as the establishment of an optical test bed environment that enables an IP network environment on a national scale and wavelength level optical testing, have established access points in all prefectures of the country, enabling linkups between industry, academia and government and regional linkups on a national scale, such as universities, research institutes, private entities and local governments.

The MIC is actively promoting a focused approach to the test bed network (Figure 4.6 above).

4.2 Current Applications and Services

4.2.1 Intelligent Transport Systems (ITS)

This section examines in-vehicular services in Japan that are offered over mobile networks. Japan is one of the most advanced countries in terms of car navigation systems, and the total sales of car navigation systems reached 15 million in September 2004. Car navigation systems are provided either as optional equipment by car manufacturers when a new car is purchased, or as additional equipment sold at car accessories shops. A total of 25 companies sell car navigation systems in Japan, including nine car manufacturers.

It can be said that car navigation systems saw three different generations of development. The first generation included map data in a CD-ROM format, which had memory limitations, could only contain comprehensive street information or detailed information to a scale of 50 metres or less. The second generation, still currently the most popular, contains map data in DVD-ROM format, thereby solving the problem of storage size. The next generation of navigation systems moved on to hard disk drives, providing significant advantages in terms of data updates and writing.

At the governmental level, the MIC, the National Policy Agency and the Ministry of Land Infrastructure and Transport are promoting the VICS (Vehicle Information and Communication System) project, which provides and collects various types of information from and to vehicles. VICS enables convenient and timely information services, such as traffic congestion, road works, car accidents and availability of parking lots. All the services are free of charge, once users buy and install the terminals. The information is provided through FM radio waves, radio wave beacons and optical beacons. A practical application is the service for drivers, which estimates the travel time to a given destination: this information is based on the calculation of another vehicle's travel time determined by the sensor ID. The total accumulated number of VICS units reached 10'439'373 at the end of September 2004, according to the Vehicle Information and Communication System Center.

Added functionality can be provided by the use of 3rd generation mobile systems with hard disk drives. For instance, map information can be updated continuously and delivered to the vehicle. A good example is Pioneer Corporation's product "Air Navi", which is equipped with a CDMA2000-1x communication module provided by KDDI. Once car navigation systems acquire always-on connectivity to the Internet, a large amount of relevant information can be provided during vehicular travel. This is not to say that second-generation car navigation systems did not provide an important information facility, allowing searches of various facilities such as hospitals, train stations, cinemas and restaurants near the position of the vehicle. However, that information was off-line and statically stored on a DVD-ROM. This was the first manifestation of Toyota's "G-Book" service. In 2002, the motor company released a new version of the service with a dedicated CDMA2000-1x data communication module. G-Book has user-friendly interfaces such as touch panel display, voice recognition and text-to-speech. Currently there are 60 different services falling into 5 different categories, as shown in Table 5.1 Toyota has released the first version of the on-line G-Book service in the car model "Will Cypha", a compact vehicle targeted at the younger generation. A large percentage of Will Cypha car owners subscribe to the service, a clear indication that demand is not limited to luxury owners. A surprisingly well-adopted service is karaoke, implying that users may be interested in information not related to driving or roads. From October 2003, Toyota has increased the number of models with G-Book, and expects to gradually expand the service to all of its car models. The main barriers of adoption are seen to be the cost of communications, the data throughput, quality of service and coverage.

Table 5.1: Service category and representative contents of G-Book

Category	Contents
Safety & security	Emergency Call support: HELPNET RoadAssist24: 24 hours accident support with easy operation by interactive menu selection. Remote Maintenance Service: Communication with the car dealer and reservation of annual maintenance My Car Search: Confirmation of current location by PC, PDA or mobile phone.
Live navigation	Shop Search: shop information in the present area or destination. G-Walker Gourmet: Restaurant information with recommendation in the present area or destination.
Information	News Information: provided by NHK (National Broadcaster) Traffic Information: Congestion, Regulation Information Location-based Information: Near Toyota Dealers, Hospitals, Clinics and Gasoline stand information Parking Lots Information: Availability of Parking Lots at the destination. Phone to Navi: Automatic phone call through Hand-free dialing News of Stock Exchange:

Entertainment & e-commerce	Gaming: Simulation game, Horoscope, etc. Karaoke: On-demand Karaoke service from the library of over 4'000 songs. Remote Monitoring: Accessing Remote controllable camera to monitor such as Pet's condition. Shopping "GAZOO Shopping" : Accessing to cybermall operated by Digital Media Service.
Communication	BBS Service. Address Book: Shared also through Internet by PC, PDA and mobile handsets. "Friend Search": Location Information of friends' cars in case of group tour. E-mailing.

Source: Toyota

In Japan, the major benefits of ITS or Intelligent Transport Systems can be classified under the following two general categories:

a) Safety: Fatal traffic accidents are to be reduced to less than 5'000 by 2014

b) Creation of a new industry: The market scale of ITS is expected to reach a total of JPY 60 trillion by 2015 and create employment for about 1.07 million people.

4.2.2 The multimedia home

Owning a personal TV and stereo has been ranked high in the wish list of youth and adults alike in Japan. In terms of stereos, this wish has been partially realized through portable cassette, CD and mini disk players that make audio media easier to carry. However, watching TV in the private space of individual rooms was not always possible due to the lack of TV antenna interfaces in homes. Home networks are a technical solution to this problem. The section describes a few examples of home networking, either through the use of wireless LAN, or through mobile handsets and broadband for content viewing while outside the home.

SONY Corporation, for instance, has been developing a home server concept and in this regard, has released several multimedia terminals for home use. One of them is the personal IT Television known as "Air Board", released in December 2000 (see Figure 4.7). "Air Board" was designed for late adopters or people who prefer simpler user interfaces and operations for using Internet access services. The "Air Board" is composed of a base station with a built-in TV tuner, an Ethernet interface and Wi-Fi, in addition to a mobile monitor detachable from the base station with touch screen and Wi-Fi connectivity. For getting recommended service menu and contents, users can sign up for the ISP service called "airbonet" by paying JPY 1'950/month as an option. Through Wi-Fi, people can enjoy the Internet connection and TV programming at home through the portable monitor. Technically, AirBoard can be regarded as a simple or first-generation home server and wireless home networking system.

Figure 4.7: Sony AirBoard: mobile monitor, base station and cradle (from left to right)

Source: Sony, http://www.sony.jp/products/Consumer/airboard/IDT-LFL1/index.html.

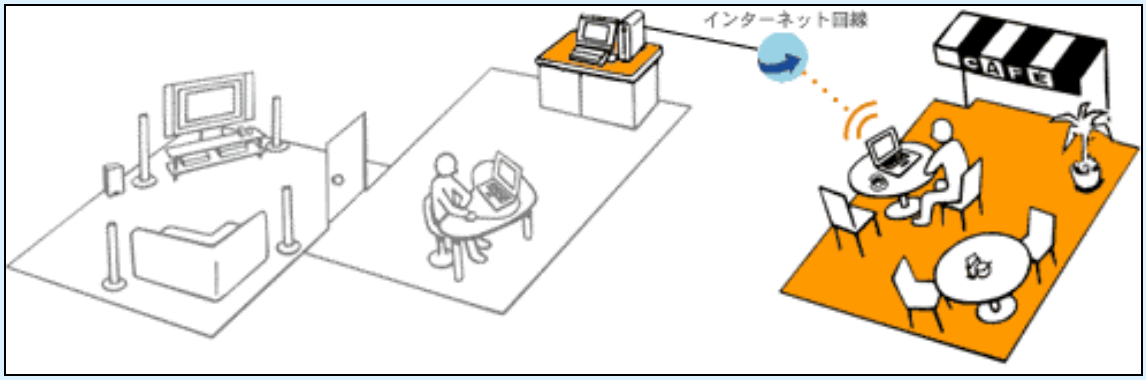
Other examples include personal computers with built-in television tuners. SONY's PC "VAIO", for instance, (named after the concept of "Video, Audio, Integrated Operation"), covers a wide range of products from the ultra light mobile laptop, to the very high performance desktop. SONY released the first VAIO model (VAIO-R), with built-in TV tuner and hardware MPEG-2 encoder in 1999. Since then SONY has been promoting the use of PCs as video recorders by releasing software to facilitate easy recording and viewing. From the autumn of 2002, the company is promoting "VAIO Media", a collective term referring to the new uses of networked VAIOs. "VAIO Media" is a portal software provided to control content: stored video content by "Giga Pocket", stored music by "Sonic Stage", and stored pictures by "Picture Gear Studio". The following 3 major services are enabled by "VAIO Media".

a) Content-sharing within home network: When a user has multiple VAIOs at home wired or wirelessly connected, users can share or access the multimedia contents stored in each terminal. For example, user can play music stored on a desktop in the living room from a laptop PC in the private room.

b) Real time streaming of TV programmes via home networks: Similar to the case above, user can enjoy TV programming in real time on their PC by streaming from the TV with network media interface.

c) Accessing contents at home from outside (Fig. 4.8): Users can access personal content from the outside, e.g. at hotspots. For example, users can enjoy Japanese TV programming recorded on one of their PCs or watch it in real time even while they are away from home, when they have Internet connection with a sufficient bandwidth. To use "VAIO Media" from outside the home, technical requirements are a) global IP address or DDNS (Dynamic DNS) and b) router with support of UpnP (Universal Plug and Play).

