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Creating a Ubiquitous Networking Market: Information Appliances

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Like consumer electronic appliances, information appliances are user-friendly. In addition, they lend themselves to specialized use, while still being eminently suited to networking. Ubiquitous networks for which the most common element is information appliances have the following four main features: (1) they can be optimized for particular services and content to provide stress-free use; (2) they can be connected to digital broadcast services and a whole range of communications networks; (3) it is easy to incorporate copyright protection features, and they are particularly suited to popularizing digital content; and (4) their ease of use (on a par with that of consumer electronic appliances) means that they can help to bridge the digital divide. These are all features capable of causing an explosion in network population and use.

However, even information appliances need appealing content. If ubiquitous networking is to take off, the sooner the public and private sectors in Japan join forces to create a ubiquitous networking market with appealing services and content, the better.

I Major Changes and Moves Towards Ubiquitous Networking

Starting this year, a whole series of major changes are due to take place in the field of information technology. (See Table 1.) Japan will also start to rapidly catch up with the United States in the field of network computing.

The first major change in 2000 will be that a system of fixed charges for access to the Internet will be introduced for home users, while the adoption of technology such as ADSL (asynchronous digital subscriber lines) will allow transmissions at 20 or so times the speed of analog modems (i.e., at 1Mbps). This will be followed towards the end of the year by BS digital satellite broadcasting, which will mark the first steps towards the full integration of digital broadcasting and the Internet.

2001–2002 will see the arrival of IMT-2000, the new ITU standard for mobile communications, which will allow transmission speeds of up to 2Mbps. As well as a dramatic increase in mobile data communications capacity, the ground will be laid for on-line contracts and electronic payments, and the automobile will join the world of e-commerce. And by 2003, we will see the beginning of electronic government and electronic money.

However, if Japan is to gain a comparative advantage over the United States during the next 10 years, it should decide to go for the next stage—i.e., ubiquitous networking—as soon as possible rather than devote all its resources to developing network computing based on personal computers. This report therefore examines the key role of information appliances in ubiquitous networking.

In the early 1990s, chip capacity increased so rapidly—doubling every 18 months—that Moore's Law (according to which, the degree of integration doubles every 24 months) had to be revised upwards, and personal computers, which are now the cornerstone of network computing, replaced mainframes as the main instrument for data processing. Personal computers probably owe their competitive edge over mainframes to the concept of "end-user computing" and, especially, the "desktop metaphor." However, given that most of today's users buy a computer to surf the Internet and that personal computers are no longer the best instrument for doing this, computers are losing their competitive edge.

In contrast, sales of digital cameras, which only appeared on the market a few years ago, totaled no less than 710,000 units worth some ¥33.7 billion in the first half of 1999. With sales of conventional still cameras still declining (in the same period, domestic shipments totaled 4.38 million units worth some ¥77.5 billion), demand for digital cameras is surging at their expense.

In the same vein, mobile telephone traffic is rapidly shifting from voice to data, with more than 50 percent of DDI Pocket calls consisting of short messages. There have also been rapid advances in specialist e-mail devices such as NTT DoCoMo's Pocket Board.

Although digital cameras and e-mail can both be used with personal computers by attaching the necessary equipment, they have been turned into extremely convenient specialist devices (information appliances) in their own right by specifying the situations in which they can be used. Although such devices gained added value by being used in combination with personal computers early on in their development, they have started to form their own (ubiquitous) networks now that they are used on their own.

II Information Appliances Currently in Use

1 The Beginnings of Information Appliances

(1) MP3 players

MP3 (MPEG-1 Layer 3) is an audio compression technology originally released into the public domain as an

Table 1. Major Changes in Information Technology

Year	Change	Impact
2000	Fixed Internet access charges (ADSL, WLL, CATV) BS digital satellite broadcasting	Speeds of 1Mbps for ¥2,000-¥3,000 a month Integration of data broadcasting and communications
2001-2002	IMT-2000 Digitalized Signature Act Use of smart credit cards for network payments Electronic toll collection	Mobile communications at speeds of 384Kbps-2Mbps On-line identification and contracts Explosive growth in electronic payments Payment function added to car navigation
From 2003	Electronic government Electronic money Digital terrestrial broadcasting	Administrative services available online Completion of infrastructure for network payments End of analog broadcasting

Notes: ADSL (asynchronous digital subscriber line); BS (broadcast satellite); CATV (cable TV); IC (integrated circuit); IMT-2000 (next-generation mobile communications system); WLL (wireless local loop).

