

Creating a Ubiquitous Networking Market: Mobile Phones

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- I Ubiquitous Environments Will Develop as a Result of Advances in Mobile Technology
 - 1 Mobile Computing and Ubiquitous Computing
 - 2 Exponential Growth of the Mobile Phone
 - 3 Mobile Phones as Data Communications Tools
- II Accessing the Internet with a Smart Phone
 - 1 Why the Smart Phone Has Caught Public Attention
 - 2 Content as the Key to Increased Use
 - 3 Smart Phones Lead the Way in the Development of Ubiquitous Environments
- III New Applications for Ubiquitous Environments
 - 1 VoiceXML—a Product of Speech Recognition Technology
 - 2 Next-Generation Mobile Phones with a Built-In Smart Card
 - 3 Mobile Phones as Electronic Wallets

When Xerox put forward the idea of “ubiquity,” ubiquitous computing and mobile computing were regarded as two separate areas. However, now that the use of mobile phones is becoming increasingly common and smart phones capable of receiving new services such as NTT DoCoMo’s “iMode” are now available, the mobile phone is becoming an important tool for accessing ubiquitous environments.

Although the use of mobile phones will continue to grow, new content will become an increasingly important factor in the development of ubiquitous environments. From this is likely to emerge a wide range of different services. One of these will be voice-based services, while another is expected to be the use of smart cards. When combined with a payment capability, these services will enable mobile phones to function as electronic wallets and become a new kind of platform.

I Ubiquitous Environments Will Develop as a Result of Advances in Mobile Technology

1 Mobile Computing and Ubiquitous Computing

The concept of ubiquitous computing first appeared in a paper published by the Xerox Palo Alto Research Center (PARC) and has since attracted increasing attention. While that paper distinguished between ubiquitous computing and mobile computing, developments in mobile environments—and especially the growing use of smart phones (see below)—are either making this distinction increasingly obsolete or leading to a fusion between the two concepts.

A wide range of different technologies has already been considered as a means of creating the infrastructure for ubiquitous environments. In practical terms, the kind of infrastructure used in mobile environments would appear to be one of the most promising solutions to this problem. This paper examines the use of mobile—and especially wireless—technology to create ubiquitous environments and considers the role that this technology and associated services can play in the cybersociety of the future.

2 Exponential Growth of the Mobile Phone

Since commercial mobile phone services in Japan began in 1987 and it became possible to use mobile phones properly, the growth in the number of subscribers in just over 10 years has been such that roughly half the population now owns a mobile phone. Subscriber density is now higher than in the United States and second only to Scandinavia. This is an impressive figure—even by comparison with the diffusion rate of computers and computer-related equipment. This is partly the result of the fact that Japanese mobile phone technology had to make the shift from analog to digital early on because of a spectrum shortage. (In the United States, on the other hand, analog phones are still common.)

If we plot the diffusion of mobile phones in Japan over the past 10 years, we can see that the moderate growth during the period of analog technology was followed by a period of rapid growth as soon as digital technology was introduced, with a gently sloping curve giving way to a steep upward-sloping curve. (See Figure 1.)

However, not all types of mobile phones are still growing. Demand for PHS (Personal Handyphone Systems), for example, peaked three years ago and has been declining since. This suggests that PHS has lost some of its competitive edge over digital systems.

However, there is scarcely anyone who thinks that overall demand for mobile phones will start to decline.

If there is any change, it is likely to be from rapid to moderate growth. In my view, demand will enter a phase of moderate growth in the next few years. (However, if use is extended to livestock and both the very old and the very young are required to carry a mobile phone around with them, the current rate of growth may continue.)

If we think of this trend as a demand growth curve, the period covering the use of analog technology and the initial phase of digital technology could be called the early stage, while the period of rapid growth that has lasted up to now could be called the growth stage, and the period of moderate growth that we are now expecting could be called the mature stage.