Figure 4.8: Watching Virtual TV through 'VAIO Media'



Source: SONY VAIO Media Official Site (http://www.vaio.sony.co.jp/Products/Solution/VAIOMedia/basic3.html).

Another pioneering product is the channel server, “Cocoon”, first released in November 2002 under the license with TiVo, a operating system of Digital Video Recorder of US company TiVo Inc., famous for its digital video recorder. The unique function of TiVo is the automatic programming and recording function, through the use of EPG (Electronic Programme Guide) and registered keywords reflecting the user’s interests. The latest model includes a 500GB disk drive, where a maximum of 342 hours of video can be recorded. The unit is currently selling at 159,000 yen. “Cocoon” uses a TV antenna interface, plus an Ethernet interface, by which users can download EPG from the Internet.

Also in the broadcasting context, a service called “One Push” has been released by CYBIRD Corporation, a successful mobile content provider established in 1998. The company’s main focus is to provide linkages between mobile phones and other types of media. As described above, digital terrestrial broadcasting service was launched in December 2003, and can provide various related information such as metadata in BML (Broadcasting Markup Language) format, a Japanese local standard based on XML. “OnePush” links personal ID information with information provided BML, in order to create another new information cycle easily by sending information to and from the mobile handset. “OnePush” mechanism works as follows:

- First users should have “OnePush” java application included on their mobile handset with IrDA (infrared) interface.
- While watching a mail order programme or advertisement of interest on television, a user can push the appropriate button of their mobile handset once, after activating the “OnePush” application.
- That information is then sent to the OnePush center through the uplink of digital broadcasting service.
- The user can then receive more related information from the server directly to his/her mobile handset.

4.2.3 New handsets and services

During 2004, more than 20 new handsets appeared in the market along with new services. Five types of handsets were selected as representatives of current Japanese mobile services in this section.

4.2.3.1 Digital-wallet services

The digital wallet service using RFID is provided only for NTT DoCoMo customers as of March 2005. This service is realized technically by integrating in the mobile phone the contactless smart chip, FeliCa, developed by SONY Corporation. Felica has been widely used by Japan Railways for their electronic train passes and pre-paid cards known as Suica, as well as in digital wallet cards issued by credit card company EDY. The main services offered are:

a) Withdrawing cash at ATMs

b) Shopping at Kiosks and vending machines,

c) Train or air tickets,

d) Ticketing for concerts, cinemas and theatres,

e) Member’s card of sports clubs and shops,

f) Key/ID to unlock automatic doors of home and companies, and

g) Online shopping (Figure 4.9)

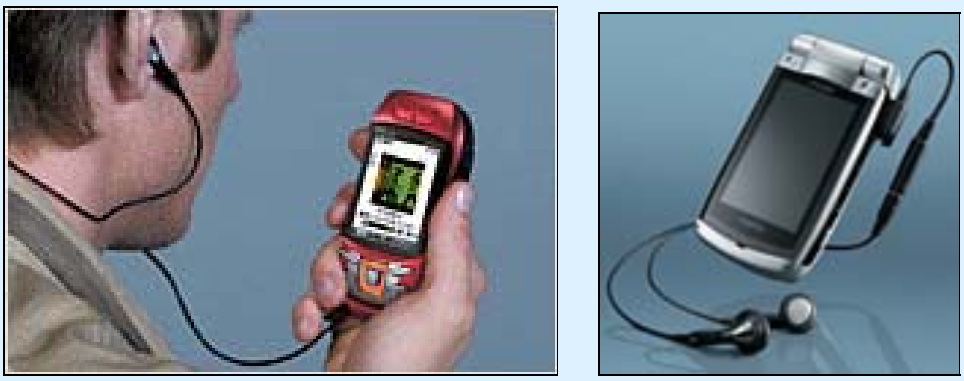
Fig 4.9: Digital wallet handsets
NTT DoCoMo's F901iC and FOMA F900iC

Source: NTT DoCoMo's URL (http://www.nttdocomo.co.jp/p_s/service/felica/f/lineup.html)

4.2.3.2 Mobile digital music

"Chaku-Uta Full", is the advanced version of the ringing tone service that was first launched for KDDI's 3G service in 2004. "Chaku-Uta" is the most popular value-added mobile service in Japan today (see Figure 4.10 for images of handsets). Initially the length of downloadable music tracks was limited to 15 seconds. With the "Chaku-Uta Full" service, the length of tracks has been extended, and it is now the most popular service among flat-rate service subscribers of KDDI's wideband 3G "WIN"(CDMA 1x Ev-Do). Though Japan is one of the leading countries in broadband, the download of music and videos over the Internet has yet take off, as evidenced, *inter alia*, from the lack of the popular Apple iTunes Music store in the country.

Figure: 4.10: Handsets for "Chaku-Uta Full" (Casio W21CA, left, and Hitachi W22H, right)



Source: Casio and Hitachi, W21CA http://www.casio.co.jp/k-tai/w21ca/detail2.html and W22H http://www.hitachi.co.jp/Prod/vims/mobilephone/w22h/music.html

4.2.3.3 Portable TV

Like in many countries, television is a very popular home appliance in Japan. A large proportion of the more recent PCs for consumers are equipped with TV antenna and recording functions. TV is still believed as potential services also for mobile handsets when digital broadcasting service for mobile handsets will start. Vodafone Japan first released TV-integrated handsets in 2003 (Figure 4.11) and television is now a standard function for high-end 2.5G handsets.

Figure 4.11: Television handsets from Vodafone: V603T(left), V601N (centre) and V603SH (right)

Source: Vodafone Japan's Homepage (http://www.vodafone.jp)

4.2.3.4 Worldwide Roaming

Before the advent of 3G in Japan, there was little possibility for international roaming, due to the use of PDC, a proprietary 2G standard deployed only in Japan. But today one of the standard services for Vodafone's 3G handsets is worldwide roaming, which is made possible through the dual system handset of W-CDMA and GSM. Recent handsets are equipped with automatic mode selection between GSM and W-CDMA. As of March 2005, Vodafone was offering voice services in 114 countries and mobile Internet services under the brand "Vodafone Live!" in 43 countries, and video phone services "TV-call" in 4 countries (Figure 4.12). NTT DoCoMo also released a GSM and W-CDMA dual system handset, catering to frequent international business travellers.

Figure 4.12: Handsets with worldwide roaming capability

Source: Vodafone Japan's Homepage (http://www.vodafone.jp)

4.2.3.5 New handset dedicated only for voice communications

Amidst all technological advance, there has also been a clear demand for a simple mobile handset among seniors who are not good at learning complicated operation or do need neither mobile Internet nor CCD camera. TU-KA, 2G service brand of KDDI, released such a handset, "Tu-Ka S" in November 2004 (Figure 4.13). Tu-Ka S, which does not have LCD or a user manual, has been a smash hit for users over 60 years old.

