ISSN 1349-3531

NICT NEWS

10
OCT. 2006
No.367

1 Universal Media Research Center
— To See, Hear, Touch, and Smell — “super presence” for natural and realistic communication —

3 NICT Public NTP Service
— The Highest Throughput Capacity in the World —

5 A Participant’s Report on the European Conference on Optical Communication (ECOC 2006)
— A Five-Year Record for Optical Fiber Transmission Speed —

6 Validation Experiment on Helicopter-Satellite Communication System
— Joint Experiment with the Fire and Disaster Management Agency —

7 Report on Our Presentation at the 33rd International Home Care & Rehabilitation Exhibition (H.C.R. 2006)
— Results of NICT’s Projects Supporting Barrier-Free Information Research and Development —

National Institute of Information and Communications Technology

Research

Universal Media Research Center

— To See, Hear, Touch, and Smell — “super presence” for natural and realistic communication —

What is the aim of the Universal Media Research Center?

The Universal Media Research Center at NICT is conducting research on “ultra-realistic communications technologies,” including 3D image and sound. Our goal is to construct an advanced information system that can offer an interesting and engaging environment by creating a natural and realistic sensation of being in a completely different and distant location, through communications and broadcasting technologies.

Our research center was inaugurated in April of this year. Our organization consists of two groups: the “3D Spatial Image and Sound Group,” which conducts studies on 3D imaging and sound technologies associated mainly with electro-holography; and the “Multimodal Communication Group,” which conducts studies to optimize the sense of realism among people by analyzing human mechanisms of cognition.

In addition to NICT’s active continuing R&D in the visual and audio technology fields, we now have research groups that include researchers in a variety of new fields such as psychophysics and the human sciences, which will allow us to pursue a wider range of projects.

What Kind of System Do We Hope to Develop?

The future concept of the ultra-realistic communications system that NICT hopes to develop may be introduced using two example illustrations.

Figure 1 shows a person enjoying a live broadcast of a soccer game on his home 3D television. Above a large table is a holographic image of the soccer stadium. He hears the cheering of the crowd in the stadium from different directions, depending on where he is sitting. He can even replay a goal from a different angle by pressing buttons on the virtual panel hovering in the air in front of him.

Figure 2 shows people engaged in remote shopping. These people are shopping in an open-air market in Paris, bargaining with the shop owner while enjoying the color and touch of the ceramic teacup. They almost feel as if they are actually there in Paris, with the bustle of the market, the reactions of the shop owner, and the touch and smell of merchandise.

The example in Fig. 1 is an excerpt from the “Study Group on Universal Communications Technologies” presented in December of FY2005 to the Ministry of Internal Affairs and Communications (http://www.soumu.go.jp/s-news/2005/pdf/051215_3_2.pdf). The report contained examples of various future applications of universal communication technologies, and in all examples, an ultra-realistic communications system is used.

This system will not only change how we enjoy television programs, but will also help establish a rich and creative environment for medicine, education, and cultural and artistic exchanges.

Fig 1. Enjoying the final match of the 201X Soccer World Cup on a 3D television set

Studies by the 3D Spatial Image and Sound Group

The 3D Spatial Image and Sound Group is conducting studies on hardware technologies for 3D spatial images and sound. These technologies are applicable to electro-holography, the ultimate 3D imaging technique, which requires no special eyeglasses for 3D visualization. Existing 3D imaging techniques that use gadgets such as polarized glasses—already in practical use at various exhibitions and expos—are simple systems that make use only of binocular parallax; these methods are not suited to viewing for extensive periods of time. In contrast, holography is the ideal technology for reproducing 3D images in space, with precedent in previous applications of still-image holograms using photoplates. Our group is attempting to create

Life and Technology

Q: We can anticipate a variety of applications for an ultra-realistic communications system, but can you give us some examples of everyday use?

