

Offering Ubiquitous Services

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Introduction

This article describes some research in our laboratory aimed at offering so-called ubiquitous services using new information technologies that will become available in the future.

It seems very likely that the railway station will come to play a pivotal part in all our lives in the future and I would like to describe some of our research towards facilitating this outcome. This article consists of five parts. First, I shall describe the mission of my laboratory. Second, I shall review the passenger transport ticketing systems, and systems for offering data and other types of information, or the progress we have made so far in. Third, I shall explain the direction and background that we proceed with the research by introducing 'ubiquitous computing' and its role in next-generation information technology against the background of our research. Fourth, I will explain the concept of the 'smart station'—the main scheme of the research on ubiquitous computing. Fifth, I will explain the potential of stations in the future, based on the concept of the ubiquitous environment along with some development systems.

Creating Value, Comfort, and Space

I would like to give a simple explanation of our laboratory. It is called the Frontier Service Development Laboratory that undertakes research into creation of high-value services using both software and hardware. As the word frontier implies, our work involves research into new cutting-edge and previously unexplored services. With the future aim of creating value, comfort, and space, some concrete examples of this type of cutting-edge R&D include information technology (IT), robotics (typified by the very popular Honda ASIMO humanoid robot), nanotechnology, sensing technologies, new material science, and other very recent development in science and technology, as well as other disciplines such as psychology, ergonomics, environmental science, etc.

There are three main directions to our research. The first involves various types of new research methods and planning aimed at creating new value for customers and new markets. It involves forecasting the future with respect to the business environment and social activities, so the work incorporates diverse subjects, such as social engineering, marketing, market research, database engineering, etc.

The second is in the field of comfort creation and the research fields include subjects such as IT, architecture, ergonomics, interior design, environmental engineering, etc. In concrete terms, it covers station design and systems, and solving various problems in stations that occur in these days.

The third is in the field of space creation and involves research into civil engineering methods offering the opportunity to create spacious stations, providing a variety of services for customers.

Promoting Passenger Ticketing Systems

Next, I would like to touch on the subjects of passenger ticketing and information systems. As shown in Figure 1, promotion of such systems is closely related to offering service and the 'heart' of service is based principally on human interaction and psychology. Moreover, services to customers by employees incorporate elements such as linguistics, intelligence, and personal behaviour. We are replacing the old labour-intensive jobs such as ticket inspection and sales by equipment and machinery, requiring more focus on functional elements for providing customers with services. The purpose of