Figure 4.13: Simple Handset TU-KA S without LCD

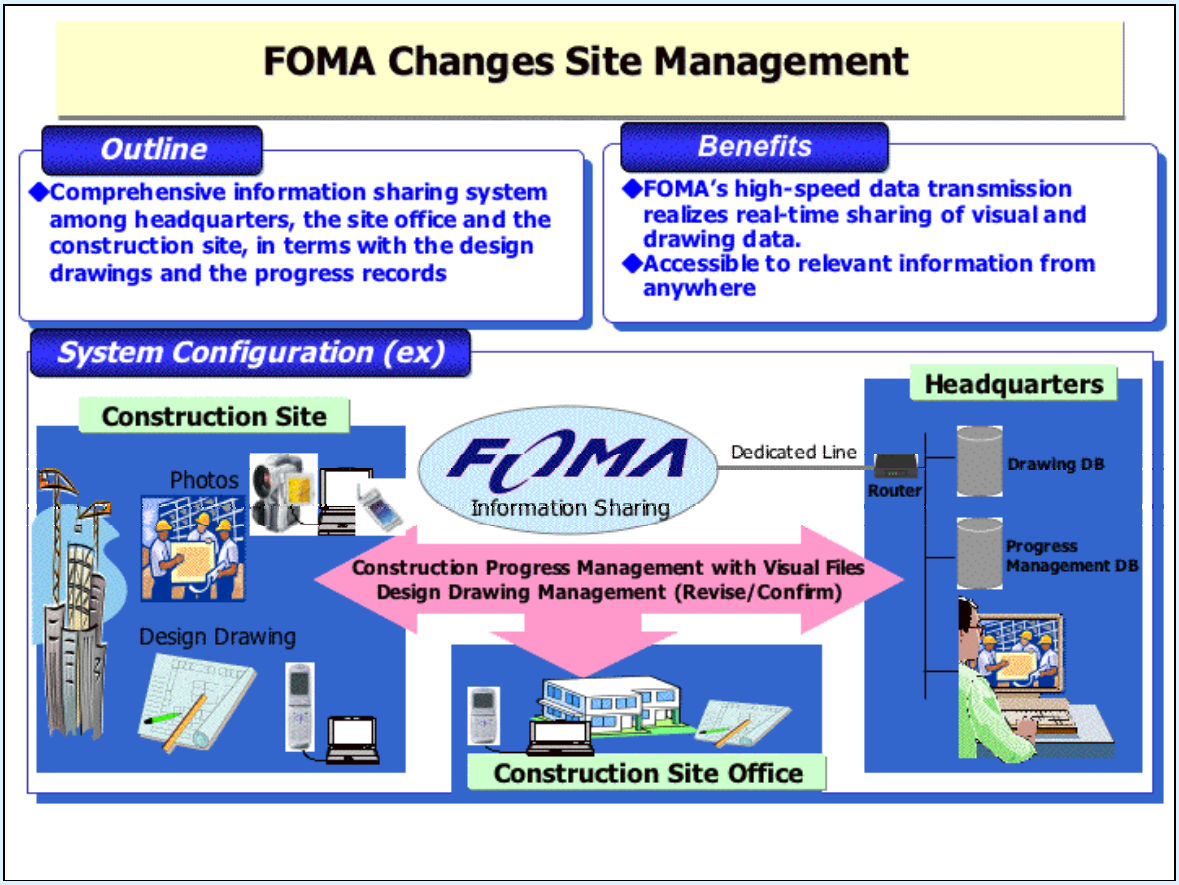
Source: TU-KA Homepage (http://www.tu-ka.co.jp/line_up/tu-kas.html)

4.2.4 The ubiquitous enterprise

Japanese businesses are rapidly moving towards ubiquitous information and communication technologies. Figure 4.14 provides a schematic representation of the use of 3G mobile technologies for the seamless and timely communication between a construction site and headquarters. In this example, staff at headquarters can share information with the people at the construction site, through the use of rich multimedia communication, (including live video phone, mapping information, and diagnostics) offered by W-CDMA 3G networks. Another good example is that of remote system installation. Before higher-speed mobile networks, specialists had to physically travel to the installation site. Now, however, less skilled engineers or first-year engineers can replace specialists and install systems by contacting specialists remotely through 3G videophone transmission, if and when it is necessary.

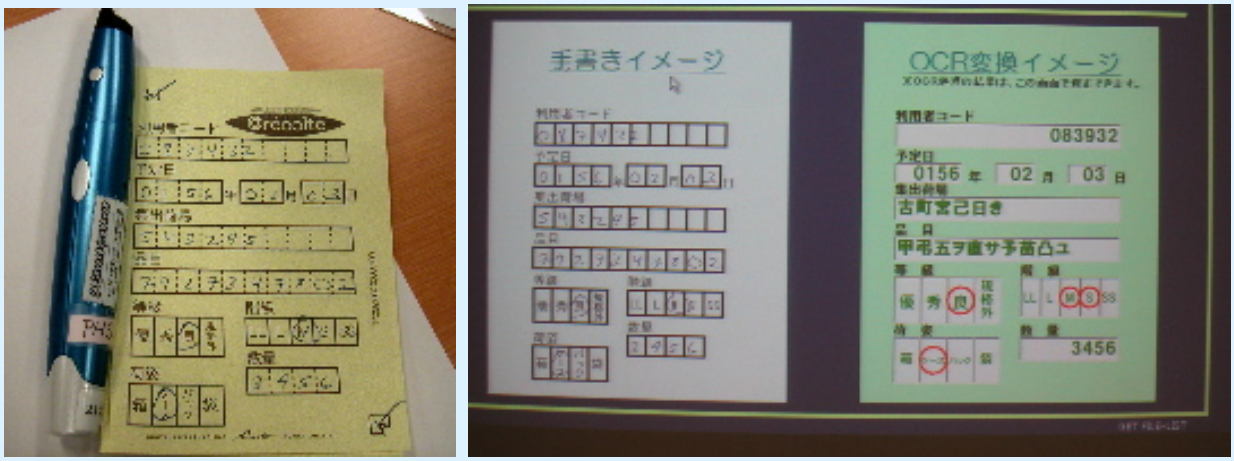
One of the disadvantages of the use of mobile terminals has been its poor user interface, due to its size and keyboard limitations. To realize the “ubiquitous networked society”, in a sense of anytime, anywhere plus “anybody”, there has been a call for innovative solutions other than carrying a PDA or an attachable keyboard. The digital intelligent pen “Anoto”, developed by Swedish company Anoto AB is just such a candidate for providing a bridge between the pen and paper world, and the digital world. Anoto’s digital intelligent pen is equipped with a bluetooth interface and sensor to read the exact location of the pen while writing on specialized 3M paper. The information is transmitted wirelessly via bluetooth (either through designated bluetooth terminals or a mobile handset), and then processed via OCR (Optical Character Recognition). The written data is automatically stored and can be utilized for various purposes as shown in Figure 4.15. One of the applications of this system by NTT DoCoMo is in the fruit and vegetable wholesale market, where people use the special pen and paper to write down information about the fruit’s origin, size, reseller and delivery route. That information is then made available digitally, and can instantly be transmitted to interested parties.

Figure 4.14: Rich Information Sharing by the 3G



Source: NTT DoCoMo Inc.

Figure 4.15: Ubiquitous input method (Anoto Pen and Paper, left and recognized Info by OCR, right)



Source: ITU, NTT DoCoMo.

4.2.5 RFID and 2-D Codes

4.2.5.1 RFID

As mentioned above, microchip-networking technologies make up an important component of the government's R&D programme for the ubiquitous information society. Indeed, early manifestations of these

types of technologies are already visible in Japan. NTT DoCoMo, for instance, has been fairly active in developing applications for radio frequency identification (RFID) tags.

RFID tags are essentially tiny microchips, some only 1/3 of a millimetre in diameter, that act as transponders (transmitters/responders), continuously waiting for radio signal to be sent by transceivers, or specially-designed RFID readers. When a transponder receives a certain radio query, it responds by transmitting a unique ID code. Most RFID tags are passive tags, that is to say they are not powered by any batteries. The most important functionality of RFID tags is the ability to track the location of the tagged item. RFID tags can cost as little as 0.50 US cents and the prices are dropping. Some analysts say that RFID will soon replace the familiar bar code in the retail world.

Since May 2003, NTT DoCoMo in collaboration with Tokyo's Academy Hills Library is testing an RFID library system in the trendy Roppongi Hills district[21]. Each one of the 12'000 books on the shelves of the Academy Hills Library contains an RFID tag on its binding. Each shelf is equipped with an RFID reader that can receive transmissions from books within 10-20 centimetres. Library users and staff are therefore able to locate books, even though they have been moved from their original position. Furthermore, checking out library books can be done quickly and efficiently using the RFID readers at the checkout desk.

A trial of NTT DoCoMo's "*R-click*" service[22] was run in 2003 and 2004. The R-Click service delivered information specific to a user's location using RFID tags (Figure 4.16). DoCoMo has issued about 4'500 RFID tags embedded in small handheld terminals. Over 200 stores were involved in the trial, and retails are now evaluating the commercial deployment of the service. Subscribers could inform the network that they wish to be located by pushing a button, but the default setting is off. The small, handheld device then enabled users to receive a wide variety of area information as they walk around the new metropolitan cultural complex of shops, restaurants, entertainment facilities, residences and hotels. Information transmitted to the user's i-mode phone was of three kinds:

1**. Koko Dake** (Area Limited) **Click**: While standing in any of approximately 10 to 20 areas (cells) in Roppongi Hills, the user can click the button on their RFID tag to receive information about that area. The user receives information tailored to their specific interests based on personal data that they pre-register.

2**. Mite Toru (**Watch and Receive) **Click**: When a user positions him or herself in front of an electronic board which shows commercials of products and services, the user can press the button on their RFID tag in order to receive information on their DoCoMo phone as well as URLs of products and services shown in the commercial multimedia presentation. The feature also allows users to go to the web pages later, at their own convenience (See Figure 5.6).