A: When the ultra-realistic communications system is realized, a person will be able to go shopping while at home by virtually entering a store, even holding an item in his hand or conversing with the shopkeeper. This will allow the elderly or handicapped to enjoy shopping on their own.

In about five years, we plan to reach a point at which we can demonstrate a basic experimental system that combines technologies such as a 3D imaging device that makes nearby objects or those held in the hand appear natural, large screens with immersive effects, 3D surround audio systems that reproduce sounds from multiple directions, and devices for generating the feeling of touch or smell.

holographic movies capable of presenting real-time and full-color images of distant locations.

We are also conducting studies on sound technologies for 3D reproduction of the sound that will accompany the 3D image.

Studies by the Multimodal Communication Group

The Multimodal Communication Group is conducting studies analyzing the sensation of realism and immersive effects, as well as the discomfort felt during a virtual experience, through psychophysical experiments and measurements of brain activity. Our group is also attempting to understand the mechanisms of cognition behind the senses, including touch and smell as well as vision and sound. Based on the knowledge obtained through such studies, we will construct a system capable of creating the most suitable "ultra-realistic sensory environment" for humans.

The ultra-realistic communications system will create an atmosphere or environment that makes you feel as if you are truly "there," or that someone is there near you, will allow objects to be "felt" in your hands, and will even permit "manipulation" of these objects. We plan to make the system for generating an atmosphere, other person, or object a comprehensive one which will acquire, transmit, and present information relating to the image, sound, touch, and smell of the target.

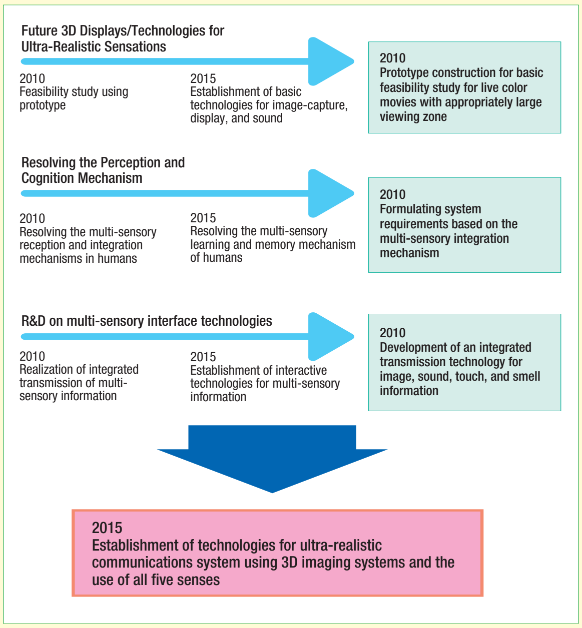
Development from a Long-Range Perspective

In order to realize the ultra-realistic communication system starting with the 3D imaging technologies presented above, we must overcome a great number of difficult problems, such as the development of image-capture and display devices with ultra-high resolution and ultra-high pixel numbers and the measurement and analysis of unresolved brain functions. However, we plan to take advantage of our role as a public research institute, conducting research that can only be undertaken—and should be undertaken—by such an institute, as we steadily move forward with long-range perspectives, as illustrated in Fig. 3.

On the other hand, efforts for the development of various techniques for 3D imaging are underway at private R&D institutes and universities in Japan and abroad, and there has been notable progress in 3D cinema, alleviating the fatigue experienced when wearing conventional 3D glasses for extended periods of time. It is important that such R&D be pursued through collaboration of industry, academia, and the government, and we hope the Center can contribute significantly to this pursuit.

