HDD Revolution Bringing New Value to World of Visual Media

Growing Application of HDD to Digital Home Appliances

The launch of digital terrestrial broadcasting in Japan is expected to promote full-scale digitization of television broadcasting, conversion to high-quality pictures, and diversification of content. At the same time, the application of high-capacity and high-performance HDDs (hard disk drives) to home appliances is expanding especially for recording, and the use of HDD/DVD (digital versatile disk) hybrid recorders has begun to spread rapidly. Hitachi, Ltd. is devoting great effort to developing and supplying video-information appliances centered about HDDs manufactured by Hitachi Global Storage Technologies, Inc. Hitachi proposes an enjoyable digital home-appliance lifestyle made possible by the convenience of HDD recording and a user-friendly interface together with high-picture quality and long-time recording.

Upper left to right: General Manager Masanori Yoshino of Marketing and Products Planning Dept., Visual Display Operation, Digital Media Div., Ubiquitous Platform Systems; Senior Engineer Hiroto Yamauchi of Storage Media Marketing and Product Planning Dept., Storage Media System Operation, Digital Media Div., Ubiquitous Platform Systems;
Lower left to right: Department Manager Atsushi Ugajin of Media Storage Development Dept., Ubiquitous Information Appliance Development Operation, Internet Systems Platform Div., Ubiquitous Platform Systems; and Director Tsutomu Numata of Development, Desktop Business Unit, Hitachi Global Storage Technologies Japan, Ltd.

From Personal Computers to Home Recorders

Up to recently, HDDs have been mostly used for storing large volumes of data in personal computers and other devices, and they have become faster with greater data capacity as the use of personal computers grew. In recent years, however, HDDs have begun to be applied to recorders for home use. Using an HDD as a recording device enables users to enjoy a variety of functions not possible with VTRs (video tape recorders). These include digital recording of high-quality pictures, long-time recording, direct access to the beginning of recorded programs, and chasing playback (watch a program from the start while the same program is being recorded). Hybrid-type recorders that combine an HDD and a DVD drive are also becoming popular rapidly.

The capacities that HDDs have obtained, while being more than enough for personal computers, are still insufficient for long-time recording of high-quality pictures. When applying HDDs to digital home appliances, they must also accommodate data-retrieval methods different from those of personal computers and be durable enough to withstand more severe usage conditions as occur in mobile and on-vehicle applications.

In April 2003, Hitachi, Ltd. and IBM Corporation in the United States founded Hitachi Global Storage Technologies, Inc. to integrate the HDD businesses of the two companies. As a dedicated manufacturer of HDDs, Hitachi Global Storage Technologies aims to develop an extensive lineup of HDDs for digital home appliances while providing diversified HDD products for personal computers, enterprise servers, and storage devices as well as microdrives for mobile equipment. The high performance of the company's current HDD products have already been highly evaluated by the market, and Hitachi is moving forward with the development of digital appliances using those products as key components.

Creating New Value with HDD-equipped Products

One of these products is the MSP1000 hybrid recorder incorporating a 120-Gbyte HDD and a DVD multidrive. Placed on the market in September 2003, the MSP1000 has a built-in streaming function for home use, a first for an HDD/DVD hybrid recorder based on the concept of "network and AV (audio-visual) convergence." This function allows, for example, a video program recorded in the living room to be viewed with a personal computer in a bedroom over a LAN connection.

In later models, there are plans to enable scheduling, program searching, and remote operation from a personal computer and to provide a function whereby several connected computers can watch different programs simultaneously. For the future, linking functions can also be envisioned to enable, for example, playback of a program recorded at home on a mobile device at an outside location. Development of these functions is in progress. In conjunction with these functions, the construction of an information platform

2.5-inch HDD (left) and 3.5-inch HDD (right)

New flat panel TV

MSP1000 HDD/DVD hybrid recorder

AVC-HR5000 digital tuner with built-in HDD recorder

is also anticipated, but a hybrid recorder is seen by Hitachi as a first step toward a world where "you can watch what you want anytime and anywhere."

Another example of an HDD-equipped product can be found in Hitachi's new series of flat panel TVs in Japan. In this series, the monitor section and AVC (audio-visual control) station in the tuner section are separated and various combinations of monitors and AVC stations can be combined as desired. As a world's first for flat panel TVs, an AVC station with a built-in HDD has recently been added to the new lineup enabling the recording of high-definition broadcasts. At a capacity of 160 Gbyte, this HDD can be used to record about 14 hours of high-definition broadcasts with the chasing-playback function possible. A sports program, for example, becomes all the more enjoyable by dividing the flat panel display into two screens and watching the live broadcast on one screen and replays of key scenes on the other.

Recording and playing back high-definition broadcasts requires the processing of high-bit-rate digital signals, and achieving the chasing-playback function in particular requires advanced signal processing technology in addition to sufficient HDD capacity. In the HDD-equipped TV introduced above, Hitachi has created new value in the form of high picture quality and convenience provided by an HDD recorder.

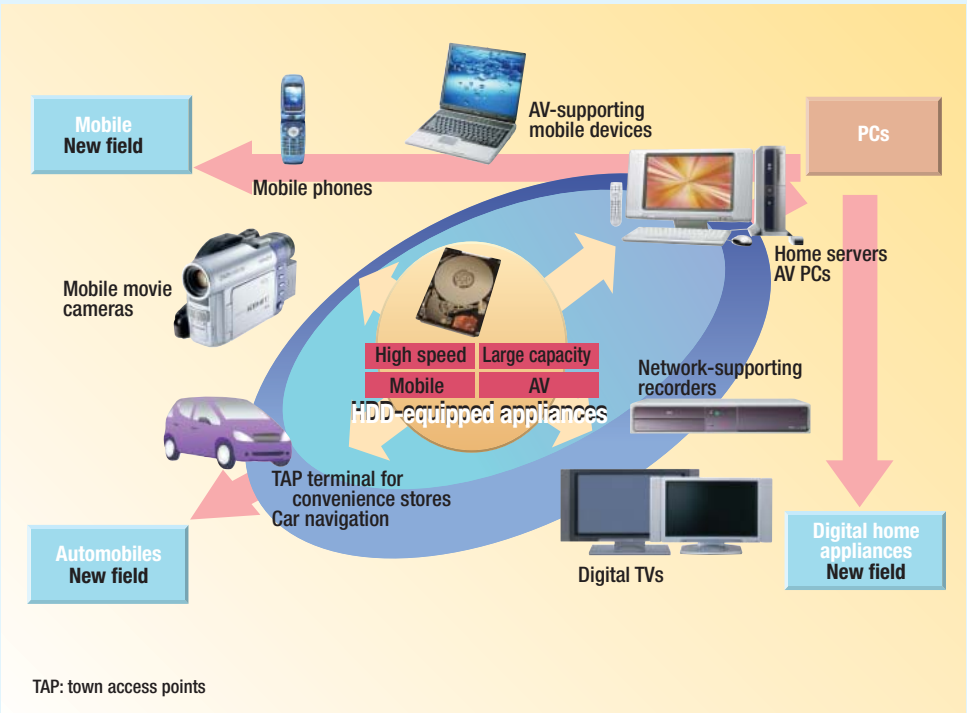
Change in Lifestyle with HDD Recorders

As TVs convert to genuine high-definition models and content becomes more diversified with the dawn of digital terrestrial broadcasting, the trend toward large-capacity HDDs should accelerate. At the same time, the increasing number of programs that can be recorded will make it important to provide a thorough search system and an easy-to-operate user interface. With ease-of-use and convenience in mind, Hitachi will devote its efforts to developing stress-free products that can be used even by people who normally have a hard time dealing with digital devices.

