

Development of Base Stations for High-speed Mobile Data Communications Using 1xEV-DO

Mobile Internet services — in which mobile phones and PDAs (personal digital assistants) are used for sending and receiving mail, Internet browsing, and downloading music files — are enjoying rapid growth. One technology that has gained particular attention is 1xEV-DO (1x Evolution – Data Only), a wireless packet communication technology optimized for data communications, thus achieving low-cost, high-speed communications. Hitachi, Ltd. led the industry by developing a base station trial system to accommodate this technology, thus taking a major step toward commercial applications.



Kuniaki Akatsuka, Senior Engineer (left) and Hiroshi Iwata, Engineer, of the Mobile System Department of the Telecommunication Systems Division: both were involved in the development of base stations for high-speed mobile data communications using 1xEV-DO.

Features of 1xEV-DO

1xEV-DO was developed by QUALCOMM Incorporated — best known for pioneering cdmaOne* — as a third-generation wireless packet communication technology for mobile applications. The two distinguishing features of 1xEV-DO are “economy” and “speed.” In terms of economy, by adding 1xEV-DO data communication systems to existing cdmaOne base stations, it is possible to minimize installation costs and at the same time to provide services at a low cost to users because existing antenna equipment and transmitter/receiver devices can be used without extensive modification. In terms of speed, compared with conventional methods combining voice and data communications, because 1xEV-DO dedicated to IP-based data communications, transmission efficiency is substantially increased, achieving a forward data transmission

speed of 2.4 Mbit/s at a maximum. This is around 37 times the speed of PHS phones, which had offered the fastest data communications at 64 kbit/s. Also, 1xEV-DO boasts even greater efficiency in radio frequency than W-CDMA (Wideband Code Division Multiple Access) methods.

Hitachi's activities targeting 1xEV-DO

Hitachi entered into its first contract with QUALCOMM Incorporated in 1996 for the licensing of cdmaOne technologies, and in January 2000 became the first vendor in the world to enter a licensing contract for 1xEV-DO. Since that time, Hitachi has been promoting joint development of 1xEV-DO system as well as controlling methods to achieve high throughput, and at the same time has developed its own original dedicated LSIs, hardware packages, and software. Thereby, it has completed earlier than others in the world the system to quickly provide comprehensive base station systems. After receiving an order from KDDI CORPORATION (formerly IDO CORPORATION) for a 1xEV-DO trial system, the company began a variety of verification tests in July 2000, regarding interference conditions in metropolitan areas with high volumes of radio wave traffic, maintaining of communication quality in simultaneous access by multiple users, etc. Hitachi is currently developing commercial systems based on technologies and abundant know-how accumulated through these activities.

What services can be expected with 1xEV-DO commercial system?

The commercial system of 1xEV-DO will facilitate large-volume, high-speed, low-cost wireless data communications, enabling a wide range of broadband services in mobile environments, whether indoors or outdoors. For example, it will be possible to achieve wireless access to high-speed Internet applications from PCs, to enjoy music and video distribution services from PDAs, and to download the latest maps using car navigation devices.

Future developments

Hitachi will continue to promote even more refined commercial systems and diverse solutions based on the valuable data and know-how derived from verification tests as well as on the merits of being able to provide comprehensive 1xEV-DO systems incorporating mobile terminals and network technologies.

* cdmaOne is a registered trademark of CDMA Development Group.

HA8000-ex/880: a High-performance, High-reliability Server Incorporating a 64-bit Processor

The rapid rise of Internet applications such as electronic commerce (EC), enterprise resource planning (ERP), customer-relationship management (CRM), and supply-chain management (SCM) is being accompanied by a huge increase in the number of electronic transactions on the Internet. Consequently, there is a growing demand for a high-performance server that can handle this increased number of transactions. In response to these circumstances, Hitachi, Ltd. has launched a next-generation server — the HA8000-ex/880 — incorporating Intel Corporation's novel 64-bit-architecture (IA-64) Intel® Itanium® processor. The high performance and outstanding expandability of the HA8000-ex/880 server make it ideally suited to the large-scale systems being constructed for the Internet generation.

Development aims of the HA8000-ex/880 server



A view of the HA8000-ex/880 server installed in a 38-unit rack.

The HA8000-ex/880 server — which has a Hitachi chip-set incorporating the Itanium 64-bit processor at its core — is an enterprise server that provides a multi-operating-system platform. Combining Hitachi's home-grown development and packaging technologies for mainframes and supercomputers with the latest technology featured in the Itanium processor has enabled a high-level-performance server to be produced as a remarkably compact unit (i.e., the server is only 10 units high, where one unit is 4.45 cm). Moreover, the novel multiple-logical-processor feature (MLPF) of the server enables it to run several operating systems and applications in parallel. In addition, it is assumed that the new server will bring together "mission critical" work and the Internet and, in doing so, that it will attain high quality in terms of reliability, availability, and maintainability.