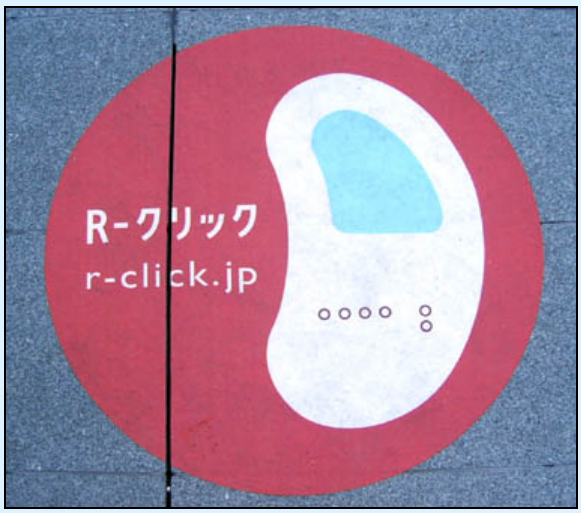
3**. Buratto** (Walk Around) **Catch**: This feature automatically emails area information as it detects the user moving about Roppongi Hills. The user receives information before actually entering a new area, because the system anticipates the user's movements. The information can be customized to a user's specific interests.

Whether the RFID tag has been activated or not, it is continuously sending identification and location information to nearby readers every 0.7 seconds. For this reason, the place and the forward direction of a user can be calculated for the delivery timely and relevant services. The R-click Service is part of the e!Project of the Ministry of Economy, Trade and Industry (METI). NTT DoCoMo and the Mori Building in Roppongi Hills had made a joint proposal for the service to METI, which funds the e!Project with the aim to promote the wider use of advanced information communication technology in Japan.

RFID tags are also making their appearance in food establishments. Pintokona, a Sushi restaurant in the Roppongi Hills district, has introduced RFID tags to track and price their plates of sushi that are presented on a rotating belt. The system facilitates the calculation of the bill, as each tag contains information such as price, sushi type, chef, time stamp and other types of information. And as it can track the precise time when the sushi is placed on the plates, once a thirty-minute period has expired, the sushi is automatically removed from the rotating belt, in order to ensure that only the freshest pieces are made available to patrons.[23] RFID is being used in for payment in Tokyo taxis[24], as well as in mobile digital wallets described in 4.2.3 above.

Figure 4.16 Only an R-Click away in Roppongi Hills

R-Click terminal and "Mite Toru" board (left picture). Service logo on a sidewalk in Roppongi Hills (right picture)



Source: ZDNet Japan.

The SIM (subscriber identity module) card embedded in GSM mobile phones will also see significant evolution. The new 3G version of the SIM card known as the UIM (universal identity module) will be incorporated into mobile phone with security measures such as PKI (public key infrastructure). This will enable secure user authentication, allowing for a wide variety of content to be stored on the mobile phone in the future, such as pre-paid coupons or credit card information as well as roaming information. Since 2002, the mobile operator KDDI's slogan has been "ubiquitous solutions company". It is currently elaborating plans for the enhanced use of UIM cards.

4.2.5.2 2-D Codes

Not only is RFID being explored as a building block for the Internet of things, but so too are two-dimensional (2D) codes and readers. The Quick Response Code (QR Code) is a 2D code developed by DENSO Corporation, and allows for the fast reading of large amounts of alphanumeric data.

Figure 4.17: Quick response for mobile phones

Image of a 2D or quick response code to be read by mobile phones

Source: NTT DoCoMo.

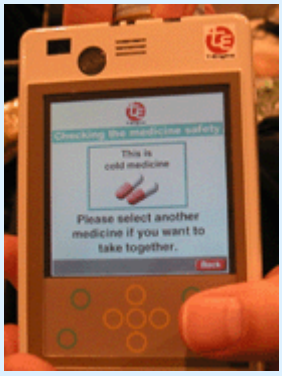
A QR code can contain up to 7'366 characters of numeric data and 1'888 Japanese characters, thereby enabling it to display to same amount of data smaller area than conventional bar codes (See Figure 4.17). NTT DoCoMo has already released two models with code readers, the Fujitsu 505i series and the Sharp 505i series. For a phone to be able to read the 2D code, it requires a digital camera and the appropriate software. From 2004 onwards, all of NTT DoCoMo's mobile phones will be 2D-code compatible. Codes will begin appearing on all kinds of products, such as newspapers, artwork, retail goods, foods and so on. By reading the code with their mobile phone, users will be able to download additional information about the product. In the early days, only text will be made available, the 2D codes will be static and off-line. But dynamic on-line 2D codes will be available shortly, embedding hyperlinks and multimedia content. This is likely to further transform the way in which we Japanese people use their mobile phones. There are currently 500'000 terminals with the appropriate software and camera capability in circulation, and NTT DoCoMo estimates that the development of a mass market for 2D codes is not far off.

The 2D code reader may be a first step towards the ubiquitous communicator or "U-Code" being developed by Japan's T-Engine Forum (Box 5.1). The U-Code is currently at an experimental stage of development.

Branded "U-code", the device looks much like a personal digital assistant, but communicates in a wide variety of ways, through TCP/IP, VoIP, bluetooth, infrared and other systems. It contains a special reader and writer for small RFID chips that can be embedded in a wide array of items, and which may eventually have broadcasting capabilities.

Box 4.1: The ubiquitous communicator
The ubiquitous communicator "U-code" at Japan's Ubiquitous Networking Laboratory

Ubiquitous communicators can offer local-area communication for accessing microchips that store " ucodes", such as RFID tags or smart cards. Furthermore, such communicators incorporate functions for wide-area network (WAN) connections, in order to obtain information about the ucodes in objects, as well as additional services associated with the objects. For example, communicators support connections with one or more of the following networks: W-CDMA 3G mobile networks; public telephone networks (for PHS and other devices); WLANs via IEEE 802.11b; or personal-area networks (PANs) via Bluetooth.



The Ubiquitous ID Center itself provides a link to information services for the objects in which ucodes are embedded. This is done using both local area networks and wide area networks. A communicator works as follows:

1. Step 1: A UC is positioned over an RFID tag in which a ucode is stored. As the UC is brought near, it uses local-area communication functions to read the ucode.

2. Step 2: The UC sends this ucode information to the Ubiquitous ID Center's ucode Resolution Server to find out where there is information about the object to which the ucode is attached. The information might be available over a WAN, and the UC may be able to obtain a website address on the Internet.

3. Step 3: The UC searches the product information database of the address obtained to retrieve information about the object.

Not only can data be retrieved, but the database function allows for data to be recorded as well.

If the RFID tag in question has only sufficient memory capacity for data about the object, the communicator can obtain this data directly from the RFID. And with the product information database, object information can be stored in the RFID or in the database. If the RFID has only enough memory capacity for data about the object, the communicator can obtain this data directly from the RFID. And with the product information database, object information can be stored directly in the RFID or in the database.

Source: Ubiquitous ID Center.

4.3 National policy and strategy

4.3.1 Promoting a "Frequency Open Policy"

As the recent explosive diffusion of mobile phones and wireless LANs has illustrated, as well as the recent interest in short-range wireless technologies such as RFID, the demand for radio spectrum in Japan has become greater and more diverse. As more new businesses emerge in the future, frequency use is becoming an indispensable factor.

In full awareness of these circumstances, an in an effort to create an advanced wireless broadband environment, MIC has been taking various measures to promote the large-scale opening up of frequencies. For instance, it is promoting a "Frequency Open Policy", described in more detail below.

4.3.1.1 Review of the Spectrum User Fee System

The Spectrum User Fee System was introduced in Japan in 1993 to ensure that radio station licensees would bear the cost of building and developing a sound radio spectrum environment.

Twelve years have passed since the introduction of this system. During this time, radio spectrum use has changed a great deal, with the introduction of important businesses such as the mobile phone business. In response to this, MIC set up a *Study Group on Policies Concerning the Effective Radio Spectrum Use* to review the Spectrum User Fee System. Following their recommendations, MIC will proceed in 2005 with a review of the system, as outlined below.

(1) A new calculation system for spectrum user fees will be introduced to promote the effective use of the radio spectrum. The system will take into account factors such as the shortage of frequencies, bandwidth range and output. It will also follow the current system of sharing the burden of radio spectrum administrative costs equally between the radio stations.