Internet standard. (MPEG-1 is an ISO standard for image compression.) MP3 enables one track of music that would have required 40MB–50MB of storage on a CD to be compressed without loss of quality so that it needs only 4MB of storage. Even with the kind of Internet connections in general use today, the data for one track can be downloaded in about 15 minutes.

As it happened, this technology soon became widely used by Internet users as an illegal means of distributing music. Then, in January 1997, the newly founded South Korean company Saehan Information Systems took advantage of this to launch the world's first portable MP3 player, the MP-MAN. (See Figure 1.) The product has been a great success. Use of a flash memory to store music data and the absence of any moving parts mean that a single battery can provide many hours of playback time.

With the price of a byte of flash memory falling rapidly, versions of the MP-MAN capable of storing 64MB of data (the equivalent of one CD) can be bought for about ¥30,000. As a result, many Internet users have bought MP3 players to listen to music they have downloaded from the Internet.

MP3 is superior to CDs and MDs (MiniDiscs) mainly in the following two respects:

- They allow music data to be sent over a network.
- Users can store large quantities of music data on their personal computers and compile their own music libraries.

The latest personal computers with a hard disk capable of storing 10GB or more of information can store the equivalent of 100 or more music CDs. MP3 player users can choose their favorite tracks from the vast music libraries available on various computers and store them on their MP3 players so that they can listen to them anywhere. The launch in 1999 by several leading Japanese consumer electronics manufacturers of MP3 players with built-in copyright protection marked the beginning of a new phase.

(2) Personal video recorders

In April 1999 two US companies (TiVo and Replay Networks) announced two innovative products—videotape-free video recorders with 10GB–30GB internal hard disk drives and capable of recording 14–30 hours of video in MPEG-2 format (or 4–9 hours in high-quality mode). (See Figure 2.) Prices vary from $499 to $999, depending on recording time.

The main use of such machines is to record on the hard disk all the programs that have been selected in advance so that users can watch them whenever they want. This is usually called time shifting. Users can also take advantage of the hard disk drive's high-speed random access feature. For example, this enables a user who comes home 10 minutes after a program has started to replay the recording from the start while continuing to record the program—something that was impossible with videocassette

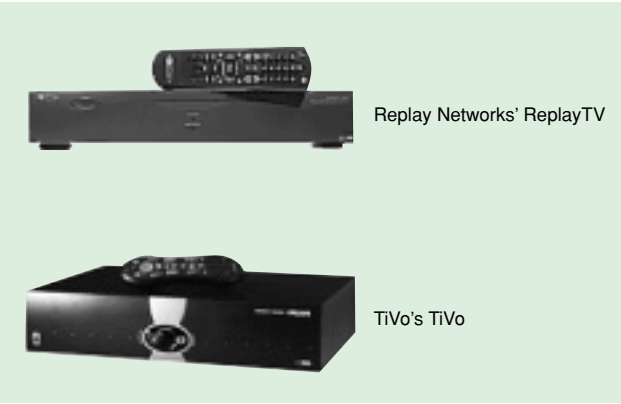
Figure 1. MP3 Players

Saehan Information Systems' MP-MAN

Diamond Multimedia Systems' RIO500

Source: Saehan Information Systems and Diamond Multimedia Systems.

Figure 2. Personal Video Recorders



Replay Networks' ReplayTV

TiVo's TiVo

Source: Replay Networks and TiVo.