Characteristics of the originally developed chip set

Intel's standard chip set can incorporate up to four processors, whereas the chip set developed for the HA8000-ex/880 server can be scaled up to a maximum of eight processors. Moreover, the developed chip set has improved memory performance and incorporated a large-capacity cache to enable rapid execution of application programs. Regarding compatibility, in the spring of 2000, Hitachi took the developed server equipment to research centers of Hewlett-Packard Company and Microsoft Corporation and started to test its performance. The results of these tests showed that the server can operate with standard equipment and successfully run applications and operating systems, such as HP-UX**, Linux***, and the 64-bit architecture for Windows****.

Main efforts of the development process

The cooling of the CPU and the operation margin of the processor bus were the two main issues of the development process. Servers developed so far consume a large amount of electrical power (about 80 W), and the HA8000-ex/880 consumes even more power (130 W). Accordingly, several ways to provide efficient cooling were tried; for example, a panel for directing airflow and a CPU temperature-monitoring function were installed. Concerning the operation margin of

the processor bus, much effort was exerted to reduce the power-supply noise. That is, several CPU boards were constructed (for example, with different power-supply circuit layouts) and the best layout to reduce the noise was determined by trial and error. As a result, an eight-way CPU — providing stable 266-MHz operation — was found to be the best configuration.

Future developments

The HA8000-ex/880 server is the world's first to incorporate the 64-bit Itanium processor. It thus represents a very significant development for Hitachi; accordingly, it is being made Hitachi's main server system for supporting "Internet business solutions." In the future, with the launch of Intel's next-generation Itanium 2 64-bit processors, the benefits to users — in terms of performance and cost — will increase. In other words, by applying the experience gained from the development of the HA8000-ex/880 server, Hitachi plans to utilize these new processors and further expand our product line-up.

* Intel and Itanium are registered trademarks of Intel Corporation or its subsidiaries in the U.S. and other countries.

** HP-UX is a version of the UNIX operating system that runs on Hewlett-Packard's workstations.

*** Linux is a trademark or registered trademark of Linus Torvalds of the U.S. and other countries.

**** Windows is a registered trademark of Microsoft Corporation of the U.S. and other countries.



Masamori Kashiyama, senior engineer (left) and Kazuhiro Akimoto, senior engineer (right), of the High-end Server Development Department, Internet Systems Platform Division.

Hitachi Opens the Curtain on the PDP Era with 3-size Lineup of High-definition Plasma TVs

With the startup of digital high-definition broadcasts, much attention has focused on PDP (plasma display panel) TVs, which can recreate high-definition images that maintain their original clarity. The television, which was for decades dominated by the cathode ray tube (CRT), has entered a new era, spurred on by the 32-inch high-definition plasma TV released by Hitachi, Ltd. in April 2001. In the autumn of the same year, 37-inch and 42-inch models were released, expanding the selection of screen sizes and opening the curtain on the true era of the PDP TV.



From left to right: Takashi Hasegawa (Engineer, Visual Media Engineering Department, Digital Media Division); Toshihiko Matsuzawa (Senior Engineer, Display Mechanical Engineering Design Department, Digital Media Division); Hiroshi Aoki (Engineer, PDP Engineering Department, Digital Media Division).

Background to development

In the past, PDPs focused mainly on commercial applications, as a result of numerous technical problems that hampered the development of small- to medium-sized screens. In its efforts to make this image quality accessible to a greater number of viewers, Hitachi first released a 32-inch model, thus offering a comfortable size that could be used easily in the home. Because this new choice of "Plasma Screens" along with the conventional CRTs had a major impact on consumers, customers from a broad range of age groups purchased the new plasma TVs. Hitachi added a 37-inch model and a 42-inch model to offer customers an even greater choice of sizes, expanding the product lineup to include five models in three sizes.

Focus on superior image quality

By adopting the new ALIS (alternating lighting of surfaces) PDP drive method, Hitachi achieved high resolution with 1,024 vertical pixels in all models, and 1,024 horizontal pixels in the 37-inch and 42-inch models. The ALIS method alternates use of light-emitting electrodes in pixel lines, reducing the load on luminescent materials and thus assuring

longer life than conventional methods. In addition, these models boast the best level of luminescence in the world by the large luminescent surface area. Hitachi also adopted newly developed MBP (multiband pass) color filters to improve contrast, and to ensure more colorful, more striking images.

Using the Advanced Progressive method, Hitachi has improved picture quality of standard definition TV programs up to the level of digital high definition TV. New multi-scan converter LSIs convert the video signals into the most appropriate format depending on the number of PDP pixels, so images in a wide range of signal formats can always be viewed under the best possible conditions. Particularly in the case of digital high-definition images, high-accuracy interpolation processing is executed using real sampling functions to draw out the original picture quality, and natural images are achieved through the use of an auto-contrast function.

Key points in design

The stands designed specifically for the 32-inch and 37-inch models feature a swivel function, allowing the user to change the viewing angle by 20° to the left or right. It is more difficult than one might expect to ensure stability in a large TV placed on a single column, but by using an aluminum die cast material, Hitachi has combined both strength and compactness in a single design. Also, because the AVC (audio-video control) — that is, the tuner unit — is separate from the monitor, users can take advantage of the monitor's slim design, which is the product's greatest advantage, to select their most preferred room layout, for example by hanging the monitor on a wall. In addition, Hitachi adopted a design that offers highly efficient heat dissipation, thus eliminating the fan and dramatically reducing noise, which was an essential resolution to the popularization of PDP monitors.