Fig 2. Remote shopping in an open-air market in Paris

Fig 3. Goal of the Universal Media Research Center



Researcher

Kazumasa Enami
Executive Director
Universal Media Research Center

After graduating from the Tokyo Institute of Technology, he joined NHK in 1971, where he mainly conducted studies on image signal-processing technologies, in addition to research management duties as Director-General of Research Labs. of NHK, until 2006. He joined NICT in September 2006. PhD (Engineering)

This month's key concept

[Holography]

Holography is a technology for recording or reproducing original 3D images on a 2D plane using the diffraction and interference of light, a technique made possible by the invention of the laser. A single light source (the laser) is split into two beams; one is directed at the target of measurement, and the other is used as the reference beam. The light reflected by the target is crossed with the reference beam from the original laser source (which was split using a half-mirror), and the resultant interference pattern is recorded. Since holography allows the recording of the intensity distribution, phase, and direction of beam propagation, it can make non-contact, high-resolution measurements of deformation, vibration, motion error, and dimensional error of objects with coarse surfaces and complex shapes from all angles simultaneously.

NICT Public NTP Service

— The Highest Throughput Capacity in the World —

Is Your Clock Keeping Correct Time?

We are surrounded by clocks: alarm clocks, wristwatches, and internal clocks in electronic appliances, clocks in cellular phones, and clocks in personal computers. Not only is the concept of time tightly woven into our daily lives, it also forms a very important foundation for science, technology, and industry. However, a clock is not a proper clock if it can't keep correct time. We have all also experienced the inconvenience of adjusting the various clocks around us after a blackout.

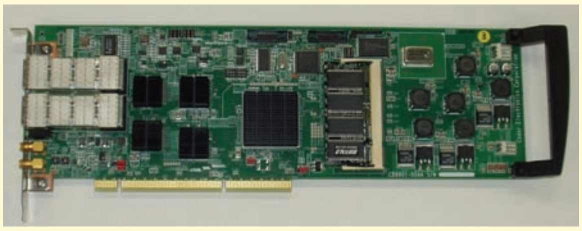
NICT provides the standard radio wave for "Japan Standard Time (JST)," which is the standard time for all of Japan. In recent years, radio-controlled clocks that use standard radio waves to adjust time automatically have been commercialized, but they cannot be used inside buildings where radio waves cannot be received. Accordingly, we have begun to provide JST through the Internet, in order to expand the availability of standard time. However, it is simply not possible to synchronize the enormous number of PC clocks connected to the Internet in Japan using the conventional PC-based time servers operated by NICT. Thus, we have employed a device previously developed for high-speed network studies to develop a new time server with increased throughput.

The Versatile High-Speed Network Module (VHNM) Adapted for the Time Server

In the past, measurements of network characteristics were generally carried out using a PC platform. However, these measurement systems were incapable of coping with increasing transmission volumes and speeds (as high as 1 Gbps to 10 Gbps). Since a PC performs all processing with a central processing unit (CPU) and is normally equipped only with a single CPU, it is incapable of processing multiple tasks simultaneously. Further, in practice a CPU must perform tasks such as (1) packet transmission and reception using the network, (2) data analysis and processing, (3) processes associated with the operating system (OS) in order, one by one, and so there is a limit to the number of tasks it can handle. Thus, time precision had to be sacrificed when handling connections in networks featuring upward of 1-Gbps transmission speeds.

In response, NICT developed a Versatile High-Speed Network Module (VHNM) to process traditional software tasks using a hardware device known as an FPGA, and this module has been used in a number of studies. The VHNM has an FPGA at its core equipped with two network interfaces, memory, and a timing terminal (1 PPS), and can be used for network characteristic measurements, packet capture, traffic generation, packet filters, and network simulators (See Fig. 1). The FPGA can execute logical operations just like software, offering precise timing through parallel processing or pipeline processing, by combining a large number of hardware logical elements without involving the OS. Thus, the device operates without any interruptions in processing, even in high-speed networks. The module can also be equipped with additional functions, simply by changing the firmware.