Figure 1 Ticketing and Information Services

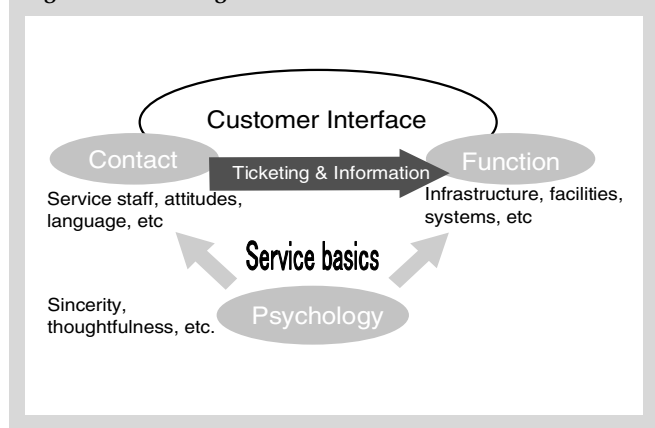


Figure 2 Improving Functionality

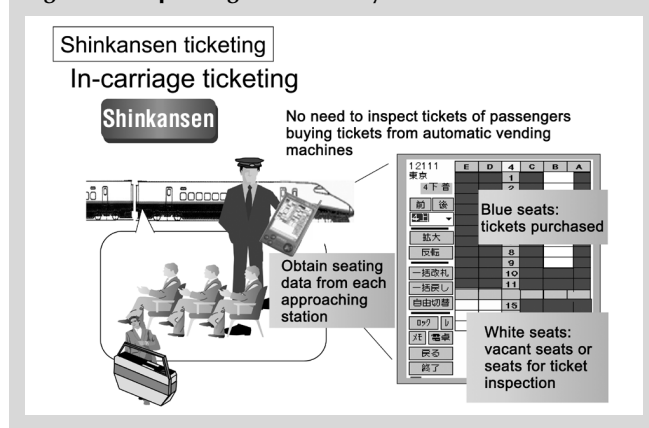


Figure 3 Improving Functionality

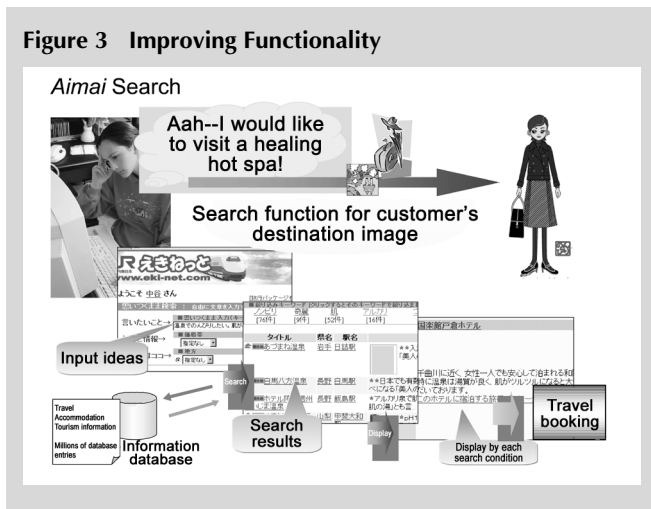
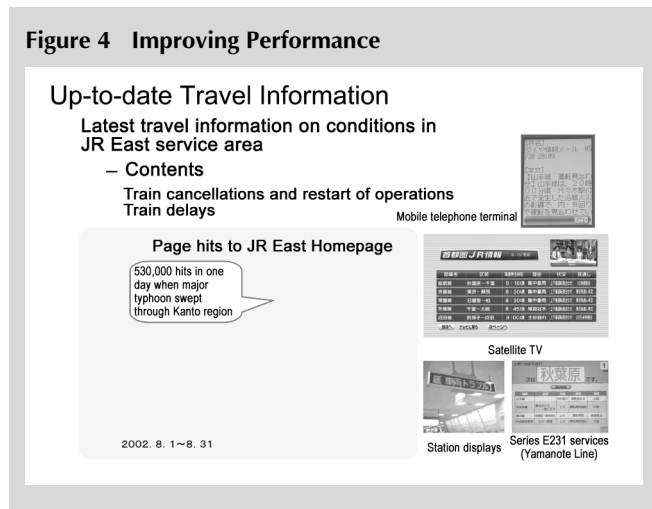


Figure 4 Improving Performance



replacing human labour with automation is to offer the public more effective, lower cost, simpler, more accurate, faster, and easier-to-understand services. The combination of the Easy & Public concepts is the basic part of our research. In considering the Easy & Public concept, there are a number of plans for ticketing and information. Currently, more than 400,000 people have used the JR *Eki-net* website to purchase passenger tickets over the Internet since it was established in April 2000 and 'General Travel Site' links with JTB and JAL were also started from April 2001. JR East's very popular non-contact Suica card had gained 6.5 million users by June 2003 following its introduction on 18 November 2001. Our laboratory was deeply involved in the 10-year development period and three field trials before the successful introduction of Suica (see *JRTR* 32, pp. 20–27). We examined improvement of services that the Suica card might offer to passengers, as well as conducted large-scale trials on its effect on transport mobility and patterns. At present, 98% of users report better convenience offered by the card when passing through newly-developed one-touch ticket wickets and addfare machine. In the future, we are aiming to develop new services based on a mobile Suica chip incorporated into next-generation mobile telephones. I would also like to describe one more ticketing system. As shown in Figure 2, we have

introduced a new in-carriage ticket inspection system for *Hayate* shinkansen since December 2001, which is based on almost 5 years of research by our laboratory. Some 500 portable terminals are used by 600 shinkansen conductors to automatically obtain seating data from automatic ticket wickets in stations. The data is transferred over the Dopa network to portable digital assistants (PDAs) carried by the inspectors. This system greatly reduces the problems of on-board ticket inspections for customers and playing a major role in establishing friendly relations between railway staff and customers.

Promoting Information Services

Next, I would like to discuss the flow of information services. After opening a homepage in 1996, by spring 2002, we had cooperated with research into developing the various systems for supplying information such as the *Eki-para* portal site offering information about products and services provided by the 9000 tenants in our company's station buildings. I would also like to briefly mention the interactive site offering travel information to customers. Figure 3 summarizes the *Aimai* (vague) search function—customers coming to the View Plaza travel sales corners of our company who want to make some sort of trip but are not sure about exact destinations, etc.,

can easily obtain information about a possible destination meeting their requirements using this service. By analyzing consumer psychology and movements we have been able to develop a system with travel consultation functions that works automatically over the Internet. For example, we may have a customer who wants to visit a hot spring where bathing in the waters softens and beautifies the skin. Just by using the simple words as natural language, the *Aimai* search engine is able to locate possible travel destinations that meet the customer's criterion. A full range of contents such as photographs and travel data, etc., are available, making it possible to perform various types of search and assisting travellers in their efforts to find travel destinations.