Future issues and developments

Hitachi will promote technological development targeting further reducing power consumption, aiming for proliferation of these products on a global scale. In addition to Europe, where the products have already been released, it will target Asian and North American markets in an effort to contribute to the popularization of plasma TVs.

Regional and Atmospheric Diffusion Simulation System for Supporting Advanced Environmental Conservation

Amid increasing concern for global environmental problems, many industries are promoting activities targeting the acquisition of ISO14001 (international standard for corporate environmental protection activities) certification. Hitachi, Ltd. has developed a Regional and Atmospheric Diffusion Simulation System to support the acquisition and maintenance of this certification. This system enables the user to predict the diffusion status of aerosols released into the atmosphere under a wide range of meteorological and geographical conditions, and to evaluate the effects of these atmospheric dispersions on the environment.

Features of the system

One important point is that the system can be used on a standard PC (personal computer). When development first began, Hitachi's engineers considered using a workstation base, but taking into consideration ease of use for the customers, some adjustments were made, including streamlining of the computation functions to ensure smooth PC operations. As a result, computation time has been significantly reduced, and the system is able to provide forecasts for one hour in advance within about 50 seconds, and even calculate conditions for 24 hours in advance within about 20 minutes. Also, by accessing wide-area meteorological data on-line from the Japan Weather Association, the system is able to execute long-term forecast calculations for as much as 30 hours in advance, to evaluate current conditions in real time and to reproduce past conditions as well. Furthermore, by adding actual meteorological data for the area immediately surrounding the facilities, simulations of even greater accuracy can be achieved.

Background to development

As a result of a growing awareness of environmental problems, there have been increasing demands in recent years for detailed investigations into how factory exhaust aerosols are dispersed, and for information on ways to reduce the effects on the surrounding environment. Simulations required for these studies, however, require highly advanced technologies, and Hitachi, Ltd. has the necessary specialized research facilities. The Atmospheric Diffusion Simulation System is an original system developed by Hitachi engineers.

Unique aspects of development

The first customer to install the system was the Fukui Prefectural Environmental Radiation Research and Monitoring Center (FERMC). There are several nuclear power plants operating in Fukui Prefecture, and many

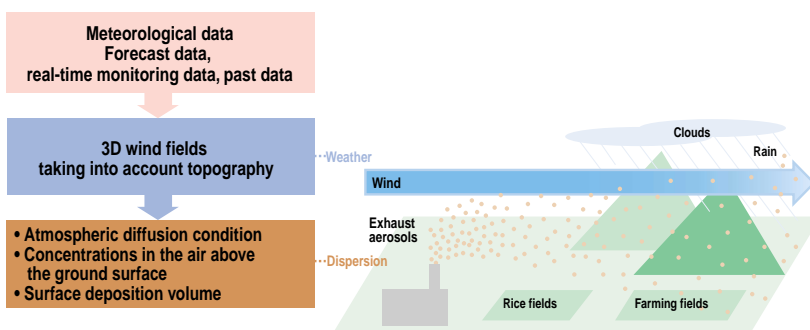


From left to right: Ryuji Kubota (Senior Engineer, Nuclear Power Systems Division); Kengo Iwashige (Senior Researcher, Power & Industrial Systems R&D Laboratory); and Toshio Kasano, (Senior Engineer, No. 1 Electric Power Control Department, Industrial Systems Division, Hitachi Engineering Co., Ltd.).

monitoring stations have been established, but a highly accurate system was required to accommodate a wide range of meteorological conditions; Hitachi's system received high evaluations for its strength in predicted computations. Through this installation, Hitachi became aware of the need for detailed settings for the exhaust source of dispersed aerosols, and thus incorporated functions to enable settings in meter units in addition to the existing longitude and latitude settings. For example, even if there are two exhaust stacks at a single factory, this system can conduct simulations for dispersions from each stack, further increasing computation accuracy.

Future developments

This system was originally developed for a broad range of environmental assessment applications. It can evaluate conditions related to sulfur oxides (SO_x) and nitrogen oxides (NO_x) as well as volcanic ash and pollen, so in addition to studies of how aerosols released from factories and other sources are dispersed, it can be used in numerous other applications, including detailed analyses of potential abnormal situations, studies of the effects of natural disasters, and calculations of the optimum height and position of exhaust stacks before factories are built, to minimize the effects on the environment. In the future, Hitachi will offer Internet-based services involving analysis alone, and will also sell package software based on a simplified version of the relevant calculations.



Outline of atmospheric diffusion simulation

IT Solutions for New Power-control Systems

Recent information technologies (IT) have led to more efficient operation and maintenance of transmission and generation (T&G) systems and reorganization of T&G sections in power utility companies. Hitachi's new power-control systems based on IT installed at the Kansai Electric Power Co., Inc. (KEPCO) have enabled the number of operation staff to be considerably reduced while maintaining the reliability of the power supply to customers.