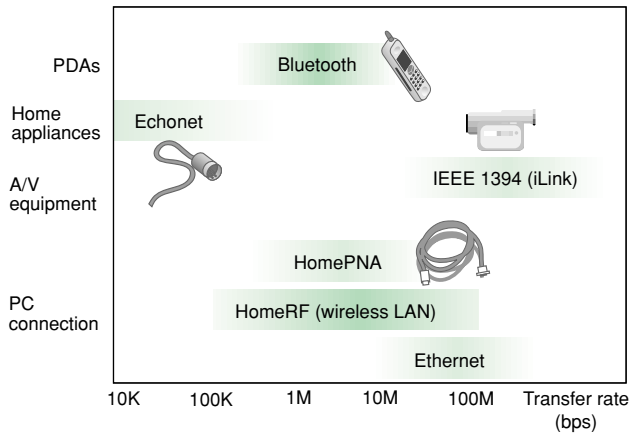
recorders. With the cost-performance of hard disk drives now nearly doubling every year, there will soon be personal video recorders capable of recording more than 100 hours of program time.

What is distinctive about personal video recorders is that they come with a modem as standard equipment and download the latest program guide as soon as they connect to the telephone network. TiVo charges $9.95 a month for this service. With all the programs from satellite broadcasters and cable TV companies now available in this multi-channel age, viewers need as much help as possible in selecting programs. Information services that select programs from the mass of information available according to viewer tastes and purposes and use networks to suggest what viewers might want to watch will be one of the most important factors in determining just how convenient information appliances are going to be.

2 The Technology Underlying Information Appliances

A wide range of networks and operating systems for integrating information appliances are becoming available. As can be seen in Figure 3, a host of network types has been proposed for such devices. Different types of net-

Figure 3. Communications Networks for Information Appliances



Notes: IEEE 1394 (international standard for high-speed digital serial interfaces); HomePNA (standard for home-based personal networks); HomeRF (standard for home-based wireless computer networks).

works have been suggested for different needs, depending on the technology used and whoever is suggesting it.

"HomePNA" (a standard for personal computer networks in the home) enables users to enjoy the benefits of a LAN by using the telephone network instead, or allows the occupants of an old building to use the existing internal telephone network to create a LAN network and thereby increase the building's added value.

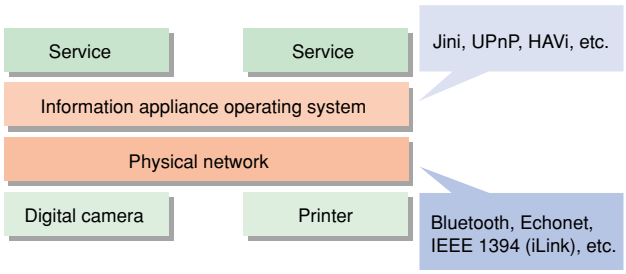
The "Echonet" standard used by Japanese consumer electronics manufacturers and electric power companies, on the other hand, uses the domestic lighting system. Although slow (only 9,600bps), Echonet allows any electrical appliance that can be powered via an electrical outlet to be linked to a domestic network. It may also be possible to use the system to control appliances such as air conditioners and refrigerators.

The two most promising wireless standards are "HomeRF" and "Bluetooth." HomeRF is an inexpensive wireless LAN used for domestic computer networks. Bluetooth is capable of communicating with devices within a 10-meter radius at a speed of 1Mbps and is expected to be used initially instead of IrDA (the standard for infrared data communications) with devices such as mobile telephones, digital cameras, and PDAs.

Meanwhile, "IEEE 1394 (iLink)," the IEEE (Institute of Electrical and Electronics Engineers) international standard used by most leading consumer electronics manufacturers, is a wired network, but nonetheless capable of speeds varying from 100Mbps to 400Mbps. It is used for sending video data between audio-visual electronic devices and personal computers.

Figure 4 shows the architecture of information appliances. The bottom-most layer constitutes hardware such as digital cameras and printers, while the layer just above it represents the physical network connecting them. The layer above that covers operating systems (such as the "Jini" distributed-object technology currently being developed by Sun Microsystems) for information appliances, while the top-most layer comprises the various network services available for each of these.