(2) Strategic measures for the development of a "radio-using" society will be expanded by using spectrum user fees for: a) research and development for the expansion of radio spectrum resources and b) expansion of possible areas of use for mobile phones and related devices

4.3.1.2 Promoting spectrum reallocation

In October 2003, MIC announced its "Frequency Reorganization Policy", which outlines their basic thinking on the reallocation of spectrum. To respond to radio demand and promote the rapid and efficient reallocation of spectrum, MIC has implemented an annual survey on the status of radio spectrum use. In addition, two new systems were introduced in 2004:

- A benefit system for the fixed compensation of losses, in exchange for the return of frequencies from existing radio spectrum users, in order to make the reallocation of frequencies smoother.
- A registration system for setting up radio stations, with a much simpler process than the existing licensing system, thus promoting the free development of the radio spectrum business.

Moreover, the MIC "Study Group for Wireless Broadband Promotion" was set up in November 2004. The topics of interest to Japan include: the image of wireless broadband use within a ubiquitous network society five to ten years in the future, the effect of penetration of wireless broadband on the economy, and the promotion of service take-up. It is in this context that the group has been investigating how to reallocate spectrum based on the MIC Frequency Reorganization Policy.

4.3.2 Broadcasting policy

Another key challenge that comes with the increased use of ubiquitous multimedia applications relates to broadcasting policy. In December 2003, Japan launched terrestrial digital broadcasting in the three major metropolitan areas of Tokyo, Nagoya and Osaka. This is the successor to communications satellite (CS) broadcasting, broadcast satellite broadcasting, and cable television broadcasting. Japan plans to switch entirely to digital broadcasting in 2011.

Digital broadcasting offers high-quality image and voice services, broadcasting to mobile terminals, storage broadcasting, and data broadcasting in combination with the Internet. This is expected to be one of the pillars that will support the "anytime, anywhere, anything and anyone" ubiquitous environment that will easily tie into networks.

It is already possible to receive current analog television broadcasting on mobile terminals. But the transition to digital broadcasting will make it possible to receive images equivalent to fixed-line standards, even when users are on the move. In addition, by integrating Global Positioning System (GPS) capability into mobile terminals, limited reception of information transmitted to users in a particular location will become possible. This is expected to have wide application across a number of service areas.

Through the development of digital networks, the television is expected to play a major role as an integrated information terminal. With server-type broadcasting expected to appear within a few years, various audio-visual options will become available in line with consumer needs and interests. These can be delivered at any time by using metadata (additional information on content attributes) on top of functions such as the large-capacity storage of DVD recorders, and automatic extraction recording using keywords.

Clearly, the medium of digital broadcasting is expected to play a major role in the realization of a ubiquitous society now and in the future, and the Japanese government is planning to promote appropriate measures for its expansion, starting with the public sector.

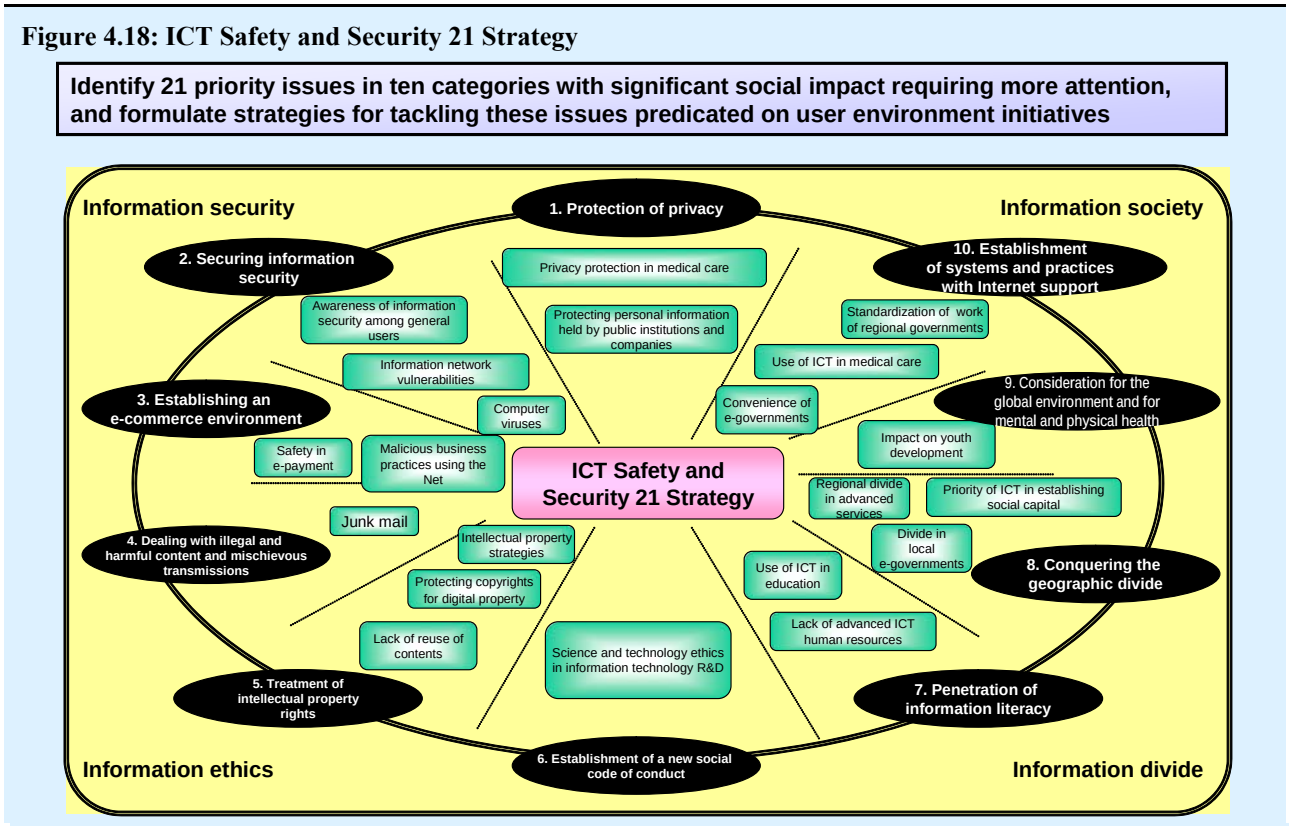
4.3.3 The user environment

Through the creation of new property and services, the ubiquitous network society will bring great convenience to people by connecting them to the network "anytime, anywhere, with anything and anyone".

Conversely, problems relating to the ubiquitous network society, such as anxiety or stress arising out of the use of ICT and any complications that need to be overcome are a cause of increasing concern. There is an even stronger call for the use of the appropriate methods to tackle and resolve these problems, which are casting a shadow over the development of ICT in Japan.

In order to achieve their stated goal of realizing "a society where 80% of the citizens can feel secure with ICT by 2010", the government of Japan is focusing on ICT safety and security. Twenty-one specific issues under the "ICT Safety and Security 21 Strategy" have been identified as priorities in this context (Figure 4.18).