KEPCO Projects

KEPCO's T&G system (28,700 square km, 33,000 peak MW) has been operated heretofore by one central load dispatching center, eight area load-dispatching centers, and about 50 control centers.

KEPCO started a project to minimize total T&G costs several years ago and came to the conclusion that new load dispatching center (LDC) systems must be tightly connected. Such tight connection would provide operators in any center with real-time information and allow them to initiate any functions installed in any center.

Using new LDC systems, T&G operators can perform multi jobs irrespectively of their working place and KEPCO can not only reduce the number of control centers but also save human resources.

Existing LDC EMS/SCADA (energy management system / supervisory control and data acquisition) systems consist of different hardware, operating systems, software architecture, and databases because they were supplied by different vendors. Such diversity is inefficient, so the software architecture and database of different systems had to be unified to achieve tight connection. It was decided to introduce an application programming interface (API) for all application programs (including SCADA functions) of area load-dispatching centers and control centers. The API includes the same common information model (CIM) and common interface specification (CIS) as those of the EPRI's (Electric Power Research Institute of the USA) CCAPI (control center application programming interface) approach. The CIM represents all objects handled in systems such as power devices and measurement equipment. The CIS defines calling procedures and services. This API enables EMS/SCADA systems of different hardware and/or operating systems to communicate with each other without any complicated conversions, because all systems share logically the same database.

Hitachi's approach

Hitachi has developed his own EMS/SCADA architecture, called D.O.R.A. (Dependable Open Real-time Architecture), which provides the API for application programs. Hitachi offered

the solution to modify D.O.R.A. and/or add some wrapper programs to meet KEPCO's API requirements, namely, a fast and reliable power-control system. New functions and detailed specifications were discussed in a joint research meetings between KEPCO, Hitachi and other system suppliers.

Following these meetings, new functions were integrated in the new LDC systems mainly to reduce the operators' workload.

- Automatic switching-order generation and execution
- Automatic fault restoration
- Back-up scheme for centers
- Centralized data maintenance

Hitachi was awarded the contracts to supply the new Osaka-Kita area load-dispatching center and the Furukawabashi control center (whose control area is the northern half of Osaka City) in March 1999. Those two computer systems were put in service in June 2001 after several months of commissioning tests.



New LDC system, installed at the Osaka-Kita area load dispatching center, Kansai Electric Power Co., Inc.

Advantages of the new power-control system

The new power-control systems work in both autonomously and in connection. The systems are connected by duplicated 1.5-Mbps private-communication lines using the RNA protocol (real-time network architecture: Japanese standard communication protocol between control centers). Many kinds of information, such as measured, calculated, and entered values, are automatically copied between systems so that operators in the two centers can get the same data at any time.

It was confirmed that the new power-control systems and their advanced functions mentioned above reduced the volume of operators' work. In particular, the work regarding monitoring and controlling the power network and performing network restorations in case of alarms can be shifted to operators in the area load-dispatching center from the control center. It therefore became possible for the operators in the control center to concentrate on maintenance and repair work.

On the other hand, if power-network alarms occur over a large area or the area load-dispatching center is damaged, the system at the control center can share or back up the network operation of the area load-dispatching center. Moreover, the data maintenance work involved in network expansion and/or modification is centralized in the area load-dispatching center and the database for the new power network is automatically copied to the control-center systems. This centralized data maintenance has significantly reduced running costs.

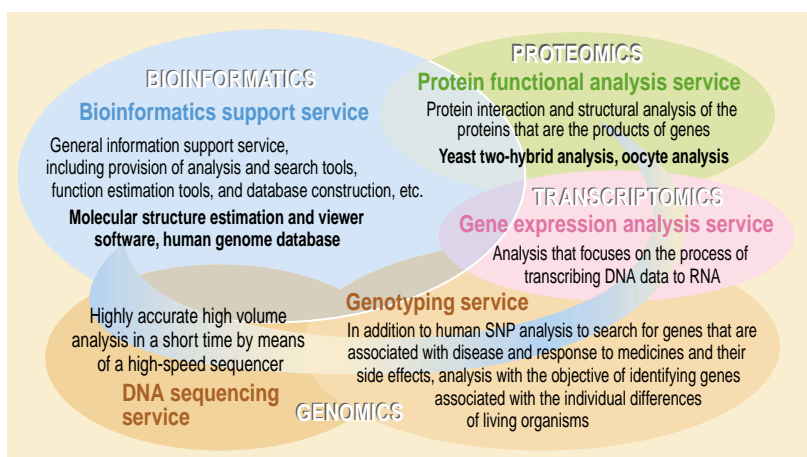
The new LDC systems have allowed KEPCO to stop 24-hour operation of the control center. As a result, KEPCO has reduced operation costs.



From left to right: Yuji Nakata (Chief Engineer, Power System Division, Information & Control Systems Division, Hitachi, Ltd.); Mitsuya Kato (Senior Engineer, Power Systems Division, Hitachi Information & Control Systems, Inc.); and Akira Hibi (Senior Engineer, Electrical Machinery & Digital Control Systems Group, Hitachi Engineering Co., Ltd.).