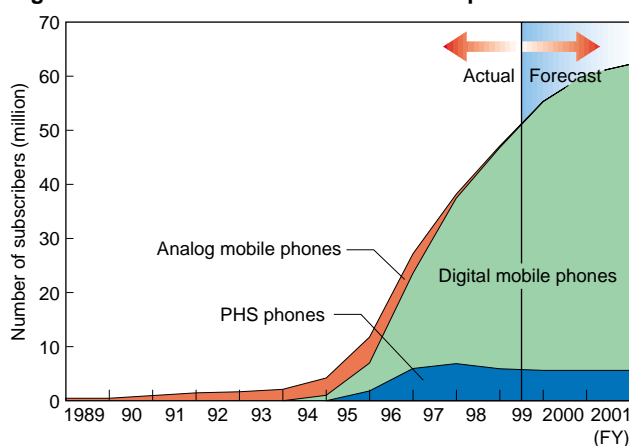
Whereas the focus of attention during the early stage is on technology and performance, user interest turns to price and services during the growth stage. Finally, at the mature stage, buyers are attracted to value-added uses, while applications are developed that service providers would once not even have imagined. A classic example of this was the use of pagers by senior high school students to send each other messages consisting entirely of numbers.

3 Mobile Phones as Data Communications Tools

Mobile phones were originally designed to communicate by voice. However, they can also be used as modems to communicate with personal computers (to connect to the Internet, for example). Even more recently, it has become possible to use mobile phones on their own to send and receive data without having to connect to a personal computer. The following are some of the value-added services that are now available:

- Short messages (including Internet mail)
- Viewing of Web sites
- Sending and receiving of multimedia content
- Mobile commerce

Figure 1. Diffusion of Mobile Phones in Japan



Source: Nomura Research Institute, from Ministry of Posts and Telecommunications data.

In fact, it would seem that users of some of these services are looking to use their mobile phones in even more sophisticated ways.

NRI has collected some interesting data about how short messages are used. Figure 2 shows the extent to which different age groups tend to use short messages and e-mail. Given the limitations of current e-mail platforms, overall use of e-mail remains low.

Short messages, meanwhile, appear to be particularly popular among young people. For example, some 60 percent of users aged 10–19 use their mobile or PHS phones to send and receive short messages. This suggests that the generation of high school students that once used pagers to send and receive messages has since moved on to mobile phones and has found them a source of just as much or even more added value.

This generation of users is positively inclined towards short messages, which they can send and receive anywhere using the same environment and without bothering other people in the way that mobile phone conversations do, and is a segment that is growing.

The number of mobile phone users who do not currently use short messages but would like to do so is particularly high among young people. (See Figure 3.) As age rises, however, this tendency declines. Having said that, it is interesting to note that there is a steady demand for “information services” among all age groups.

For example, it seems reasonable to assume that owning a mobile phone can be justified if users can use it on its own to obtain local information on the places they are going for business or holidays. The same is true of information on local cuisine or on railway timetables. Users of mobile phones can now find out what they want to know—either on the road or when they reach their destination—by using the new services that are available without having to make a trip to a bookstore.

That all this is now possible is largely the result of the development of the smart phone, which will be the subject of the next section.

II Accessing the Internet with a Smart Phone

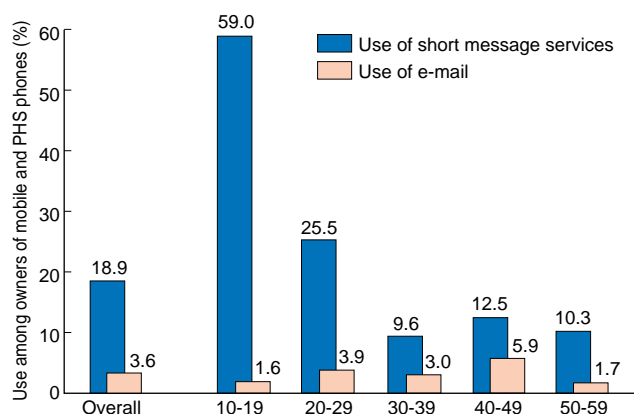
1 Why the Smart Phone Has Caught Public Attention

The smart phone is a telephone-like device equipped with a small browser (“microbrowser”) and used to access the Internet.

The image of the kind of device needed to display information from the Internet used to be that of a personal digital assistant (PDA) or a handheld computer (HPC) with a built-in wireless capability. (Devices of this kind are still being developed.) However, the main types in use today basically resemble a mobile phone. NTT DoCoMo’s iMode system, which has enjoyed such a rapid increase in use, belongs to this category.