Figure 4.18: ICT Safety and Security 21 Strategy



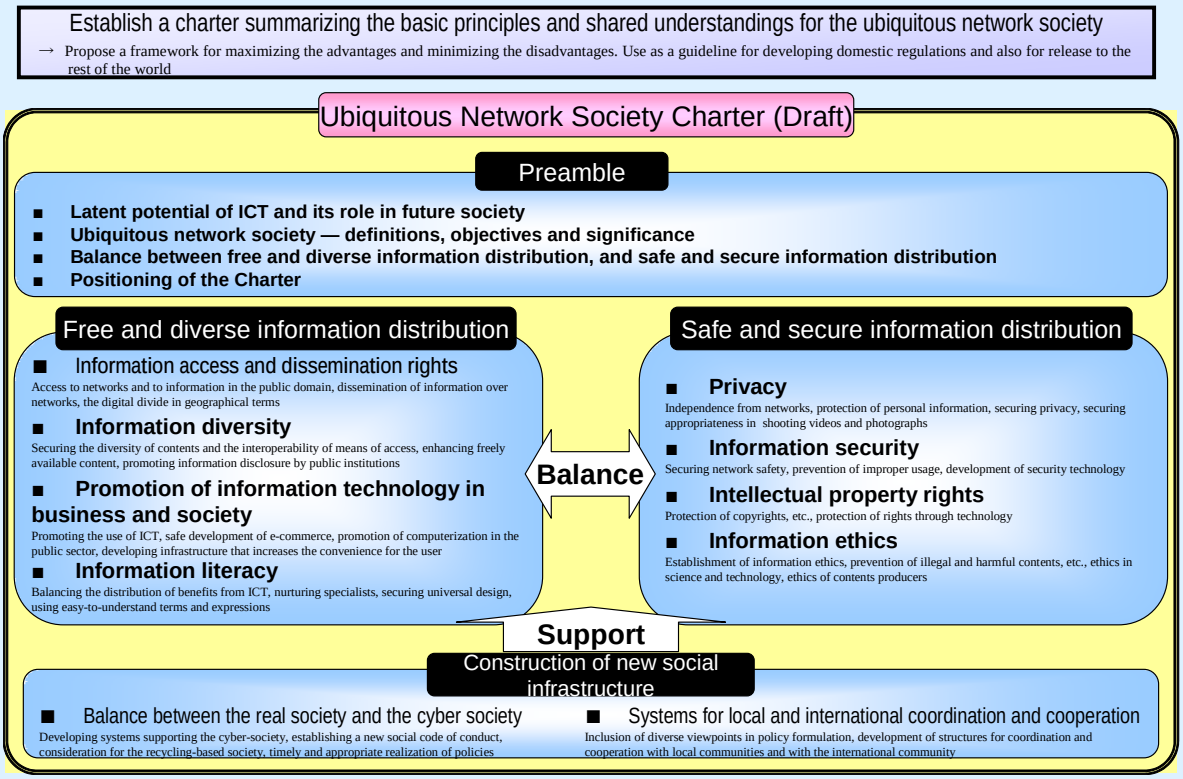
Source: MIC

4.4.3.2 Ubiquitous Network Society Charter

Addressing the "shadow" mentioned above, through the ICT Safety and Security 21 Strategy, will be a major step towards realizing the ubiquitous network society. Nevertheless, such problems are not temporary – in the future, new issues may arise, posing even greater challenges, particularly as technologies become increasingly sophisticated and pervasive.

There will, of course, be both unique benefits and disadvantages to the ubiquitous network society, many of which will be new to us. As Japan continues to investigate these issues, within the context of the unique nature of the ubiquitous network society, it has considered it appropriate to formulate guidelines, in the form of a "Ubiquitous Network Society Charter" (Figure 4.19). This Charter has been proposed to ensure that this society is realized in a smooth fashion, and in full awareness of the international environment.

Figure 4.19: Ubiquitous Network Society Charter



Source: MIC

5 The social and human context

This chapter takes a look at the social and human considerations in a ubiquitous network society. As these are early days in the development of this future society, the near ubiquitous mobile phone is taken as a starting point for the analysis.

No one will deny the perception that the Japanese are a highly technophile people, who are regularly seen sporting the latest technological gadgets. This holds just as true for the mobile phone. No tourist visiting Japan can miss the dazzling array of mobile handsets and accessories on display all over Tokyo, and notably in the "electric towns" of "Shibuya" and "Akihabara". Indeed many of those interviewed during the research phase preceding the publication of this case study, pointed to the cultural factors affecting the take-up of new technologies in the country. In particular, they highlighted the fact that the Japanese consumer is informed and demanding, carefully choosing technology for its innovative quality, functionality, and value for money. At the same time, Japan is a highly homogeneous society, and consumers are keen on having the latest gadgets, in order not to be outdone by their neighbours and friends. Therefore, the threshold for a product to hit the mass market is much lower in Japan than in other countries. If a service or technology reaches 15 per cent penetration, it is well on its way to becoming a mass-market product.

In terms of manufacturing and distribution, Japan is famous for developments in miniaturization and product packaging. Foreign pharmaceutical firms, for instance, face significant challenges when distributing products

in Japan, due to the strict packaging requirements imposed on them. The look and design of a product are key marketing elements, particularly for mobile phones, and the discriminating Japanese consumer takes careful note of these when purchasing electronics. Mobile phones and other electronic devices (e.g. mp3 players) are important fashion accessories in Japan today. Users have access to a wide variety of colourful tags and stickers that can be used to personalize mobile phones, in line with the latest trend and fashion of the day. Handset replacements are thus very common in Japan. According to a survey conducted by Video Research in July 2002[25], 63 per cent of users replace their mobile devices within two years. Young students have an even shorter replacement cycle: almost half of those surveyed reported an annual replacement cycle. 40 per cent of those who replaced their handset at least once, reported one of the following reasons for their latest replacement: a desire to have the latest model or service, or the fact that the design or function was "out of date". Mobile phones have become such trendsetters in Japan that KDDI has recently released a "retro" design, with a certain hint of the past, in order to appeal to the younger generation. The slim-line phone is known as "Infobar" and comes in three different colours, each with a different catchy name.

Another interesting aspect of the use of consumer electronics, in particular the mobile phone, in Japan is the portability and proximity of the device to the human user. According to the Mobile Content Forum, 70 per cent of Japanese mobile users keep their mobile within one meter of their body during the day time, and 40 per cent during the night, most likely not far from their pillow. In this respect, the mobile phone has become somewhat an extension of one's physical self, intrinsically linked to identity and accessibility. Box 3.1 describers a day in the life of a typical 22-year old Japanese and her mobile phone.

Box 4.2 A day in the life of 22-year old Kyoko and her *keitai*
A fictional story based on the observations of authors and interviewees while researching this case study

Kyoko, a 22 year-old woman works at an office in the city. Kyoko woke up at 6.30 AM to the sound of her mobile phone. She checks her *keitai* (the Japanese word for mobile phone) immediately for new mails: 10 e-mails from friends/family and 5 SPAM messages. Her best friend Noriko suggests a new movie tonight. Her newly met boyfriend Takeshi asks for a date over the weekend. Her sister Kaori, currently studying in USA, asks for easy Japanese recipes. Her mother in her hometown asking how she is. Her father on a business trip wants to know what souvenirs she would like. After acquiring a mobile phone, she has more had more contact with her father and he is so happy that he continues to subsidize her mobile bills. Kyoko then starts here commute to work.

During her time on the train, she replies to most of her messages. She interrupted her mobile game, after she received a call. Before she boarded the train, however, she had set her mobile to 'manner mode' so that it didn't ring. Her mobile also has a sticky film covering, an accessory for the LCD display. This film covering is recently a popular item to avoid a snooping by others especially in the very crowded trains. It means that mobile screens can only be viewed by the person who is facing the phone directly, and not by people on either side of the phone. Kyoko heard from her friends that a new ringing tone of a popular Japanese song has just been released, so she immediately downloads it to her mobile phone for a small fee. Kyoko works as a secretary for a worldwide trading company. Typically, she sits in front of her PC in the office, but she communicates with her friends only through her mobile phone, because she doesn't have computer at home.

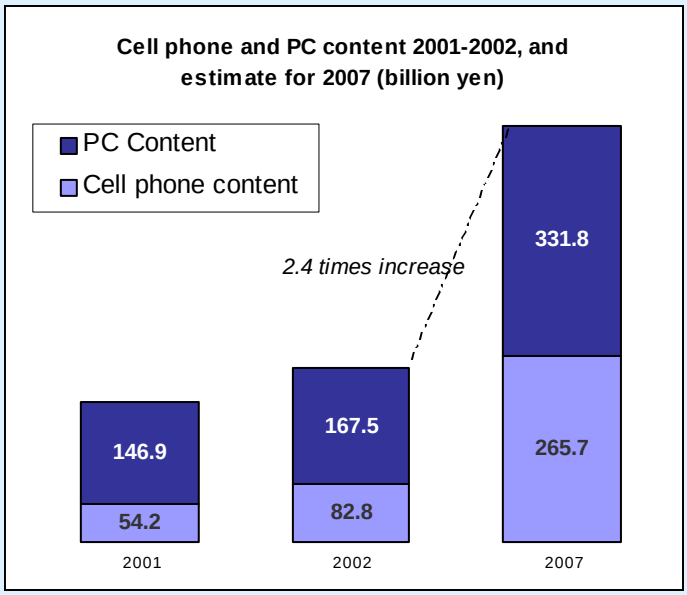
After her day at work, she goes shopping and replaces her mobile phone with a newer model, one that has a very secure system with fingerprint identification. Now, she can assign different fingers for accessing different data: for instance, the right forefinger for Noriko's folder, the left middle finger for Takeshi's folder and so on. Another attractive function that Kyoko enjoys mobile chatting: this allows a series of message to be exchanged in the form of near real-time dialogue similar to Internet chatting software. She did end up going to the movie with Noriko, after buying both tickets electronically through her keitai. She did not find the new movie interesting. So in the theatre, she wrote a few more e-mails and sent pictures to friends with her new mobile handset….

Source: ITU.

5.1 Good content, bad content

In 2002, one-third of all content revenues stemmed from mobile content. The MIC estimates that by 2007, mobile content in Japan will more than double (see Figure 5.1). For this reason, efforts to foster a healthy content market are being stepped up at the governmental and industry level.

Figure 5.1: Mobile phone and PC content



Source: MIC White paper on Information and Communications in Japan, 2003.

More and more content is being stored on the mobile phones of private users, such as personal e-mail, address book information and calendar. Managing the use of this data is vital for consumers to feel comfortable with current and future services.