21st Century "Life Science" Business that Contributes to a Healthy and Prosperous Future

The 21st century is being called the century of "Life science." In this century, research on the genome, which is the design map for life, is expected to produce abundant results in the fields of medical treatment, food products, etc. for the future of mankind. In October 1999, Hitachi established the Life Science Group, which specializes in services related to research on the genome. This adds the "measurement technology" and "information technology" that we have accumulated as a general electronics manufacturer to the "gene and protein functional analysis technology" which has been the focus of R&D in the laboratory. By doing so, we have begun the development of a new information service business that fuses the approach to "wet biology," which involves the analysis of the structure of genes, proteins, etc., with the approach to "dry biology," which involves the development of analytical instruments and data processing technology. A service that integrates both "wet" and "dry" approaches is unprecedented in Japan. For Hitachi, which possesses technology and expertise in a wide range of business areas, this is a new challenge.



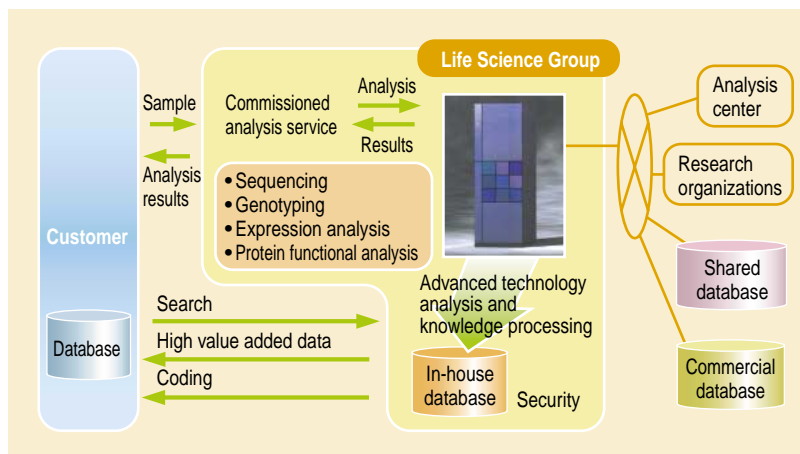
Solution service menu

Development of service business by expert groups

The service menu of the Life Science Group comprises four analysis services: (1) Proteomics, (2) Gene Expression Profiling, (3) SNP Discovery and Genotyping and (4) DNA Sequencing. It also features a bioinformatics support service that 1) performs large-scale, high-speed processing of the huge amounts of data produced by those four analysis services so as to add further value to the information, and 2) provides support for the system integration and laboratory information management system.

In the execution of these services, the expertise of advanced specialists is needed. Therefore, sales teams consisting of some specialists who hold advanced degrees are being formed. Those specialists can make sales calls personally as a "sales scientist." That makes it possible to cope with a diversity of needs by providing consultation services rather than a simple provision of data, and thus take on the role of a "solution partner" by working with the research departments of the enterprise or government organization that is the customer.

Furthermore, Hitachi is aggressively forming alliances with the most advanced companies in other countries. Examples include obtaining a protein interaction database and exclusive rights in Japan to the protein network search technology from the Myriad Genetics corporation of the US, and acquiring exclusive rights to distribute the 3-D protein structure



Services related to the genome and proteome

analysis tool, etc. from the MolSoft Corporation.

The Life Science business, which can be counted as part of the national Millennium Project, expects the market scale (in Japan) to expand to 2.5 trillion/JPY by 2010. Hitachi will contribute in leading-edge research fields by actively taking part in the planning of national projects and serving as a solution partner to various companies. It will also take up the challenge of expanding services in the various countries and regions of Asia and Oceania and creating new business based on intellectual property rights developed in-house.

The Proton Beam Therapy System — an accelerator for medical treatment that attacks cancer cells selectively —

The particle accelerator was originally developed as a tool for use in elementary particle research, such as searching for unknown elementary particles and learning about particle structure. A shift to the use of proton beams generated by such systems for practical medical treatment is underway. Proton Medical Research Center of the University of Tsukuba has acquired a "Proton Beam Therapy System," which has been developed on the basis of years of research results by Hitachi, Ltd. The Center began clinical trials in September 2001.

Results of accelerator development efforts

Since the 1950s, Hitachi has been accumulating experience in the development of various types of main accelerator systems, such as TRISTAN, the world's largest accelerator owned by the High Energy Research Organization. In the field of accelerator systems for medical therapy, Hitachi completed construction of the core device for the Heavy Ion Medical Accelerator in Chiba (HIMAC) of the National Institute of Radiological Sciences in 1994. These experiences have led to the development of the Proton Beam Therapy System at the Proton Medical Research Center of the University of Tsukuba. Hitachi also completed a multipurpose synchrotron tandem accelerator in Fukui Prefecture in March 2000, which we believe demonstrates the high level of Hitachi technology for both multipurpose and therapeutic types of accelerators.