For example, an HDD recorder put on sale in August 2003 was provided with a function called "*mirukamo* (may view)" scheduling. This function enables the user to automatically and continuously record all programs for a designated day, time, and channel, i.e. "programs that one might view." The user is consequently relieved of the bother of individual scheduling and of the fear of forgetting to schedule. A special feature of this function is that the television program schedule can be displayed on an operation screen for review and for designating recording, playback, and storing of programs in a visual manner.

In future developments, it will be possible to record multiple programs simultaneously and it will no longer be necessary to worry about broadcast time and channel. Furthermore, with the coming of video delivery via broadband connections, it will be possible to watch programs at any time. It would not be an exaggeration to say that releasing users from traditional time constraints when viewing television will revolutionize TV viewing and alter viewer lifestyle.

To enable as many people as possible to enjoy this new convenient and enjoyable world of video entertainment made possible by the HDD, Hitachi will endeavor to propose a wide variety of products to meet diversified needs, from those introduced here and those under development to mobile playback devices equipped with microdrives.



New HDD application fields including information appliances and on-vehicle information systems

Highlights 2004–2005

"Light City Tokyo": Proposal for City Design One Hundred Years into Future as One Solution for Urban Revitalization

Winner of Special Jury Award in the International Competition on Sustainable Urban Systems Design

Against the background of an aging society in developed countries, increasing population in developing countries, and change in the world-wide industrial structure, urban renewal has become a major international issue. With this in mind, an international competition on "sustainable urban systems design" was held at the 22nd World Gas Conference held in Tokyo in 2003. At this competition, a project team composed of Professor Motomu Uno of Chiba University, Keizo Ikemura of Phase Associates, and several members of the Hitachi, Ltd. Design Division received a Special Jury Award for their proposal titled "Light City Tokyo." This proposal presents a clear vision of urban revitalization and methods of using highly promising elemental technologies all from various perspectives.

Architect/Professor Motomu Uno at Chiba University (left) and Design Producer Jun Furuya at Information Solution Department, Design Div., Hitachi, Ltd.

International Praise for Results of 3 Years of Research

The 22nd World Gas Conference was held in June 2003 in Tokyo, Japan. This conference, which is one of the three largest energy-related conferences in the world, is held every three years. At this latest meeting, an international competition on "sustainable urban systems design" was held as a special program, and the proposal presented by the "tyo_e.2003.PRJ" project team composed of Professor Motomu Uno of Chiba University, Keizo Ikemura of Phase Associates, and several members of the Hitachi, Ltd. Design Division received the Special Jury Award for "Introducing High Density into the City Center by the Mixed-use."

The theme of this competition was "Sustainable Urban Systems Design into the 22nd Century—Conception of a Sustainable Future City and Process toward that Ideal." Targeting an existing city with a population of over 100,000 people, proposals were asked to present a vision of a city capable of sustainable growth over the next 100 years and the specific process for achieving that vision while taking efficient use of energy and reduction of environmental load into account. From Japan, the above project team and one other participated in this competition after passing the first and second rounds in domestic qualifications attended by some 30 teams in May 2000.

Our team came about on the recommendation of Professor Uno who has been collaborating with Hitachi for some time on elevator development and other projects. Considering that the experiences gained would certainly be useful and that the Design Division could provide ample backup to the endeavor, team activities got under way in the form of an autonomous study group. Meeting about once a month, our discussions often lasted from the evening into the middle of the night. We also went on field trips on holidays and interviewed environmental and energy specialists within the company and researchers from Hitachi's Advanced Research Laboratory and Central Research Laboratory.

The final proposal was well received from among those of eight countries and nine teams indicating that our research activities over the three-year period beginning with domestic qualifications bore fruitful results.

Technologies and Life-cycle Design for Achieving Sustainable City

The award-winning "Light City Tokyo" proposal presents a scenario of sustainable growth and development 100 years into the future for Tokyo's Chuo City, which has thrived as a popular area for living and working for about 400 years since Japan's Edo era.

In brief, this scenario calls for the development of a "Light City" capable of changing with the times while coexisting with nature by combining lightweight and flexible structures with advanced infrastructures and by controlling material consumption through IT (information technologies). It also calls for a "Light Life" lifestyle in which people who live in a high-density area that combines commercial and residential districts place importance on non-materialistic values such as information and culture.

Various technologies can be considered to support this scenario. First, there are network technologies and distributed-control technologies for optimizing energy consumption throughout an area. These include efficient distribution networks that combine various means of energy transport and ECHONET (Energy Conservation and Homecare Network). Dispersed power supplies using fuel cells for home use and on-demand clean water through small-scale water-purification plants and dispersed water-purification systems are also key technologies. Distributing conventional infrastructures while constructing networks and controlling them by IT will


This is to certify that
tyo_e.2003.PRJ Team of Japan
under team leader
Motomu Uno
has been awarded the
Special Jury Award
(Introducing High Density into the City Center by the Mixed-use)
of the
Sustainable Urban Systems Design
International Competition
on this Fourth Day of June, 2003

Special Jury Award for "Introducing High Density into the City Center by the Mixed-use" in Sustainable Urban Systems Design International Competition

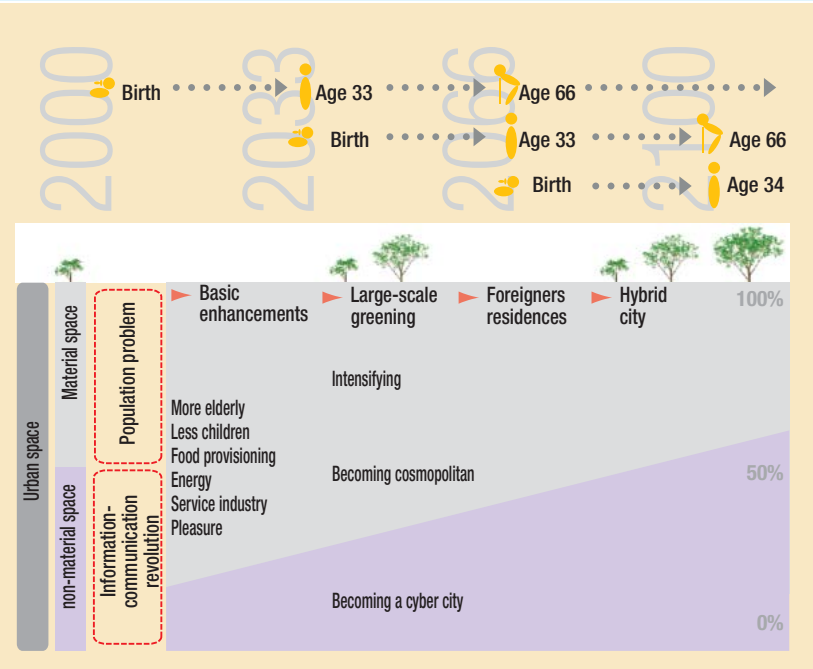
Image of "Light City Tokyo" (aerial photo provided by Chuo City, Tokyo)
Starting at Hama Detached Palace, a wide green belt will be constructed over a period of 100 years along the Sumida River as a place to live for a variety of living things. An abundance of green zones will also be cultivated by city residents to create a "Garden City" like the green-filled streets of old Edo.