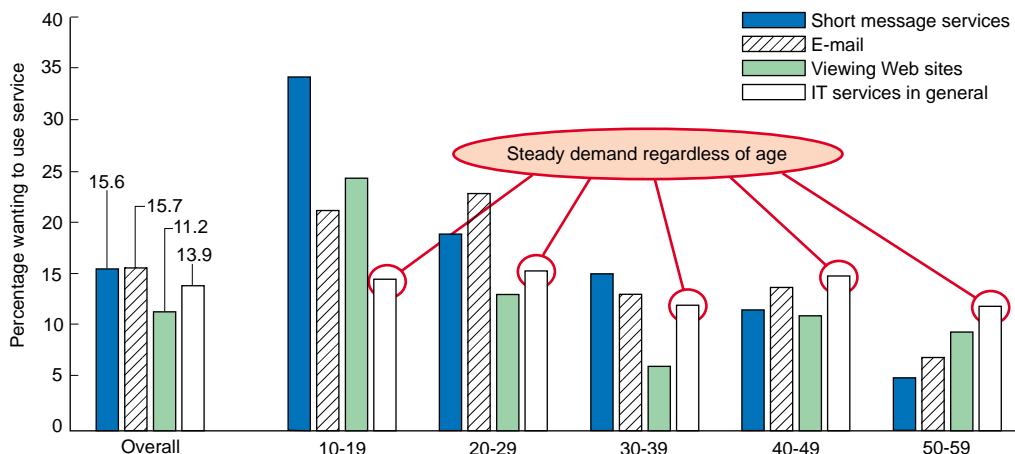
Because Internet access is a prerequisite of smart phones, they come with more compact browsers, or

Figure 2. Use of Short Message Services and E-Mail (by Age Group)



Source: *Joho Kiki ya Sabisu no Riyo ni Kansuru Anketo* [Cyber Life Observations], Nomura Research Institute, March 1999.

Figure 3. Use of Mobile Phone Services (by Age Group)



Source: *Cyber Life Observations*, Nomura Research Institute, March 1999.

microbrowsers, than personal computers. It is also becoming increasingly common for application software to be stored on line (i.e., at server level) rather than on the phones themselves. (However, the option of downloading Java applets—basic programs—from the network and running them directly on phones is also being considered.) In other words, smart phones could also be described as the ultimate in PC “thin client” architecture (i.e., devices designed to reduce operating costs to a minimum).

Smart phones also have an operating system. However, most products on the market use a proprietary system rather than an open one, and there is still no standard for operating environments. The EPOC micro-operating system developed by Symbian (a consortium that includes companies such as Nokia, Motorola and Psion) was designed for use with both mobile phones and PDAs and is seen as a threat even by Microsoft’s Bill Gates.

It would therefore appear that the smart phone could develop in three possible ways:

- Common application software could be developed on the basis of a standard micro-operating system.
- Application software could be run on a World Wide Web server by using a microbrowser.
- Applications with a high degree of interoperability could be developed by using Java, for example.

The use of microbrowsers, in particular, can be considered to have made the first contribution to making smart phones what they are today.

2 Content as the Key to Increased Use

However, just because smart phones have browsers does not mean that users can access all the content available on the Internet. Because Internet access from mobile environments is restricted to a narrower bandwidth (i.e., transfer rate) than that available on fixed lines, existing Web languages have either to be scaled down or optimized. In Japan a number of such services have been developed, the most popular of which are NTT DoCoMo’s iMode service and the IDO-DDI Group’s EZ Series.

The iMode service uses compact HTML, which is a simplified version of the HTML language used for Web servers. The advantage of this language is that anyone who has used HTML to set up a Web server will find it quite easy to use. This is probably also why iMode has enjoyed such rapid growth since it was launched.

The EZ Series, on the other hand, uses WAP (wireless application protocol), a protocol written specifically for mobile environments. Much of the work in designing WAP has been carried out by mobile equipment vendors such as Motorola, Nokia and Ericsson, and it is expected to become the international standard for smart phones.