The increase in unsolicited e-mail messages is also of particular concern. Most “spam” messages on mobile phones are supposedly sent from personal computers. Readily available e-mail address generating software can even automate sending processes. For this reason, in Japan and in many other countries, spam has become a serious problem, particularly exacerbated when users are charged for each e-mail they receive. Slogans such as “are you paying for spam?” have been bandied about by those operators offering free e-mail reception service. Many operators have since begun providing free incoming e-mail packages: in the case of DoCoMo for instance, the first 400 packets per month are free. As for other measures, operators are repeatedly encouraging users to change their mobile e-mail address so that it differs significantly from their phone number, or to use more complicated and original nicknames, in order to make it difficult for address-generating software. Users can already block all e-mails with Internet addresses and domains, but this may not be an effective measure given that spam messages are often sent from different addresses each time. On 25 December 2003, DoCoMo introduced a new anti-spam measure that will enable its i-mode users (including 3G or FOMA) to block all e-mails from user-selected domains of other cellular or PHS companies. DoCoMo has also taken aggressive countermeasures against spam mail sent from its i-mode network, such as limiting the amount of e-mails sent daily from a single i-mode account and suspending or rescinding the contracts of DoCoMo handsets registered to known spammers. With this new feature, users will simply go to the "i-Menu" official i-mode portal site in order to select which cellular or PHS domains to block. No packet transmission charge will be required to change the settings.

In July 2002, the Japanese government passed the “Law on Regulation of Transmission of Specified Electronic Mail”. This law addresses “Specified Electronic Mail”, which is defined as e-mail for advertisement purposes sent to users who have not opted in for the service. The legislation specifies that the sender’s name must be mandatory information, and prohibits e-mail delivery in the case of user opt-out and the use of address-generating software. Furthermore, it gives the right to Type I carriers to reject sending requests of “Specified Electronic Mail” and requires mobile operators to provide necessary information and develop technical solutions. Although the legislation has introduced some positive measures to address spam, critics of these measures argue that the law negatively affects user convenience, destroying legitimate business models like e-mail magazines. Japan’s Spam Mail Consultation Centre received nearly 20’000 notifications of illegal email per month in 2003, which is still a fairly high number. Further work will be needed, at the national and international level, to combat spam.

Internet dating is gaining in popularity around the world. In Japan, given the success of mobile Internet services, mobile dating and flirting services have been particularly successful. However, the number of crimes linked to such services has increased. According to the national police agency, there were 793 cases of mobile dating crimes in the first half of 2002, which represents a 260% increase from the previous year. 400 of these cases related to prostitution of underage youngsters and 390 of these were directly generated through mobile Internet communications. Mobile operators and government are working in tandem to address this problem. KDDI and NTT DoCoMo, for instance, have included information on their websites regarding "access to dating sites" in order to alert users to the possible danger of dating services. In addition, as of August 2003, NTT DoCoMo introduced an access restriction service, which limits user's mobile Internet access only to authorized, "official" DoCoMo sites. At their end, in September 2003, the government enacted the "Law of regulating the act that attracts children using the Internet opposite-sex introduction sites", of which the following are the main elements:

a) Defines "dating service" as "electronic communication channel providing service for opposite sex";

b) Requires dating service providers to put effort to avoid subscription of youngsters under 18;

c) Requires dating service providers to announce that their service is only for an adult and confirm the age of the users;

d) Perpetrators of abuse cases, such as illegal prostitution for under age 18 or any types of dating based on payment will be punished. This means that, for instance, personal ads such as "I'll give you 30,000 yen if you play tennis with me" are prohibited.

The question of whether this law will give police the right to violate private information is still under discussion. The Mobile Content Forum (MCF), an initiative established in 1999 by the private sector to band together to ensure a healthy mobile content market, submitted comments to the Government on this new law. They argue that the law may become a barrier for the development of community sites, a key content driver for the mobile community. MCF also pointed to the lack of technology that can determine a user's age.

5.2 Data security and privacy protection

The explosive growth of the Internet has raised concerns relating to the protection of private information, e.g. the tracking of human behaviour and financial data. The ubiquity of the mobile phone, now an intimate part of daily life, has taken privacy concerns to a new level. Given the amount of personal information stored on mobiles today (e.g. text, photos, videos, and call data), operators should be required to limit access to this data by third parties. The advent of RFID and sensor technologies will exacerbate the situation even further.

To address these issues, the Japanese government has been issuing guidelines and taking legislative measures. The "Personal Information Protection Act" was enacted in May 2003. In December 1998, the MIC issued the "Guidelines on the Protection of Personal Data in Telecommunications Business" and has since been holding a regular study group concerning information privacy in the business field. Still, in February 2004, the personal information of approximately 4.5 million subscribers (including names, addresses, telephone numbers and e-mail addresses) in the possession of a major telecommunication carrier was leaked[26].

The "Unauthorized Computer Access Law" was enacted in 2000 to prohibit unauthorized access either by using the person's ID and password without authorization or by attacking a security hole. During 2003, there were 58 cases of infringement reported under this law, and 76 people were arrested (an slight increase from the previous year)[27].

The "Privacy Protection Law" came into effect in May 2003. This law gave individuals the right to obtain information that companies have collected about them and restricts the use and sharing of such personal data. Backers of the new legislation say it responds to consumer complaints about personal information circulating in dubious databases and mailing lists.

Critics of the "Unauthorized Computer Access Law" argue that operators of Internet sites and other businesses will be overwhelmed by requests from individuals to delete personal information. There are statements mainly from the media that it could restrict freedom of speech. Its provisions were amended to exempt news reporting by media organizations, but magazine publishers have complained they may not necessarily be protected because they are not specifically mentioned in the law's definition of a media organization. Individuals who believe a company has misused their personal information can complain to the

government, which can then act to put a stop for such activities or slap violators with penalties of up to six months in prison or up to 300'000 yen. It is likely that new mobile handsets with enhanced personal identification technologies such as biometrics (e.g. fingerprints) will be in great demand.

Important privacy concerns are also raised by the use and anywhere/anytime availability of digital cameras on mobile phones. Pictures have been taken of people surreptitiously and without their consent. Tipness Fitness, a chain of health clubs in Japan, has now banned camera phones from their facilities. Handset manufactures have also taken note: self-regulatory measures have ensured that each mobile phone makes a noise when the camera phone is used, so that at least others can be alerted to the opening and closing of the shutter.

In mobile and Internet chat rooms, discussions that might foster mental abuse or violate privacy rights can sometimes occur. Individual users may also violate important intellectual property rights through the fixed or mobile Internet. In an effort to address the role of service providers in this regard, "the Law to Limit the Liability of Electronic Communication Service Providers and Permit the Disclosure of User Information" was passed in May 2002. The purpose of the law is essentially to limit the level of responsibility that an electronic communications service provider will have to shoulder when they are confronted with complaints about the activities or conduct of their users. Providers will generally not be held responsible, with the exception of cases in which a provider does not take protective action when they are aware of a violation and have an effective technical solution to address it. If the measures taken are reasonable, exemption from responsibility is granted. Another objective of the law is to allow service providers to reveal the personal details of a user when that user finds that their information has been used unfairly in a privacy rights case.

5.3 User concerns relating to the future ubiquitous environment

With advances in radio frequency identification and location-based services, there is increasing concern relating to the impact of these technologies on the daily lives of users, and on social behaviour. In a ubiquitous communications environment, protecting private consumer data may well become a greater challenge. In order to ensure that users control information stemming from cell phone use, such as location and purchasing habits, appropriate regulatory measures should be put into place, and user awareness must be raised. In an effort to address these issues, the MIC has created web site entitled "MIC Information Security Site for citizens – for safe use of Internet"[28]. On this site, users can find basic information about Internet security, a dictionary of terms, examples of real cases, as well as a number of recommendations for setting secure network environments. MIC has also set up a number of study groups composed of experts, academics and industry representatives, in order to continue its work in this area.

Since March 2004, the MIC has been conducting meetings of the Policy Roundtable on the ubiquitous network society, which is considering, *inter alia,* the "measures to remedy areas that fall into the dark side of the ubiquitous network society". In this context, a survey has been conducted on the most common areas of insecurity relating to a future ubiquitous environment (Figure 5.2). The most common concerns are fraud and the protection of personal information. 62.7 per cent of those surveyed were concerned about unscrupulous and fraudulent business methods, 59.7 per cent about the leaks of personal information in the possession of businesses, 58.2 per cent about improper access and use of personal information. A surprising 49.2 per cent were also concerned about the increasing complexity of services.

In addition, the MIC and METI have made and disclosed a guideline for privacy safeguards for the use of RFID, on the 8th of June 2004. These guidelines focus on the following aspects: user notice, user choice, information disclosure, and access control to personal information. The two ministries are currently carrying out awareness campaigns on these guidelines among relevant organizations and consumers.