Front left to right: Motomu Uno; Chief Designer Shigeki Masatsugu of Design Div., Hitachi, Ltd.; Architect Keizo Ikemura of Phase Associates;
Back left to right: Jun Furuya; Chief Designer Kenta Kumagai of Design Div., Hitachi, Ltd.; Designer Yujin Tsukada of Information Solution Dept., Design Div., Hitachi, Ltd.

help decrease environmental load while maintaining convenient services in everyday life. And to move people from one place to another, the subway network can be supplemented by shared bicycles rented by smart cards to further reduce energy consumption.
Lifestyle design is also important in achieving a sustainable city. While functionality and convenience are essential conditions for a sustainable city, a shift must also be made to a lifestyle that places importance on an attractive city for people that live, work, and visit there and on spiritual and cultural values. For example, incorporating the natural world by forming a green belt along the Sumida River starting from *Hamarikyu* (Hama Detached Palace) and forming green zones on the walls and roofs of buildings is one important element in achieving an attractive lifestyle.
These changes are expected to be completed in three stages each about 30 years in length with the results of one generation to be passed on to the next—a scenario for growth on a human scale.

Importance of Vision that Puts Elemental Technologies to Practical Use

This proposal is thought to have been well received for two reasons. First, it presents a clear solution for achieving sustainable development while targeting Tokyo, a high-density city poor in natural scenery. Second, it employs elemental technologies each having a high potential for practical use.
An important issue surrounding the future of large cities in Asia is how to achieve a balance among population increase, urban concentration, economic growth, and environmental problems. A major achievement of this proposal is that it presents a clear vision for achieving this balance.
Like many other countries, Japan is an aging society with a changing industrial structure. A variety of urban problems are consequently arising including migration to large cities, the hollowing of central districts in regional cities, decrease in population, and decline of suburban residential towns and industrial cities. In the face of these problems, urban revitalization is becoming a matter of urgency, and large-scale "scrap and build" can no longer provide all the answers. No doubt a plan is needed for revitalizing a city and making it more enjoyable while utilizing existing ways of living from the perspective of the people that live there (as opposed to that of the supply side).
In April 2003, Hitachi established the Urban Planning and Development Systems Group to promote urban-development business capitalizing on various technologies within the Hitachi Group. The scenario of "creating a city capable of sustainable growth from the perspective of people that live there" as presented in this proposal can be thought of as the foundation for urban development at Hitachi, Ltd.
To revitalize a city, both elemental technologies and a total vision that extracts the potential of those technologies are indispensable. If the technical know-how of the Hitachi Group can be appropriately applied to the vision set forth here by Professor Uno and the project team, the "Light City Tokyo" proposal should contribute to the revitalization, stimulation, and sustainable growth of various cities. Our hope is that the results of our activities can provide a bridge between the needs of society and technologies that can satisfy those needs and lead to the next step in urban revitalization.

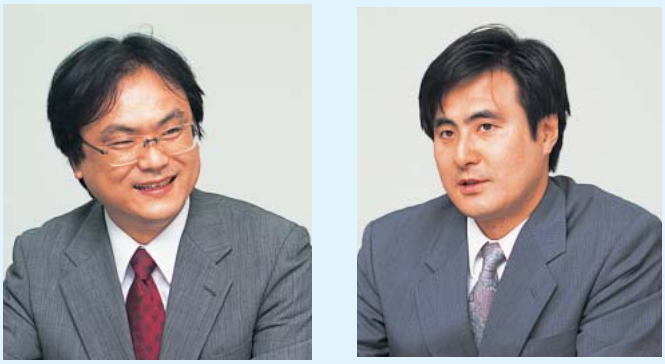


100-year scenario for living

Expanding Possibilities from World's Smallest RFID IC Chip

Using "μ-chip" in Admission Tickets for Expo 2005 Aichi Japan

RFID (radio-frequency identification) is a highly promising technology for tracing foodstuffs and products and solving security-related problems, issues of increasing importance. Hitachi, Ltd. has developed an IC chip called the "μ-chip" for RFID purposes that can store a maximum of 38 numerical digits although only 0.4-mm square in size. With the establishment of an in-house venture company in 2001 for commercializing this chip and the Mu-Solutions Division within the Information & Telecommunication Systems in January 2004, the expansion of business solutions using this chip is progressing. The μ-chip will be used in admission tickets for the 2005 World Exposition to be held in Aichi, Japan in 2005 (Expo 2005 Aichi Japan), and is expected to be applied to a wide range of fields in the years to come.



Senior Manager Hidehiko Kando (left) of Development and Engineering Operation, Mu-Solutions Division and Chief Engineering Manager Minoru Ashizawa (right) of Development and Engineering Operation, Mu-Solutions Division

Business Promotion through In-house Venture Company

The development of the μ-chip (mu-chip) originated in the idea that a smart card could be used as an anti-counterfeiting measure in paper money if it could be made small enough for that purpose. This idea was born seven years ago by a group of researchers assembled from three different research laboratories, and development got under way by one of these researchers, namely, Mitsuo Usami, then a senior researcher at Central Research Laboratory. Research and development of the μ-chip then accelerated as additional researchers from throughout the company joined up to form a research group, and development of the μ-chip was completed in June 2001.

The μ-chip is the world's smallest RFID IC chip. At only 0.4-mm square, it is an extremely fine device that can be embedded in paper. Despite its size, the μ-chip incorporates a communications circuit, a memory that can store up to 38 numerical digits, and other elements.

With 38 digits, an incredible number of ID (identification) numbers can be set, which means that they could not be used up over the next several billion years even if each number was never reused. In addition, the ID number is stored in ROM (read-only memory) at the time of chip manufacture making counterfeiting by overwriting impossible.

Attaching an external antenna of about 5 cm in length enables data to be read from the μ-chip within a range of about 30 cm. The chip converts some of the energy of the wireless signal received from a reader into electricity at the antenna, and uses that power to transmit the ID number in the chip back to the reader.

Regardless of how amazing this function may be, business cannot be established on the basis of a chip only. True value is obtained by establishing a network system that can manage readers and ID numbers and by creating solutions through ideas on how best to apply this function.

Recognizing that this new "horizontal" business format cannot be incorporated within the framework of existing business departments, Hitachi established an in-house venture company called "Mu-Solutions Venture Company" in July 2001. This company came to be staffed with people from various fields within the Hitachi Group in addition to researchers and engineers from our research laboratories. Then, in January 2004, Hitachi set up the Mu-Solutions Division within the Information & Telecommunication Systems as an outgrowth of the venture company with the aim of accelerating the solutions business.

Application Stage Finally Arrives

For the two-and-a-half year period following the founding of the venture company, about 7,000 inquiries were received regarding the μ-chip. The demand for traceability is growing as new problems such as the intentional mislabeling of foodstuffs have arisen in

CompactFlash card-type μ-chip reader (left) and a variety of inlets*

* See "Trademarks" on page 90.

addition to well-known problems such as the counterfeiting of name-brand products. There is no doubt that technology for managing the allocation of ID numbers on servers and for enabling the use of those numbers as needed is eagerly awaited for satisfying the needs of the times.

While there are some customers who disagree with the read-only nature of the μ-chip, we ourselves feel that a write function is not necessary. In this way, critical information whose leakage or loss would present problems may be stored on a server as opposed to the chip attached to a product. The read-only function also facilitates a small-size and low-cost design making for an even more secure configuration.