Cancer therapy by proton beam

The proton beam treatment of cancer involves irradiating the affected part with hydrogen nuclei that have been accelerated up to approximately 60% of the speed of light (i.e., with a proton beam). Although conventional radiation therapy is done primarily with the use of x-rays, x-ray radiation is most strongly absorbed at locations near the surface of the body, and the energy of the radiation decreases as it penetrates deeper into the body. That characteristic creates the problem that normal tissues receive a higher dosage of radiation than will tumors located deep in the body. In contrast to that, proton beams can be focused at a certain depth within the body so as to release the greatest amount of energy just before stopping, and the depth can be controlled as well. That is to say, tumors that are deep within the body can be attacked selectively.

System configuration

The therapy system consists of a diagnostic system, a therapy planning system, and an irradiation system. In the diagnostic unit, x-ray CT (computed tomography) and MRI (magnetic resonance imaging) are used to determine the shape of the tumor and its depth within the body. In the therapy planning unit, on the basis of the data obtained by the diagnostic unit, the most effective dosage and direction of irradiation are determined. The irradiation system comprises an accelerator that generates and accelerates the high-energy protons that are needed to reach deep into the body, a beam delivery system that controls the direction and shape of the beam, an irradiation device, and other such components.

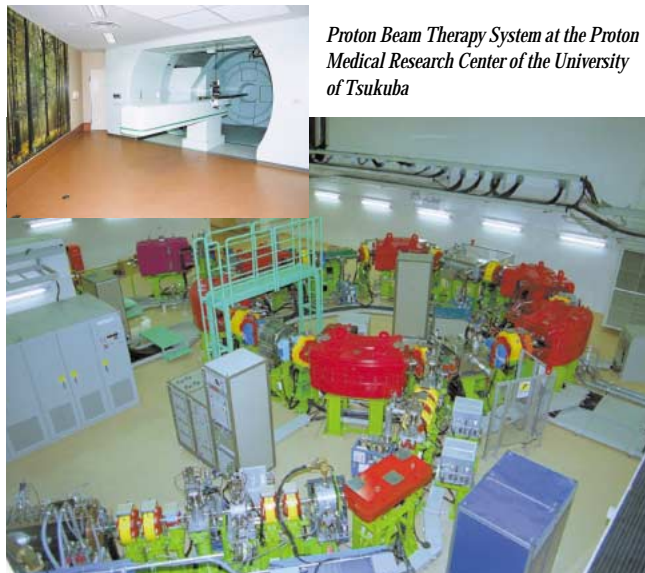


Kazuo Hiramoto (center), Ph.D. Eng. and Chief Researcher of the Radiation Therapy Project of the Therapeutic Accelerator Group of the Power & Industrial Systems R&D Laboratory, Wataru Sagawa (right), Director of the Radiation Business Promotion Center of the New Business Development Department of the Nuclear Systems Division, and Katsuyuki Kumasaka (left), Group Leader of the Proton Beam Therapy System Group of the same department.

What is difficult in proton beam therapy is determining and setting the position for the irradiation. We developed technology for coping with movement of the internal organs due to the patient's respiration by turning the beam on and off in synchronization with the respiration, as well as technology for momentary control of the beam at times such as when the patient is coughing.

Future development

The proton beam attacks the tumor selectively, so the negative effect on the patient is slight; this treatment therefore promises to return the patient to a normal life quickly. We wish to strive for widespread use of this kind of therapy so that many people can receive it.



Proton Beam Therapy System at the Proton Medical Research Center of the University of Tsukuba

Usability Design: Creating Value Through Ease of Use

In the midst of developing products that have more functions and more advanced functions through advances in IT (Information Technology) and digital technology, the subject of attention is now “usability design,” or design that reflects the user needs of “ease of use” or “ease of understanding.” In June 1999, “ISO13407” was established as an international standard for defining this campaign for usability. Following the incorporation into the JIS (Japanese Industrial Standards) in 2000, Hitachi has taken up the challenge of making products by means of a human-centred design process.

What is usability?

In brief, ease of use is, from the user’s viewpoint, ease of understanding. The technological revolution is moving forward and now products that have diverse and advanced functions are available to anyone. In reality, however, users are often not able to enjoy the value of those functions because they do not understand how to use them. Even if a product has advanced functions, if those functions cannot be used or if mistakes in operation occur frequently, the product cannot be said to be satisfying to the user. Usability design is about scientifically and objectively evaluating and analyzing the context of use and the degree of user satisfaction with respect to the product, and reflecting those results in product development to make products easy to use in order to give a high degree of satisfaction to the user.

Specific methods

Beginning at the product planning stage, specific methods are: investigate and understand the context of use, determine the functions that are truly needed by the user and set the specifications for those functions, conduct design activities that emphasize ease of use, evaluate the finished product for ease of use and ease of understanding, and obtain feedback for improvement of the design. For example, to improve the usability of a Web site, a Web site prototype can be made available for operation by users. The user’s actual use of the Web site can be observed to extract the problems of use and its reasons, and real cause of problems is identified by the usability designer. This evaluation is done repeatedly during the development process stage and seen by the members related to development such as designers and engineers. By analyzing the results, we try to find better design solutions that suite to users. In an example of the search page for a certain Web site, the operation time required to do a search was reduced from an average of 165 seconds to 7 seconds as the result of our proposed improvements.