Figure 4. Information Appliance Architecture



Notes: HAVi (Home Audio Video Interoperability); UPnP (Universal Plug and Play).

These operating systems absorb the differences between the various devices in the physical network and even enable devices that are not directly connected to the network to form part of one logical network by being routed via other devices. This allows networks to be created using a combination of both wireless and wired devices, depending on the particular purpose.

These operating systems have two major functions: to detect devices and to activate services. The first function—device detection—recognizes a new device when it is added to the network in preparation for receiving the service available from the device via other devices.

The second function—service activation—enables the network as a whole to access the services performed by individual information appliances and use them at any location. In the case of Jini, for example, services are described using Java and activated using Java code. One of the services provided by a printer—just to take a particular example—is printing images. In order to print a photograph taken by a digital camera, the Java program that is needed to send the image is transmitted from the printer to the digital camera and activated. The printing operation is then carried out. The advantage of this method is that it makes the most of the outstanding portability of Java code and even allows old devices to control new, unknown devices.

Although there are many different types of information appliances, none has the display, keyboard or hard disk of a persanal computer. All they have is a very diverse physical network and an operating system with the basic protocol for individual devices to interact. However, this gives designers of such devices considerable scope and ensures that they use their imaginations to the full.

III Creating a Ubiquitous Networking Market

Let us look at two approaches: a bottom-up approach and a top-down approach. The bottom-up approach tries to develop new information appliances by analyzing the

features of successful existing devices and linking their common features to a ubiquitous network. The top-down approach, on the other hand, uses insights from ubiquitous networking to try to improve projects being carried out, for example, under rapidly changing circumstances or jointly by the public and private sectors.

1 The Bottom-Up Approach

Table 2 is a list of existing information appliances that have already achieved a certain degree of success. In terms of technology, digital cameras, MP3 players, and personal video recorders compete with existing products. By making full use of rapid advances in semiconductor technology, however, they are technically entirely different from them and seek to offer added value through the use of information technology.

The information appliances grouped as network-type devices in Table 2 are used to exchange data such as photographs, e-mail and music. By making such devices mobile, it has become possible to use them anywhere and at any time. In contrast, application-type devices have been optimized for particular purposes—e.g., videogames and car navigation.

These devices can also be considered in terms of ubiquitous networking. Network-type information appliances can then be thought of as specialized hardware that uses popular applications widely available on the Internet. Given the large number of other applications that are generally available, the same approach could be used to create specialist information appliances for them. Figure 3 gives a number of such examples.

The advantage of this approach is that even in the case of applications, such as data exchanges between individuals, that require someone else to send or receive the data, there are a large number of personal computer and Internet users who already do this. As a result, even new information appliances start life with the added value of an existing body of users.

One of the keys to marketing such devices for use with applications such as bulletin boards where content tends to originate spontaneously—largely as a result of the work of volunteers—is likely to be the ability to provide an information service that combines a large and up-to-date content database with a classification and search service. Similarly, companies developing information appliances for use with applications such as e-commerce and online auctions, where content is normally produced by profit-making organizations, will have to join forces with companies engaged in e-commerce.

Returning to Table 2, let us consider application-type information appliances for a moment. It will be no easy matter to adapt these for use in ubiquitous networking.

For example, Zojirushi has developed the concept of an electrical vacuum bottle with a network capability. The concept is based on the fact that an elderly person drinks tea using the bottle several times a day. By connecting it to an information network, it is possible for a monitoring station to check whether the person concerned is incapacitated or not. Another example is the experiment that Electrolux conducted on the Internet when it demonstrated how it was possible to use a camera installed inside a refrigerator to check the contents from the outside via a network.

Similarly, a Swedish venture capital company, Easy Living, has developed electric sensors with wireless controls, and is currently developing a product that can be used with a WAP (wireless application protocol) mobile telephone to check remotely, for example, whether one has forgotten to switch off a light or shut a door.