Solutions that make use of the μ-chip have finally reached the business stage in earnest. One excellent example is the use of μ-chips in admission tickets for Expo 2005 Aichi Japan. The plan is to produce and provide these admission tickets in a quantity exceeding the 15 million people expected to visit the exposition. Advance sale of the tickets has already begun.

Management of event admission is of course a field that the μ-chip excels in, but with this admission ticket, the μ-chip with an external antenna will be inserted within paper. This prompted us to carry out moisture-resistance and durability tests to ensure that anyone could place their ticket in a pocket or train-pass holder, for example. The μ-chip is the only IC chip at present that can be completely enclosed within ordinary paper.

Studies are now under way to provide a variety of services using ID numbers at Expo 2005 Aichi Japan in addition to admission management. These include an admission reservation system for entering pavilions to do away with long lines and a system for providing reports on crowd congestion, plus digital photo services, "stamp rallies" (collecting memorial ink stamps in a stamp book), and accumulation of eco points. All in all, the μ-chip will allow visitors to enjoy advanced services.

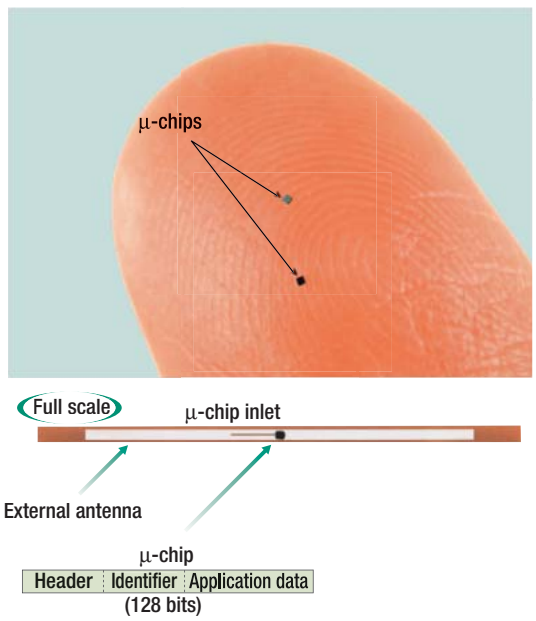
Toward New Solutions Businesses

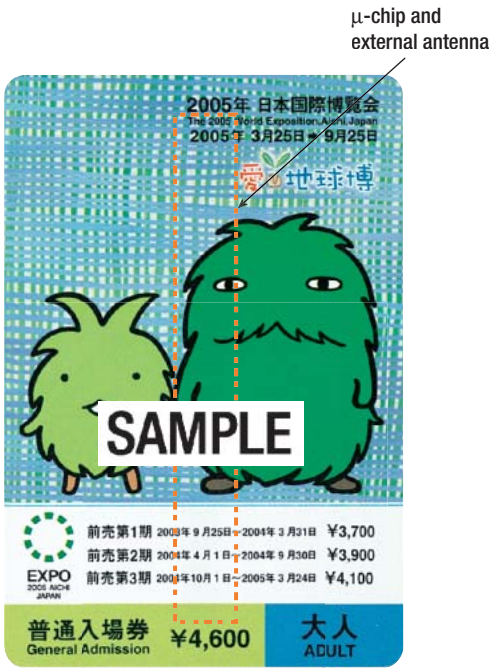
In this way, solutions using the μ-chip are expanding to various fields as new ideas come along. The prevention of counterfeiting, one reason for developing the μ-chip, is of course a case in point. In the manufacturing industry, for example, the μ-chip can be used to perform total management from the manufacturing of materials to the processing, shipping, and distribution of products. The μ-chip can improve quality control and work efficiency and contribute to the SCM (supply chain management) process. In fact, a system for tracing and managing steel materials and actual steel products using μ-chips is already under development. This system, named the KIDS (Kouzai Identification System), is a joint development project with Marubeni-Itochu Steel Inc. In a similar manner, we can expect use of the μ-chip to expand to many other fields from here on. The μ-chip should be able to withstand the harsh conditions of washing clothes and dry cleaning, for example, provided that it is packaged by some appropriate method, which means that it could conceivably be applied to the linen-rental and uniform-management businesses. Application to the agricultural industry by tracing producing districts, producers, and cultivation history and application to the recycling industry can also be envisioned.

As for cost, which is also an important issue, Hitachi announced at the end of 2003 that μ-chip prices had reached a practical level. Specifically, for large orders of at least a million units, the price per unit for an inexpensive type of inlet incorporating antenna material (μ-chip with external antenna) had reached the 10–19-yen level, while that for a small-package type that encloses only the chip in a small component case had likewise reached the 10–19-yen level.

The μ-chip business, which can also be called the "solutions business using IDs," has a form unlike any other business to date. As a consequence, the tasks that we faced from researching and developing μ-chip products and systems to commercializing them were often performed on the run. In the end, however, it appears that our efforts have borne fruit.

For the future, while continuing to develop technology for meeting the needs of an even wider range of customers, Hitachi will endeavor to provide optimal solutions in close cooperation with customers. It is our sincere hope that these efforts will contribute to a safer and more comfortable life and to the realization of an enjoyable ubiquitous information society.





μ-chip has been adopted for use in admission tickets to Expo 2005 Aichi Japan.

Showroom for Exhibiting Electronic-Government Systems for Creating Society with New Structure: "CyberGovernment Square"

Electronic-government systems—aimed at realizing a convenient and comfortable society—are being implemented in municipalities all across Japan. "CyberGovernment Square" is a showroom established to support such implementation of electronic government. It presents exhibits according to four concepts: "watch" cutting-edge electronic government in action, "talk" thoroughly to deeply understand it; "apply" the latest technologies to everyday affairs; and "create" a society based on new structures and mechanisms. These four concepts—"watch," "talk," "apply," and "create"—form the basis of Hitachi's solutions for electronic government.

Supervisor Naoko Izumi (right) and Technical staff Wakako Hagiwara (left) both of CGS Group, Customer Relationships Center, Government & Public Corporation Information Systems Sales Management Div.

What is CyberGovernment Square?

CyberGovernment Square is a showroom for presenting the efforts that Hitachi, Ltd. is making in the field of electronic government. As a facility for presenting trends and practical examples regarding Hitachi's Electronic Government Project—and as the first of its kind in Japan—it was established in the spring of the year 2000. In 1999, the Japanese government launched their so-called Millennium Project, the aim of which is to establish electronic government by exploiting information technology. In response to this government project, Hitachi started work on "solutions for electronic government" at the same time. However, at that time, there were a great many people asking the question, "What is electronic government?" Accordingly, aimed at first broadening the understanding of electronic government and providing a place for discussion, Hitachi established the "CyberGovernment Square" showroom. Already, over 15,000 visitors—including around 1,000 people from overseas on study tours and training courses—have visited the showroom. A large proportion of these visitors, particularly people wanting to see the state of electronic government in Japan and the technologies involved for themselves, is made up of people in Japan for on-the-job training at government ministries and agencies.

Features of CyberGovernment Square

The key feature of CyberGovernment Square is that it offers a more specific kind of exhibition; that is, it not only exhibits new products but also demonstrates their practical applications. Two examples being exhibited are as follows. In Okayama Prefecture in July 2003, an electronic application system that utilizes cooperation between local authorities was launched as the first of its kind in Japan, and Hitachi supported the development of this system. In addition, the launch of a public service for individual authentication in January 2004 made it possible for individuals to be authenticated via the Internet. This service allows passport applications and tax returns to be processed on-line. It is such specific examples of electronic government that officials from municipalities from all over Japan have been coming to see. And it is hoped that by actually touching and handling real products, people in charge of administrations will get a better understanding of the uses and advantages of electronic government. CyberGovernment Square provides all the information needed to further this understanding.