However, a more widespread use of WAP has been hampered by the fact that servers have to be set up using WML (a special wireless markup language). As a result, some US analysts take the view that WAP is just a step-

ping stone to the age of mobile multimedia. (Recently servers with HTML filters have been developed to convert HTML to WML in order to make efficient use of existing resources.)

A comparison of the services that use these two technologies helps us to understand what is needed if the market is to expand. In other words, no matter how sophisticated the technology, it will fail to gain recognition and market share unless it is backed up by an infrastructure.

In particular, whether or not smart phones succeed in satisfying user needs will depend mainly on the quality of the service content that is offered. That is why NTT DoCoMo’s iMode, which can offer new services without the existing infrastructure having to be expanded, has been so successful.

In the United States, where analog mobile phones are still widely used, not all users are positively inclined towards smart phone services. While such users see the next generation of mobile phones, which will access the Internet using bandwidths comparable to those of fixed-line services, as marking a significant advance, they feel that the current technology is not something to become too excited about.

Given the rapid technological advances that are taking place all the time, new technology will inevitably appear before a market matures. The spread of WAP services in Japan will probably depend more than anything else on how long it takes to provide new content.

3 Smart Phones Lead the Way in the Development of Ubiquitous Environments

Smart phones are therefore one of the most promising tools for accessing the vast infrastructure of the Internet in the form of a ubiquitous environment in the near future. With just a single smart phone it will be possible in Japan to use the country’s wireless infrastructure to access the same services and content from any location.

Although carrying a smart phone around is perhaps not quite the same thing as ubiquitous computing in the strict sense of the term, smart phones are still the most practical means of accessing communications networks in that they are a readily available gateway to ubiquitous networks.

Even if demand for mobile phones begins to ease, smart phones are likely to account for a rapidly increasing share of the market. NTT DoCoMo, for example, reckons that iMode-compliant phones will account for as much as 80 percent of the mobile phones it ships during the next few years.

NTT DoCoMo’s iMode service is no longer an untried product and is expected to become a household item in the next few years. In other words, in just the same way that mobile phones are now an everyday means of making telephone calls or, especially among the younger generation, of sending and receiving short messages, smart

phones will be an everyday means of accessing ubiquitous networks in the near future. What is now needed, however, is a wider range of content-based network services.

If we consider the first smart phone services as Stage 1, Japan is now at Stage 2 in the development of the smart phone. This stage includes features such as color displays (which are not needed if all one wants to display is telephone numbers or text) and MIDI (a standard for sending and receiving audio data and which can be used to generate different tones for different messages).

The use of color was a particularly important development because it can be used to express meaning, rather than simply to brighten up the display panel. By being able to view in color the text and GIF images that they have to select in order to access the Internet, users find it much easier to make decisions and choices. Once smart phones are in everyday use, mobile phones with traditional monochrome displays may even become obsolete.

At the next stage, Stage 3, users will be able to run their own applications. With the kind of mobile phones in current use (which use firmware—a combination of hardware and software), users are unable to load their own programs. This means, for example, that users who are unhappy with the address book interface of today's mobile phone cannot simply replace it with a completely different one.

At Stage 3, however, users will be able to run Java applets on their smart phones. They will be able either to download these applets from the network or write their own. As a result, it will be possible to use smart phones not just in the ways in which we currently use mobile phones, but for a whole host of purposes—just like computers.

Once users are able to run their own programs, smart phones will become increasingly customized. They will come to be seen as a platform on which users can even store important personal data. (In actual fact, important data might be stored on the network.) With smart phones that incorporate the kind of PIM (personal information management) capability found on PDAs, users may become increasingly dependent on them for all sorts of daily uses.

Users will therefore be able to use smart phones not just as the next generation of mobile phones with the same communications capabilities, but as a tool for accessing the Web. Smart phones can be seen as a platform for accessing the Internet at the stage when it has become a ubiquitous environment.

III New Applications for Ubiquitous Environments

Even if smart phones do become more sophisticated, they could remain simply extensions of the current genera-

tion of mobile phones unless the services on offer undergo a transformation. In other words, it is the services that count rather than the smart phones themselves, which are simply one means of accessing the services.