Fig 1. Versatile High-Speed Network Module (VHNM)



NICT Public NTP Service

The standard method normally used for synchronizing a clock via the Internet is known as NTP (Network Time Protocol). With NTP, the time server, upon receiving a request from the client, inserts the present time (a "time stamp") into the NTP packets and returns it to the client. In this way, the time stamp insertion function—one of the basic functions of the VHNM—has become compatible with the NTP packet format, allowing the VHNM to take on an NTP server function. Existing NTP servers, even those that have been specially manufactured as time servers, executed this task internally via software processing within the PC; as a result, the maximum processing capacity was restricted to about 5,000 requests per second. However, the present hardware NTP server has extended this limit up three orders of a magnitude, and boasts the highest processing capacity in the world, in excess of one million

Life and Technology

Q: Will the time server utilizing the VHNM be able to handle concentrated access from users all over Japan?

A: Yes, it will. The internal clocks of personal computers and home electronic appliances are quartz-based, and can keep time well within a margin of error of one second by carrying out time synchronization at a frequency of about ten times a day; continuous time synchronization is thus unnecessary. Let's assume that a single Japanese person owns ten instruments with internal clocks, such as personal computers and electronic appliances. If all of these devices belonging to all users access the NICT server, we will see a total of 13 billion hits per day. Since the NICT server has a processing capacity of 100 billion requests per day, a significant margin will remain.

requests per second*1. Further, since this server is installed within the NICT facility and is directly connected to the JST, we have achieved time precision of higher than 10 nanoseconds (one hundred-millionth of a second) for the server. In addition, the server excels in terms of security, thanks to the properties of a single-function hardware device.

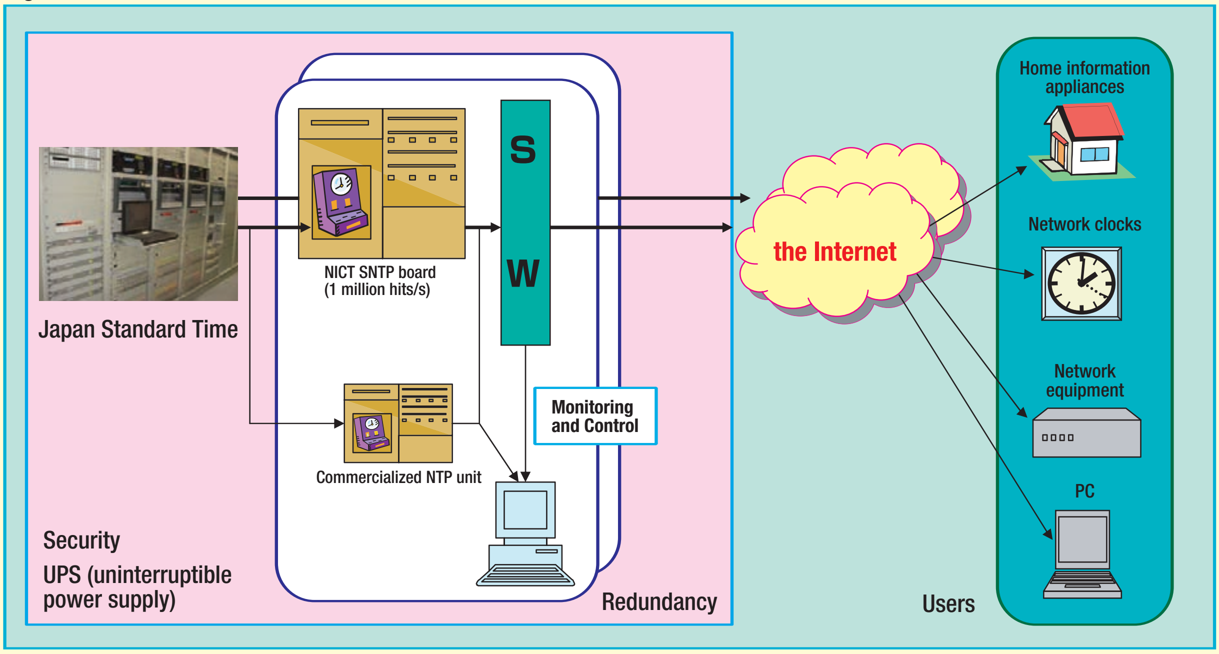
This NTP server is presently used at NICT for the public NTP service (ntp.nict.jp), and after several months of operation, it now receives several tens of millions of hits a day. Not only is this a high-performance server, but it also features redundant design for the server, time source, power source, and network in the event of emergencies. Moreover, the server environment and system characteristics—such as temperature, humidity, and electromagnetic wave conditions, entry check, and seismic-resistance of the server room—are on the same level as those for other JST facilities. NICT's accumulated expertise in providing stable time has thus been put to full use in this project.