Next, I would like to discuss travel information that meets the real needs of travellers making reservation; we offer the information to the iMode, Japan Broadcasting Corporation (NHK) and BS digital broadcasts. The graph in Figure 4 shows the number of hits made to our Internet homepage around the time that a major typhoon struck the Kanto region of Japan in August 2002. On the day of the typhoon, there were 530,000 page hits—this compares to a normal daily average of 240,000 hits. However, comparing these 240,000 hits with the average of 63,000 hits per day in the previous year, we can see there has been a rapid increase

Figure 5 Trend towards Ubiquitous Computing

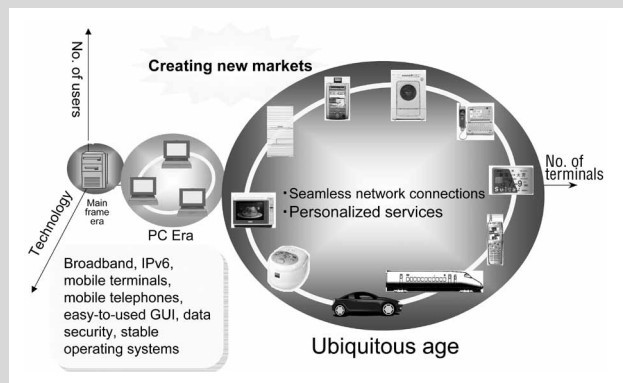
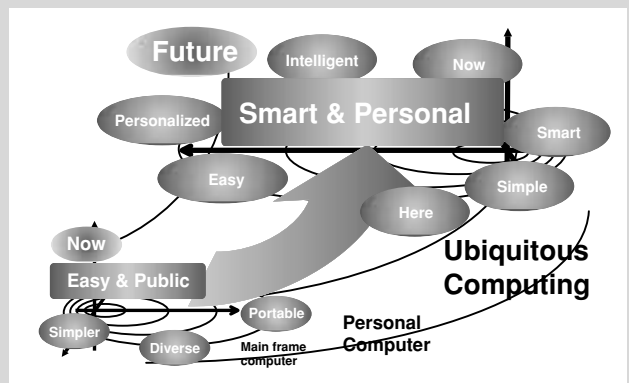


Figure 6 Service Paradigm Shift



in the number of customers using the Internet to obtain travel information. Our laboratory is looking carefully at changes in travellers caused by information with high responsibility.

Business Environment and Changing Consumers

We are fully aware of the necessity to be receptive to the major changes that are occurring in consumer trends due to the advent of the Internet society, while remaining to use R&D using earlier information technologies.

Using the concept of ubiquitous computing we are considering R&D into next-generation systems using advanced IT. With the advent of ubiquitous computing I am sure that we shall be giving a great deal of consideration to social trends and the changing business environment. These changes are not occurring just in the field of transport but also in other industries due to its relationship to the transport operators, mostly to social changes. Already, 18% of the Japanese population is very aged and within 10 years this figure will have risen to one in four people. This is quite common knowledge but I think it is necessary for us all to be aware of the massive changes occurring in our customer base.

Our survey of personal trips in Tokyo showed that journeys by senior citizens and women were extremely high. In the

future, it may be necessary to base our business strategy around the concept of active senior citizens forming our core customer base. Furthermore, since the total fertility rate in Japan has dropped to just 1.32, we can expect to see a decline in our younger customer base, such as commuting students. The trend in our R&D strategy should be directed from the viewpoint of generating demand in new customer bases.

In addition, as a result of the increasing speed of information networks, we must consider the impact of empowering customers to retrieve and send information. This is quite clearly demonstrated by the 100,000 or so opinions, complaints, praise, etc., collected from customers each year by our Green Information System.

With the increasing participation of disabled people in everyday society, it will become more important to focus our attentions on creating easy-to-use barrier-free stations and this theme of better accessibility for all has become an important part of our research. There is clearly a need to strengthen two-way communications offering suitable information to customers following socialization of knowledge. In addition, as women and men take more equal roles in society, we shall need to pursue environmental creation from the perspective of equal opportunity in which men and women both have roles to play in work and home making.

As part of our company's *New Frontier 21* plan, we are looking at working in harmony with the environment and sharing with society, but environmental considerations are an inevitable part of any business today.