Usability design activities and their effects

By improving the ease of use for a product, the user’s level of satisfaction can be raised and the product’s image can be improved. An improvement in the accuracy of development can also be expected. If evaluation of usability is done repeatedly from an early stage in the development process, cost increases due to process revisions and response to complaints can be prevented. Furthermore, these investigations and evaluations can be utilized to collect effective marketing data that can be applied in the next round of product development.



The usability laboratory “FACE,” which allows observation of the users activity through the one-way mirror.

Future issues

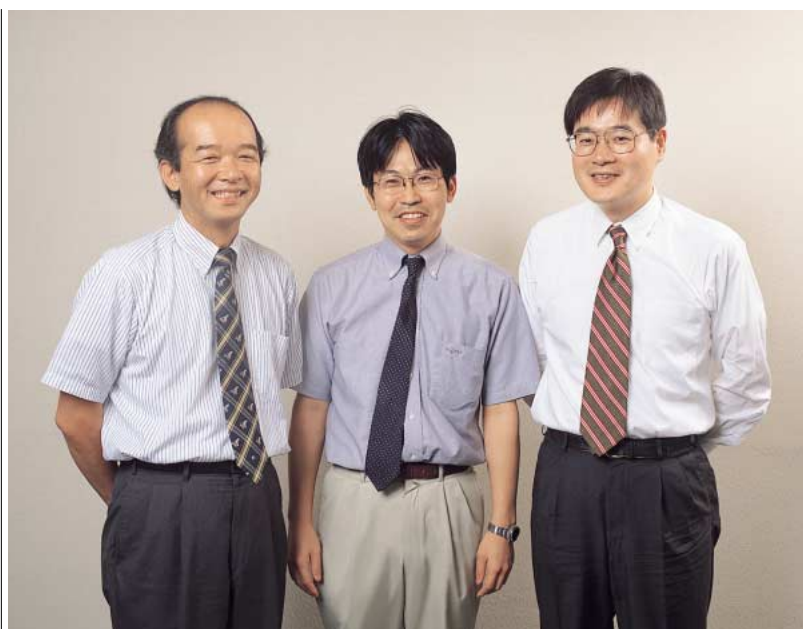
With the objective of establishing a development process that conforms to the “human-centred design process” advocated by international standard ISO13407, we would like to continue analyzing user behavior and comments from the multifaceted viewpoints of interdisciplinary team members. In September 2000, we set up “usability laboratories” called “FACE” for observation of user behavior at the Aoyama and Kokubunji offices in Tokyo. In future, we want to publicize our activities widely and continue to strengthen usability design activities in cooperation with design departments and product planning departments, etc., with the objective of improving ease of use.



Kaori Kashimura (right), Senior Designer in the Usability Design Group of the Design Division and Takafumi Kawasaki (left), Designer.

World's First Prototype of a 40-Gbit/s Optical Transmitter and Receiver Using Fully Monolithic IC

The rapid growth of the Internet has been accompanied by a demand for increased network capacity. Hitachi, Ltd. has succeeded in making the world's first 40-Gbit/s optical transmitter and receiver in which all of the devices' main functions are integrated on a monolithic IC chip. This is a big step towards realizing a practical next-generation optical transmission system, as the transmission capacity of the individual compact, low-power transmitters and receivers can be increased.



Katsuyoshi Washio (left), Senior Researcher in the ULSI Research Department, Central Research Laboratory, Masataka Shirai (middle), Researcher, and Ryoji Takeyari (right), Senior Researcher, both in the Optoelectronics Research Department, Central Research Laboratory.

Development background

The mainstream technology for increasing optical transmission capacity is wavelength division multiplexing (WDM), where multiple optical signals of different wavelengths are propagated through a single optical fiber. The new technology, on the other hand, increases the transmission speed of the wavelength itself. As faster devices are indispensable in achieving an increase in wavelength speed, research started in 1992 with the development of the device itself. The devices used in the prototype can be broadly grouped into either optical devices or electronic devices. The optical modulator was developed first. This was followed by the development of two electronic devices: an InP HBT

(indium phosphide heterojunction bipolar transistor), and a SiGe (silicon germanium) HBT. The prototype transmitter and prototype receiver were completed by integrating these three technologies.

Advantages of the optical transmitter and receiver

The new transmitter and receiver can send and receive data at the extremely high rate of 40 Gbit/s, a four-fold increase over the current 10-Gbit/s transmitter/receivers. In terms of data amount, this is approximately 8 CDs per second. Other research organizations are working on transmitters and receivers that operate at the same speed; however, what makes this technology essentially different is that all the main components are integrated on monolithic ICs. By doing so, it is possible to achieve the compactness and energy efficiency essential for practical implementation. Currently, a realistic power consumption level of only 14.4 W has been achieved. In terms of size, the transmitter and

receiver is about the size of an A4 sheet of paper (29.7 cm × 21 cm, 11.7 × 8.3 inches). The target, however, is about one-eighth this size; that is, both device should be able to be contained within an area the size of an A6 sheet of paper (14.8 cm × 10.5 cm, 5.8 × 4.1 inches).