Toward a Ubiquitous Society

In recent years, the demand for correct clocks (i.e., for accurate time information) has increased with the enactment of the Japanese SOX Law (Financial Instruments and Exchange Law) and the increase in time-related businesses. What's more, we expect to see an increasing number of instruments connected to the network, as we continue to progress toward the creation of a ubiquitous society and the launch of power-line communications (PLC). In such a dispersed system, time may become an effective key for coordination among the many systems involved. Time synchronization using a network requires only that the system have network functions and eliminates the need for extra, specialized hardware for the purpose. Thus, this technology provides a cost-efficient solution to the problem of time synchronization. These factors make the present NTP server a promising infrastructural element in time synchronization, one that will support the coming ubiquitous society. Since the development of the pendulum clock in the 17th century, the precision of timekeeping has improved continually, and this development has had a great impact on our lives. Time synchronization using the network will allow the common clock to be synchronized with a precision of several milliseconds. How will this affect our lives? We will have to wait and see.

*1: the maximum number of requests on a 1-Gbps line

Fig 2. General Scheme of the NICT Public NTP Service



Researcher

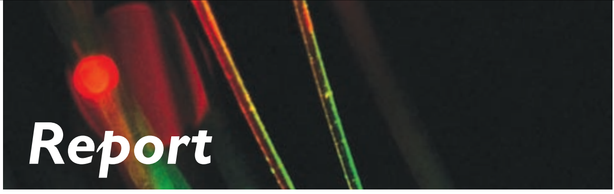
Akihiko Machizawa
Senior Researcher
Space-Time Standards Group
New Generation Network Research Center

He graduated from Sophia University in 1984 and joined the Radio Research Laboratories of the Ministry of Posts and Telecommunications (presently NICT).
He has conducted research on high-efficiency coding of images, visual information processing, computer networks, and time synchronization, with a special focus on parallel distributed processing. He was a visiting researcher at the University of Canterbury in 1996–1999.

This month's key concept

[FPGA (Field Programmable Gate Array)]

An FPGA is a logic IC that can be programmed by the user. This component is designed to allow functions to be redefined freely, and the circuit may be redefined repeatedly. For example, it is possible to perform a circuit simulation with the addition of a microprocessor or ASIC (Application-Specific Integrated Circuit). This circuit simulation may be performed much faster than corresponding software-based simulation. Since the FPGA is programmable in the factory as well as in the laboratory, the product offers significant flexibility.



A Participant's Report on the European Conference on Optical Communication (ECOC 2006)

— A Five-Year Record for Optical Fiber Transmission Speed —

Tetsuya Kawanishi, Research Manager, Advanced Communications Technology Group, New Generation Network Research Center

The European Conference on Optical Communication (ECOC), one of the two major international conferences in the optical communications field, was held in Cannes, France, on September 24–28. Our New Generation Network Research Center participated in the event with the submission of two post-deadline (PD) papers, numerous paper presentations, and exhibition booths. In a situation where only 30% of the papers are selected for oral presentations, NICT was able to present 14 papers (including poster sessions), and we were given an opportunity to demonstrate our advanced level of research in this field.