Future Developments

No longer being restricted to systems within administrations, as it has been up till now, electronic government is becoming widespread as whole communities become computerized. Under such circumstances, it is necessary to provide information in such a way so that it can be referred to by enterprises that offer services to the public (such as banks, utilities, railways, etc.) and are also linked with municipal administrations. Now that cooperation between government and citizens is actually underway—and since public institutions and private enterprises will closely cooperate in future—we at Hitachi are considering what themes to present in regards to new services for citizens. Though four years have passed since the showroom was opened, every year the systems on show are replaced and updated; visitors can thus see the latest systems even if they are on their second or third visits. Moreover, as many examples as possible of the latest applications and trends regarding electronic government around the world have been collected together for presentation. In this way, we are aiming to create an "evolving showroom."

Four concepts "watch," "talk," "apply," and "create" on the signboard at showroom

Hitachi Application Server Enhanced Support of J2EE for Mission Critical Systems

Hitachi introduces the new version of its application server, which has received high marks as a collaborative e-business platform supporting Web-application development and runtime environments such as Java*/XML, XBRL, and Web services. This version of Hitachi application server features significantly improved reliability for J2EE (Java development and runtime environment for enterprises) to achieve mission-critical information systems that must provide uninterruptible services. (Hitachi application server is called "Cosminexus" in Japan.)

Development Background

Java*-based application development is becoming the norm in the information-systems industry. With its highly productive development tools, Java excels at responding to quickly changing business models, and with an ever increasing number of engineers proficient in Java technology, many sites are coming to actively employ Java. Past systems developed with Java, however, have not been able to achieve the same reliability as mainframe- and server-based online systems. This is because scheduling, fault-response, and troubleshooting functions implemented in these online systems have not been standard in the conventional Web hierarchical system. In the new version of its application server, Hitachi incorporates online technology that it has cultivated over many years in developing and operating mission-critical systems. The result is the reliability, availability, and operability of world's highest level in a J2EE development and runtime environment.

From left to right, Senior Engineer Mitsuharu Nagayama of the Network Application Solution Dept., Network Software, Software Division, Product Manager Narizumi Shindo of the Integrated Network System Dept., Network Software, Software Division, and Section Manager Takashi Murakami of the Product Planning Dept., Enterprise Business Planning, Software Division

Introducing QoS Technology

The new application server introduces several QoS (quality of service) technologies into Web systems. These include "transaction flow control" for specifying the number of simultaneously executing threads, and "priority control" for establishing independent request queues according to job type and providing stable processing of priority jobs at high-load times. The new version of Hitachi's application server also provides "service suspension" in job units to enable certain applications to be serviced without having to shut down the entire system. It can perform "dynamic load balancing" to automatically transfer requests made from the Web front system to EJB (Enterprise JavaBeans) to servers having low loads. In addition to server load balancing, the new application server allows for fallback operation at the time of a fault making for significantly better availability.

Easing Troubleshooting

The new application server features abundant functions for decreasing the time and cost involved in troubleshooting and for reducing TCO (total cost of ownership). The "performance analysis trace," for example, makes it easy to isolate performance bottlenecks and sources of faults. The "JavaVM monitoring agent" makes troubleshooting more efficient by facilitating JavaVM memory tuning (a task that previously required much work) and by presenting the sources of faults visually through a GUI (graphical user interface). Integrating with Hitachi's JP1 (integrated enterprise system management) software has also been enhanced to provide uniform monitoring and automation of operations. With the new application server and its previous version, Hitachi is most proud of the fact that it supports JavaVM of all major platforms, i.e. Windows*, HP-UX*, AIX*, Linux*, and Solaris*. This greatly reduces the time required for user problem solving.

Finally, in addition to providing a development environment for EAI (enterprise application integration), B2B (business-to-business) applications, and other core enterprise systems, the new application server provides a new portal-based collaborative workplace integrating tools such as discussion forums, document sharing, and messaging, which enables effective information sharing across the organization to improve productivity of their business. Hitachi encourages you to give the new version of its application server a try.

* See "Trademarks" on page 90.

Expansion of IPv6 in China and Development of IPv6 Supporting Platform

As a vast country experiencing rapid economic growth with a population of more than 1.3 billion people, China is constructing an IP (Internet protocol) platform as a foundation for information-communications within the country. For China, however, a serious problem that could impede future network expansion is the insufficient number of addresses provided by IPv4 (IP Version 4), the current version of Internet protocol. The next-generation protocol known as IPv6 (IP Version 6) is expected to be a key technology for solving this problem as well as for enhancing communication functions and improving communication efficiency. Hitachi, Ltd. has been involved with IPv6 R&D for some time and has begun to expand its IPv6-related business into the China market.

Engineer Bo Wei (right) of the IP Solutions Center, Network Systems Solutions Div., and Senior Engineer Kenji Hayashi (left), products Marketing & Planning Dept., IP Network Systems Div.

Necessity of IPv6 in China

The insufficient number of IP addresses for identifying communicating entities by IP is becoming an urgent matter in a rapidly expanding Chinese telecommunications market, and is the main reason why IPv6 is needed in China. According to a statistical survey conducted by the China Internet Network Information Center (CNNIC), the number of Internet users in China reached 68 million by June 2003 as the fast pace of Internet growth continues. At the same time, more than half of the roughly 4 billion possible IPv4 addresses have already been used up with the result that measures are being implemented to restrict address allocation and economize on address use. It is therefore feared that increase in the number of users and terminals around the world has a high possibility of hindering expansion of the IP network. This concern has generated much attention on IPv6-related equipment that features superior address extendibility and other advanced functions. Furthermore, as the demand grows for high levels of communication quality, security, and mobility to provide audio, data, and video services in an "end-to-end" manner, IPv6 is expected to become a key technology for simplifying the management of communication quality and security.

Since commercializing the world's first IPv6 router with NAT function in 1997, Hitachi has developed and commercialized a range of IPv6 equipment in its gigabit router 2000/gigabit router 4000, gigabit switch 4000, and access gateway 8100 series of products and has accumulated considerable experience in their deployment. As a world leader in high-quality IPv6 equipment with extensive know-how, Hitachi is studying the introduction of its IPv6-related products in China in conjunction with the Chinese government and Chinese telecommunication carriers.

Hitachi's Activities in China

Hitachi has been involved in a variety of research activities with the aim of implementing a commercial IPv6 network in China. It participated in China's first IPv6 trial project launched in May 2002 in Hunan Province, and has been active since June of that year in the IPv6 Collaboration between Japan and China Project (IPv6-JC) promoted by the Japanese and Chinese governments and companies in both countries. In this project, Hitachi is involved with the China Education and Research Network (CERNET), an academic network in China, as a participating institution. In October 2002, Hitachi concluded a sales-consignment contract for IPv6 products in China with the Beijing Internet Institute (BII) Group, the leader in China's IPv6 industry.