1 VoiceXML—a Product of Speech Recognition Technology

Discussions on the use of mobile terminals in ubiquitous environments tend to focus on their use in data communications. However, the basic function of mobile phones is undoubtedly in voice communications. A group of companies, including Motorola and IBM, is developing a technology for converting speech into data and accessing servers on the Internet. Known as VoiceXML, it has been proposed to the World Wide Web Consortium as a sub-protocol of the standard XML (eXtensible Markup Language) protocol.

Users use their mobile phone to access Web sites. Unlike accessing the Internet with a smart phone, this does not require a browser—only the spoken voice. Normally, the process is exactly the same as making a phone call. The Web sites emit a set of audio prompts to guide users, who then issue voice requests in response.

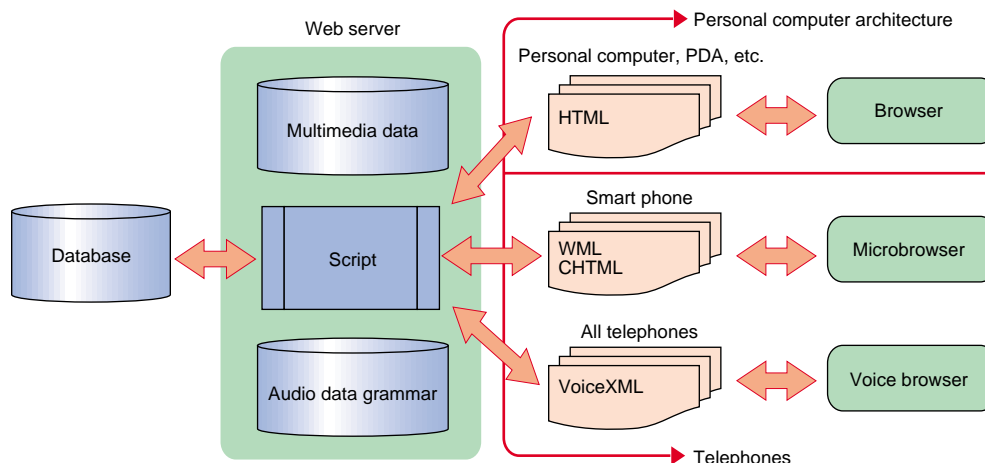
The point is that VoiceXML does not use DTMF tones (i.e., those emitted when you press the keys of a push-button phone) to select menu items. Nor does an operator appear once such items have been selected. The user's words are sent to the server as a voice command and then processed—rather like what happens at an unmanned call center.

The speech recognition technology that is used is one designed for use with non-specific users. Once the voice command has been decoded, the VoiceXML server sends back the query result in the form of text data. This is converted into audio data and transmitted to the receiver of the user's mobile phone. (See Figure 4.)

Let us take an example—that of making a flight reservation. A user on the way to the airport uses a mobile phone to access the airline's VoiceXML server. When the voice menu is played, all the user needs to do to make the reservation is say (without waiting for any response) something such as: "One seat on the next flight to Fukuoka."

In response, the server decodes the voice command and accesses the flight database. At the same time, it checks whether there are any seats left. Once it has done this, it registers the user and sends the result as a voice response. If the user uses Caller ID, all that is needed is to dial the server from one's own mobile phone and to be automatically authenticated.

With a traditional call center, when a user presses a number key in response to a spoken menu, a new menu is played. The user must then enter another number and hear another menu. This "layering" is normal practice. By using VoiceXML, a user can input (i.e., utter) the necessary voice command and receive the service re-

Figure 4. Comparison of VoiceXML and Personal Computer Architecture

Notes: CHTML (compact HTML); HTML (Hypertext Markup Language); PDA (personal digital assistant); WML (Wireless Markup Language); XML (eXtensible Markup Language).

Source: Nomura Research Institute, from Motorola data.

requested without having to bother about such layering. Moreover, voice commands are designed specifically for accessing Web servers. This is the advantage of using VoiceXML.

VoiceXML is currently under trial in the United States, and VoiceXML services are expected to become available gradually. The technology is being tested specifically for use with American Airlines' flight reservation system (see above) and Fidelity Investments' trading system as well as for use with holiday booking services and news, weather and traffic reports. VoiceXML services can also be used within companies. For example, sales personnel out visiting a customer can find out about such things as current inventory levels, delivery dates, and the current state of deliveries immediately simply by saying the name of their company's product into a mobile phone.