Benefits

We would like to reach production-level within a few years. By then, optical fiber networks will be widespread, and the use of high-speed transceivers that are currently being used in trunk networks will likely spread to include local networks as well. This will result in an increase in communication speed by a factor of ten or so and will change the form of applications themselves. For example, e-engineering, in which any number of engineers in various parts of the world work collaboratively on detailed product design by sharing a 3-D simulation image of the product over the network, may become possible. Although research and development on ultra-fast transceivers is not a high-visibility field, we take pride in this being an extremely important technology that has the potential to change industry and society as well as how we spend our leisure time.



Optical receiver (left) and optical transmitter (right)

Next-generation ETC “Free Flow System” for Identification of Moving Cars

The Free Flow System is gathering attention as the core system for next-generation Electronic Toll Collection (ETC). This system makes use of both image-processing equipment and equipment for detecting the position of on-board equipment for ETC (OBE) to collect information on automobiles in a fixed area and identify ETC and non-ETC vehicles. The spread of the Free Flow System is expected to make tollgates unnecessary and to significantly decrease traffic jams.

Features of the free flow system

The present ETC system collects a toll by identifying an OBE by radio communications when a vehicle passes through a tollgate. If, however, tollgates themselves could be eliminated, vehicles would not have to slow down and their passage through the toll plaza would be much smoother. In addition, toll plazas themselves could be constructed at much lower cost. The system for realizing such a toll-plaza format is called a “Free Flow System.” In implementing a Free Flow System, however, while no problems would occur if all moving vehicles had ETC on-vehicle devices, surely non-ETC vehicles will be involved as well. This system addresses the issue of how best to identify ETC and non-ETC vehicles. While the most accurate method might be to record and check the license-plate numbers of all moving vehicles, this would be extremely time consuming and costly not to mention controversial in terms of privacy issues. In light of the above, it can be seen that required time and cost can be greatly decreased if only non-ETC vehicles were to be identified.

System features

The system includes Roadside Unit (RSU) to make radio contact with OBEs. RSU can communicate with more than one moving OBE at a time. Furthermore, to instantly identify fast-moving vehicles, the system also includes image-processing equipment and equipment for detecting the position of ETC on-vehicle devices. The image-processing equipment processes 30 images per second and tracks vehicles using the “template-matching method.” The position-detection equipment, on the other hand, detects the direction of arriving radio waves and tracks ETC on-vehicle devices. The system compares these two types of information to determine where ETC vehicles are. Here, as image-processing information and position information do not necessarily match at all times, the system measures the “matching rate,” that is, the ratio of the two types of information that matches up during transmissions. The system combines this process with one that estimates the position of OBEs, and highly accurate identification becomes possible. Image-processing technology has become a major field of Hitachi, Ltd., and this system makes use of this advanced technology. Combining this image-processing technology and position-detection technology makes the Free Flow System

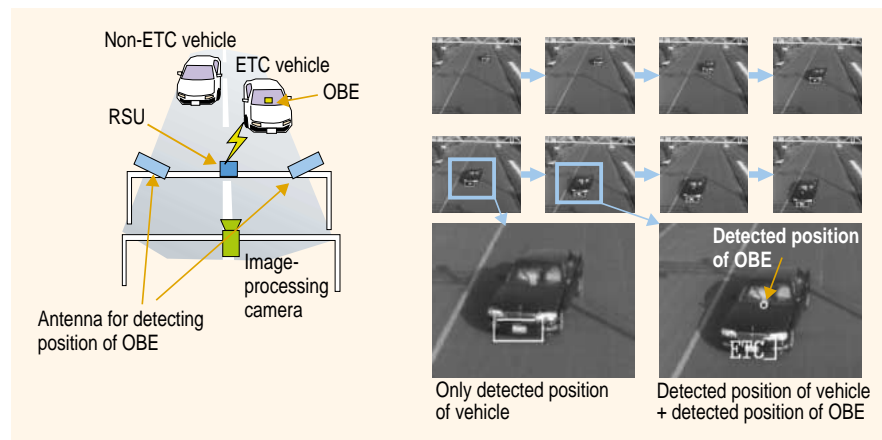


Kazunori Takahashi (left), Senior Researcher, and Yoshihito Sato (right), Researcher, of the Hitachi Research Laboratory.

possible.

Future outlook

The Ministry of Land, Infrastructure and Transport in Japan is currently promoting the Smart Interchange concept with the aim of achieving low-cost interchanges. At the same time, the city of Tokyo is attempting to introduce a “Road Pricing System” to manage automobiles coming into the metropolitan area. The use of OBE is expected to increase in the coming years and the demand for a Free Flow System should become even stronger. We intend to continue in our efforts to make this system even more accurate.



Outline of free flow system