Hitachi gigabit router 4000 model 160

Next, in January 2003, Hitachi's gigabit routers 2000-10H/20H passed a product certification test based on a draft version of an IPv6 national standard under China's Ministry of Information Industry. This marked the first Hitachi IPv6 product to be formally approved for sale in China and for connection to commercial networks. This certification was followed in October of the same year by one for the access gateway 8100 series marking Hitachi's first IPv6 broadband access servers to be approved in China. Hitachi's gigabit router 4000 series of IPv6 products also went on sale in November 2003. Through activities such as these, Hitachi hopes to contribute its IPv6 technology to the development of an IP platform that can support China's economic expansion.

New Gigabit Router 4000/Gigabit Switch 4000 Series of Products

Developed as an enhancement of the gigabit router 2000 series, the gigabit router 4000 series of products are high-end routers targeting carriers who wish to construct mission-critical IP backbones. The gigabit switch 4000 series of products are mission-critical high-end layer-3 switches for Ethernet* networks that can support a wide range of users from companies to carriers. Both series feature significant improvements—they inherit and expand upon the gigabit router 2000 IPv6 functions, and in terms of performance, they can deliver full 10G Ethernet. They also apply an extensive array of high-reliability technologies such as redundant power supplies built into the equipment and modules and functions for quick switching to backup paths and links in the network system. Furthermore, by incorporating original IP/Ethernet bandwidth-guarantee technology, L2-VPN (virtual private network)/VLAN (virtual local area network) (the gigabit switch 4000 only), and security technologies such as detailed, high-performance filtering, the gigabit router 4000/gigabit switch 4000 series of IPv6 products provide a high-reliability IP network platform for mission-critical needs.

Future Outlook

From here on, while working to obtain certification for its gigabit router 4000 series and other IPv6 products, Hitachi hopes to make a substantial contribution to the construction of next-generation networks in China by strengthening sales, maintenance, and after-sales service on the China mainland.

* See "Trademarks" on page 90.

Transport and Storage Dual-purpose Dry Metal Cask for Interim Storage of Spent Nuclear Fuel

The use of a nuclear fuel cycle is being promoted to facilitate the reprocessing of spent fuel generated by nuclear power plants and the reuse of fuels like uranium and plutonium. An essential element of this cycle is an intermediate storage facility for temporarily storing and managing spent fuel outside of the nuclear power plants up to the time of reprocessing. Hitachi, Ltd. is developing a transport and storage dual-purpose dry metal cask to enable spent fuel from nuclear power plants to be removed, transported, and stored in an appropriate manner for a period spanning several decades.

Senior Engineers Masashi Shimizu (left) and Jun Kashiwakura (right) of Advanced Reactor Engineering Section, Nuclear Fuel Cycle Project Dept., Nuclear Systems Div., Power Systems

What is a Metal Cask Used in Intermediate Storage Facilities for Spent Nuclear Fuel?

A metal cask is a container for transporting and storing spent fuel generated by nuclear power plants. To give some background to its use, the adoption of a nuclear fuel cycle is currently being promoted in the field of nuclear energy to enable more efficient use of resources. As a part of this cycle, spent fuel must be appropriately stored and managed for a fixed duration up to the time of reprocessing to maintain flexibility in the nuclear fuel cycle. To this end, plans are being made to construct intermediate storage facilities with completion targeted for 2010.

Storage systems for spent fuel are of two main types: storage by water pool and storage by dry cask. For intermediate storage facilities, the latter method is receiving attention as it simplifies the maintenance and management of spent fuel and achieves greater cost efficiency. Against this background, Hitachi has developed a "transport and storage dual-purpose dry metal cask" (height: 5.5 m; diameter: 2.5 m) by adding a storage function to an established transport metal cask.

Requirements of Dry Metal Cask

This dry metal cask must guarantee a high level of reliability for both transport and storage, which are two greatly different functions. To begin with, the transport function requires that a dry metal cask incorporate four safety functions: (1) sealing of radioactive materials, (2) shielding of radiation, (3) prevention of criticality; and (4) heat removal. A dry metal cask must also have a robust design and structure to prevent damage or disaster due to shock or fire in the event that the cask is dropped during transport both before and after storage. Next, the storage function requires that a dry metal cask be durable enough to withstand long-term storage of several decades as well as incorporate the same four safety functions described above. To satisfy these requirements and achieve reliable performance, we propose a transport/storage dry metal cask that uses carbon-steel forged material for the main body, boron-doped stainless steel for the basket that supports spent fuel inside the cask, and metal gaskets as sealing material in the lid section. In this design, we endeavored to raise performance by performing various elemental tests, by performing drop tests using a scale model at the level of a comprehensive evaluation, and by manufacturing actual-scale casks.

Features of Dry Metal Cask

With the aim of preventing the leakage of spent fuel, cask sealing is improved by adopting a double-lid structure and using metal gaskets as sealing material. The cask interior is also filled with helium gas to prevent rust and corrosion. A lattice-shaped basket is used inside the cask to store spent fuel at fixed intervals to prevent criticality that occurs when uranium in excess of a certain amount is grouped together in one place. This basket features a "fit structure" to avoid welding as much as possible and simplify cask structure, improve safety, and raise cost performance. A shock absorber has also been developed to minimize shock if the cask should be dropped.

To prevent radiation from being emitted, the cask main body is given a gamma-ray shield and a neutron shield to reduce the amount of radiation at the outer surface of the cask to about one-millionth the total amount of radiation inside the cask. Here, neutron shielding resin is cast beforehand into block-shaped units that are then attached to the sides of aluminum-alloy fins. This structure can satisfy high-quality and mass-production requirements.

Future Outlook

The annual amount of spent fuel generated by nuclear power plants in Japan is about 900 to 1,000 tons at present. Growing demand for electric power in the future, however, is expected to increase this amount to about 1,400 tons by about 2010 and about 1,900 tons by about 2030. The construction of intermediate storage facilities is a matter of urgency, and Hitachi is working energetically to develop a high-reliability and cost-efficient transport and storage dual-purpose dry metal cask.

External appearance of cask

New Series of Flat Panel TVs: High Picture Quality and Range of Products to Choose from for New Video Lifestyle

In Japan, the launch of digital terrestrial broadcasting at the end of 2003 marked the beginning of a genuine high-definition era together with BS (Broadcast Satellite) and CS (Communication Satellite) digital broadcasting. Flat panel TVs are now becoming increasingly popular as a means of enjoying high-definition programs on large screens while saving on space. Hitachi, Ltd. first ventured into the plasma TV market with its new series of flat panel TVs, and in 2003, it expanded this series and proposed a new product concept whereby two sizes of liquid-crystal TV monitors, four sizes of plasma TV monitors, and four types of tuners could be combined as desired. In this way, Hitachi aims to meet diverse customer needs and further expand its flat panel TV market.

From left to right: Ken Kumakura, Product Design Dept., Product Design Div. of Fujitsu Hitachi Plasma Display Limited; Engineer Hiroyuki Suzuki, Marketing and Products Dept., Visual Display Operation, Digital Media Div. of the Ubiquitous Platform Systems; Senior Engineer Kenichi Matsumoto, Flat Panel Display Engineering Dept., Visual Display Operation, Digital Media Div. of the Ubiquitous Platform Systems; Senior Engineer Yasushi Naitou, Development Center, Visual Display Operation, Digital Media Div. of the Ubiquitous Platform Systems; Engineering Manager Hisashi Ishino, Product Manager, Design Department, Large-sized FPD Div. of Hitachi Displays, Ltd., and Associate Manager Naoto Kobayashi, Design Department, Large-sized FPD Div. of Hitachi Displays, Ltd.