In considering this business environment, there is no doubt that we shall have to consider diversified approaches to these markets. Diversity has been an important concept in American society and market since the early 1990s and even Japan has finally caught up with the concept as evidenced by the *Keidanren* (Japan Federation of Economic Organizations) theme of creating dynamism through diversified value. One approach to diversity is building dialogue-type relationships between businesses and customers, businesses and regions, and businesses and society. I think we need to create so-called interactive communication methods as a company and we are looking at establishing systems for creating new markets based on interactive communications.

As part of this type of business environment I would like to explain some of our ideas about ubiquitous computing.

Ubiquitous Computing Research

Part of the work in our Laboratory involves planning concepts based on understanding the human psyche to ensure the compulsory, proper richness and

Figure 7 Smart Station Concept

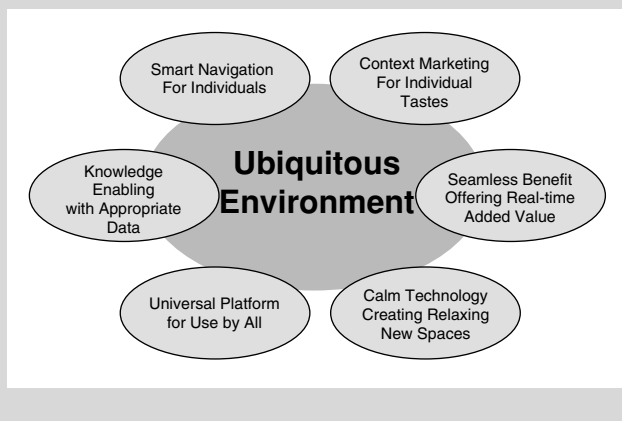
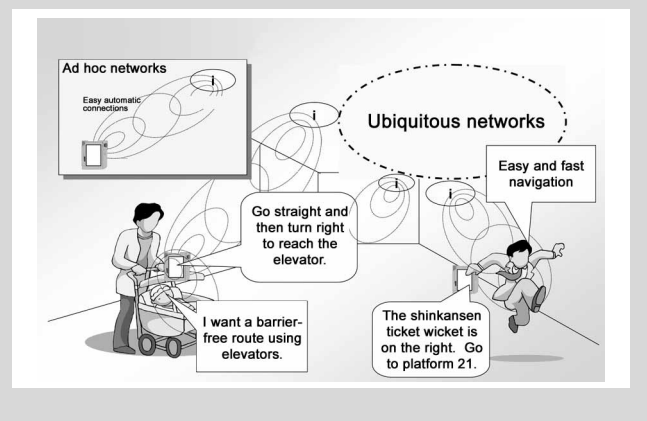


Figure 8 Smart Navigation



effectiveness of social and business activities and linking with support for diversification.

The term ubiquitous in the title of this section originally comes from Latin word that means existing everywhere and could be applied to the concept of the existence of God in all places simultaneously. It is used here to give the idea of human-centric computer technology existing in widespread use. The idea of ubiquitous computing technology evolved following the 1960s and 1970s when a single very expensive computer such as a mainframe was shared by many users. This era was followed by the age of personal computing when each user had his or her own computer. Now, with the spread of portable information terminals and broadband communications, we have really entered the age of ubiquitous computing (Fig. 5). As the new IPv6 TC/IP protocol comes into widespread use and offers almost an infinite number of IP addresses to the world's population, people everywhere will almost certainly be connected to computer networks on a 24/7 basis and we will have arrived at the ubiquitous computing environment with easy-to-use computer interfaces, reliable security technology, crash-proof operating systems, and high added-value cutting-edge technologies.

Research in the field of ubiquitous computing started in the late 1980s at several leading laboratories around the world. In the USA, the Xerox PARC laboratories took the lead under the late Dr Mark Weiser (1952–99) who developed the idea of active infra-red badges emitting a personal ID that would allow the wearer to interact in their daily lives with an environment into which computers were seamlessly blended in. Massachusetts Institute of Technology in Boston—where JR East has a professorship—is conducting research in the same field as the oxygen project. In this work, people's daily lives are supported by computers and network technologies blended into their living environment.

At Keio University in Japan, the Smart Space research project is in the test phase. In this project, a variety of sensor and computer networks are embedded at various locations with the aim of achieving a personalized intelligent information environment.

Six Tests of Smart Station Concept

Now, I would like to introduce some of our research activities in ubiquitous computing. Figure 6 shows our Easy & Public concept for offering standardized

services to large numbers of people. However, we must not forget the changing activities and needs of consumers who express opinions like: 'must be easy to understand, needs to be more intelligent, want to be able to use only here, must provide up-to-date information, must be more advanced, must be customized, must be simple, etc.' In the future, it seems that there will be a paradigm shift towards a so-called Smart & Personal space providing personalized information to a more diverse range of customers.