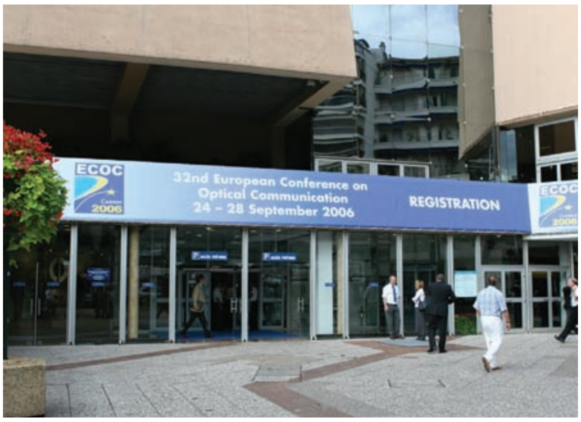
The Photonic Network Group was mainly in charge of the exhibition booth, and they offered a dynamic demonstration of the technologies associated with optical packet switching. The exhibition was a great success, with the audience spilling out of the booth.

The PD papers of ECOC are regarded as a stage for presenting the results of major studies. The most noteworthy result at this conference was the new record set for optical fiber transmission speed, which represented an enormous leap from the previous record. Transmission speed may be likened to the maximum speed or engine power for an automobile. This value represents the most clear-cut characteristic reflecting performance. Since the collapse of the IT bubble, improvements in transmission speeds had been limited. The news of the record-breaking improvement–the first such breakthrough in five years—thus represents a significant success.

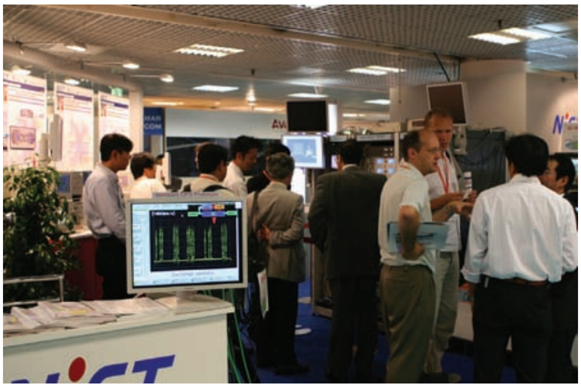
At this conference, NICT (specifically, the Advanced Communications Technology Group) reported on the 12.3-Tb/s transmission achieved through a joint project with Bell Laboratories of the US. In terms of total transmission speed, the 14 Tb/s reported by the NTT group in the same session using a new type of optical amplifier and fiber holds the world record, but our results were achieved using existing fibers and optical amplifiers, and so may be said to be more applicable in practice. However, the main thrust of our results is seen in the achievement of the world's highest spatial capacity, and we can fully expect further improvement in transmission volume. Both NICT and NTT use a common signal format, but NICT was the first in the world to report on a device that makes use of this format, at last year's ECOC. Studies on devices appear to be somewhat removed from system studies due to the basic nature of his research, but we have discovered that breakthroughs in device studies can have a great impact on total system performance within a surprisingly short period of time.

Further, we were able to confirm at the present ECOC that transnational alliances and mergers have become commonplace in the communications industry, leading us to conclude that even in the field of research, projects with global perspectives will become increasingly important.

European Conference on Optical Communication (ECOC2006)
Date: Sept. 24–28, 2006
Venue: Cannes, France

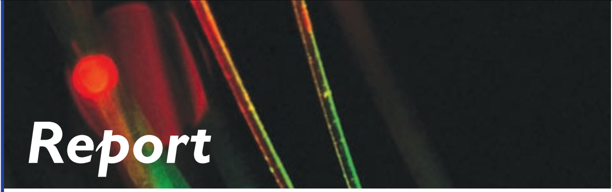


Venue of the ECOC



NICT Exhibition Booth

Center: Dr. Peter Winzer of Bell Laboratories; right, Dr. Kawanishi, Research Manager; left: Dr. Sakamoto, Researcher
Successful 12.3-Tb/s transmission with the world's highest spatial capacity, and 2,000-km transmission of a 100-GbE-compatible signal