Overview of New HD Flat Panel TV

As early as 2001, Hitachi was shipping a plasma TV in a popular 32-inch configuration to world markets, and in 2002, with its plasma TV 3000 series, the company had gained the largest share in plasma TVs at home-appliance volume retailers. With these accomplishments, Hitachi established a name for itself in the plasma-TV market under the slogan "If it's plasma, it's Hitachi." With the present new 5000 series of flat panel TVs, Hitachi aims to accommodate digital terrestrial broadcasting as well as improve picture quality and provide a more extensive lineup of products. In the tuner section, for example, the industry's first AVC (audio-visual control) station with a built-in HDD (hard disk drive) has been added to allow recording and playback of high-definition broadcasts. Hitachi is also expanding its lineup of liquid-crystal TV monitors to provide diversity in its flat panel displays. Customers may choose between plasma TVs for "theater living room" using large screens and liquid-crystal TVs for "casual living room" brightly lit in accordance with personal needs. The new 5000 series of flat panel TVs incorporates latest technologies for both plasma and liquid-crystal types to provide high picture quality, and Hitachi firmly believes that customers will be fully satisfied whichever type they choose.

Features of New Plasma Displays

The new series plasma TV monitors are highly praised for their fine detail and brightness achieved by ALIS (alternate lighting of surfaces), an original system developed by Fujitsu Hitachi Plasma Display Limited. With the new 5000 series, this system has evolved into the Advanced ALIS Panel that further improves emission efficiency and achieves a top class of brightness for the industry. This new system reduces the load on the panel's fluorescent material making for sufficient durability at a lifetime of 60,000 hours or more, and increases white color temperature to 12,000K achieving a pure white of transparent-like quality. New technology has also been introduced for digital image processing, and while past plasma displays suffered from a small amount of picture noise, a newly developed LSI in the 5000 series suppresses this noise to provide a clear picture.

Attractive Features of New Liquid Crystal Displays

Past liquid-crystal TVs were mainly of the 20-inch class in terms of size, but the new 5000 series features 28-inch and 32-inch types representing a significant jump in size. In terms of technology, the new liquid-crystal TVs continue to incorporate two key techniques developed by Hitachi Displays, Ltd. These are AS-IPS (advanced super in-plane switching), which excels in brightness and color reproduction at a wide visual angle, and the "super impulse system," which inserts black display data at fixed intervals to eliminate after-images characteristic of liquid crystal displays. And to improve response speed, an important issue with past liquid crystal displays, an "overdrive circuit" has been introduced so that video with excessive movement can be displayed clearly. Finally, by attaching a newly developed, specialized "wide view filter" to the AS-IPS system, which already features high visual characteristics, the new liquid-crystal TVs can display flicker-free vivid images even when viewing from diagonal angles.

Future Outlook

Hitachi has begun to market the industry's first 55-inch plasma TV to add to the 32-inch, 37-inch, and 42-inch types already on the market. Although the number of competing manufacturers is increasing, Hitachi, as a leader in the flat panel TV market, aims to provide its valued customers with a new video lifestyle through a rich array of products and a maximum level of picture quality. Considering, moreover, that the demand for large-screens is even higher overseas than in Japan, Hitachi plans to give even liquid-crystal TVs larger screens and to expand its world-wide share in flat panel displays.

W11H Broadband Mobile Phone Supporting CDMA 1X WIN for High-speed, Large-capacity Data Communications

Mobile phones are rushing headlong into the broadband era. The "CDMA 1X WIN*" 3G service providing heretofore unachievable data transfer speeds represents the next step in the evolution of third-generation mobile phones. Hitachi, Ltd., as a leading vendor of this system, announced the "W11H" handset in November 2003 as a mobile phone supporting this service. The W11H is capable of high-speed data communications at a maximum speed of 2.4 Mbit/s (downstream) allowing users to enjoy a variety of new services such as EZChannel, an automatic program delivery service, and Live Video Distribution, a real-time video delivery service. This novel product represents a new concept in mobile phones and a basis for new lifestyles.

Features of the W11H Mobile Phone

The most outstanding function of the W11H phone is the high-speed communications function designed especially for data communications with a maximum transmission speed of 2.4 Mbit/s (downstream). This function enables users to enjoy multimedia content like television programs and motion-picture programs like movies and sports programs at unbelievable speeds and to download a maximum of 3 megabytes of content. A variety of services will be offered to deliver this content. These include EZChannel* for automatically delivering and storing content periodically, Movie for smooth playback of movies, and Live Video Distribution for checking traffic conditions on highways, regional weather reports, and resort conditions all by real-time video. The W11H extends the playback duration of downloaded video to about 3 minutes from the conventional 15-30 seconds, and allows a maximum of about 10 minutes of video to be recorded and played back by the mobile phone itself. To enable the user to enjoy this video in a comfortable manner, a QVGA (quarter-size video graphics array) having great expressive power and supporting streaming playback functions has been adopted for the display. In addition, to help users enjoy large-capacity content without worry, KDDI, the company offering these services, has introduced EZFlat*, the first fixed-rate packet communications service for mobile phones. As a result, users now have unlimited access to EZweb* services including e-mail for a monthly fee of 4,200 yen.

Development Issues

Realizing the need for an appropriate infrastructure to achieve a stable environment for high-speed, large-capacity communications, Hitachi is developing new base stations and other facilities in cooperation with Hitachi Communication Technologies, Ltd. Here, the development of terminals goes hand-in-hand with development of the communications platform. While providing these terminals with a full array of functions, it must be kept in mind that those functions have be accommodated within the size of an ordinary mobile phone. For the W11H, this required an exceedingly high level of design and development work. For example, a stable signal environment must be secured to achieve stable, high-speed data communications, and for this reason, two antennas including an internal one had to be incorporated at two locations. This, in turn, required that two communication circuits be included within the enclosure. The liquid crystal also had to be larger resulting in the use of a 2.2-inch type, and the terminal had to support the SD (Secure Digital) card. Satisfying both size requirements and the need for many functions presented a formidable barrier, but this problem was surmounted by adopting a miniSD* jacket system that allows for insertion or removal of miniSD memory cards as needed.

From left to right: Engineer Takanori Matsunaga of the Product Planning Section, Business Planning Headquarters, Mobile Information & Communication Appliance Div.; Senior Engineer Hideo Ito of the Mobile IT Development Section, Digital Media Systems R&D Div.; Special Designer Norihiro Iwama of the Home Solutions Design Section, Design Div.; Senior Engineer Masaki Uesugi of the Mobile Design Section, No. 1 Design Headquarters, Mobile Information & Communication Appliance Div.; and Senior Engineer Shinichi Yoshida of the No. 2 Software Design Section, No. 2 Design Headquarters, Mobile Information & Communication Appliance Div.

Design Concept

Based on an "anticipating the future" design theme, the W11H wraps its advanced functions in a soft round form creating a floating, space-like feeling. It comes in two colors: a silver that creates a calming, relaxing effect and a turquoise that gives a feeling of newness. The phone also features a unique "luminous shell" function whereby the light from built-in LEDs (light-emitting diodes) shines through the enclosure. This function attempts to give "character" to an inorganic machine like the mobile phone and to create a sense of wonder not seen in past mobile phones. To achieve such effects, Hitachi has been expending effort to develop new materials including plastics that can provide both transparency and strength and coatings that allow light to pass.