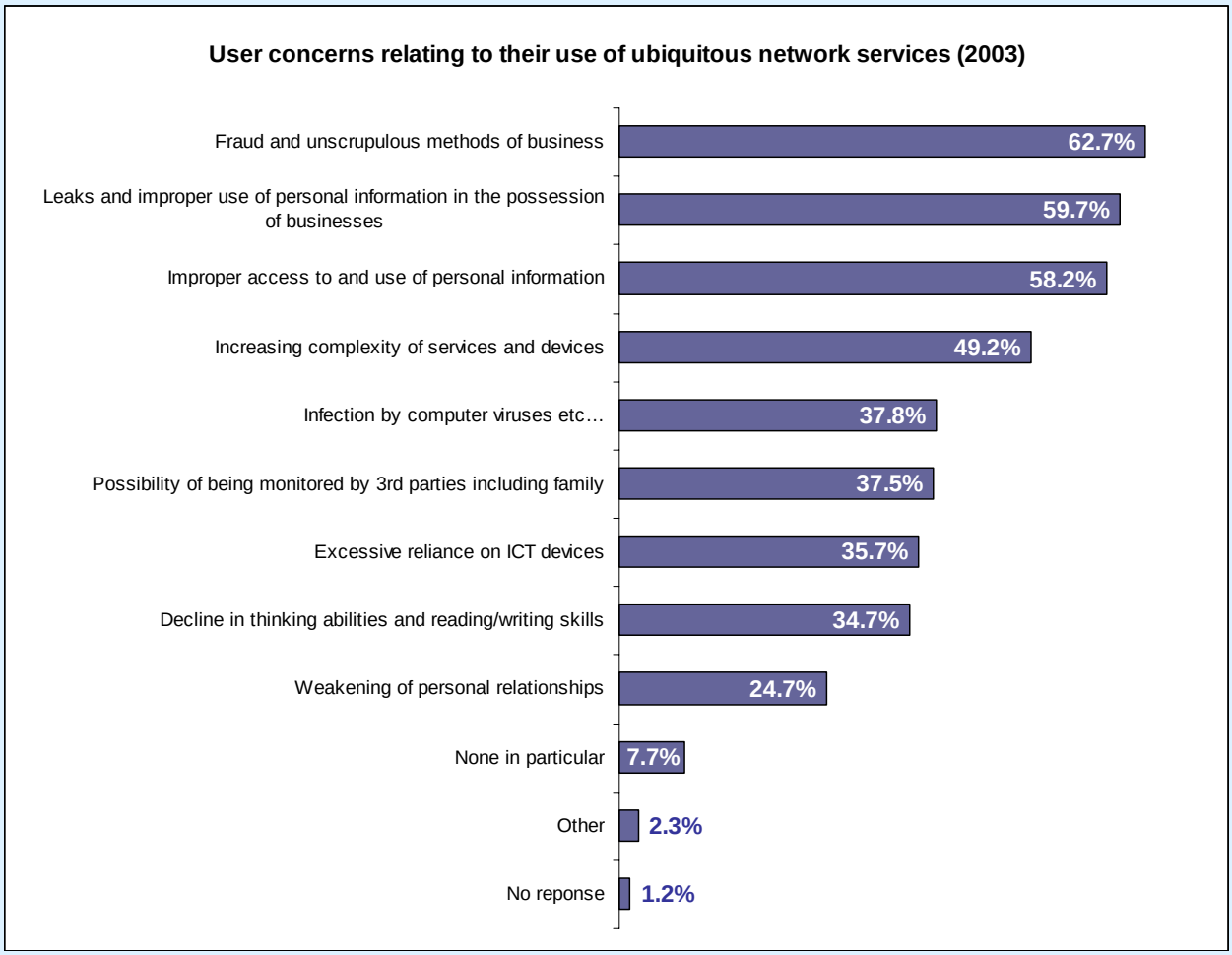
6 Conclusion

Japan has long been recognized as a leader in ICT innovation, and is now at the cutting-edge of developments relating to ubiquitous networks and computing.

In the face of a rapidly evolving technological landscape, and in the current economic climate, Japan is actively creating and implementing coherent national e-strategies and "u-strategies". These strategies have enabled the deployment of new infrastructure and innovative services. The diffusion of broadband Internet

and mobile networks has been very successful in the country, due primarily to close collaboration between government and industry, and the introduction of new entrants. National competition policy coupled with rapid service innovation has resulted in affordable, flat-rate, and always-on connectivity. Japan is capitalizing on its strengths in mobile handsets and consumer electronics by extending its research and development into areas such as RFID and sensor networks. In order to further stimulate the ubiquitous communication environment, it is keen on promoting the efficient utilization of spectrum, as evidenced by its ongoing evaluation of frequency allocation methods.

Figure 5.2: User concerns in a ubiquitous network society



Source: MIC White paper 2004

Not only is Japan establishing technical and policy measures for the rapid and smooth development of a "ubiquitous network society", but it is also taking a closer look at user concerns and the overall social impact of technology. It is expected that the development of a ubiquitous network society will bring benefits to the economy, help alleviate social problems and, in general, enrich human life. But in order to realize such a vision, citizens must be made aware of their responsibilities and obligations as members of a ubiquitous network society. In this context, ensuring information security and consumer privacy are key concerns, as is the creation of a social framework to ensure that the benefits of the ubiquitous network society are extended equally to all. As such, Japan's holistic view of technology development may provide inspiration to other national and international bodies in their own transitions to the ubiquitous network society.

[1] The 2004 case study was written in the context of the ITU New Initiatives Workshop held in Seoul, Republic of Korea, in March 2004. The report, along with other papers and case studies, is available at http://www.itu.int/futuremobile.

[2] Documents and information about the ITU Workshop on Ubiquitous Network Societies (April 2005) can be found at http://www.itu.int/ubiquitous.

[3] The UNDP's HDI is a composite of key indicators of well-being such as life expectancy, literacy, school enrolment and per capita GDP. See http://hdr.undp.org

[4] ITU World Telecommunication Indicators Database.

[5] MIC, 2004 White Paper "Building a Ubiquitous Network Society That Spreads Throughout the World", available at http://www.johotsusintokei.soumu.go.jp/whitepaper/eng/WP2004/2004-index.html

[6] IT Strategic Headquarters: http://www.kantei.go.jp/foreign/policy/it/index_e.html.

[7] The Basic Law on the formation of an Advanced Information and Telecommunications Network Society: http://www.kantei.go.jp/foreign/it/it_basiclaw/it_basiclaw.html.

[8] e-Japan Strategy full text: http://www.kantei.go.jp/foreign/it/network/0122full_e.html.

[9] e-Japan Priority Policy Program summary: http://www.kantei.go.jp/foreign/policy/it/0618summary/01_e.html.

[10] See ITU Internet Reports 2003: The Birth of Broadband, available at http://www.itu.int/birthofbroadband.

[11] E-Japan Strategy II.

[12] .However, an unforeseen effect of all this competition was its negative impact on PHS operators. In October 1997, there were over 7 million PHS subscribers, but in January 2003, the number had dropped to 5.5 million.

[13] In 1992, mobile phone subscribers were a mere 1 million.

[14] See http://www.kddi.com/english/corporate/news_release/2003/1022/index.html .

[15] MIC (formerly MPHPT) Communications Usage Survey 2003.

[16] See http://www.nttdocomo.co.jp/p_s/mzone/home.html (Japanese only).

[17] For 5 weeks starting pn 17 November 2003, JR East, Japan Telecom and NTT DoCoMo tested a trial roaming service of Mzone at railway stations, thereby expanding the service to areas not covered by DoCoMo's own WLAN service.

[18] See L. Srivastava, *3G Mobile Policy: The Case of Japan*, INFO, vol. 3, no. 6, December 2001.

[19] Analysys Consulting, 2003. See http://www.analysys.com.

[20] *Ibid.*

[21] For more information about the Roppongi Hills district, go to http://www.roppongihills.com/en/information/index.html.

[22] To sign up for the service, users can go to http://r-click.jp/ (Japanese only).

[23] See http://2.pro.tok2.com/~higashi-nagasaki/anti/pintokona.html for pictures and text (Japanese only). See also http://urawa.cool.ne.jp/vfsarah/kaiten2_pinto.html .

[24] See ITU, "Ubiquitous Network Societies: The Case of RFID", March 2005, available at www.itu.int/ubiquitous/

[25] "Mobile Phone Usage Situation" , Video Research Ltd, September 2002.

[26] MIC White Paper 2004.

[27] *Ibid.*

[28] See http://www.soumu.go.jp/joho_tsusin/security/index.htm.