Table 2. Established Information Appliances

Type	Device	Distinctive hardware	Advantages of use with network	Advantages of use with broadcasting	Many uses
Network type	Digital camera	Charge-coupled device, flash memory	Many	Few	• Editing images, creating albums • Exchanging images by e-mail • Use with home pages
	Short message	Mobile telephone	Many	Few	• E-mail
	Pocket Board	Flash memory, miniature keyboard	Many	Few	• E-mail
	MP3 player	Flash memory	Many	Few (at present)	• Exchanging music data • Playing music, compiling libraries
Application type	Personal video recorder	Hard disk, tuner	Some	Many	• Time-shifted viewing of broadcast programs
	Home videogame machine	Control pad, DVD, flash memory	Few (at present)	Few	• Videogames
	Car navigation	GPS, DVD, VICS receiver	Few (at present)	Many	• Establishing current location and viewing maps • Viewing information about traffic-congestion

Notes: GPS (global positioning system); VICS (vehicle information communications system).

Table 3. Examples of Information Appliances Used in Ubiquitous Networks

Device	Description	PC applications	Services	Sources of income
Bulletin board viewer	Finding, viewing and storing bulletin boards	Browser for viewing home page bulletin boards	• Notification of new bulletin boards • Input and display adjustment • Search function	Advertising and information service charges
Instant messenger	Other users are informed when a user switches on the device, thereby enabling the device to be used as a two-way pager for exchanging messages	Mirabilis ICQ, AOL Messenger, etc.	• Collecting and distributing on-line information • Forums and chat sites • Searching for friends	Advertising and communications charges
Java videogame machine	Java-based network videogame machine	Java-enabled environment, home pages of Java videogames on the Internet	• Place to play videogames • Matching opponents, displaying rankings, etc.	Advertising and service charges
E-commerce shopping terminal	Enables users to comparison shop in selecting stores or products and to easily order and pay for goods	Browser and multiple e-commerce home pages	• Information on bargains • Brokerage of orders and payments	Advertising charges and brokerage commissions
Auction terminal	Enables users to select goods, check the credit status of counterparties, follow the auction progress, place bids and make payments	Home pages of auction sites such as that of eBay	• Auction room	Advertising charges and brokerage commissions
Network radio, network TV	Enables users to receive broadcasts from stations all over the world online	RealNetworks' RealPlayer, etc.	• Up-to-date list of broadcasters, database of program lists	Advertising and information service charges

It remains to be seen whether there will, in fact, be any demand for these products. However, none of them has been produced simply by adding a personal computer to a domestic appliance. They all rely on ubiquitous networking, which, in the full sense of the term, is the accumulated result of many such concepts and has a vast potential.

2 The Top-Down Approach

The term top-down approach refers to a joint effort by the public and private sectors to create a large social system based on the concept of creating a market. The following section examines three particular examples of a top-down approach to creating a ubiquitous network market.

(1) Broadcasting goes digital

At the end of this year, broadcasting by broadcast satellite will start to go digital, while the communications satellite due to be launched this summer will go into orbit at the same position (Long. 110° E)as the broadcast satellite. Television viewers will therefore be able to use the same antenna to receive both types of broadcasts. This is likely to give a boost to digital television and increase the number of households in Japan that are connected to a ubiquitous network. The problem is the continued lack of attractive services, especially for data broadcasting.

The personal video recorder discussed in Section II (Information Appliances Currently in Use) could become the information appliance of the digital broadcasting age virtually in its current form. However, I should like to go one step further and propose a new service that would integrate the Internet and broadcasting.

For example, those taking part in the kind of online auctions that are organized by companies such as Onsale and eBay need to be able to both receive and send data for price formation to function properly. With the system used by Onsale, companies put up goods for auction, while prices are determined by bids from a large number of consumers. With the system used by eBay, however, it is individuals who put up goods for auction, while prices are determined by a bidding system.