Future Outlook

A mobile phone designed especially for data communications has the potential of becoming a new communication tool unlike anything seen before. In addition to being good news for heavy users of services like e-mail and EZweb, a mobile phone of this type should also enable users who have traditionally refrained from data communications because of high charges the ability to enjoy "cellular broadband" without worry. For the future, Hitachi is setting its sights on developing a more comfortable communications environment and mobile phones that are more enjoyable and easier to use.

* See "Trademarks" on page 90.

Optical Topography: Creating New Possibilities in Brain Science

In the field of brain research, real-time observation of human brain activities has been every researcher's dream for a long time. A variety of technologies have recently appeared, however, to make that dream a reality. These include SPECT (single photon emission computed topography), PET (positron emission tomography), fMRI (functional magnetic resonance imaging), and MEG (magneto-encephalography). Progress is also being made on the practical application of a breakthrough technology that uses light to capture images of brain activity. This is "optical topography," whose development is being spearheaded by Hitachi, Ltd.

Senior Researcher Atsushi Maki (left) of Advanced Research Laboratory and Dr. Eiju Watanabe (right), Chief of Department of Neurosurgery, Jichi Medical School. Dr. Watanabe has provided Hitachi with medical advice since the beginning of optical topography development.

What is Optical Topography?

Using near-infrared light that can barely be seen by the human eye, optical topography is a technology for detecting changes in local blood volume and producing images of brain activity. In this process, optical-topography system irradiates the scalp of a subject with near-infrared light via optical fibers. Some of that light passes through the cranium and scatters within brain tissue, and some of that scattered light returns to the surface of the scalp. The system then detects and measures near-infrared light that has passed through tissue situated about 20 mm below the scalp—a depth corresponding to the cerebral cortex—to determine the state of nerve-cell activity in that region. If a certain region of the brain becomes active, blood volume will increase regionally to send in oxygen and nutrients necessary for nerve-cell activity and the amount of hemoglobin will likewise increase to transport and release oxygen. Because near-infrared light is absorbed by hemoglobin in the blood, measuring the amount of that absorption indicates the extent to which blood volume is increasing or decreasing in that region enabling nerve-cell activity to be graphically displayed.

Features of Optical Topography

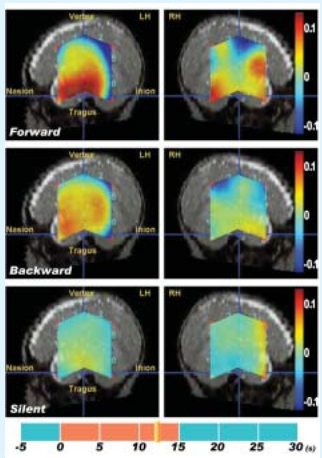
Compared to conventional methods of observing brain activity like PET and fMRI, optical topography is non-invasive and non-constraining, i.e. it applies minimal load on the human body. In addition, the light irradiated by an optical-topography system is infrared light of an extent similar to that in sunlight, and as such, is completely harmless. Furthermore, in contrast to PET and fMRI methods that require large-scale equipment, optical-topography equipment is portable, and because phenomena like the movement of hemoglobin can be precisely analyzed with that equipment, the range of application of optical topography when used at a hospital or other medical facilities is extremely broad. Optical topography is also ideal for patients and children for which staying motionless is extremely difficult. For example, it can be used to observe brain activity of patients undergoing an epileptic seizure and to isolate that part of the brain generating the seizure, a task that has been impossible up to now. In this capacity, optical topography has demonstrated considerable effectiveness in treatment (joint research with Dr. Eiju Watanabe of Jichi Medical School).

Future Outlook

As an example of recent achievements with optical topography, the results of measuring language functions of newly born infants were announced in September 2003 generating world-wide interest (joint research with Professor Jacques Mehler of the International School for Advanced Studies in Italy). This experiment measured changes in brain activity of infants from 2 to 5 days old under three conditions: (1) having them listen to talk in their mother language, (2) having them listen to that talk in reverse, and (3) giving them no audio stimuli at all. It was found that a clear response could be observed in the left temporal lobe of the infants when listening to talk in normal forward order. This was the first experiment in the world to show that newly born infants were already processing language in the auditory-language area of their left temporal lobe.

In addition to the human speech area, optical topography can deal with brain functions that are difficult for other technologies to measure. It can also be used to clarify the developmental process of various brain functions, to detect brain damage early, to determine the aftereffects of cerebral hemorrhage, cerebral infarction, and other conditions, and the degree to which a brain function is recovering. Optical topography is bringing about a new approach to the brain.

Measuring brain functions of a child using the ETG7000 of Hitachi Medical Corporation



Images of brain activity in a newly born infant using the ETG100 of Hitachi Medical Corporation. When listening to ordinary speech (top), the speech area in the left hemisphere becomes activated, but when listening to speech in reverse (middle) or listening to nothing (bottom), no obvious activity occurs.

Achieving High-Quality Organic EL Displays "Luminescent-Period Control Circuit Technology"

Featuring a thin and lightweight configuration with excellent visibility, organic EL (electro luminescence) displays are expected to succeed LCDs (liquid-crystal displays) as next-generation displays. Hitachi, Ltd. has developed "luminescent-period control circuit technology" as a display system for these displays. This landmark technology provides a highly precise, crystal-clear picture far better than past display technologies, and is now gathering attention as a means of opening the way to new application products for organic EL displays.

Senior Researcher Hajime Akimoto (left) and Researcher Hiroshi Kageyama, ULSI Research Dept., Central Research Laboratory.

Background to Development of New Circuit Technology

While the development of organic EL displays goes back to the 1980s, current development efforts are becoming increasingly competitive with a view toward commercialization. At Hitachi, Ltd., we have endeavored from the very beginning to achieve a level of performance in EL displays that cannot be mimicked by other companies through an approach completely different from past development work. Starting in 2001, we fabricated prototypes repeatedly through close teamwork between our R&D division, business division, and Hitachi Displays, Ltd. and completed development of our new circuit technology at the end of 2003.

Features of "Luminescent-period Control Circuit Technology"

To display gray scaling in a picture, past methods controlled the brightness of organic luminescent devices. The new method, in contrast, controls the emission period of organic luminescent devices by a newly developed pixel circuit. This development solved several problems associated with organic EL. First, the new pixel circuit eliminates irregularities in luminosity caused by variance in transistor performance and enables high-precision emission of light in 260,000 colors (64 gray levels). Second, it produces no after images resulting in smooth display of video. And third, it enables "peak intensity control" for brightening a local bright spot on the screen (as in glittering light) to more than twice the brightness of an all white plane picture, the first in flat panel displays. The resulting picture quality matches that of a CRT known for its beautiful picture, indicating that crystal-clear, high-quality images are now possible in medium- and small-size flat panel displays.

Future Outlook

Because the pixels themselves emit light, organic EL displays feature low-power operation and bright images that can be viewed from a wide angle. They can also be made super-thin and light to achieve an ideal display. By extending display lifetime through improved materials, organic EL displays will first be applied to compact displays as in digital cameras and cellular phones. But with the high-picture-quality technology that we have developed, organic EL displays can be expected to find practical use in home television monitors. In the future, it should also be possible to form thin and light flexible panels into displays.

In the years to come, information will become increasingly important in many respects, and to eliminate the gap in information access between countries and regions, the display as one means of conveying information will no doubt become an even more important component. Our aim is to develop and implement displays to enable everyone to enjoy beautiful images close at hand and to contribute to improving society for the betterment of all.

3.5-inch prototype organic EL display constructed with this technology; it is 1.8-mm thick and has 230,400 pixels (320 X 240 X RGB).