Validation Experiment on Helicopter-Satellite Communication System

— Joint Experiment with the Fire and Disaster Management Agency —

Yoshiyuki Fujino, Senior Researcher, Space Communications Group, New Generation Wireless Communication Research Center

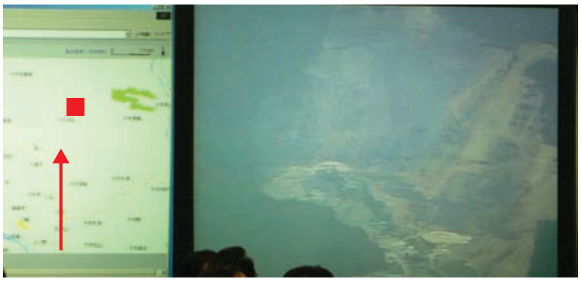
On Sept. 26, 2006, NICT conducted a validation experiment in a joint effort with the Fire and Disaster Management Agency (FDMA) using a helicopter-satellite communication system developed by NICT and the fire- and disaster-prevention communications network of the Fire and Disaster Management Agency to test whether image data from a disaster area can be sent in real time to the Fire and Disaster Management Agency by direct transmission of radio waves from a helicopter to a satellite. During the Niigata Chuetsu Earthquake, images of the disaster area photographed by the fire- and disaster-prevention helicopter could not be transmitted in real time. This experience led to an attempt to improve the system. Modifications were made in 2004 to NICT's helicopter-satellite communication system, which previously featured image-data transmission speed of 384 kbps, with a resultant four-fold improvement to 1.5 Mbps. The present experiment will verify whether the system can perform real-time transmission of images photographed in Gifu prefecture to the Fire and Disaster Management Agency of the Ministry of Internal Affairs and Communications (MIC) located in Kasumigaseki, Tokyo via a geostationary satellite.

There were more than 100 participants on the day of the experiment, and the spacious grounds of the Crisis Management Center for Fire and Disaster Prevention were standing-room only. As Mr. Takabe, Commissioner of the Fire and Disaster Management Agency, Mr. Matsumoto, Director-General for Technology Policy Coordination of MIC, and Dr. Nagao, President of NICT, stood by and watched, the helicopter performed clear, real-time transmission of images of urban areas, rivers and streams, and mountainous areas. At one point, real-time dialogue took place with Mr. Ogasawara, Director-General of the Civil Protection and Disaster Management Department of FDMA, and a NICT researcher aboard the helicopter, to test the actual operational conditions of the helicopter—for example, relaying requests to zoom in to scales at which people on the ground could be identified, or to enlarge images of cars on bridges, or to change the position of the photographed area based on commands from the Crisis Management Center.

Participants looking at the images transmitted from the helicopter

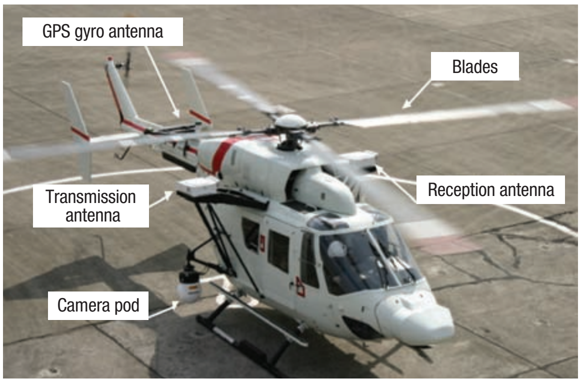
> Validation Experiment on Helicopter-Satellite Communication System
> Date: beginning at 1:30 p.m., Sept. 26, 2006
> Place: Crisis Management Center for Fire and Disaster Prevention of the Ministry of Internal Affairs and Communications

The most urgent issues remaining for the future are to create a compact and lightweight model of the unit placed aboard the helicopter, expansion of the transmission range, construction of versatile model technologies, and improvements in image resolution. Much more work will be necessary to put this system into practical use, and these issues will be investigated with the cooperation of the private businesses that will commercialize the system; the Fire and Disaster Management Agency, which will be its main user; and NICT, the main developer. System standardization efforts will also be essential. The present system will be regarded as one of the primary technologies designed by NICT for practical application, one that will contribute demonstrably to the safety and security of society.