Both systems have to be able to receive and broadcast data from a large number of consumers. At the moment, this cannot be done because of technical limitations (e.g., the volume of data the Internet can cope with), but broadcasting will allow companies to conduct auctions in real time and use moving images to explain their products, for example.

Online auctions are only one example of a widespread demand for services that use communications networks to collect data from consumers and distribute it using (data) broadcasting. Digital broadcasting requires a completely different approach to program design from traditional, one-way broadcasting. Companies should therefore seek to form alliances with companies in other sectors in order to establish ubiquitous networks based on digital broadcasting as soon as possible.

(2) Intelligent Transport Systems (ITS)

More than 4.8 million car navigation systems have been shipped in Japan since 1992, giving Japan the world's most advanced vehicle information infrastructure. In addition to vehicle information communications systems

(VICS), which provide information about traffic congestion, this year will see the first trial operation of electronic toll collection (ETC) systems, which allow tolls to be charged on some motorways in the Tokyo metropolitan area without drivers having to stop their vehicles. As a result, a payment function will now be added to Japan's vehicle information infrastructure at long last. Electronic toll collection uses in-car wireless communications and smart cards, and may be used not only to collect road tolls but also in car parks, service stations and drive-throughs.

There have also been moves to incorporate a communications function in car navigation systems. Services such as Daimler-Chrysler's "E-call" and Toyota Motor's "MONET," which automatically send information such as a car's location and chassis number to a central station in the event of an accident, do this by means of a mobile telephone and allow drivers to exchange information on their vehicle's current location and weather conditions at their destinations, access home pages on the basis of geographical location, and send/receive e-mail, for example. Further advances will follow with the start of broadband mobile communications services using the IMT-2000 standard mentioned above and the spread of electronic toll collection.

Any further progress in ubiquitous networking will require a broader approach than just the use of ITS systems. This could include the following: (1) connecting car-based information appliances to a network permanently; (2) adopting an open-systems approach to car-based information networks so that they can be used in combination with other information appliances to achieve synergies; (3) allowing users to access information on traffic and travel from information kiosks in convenience stores and home-based networks; and (4) using electronic money and general-purpose smart credit cards at electronic toll collection points.

(3) Digital democracy

If plans to establish electronic government by 2003 are successful, public "Certification Authorities" will be set up to legally support digital signatures, and Japanese public offices may be accessed via the Internet so that citizens can report, register and request official documents electronically. Content such as this has the potential to give ubiquitous networking a major boost. Possibilities include the development of information appliances for government services with an interface that even elderly people could use, and access to such services via information kiosks.

The biggest impact from any government content is likely to come from "digital democracy." A start should be made on establishing a true digital democracy where, instead of moving straight to direct democracy, online communities are first of all formed at local government level so that ordinary citizens can not only voice their opinions and petition government, but also follow debates on policies and bills and vote electronically on important policies via the Internet. The main obstacle is likely to be the digital divide, but information appliances should hopefully relegate this problem to the past.

IV The Future of Ubiquitous Networking

Ubiquitous networking is a new environment comprising (1) high-speed fixed and mobile communications networks, (2) digital broadcasting, (3) information kiosks located in the street or in convenience stores, and (4) home-based, in-car, or mobile information appliances. This is very much still uncharted territory with ample scope for creation.

The next few years will see rapid changes in information systems in Japan. Even though Japanese companies lead the field in the development of information appliances, they will find themselves having to relinquish this lead to US companies unless they can continue to develop new content faster than these changes occur.

This paper has described current developments and ideas in the field of information appliances and examined how such devices could be used to create a ubiquitous networking market. Their future is closely connected with that of network business. Any company involved not just in manufacturing but in consumer-related business should start to consider how it could use them.

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As a leading think-tank and systems integrator in Japan, Nomura Research Institute is opening new perspectives for the 21st Century through creating intellectual property for the benefit of all industries. NRI serves domestic as well as overseas clients both in the public and private sectors through knowledge creation and integration in the three creative spheres of "Research and Consulting," "Knowledge Solutions" and "Systems Solutions."

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