Next, I want to introduce our Smart Station research test scheme. Figure 7 shows six tests for providing a ubiquitous environment today. The first test is what we have labelled Smart Navigation, which provides personalized navigation services to individuals. Next, we have Context Marketing, which offers marketing information based on an individual's preferences and tastes. The third test is the so-called Seamless Benefit, which offers high added value in real time according to an individual's changes in time and space. The fourth test is Calm Technology, which not only includes technologies such as noise reduction designs and use of open stress-free spaces, but also aims to create a calm environment for people in which advanced technologies recede into the background. Next, we have the so-called

Figure 9 Calm Technology

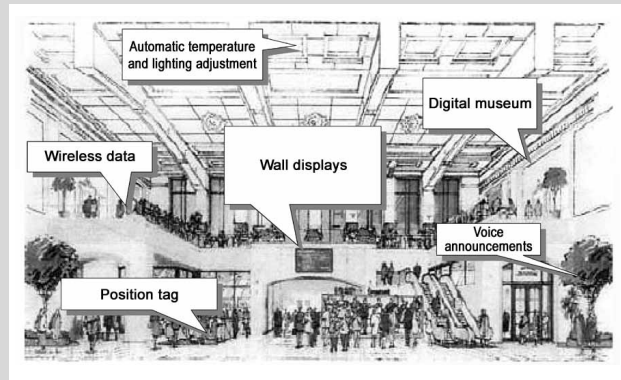
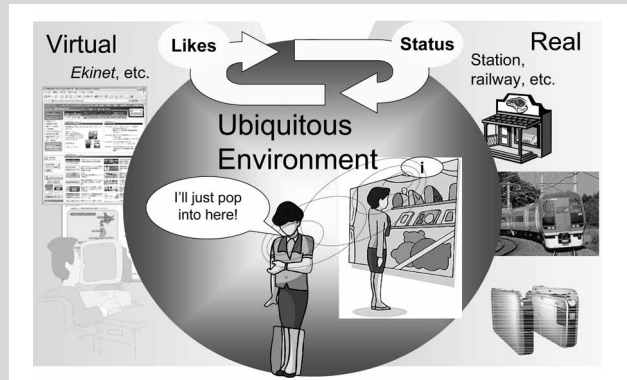


Figure 10 Context Marketing



Universal Platform, which aims to create a simpler environment that anybody may use with ease. Finally, we have a Personalized Information space that offers improved services by providing the appropriate information matching people's individual needs, likes and desires.

For example, customers in stations and on trains require a lot of effort and stress to obtain information that is necessary through conventional means such as pamphlets, signs and written materials. Within a Smart Navigation space, wireless tags and ubiquitous terminals would be used with ad-hoc network technology to create an environment in which connections could be made naturally to obtain personalized information. As a concrete example, imagine a mother pushing a stroller. She might input the information she requires into her mobile telephone, which would then display the route to the nearest elevator, which cars in the train have less air conditioning, and which is the shortest route to places in the station (Fig. 8). In a typical set up, an ad-hoc network terminal in a station corner might be able to use natural voice commands to display the information required by the customer.

Calm Technology involves creating an environment in which accurate sensors in

the ceilings, etc., could sense and adjust ambient light and temperature levels. Such technology could also be used to create virtual realities such as digital museums on the wall where people might relax whilst waiting (Fig. 9). Other examples might be use of calming natural sounds such as bird songs from greenery. Other information might be provided from well designed displays with good ergonomic features. Position sensing tags in walls and floors might use wireless technology to inform vision impaired people about the location of staircases and other obstacles. The ultimate aim of Calm Technology is to create beautiful spaces using new technology hidden within the space and design.

What about Context Marketing? This is a relatively new term but it is basically a method of marketing with improved success rate due to the ability to 'push' information to consumers that matches their needs at that point in time based on their interests and current circumstances

(Fig. 10). It is still in the early stages but a trial has been performed on the private Tokyu Corp. railway. We need to figure an effective marketing information service in JR East's widespread railway network and future trials are being planned based on customer trends using virtual and real models.

To make the above described themes become reality, we are planning a number of joint research efforts in a variety of fields using open networks. But we are not restricting our vision simply to ubiquitous computing, and we are actively pursuing research into other forms of service.

To summarize, our research is aimed at creating new value and comfort for our customers by developing new services that combine cutting-edge software and hardware technologies. ■



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