VoiceXML does not require a high degree of computer literacy. It can also be regarded as new infrastructure in that anyone can access VoiceXML services anywhere with a device such as a mobile phone. As (Japanese-language) speech recognition technology becomes more sophisticated, a whole new range of related services will become available.

2 Next-Generation Mobile Phones with a Built-In Smart Card

The current generation of mobile phones in use in Japan requires telephone number information to be stored on a device called an ID-ROM. If a user wants to use a different model, it is necessary to take the phone to an outlet that can input the data. This is because the phone's ROM cannot be removed.

In contrast, the GSM (Global System for Mobile Communications—a Pan-European standard for digital mobile services) phones in general use in Europe have a built-in chip, called a SIM (subscriber identification

module) card, on which the phone's number is stored. The chip can be removed quite simply—even by the user. This means that if a phone fails to work or if the user wants to switch to a new model, it is possible to continue using the same number simply by removing the SIM card from the old phone and inserting it in the new one.

The next generation of mobile phones in Japan (due to be launched in March 2001) will have a removable chip of this kind—called a UIM (user identification module) card. This will store information such as the phone number and the key needed to access the wireless network. Since the UIM card will be a smart card, it has the potential to do many different kinds of data processing, depending on its processing power and memory.

It will be able, for example, to store cumulative billing data or data on how much call time is left on a prepaid phone. As with a SIM card, users will be able to change to a different model (or even, if they are overseas, use the same model) simply by removing the UIM card from their old phone and inserting it in their new one.

With smart phones (see above) there is no guarantee that users will be able to continue to use all the predefined information stored on their phones if they change models, unless it is stored on line. One solution might be to use a UIM card.

Because UIM cards have the same functionality as smart cards, they can be used to store all sorts of data—including, possibly, applets. If a user changes to a different phone model, it will be possible to physically transfer (by removing the UIM card from the old phone and inserting it in the new one) any information that enables the UIM card to function as an electronic wallet. This procedure allows each user's personal data to be transferred simply and safely with no need for duplication. As it becomes possible to store an increasing variety of useful data on UIM cards, they will become an increasingly valuable tool.

3 Mobile Phones as Electronic Wallets

As the use of mobile phones has become increasingly common, it has been suggested—not altogether unreasonably—that they could replace traditional wallets and purses.

Nokia, the Finnish mobile equipment vendor, supplies vending machines for soft drinks to Finland's largest mobile communications service provider, Sonera. Although it may seem strange that a mobile equipment vendor should be making vending machines, these are rather special ones. There are no buttons for selecting drinks. (In fact, there is nothing on the outside of the machines except the door at the bottom where the cans are delivered.) Instead, there is a phone number.

If you call the number using a GSM phone, there is a message (in Finnish) followed by the sound of data being sent down a telephone line. At the same time, a can of drink is delivered. Instead of paying there and then, the user is billed for the drink on that month's phone bill.

These vending machines are installed at airports in Finland and at Sonera's retail outlets. However, the aim was not to provide a full-scale commercial service but simply to demonstrate that it was possible to buy a can of drink from a vending machine by using a mobile phone. (Another reason for not providing full-scale commercial service was probably the fact that the cost of a phone call

would have been too high compared with the cost of the canned drink.) However, it does show the mobile phone's potential as an electronic wallet.

Mobile phones are owned by individuals, and each person's caller identification number is unique. There is no reason why they should not be used to make all sorts of payments. Moreover, the next generation of mobile phones in Japan will come with a smart card. This could be used to store "value" in a phone—just like an electronic wallet. If one's mobile phone were stolen, a user could call the service provider and have this payment capability frozen immediately.

If mobile phones can be successfully used as electronic wallets in this way, they may complement or, in some cases, even compete with smart cards, which are finally coming into actual use after numerous trials.

If mobile phones are to function as electronic wallets, they will need an infrastructure for providing a wide range of services. It is this infrastructure that will constitute the ubiquitous environments of the future. And the day when mobile phones will be the platform used to access these environments is not far off.

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