Right: Image transmitted from the helicopter. Closed squares on the map on the left denote the location where the image was taken, and the arrows show the route of the flight.

The hall where the demonstration was held
—a great success that quickly became standing-room-only



Helicopter standing by at the Gifu airport with the onboard satellite communication system

Report on Our Presentation at the 33rd International Home Care & Rehabilitation Exhibition (H.C.R. 2006)

— Results of NICT's Projects Supporting Barrier-Free Information Research and Development —

Hisami Tajima, Group Leader, Specific Research Promotion Group, Collaborative Research Department

The "33rd International Home Care & Rehabilitation Exhibition (H.C.R. 2006)" was held at the Tokyo Big Sight from Wednesday, September 27 to Friday, September 29, 2006. At the exhibition, nearly 25,000 home care & rehabilitation devices (beds, vehicles, communication devices, etc.) were displayed by 554 domestic companies and 78 foreign companies from 16 different countries. Over 130,000 people attended the exhibition during the three-day period, consisting of representatives from manufacturers, retailers, welfare organizations, welfare facility staff, personnel from governmental and academic institutions, and domestic and foreign individuals from welfare-associated fields, as well as ordinary visitors such as students in welfare-related schools.

The Collaborative Research Department and the ICT Proactive Outreach Department dedicated a corner to NICT's barrier-free information research and development, to publicize the results of its projects relating to the "Grant for R&D on Communication and Broadcasting Services for the Elderly and Handicapped," and the "Grant to Promote Communication and Broadcasting Roles and Development for the Physically Handicapped." A booth was set up inside the corner for each contracted business enterprise (a total of 13 companies) that conducted the R&D for FY2005. On the final day, each of the businesses presented their results of R&D efforts in the home care & rehabilitation device seminar room.

The exhibitions at the NICT corner were visited by Mr. Tera, Director-General for Policy Planning; Mr. Katsuno, Deputy Director General, and four others from the Ministry of Internal Affairs and Communications.

The exhibitions at the NICT corner were visited by Mr. Tera, Director-General for Policy Planning; Mr. Katsuno, Deputy Director General, and four others from the Ministry of Internal Affairs and Communications.

The demonstrations and presentations at the seminars were attended by many of those who were at the exhibition, and the businesses that have received aid from NICT expressed very positive opinions of their experience. One commented, "Both the scale of the exhibition and the number of attendees were far larger than we had expected—this really demonstrates the widespread interest in the field of nursing and welfare," while another noted that "The number of visits to the booths by handicapped persons was simply astonishing. It was a great opportunity to talk with may of these individuals, which will be a great benefit to our future research." Our participation in the present international exhibition proved to be a very effective way to present our results, as compared to last year when our results were presented only within NICT. This impression was reinforced by the results of a survey we conducted on our visitors to our corner—86% replied that our results were directly useful to them.

Demonstrations at exhibition booths for each business at NICT's corner


Scene of presentations given in the seminar room


Mr. Tera, Director-General for Policy Planning (left) and Mr. Katsuno, Deputy Director General (center) of the Ministry of Internal Affairs and Communications

NICT NEWS

Published by:
Public Relations Division, General Affairs Department
National Institute of Information and Communications Technology

4-2-1 Nukui-Kitamachi, Koganei, Tokyo 184-8795 Japan
■ Tel: (042) 327-5392 ■ Fax: (042) 327-7587
■ e-mail: publicity@nict.go.jp
■ URL: http://www.nict.go.jp/

Oct. 2006 No. 367

NICT NEWS at: http://www.nict.go.jp/overview/news/nict-news.html