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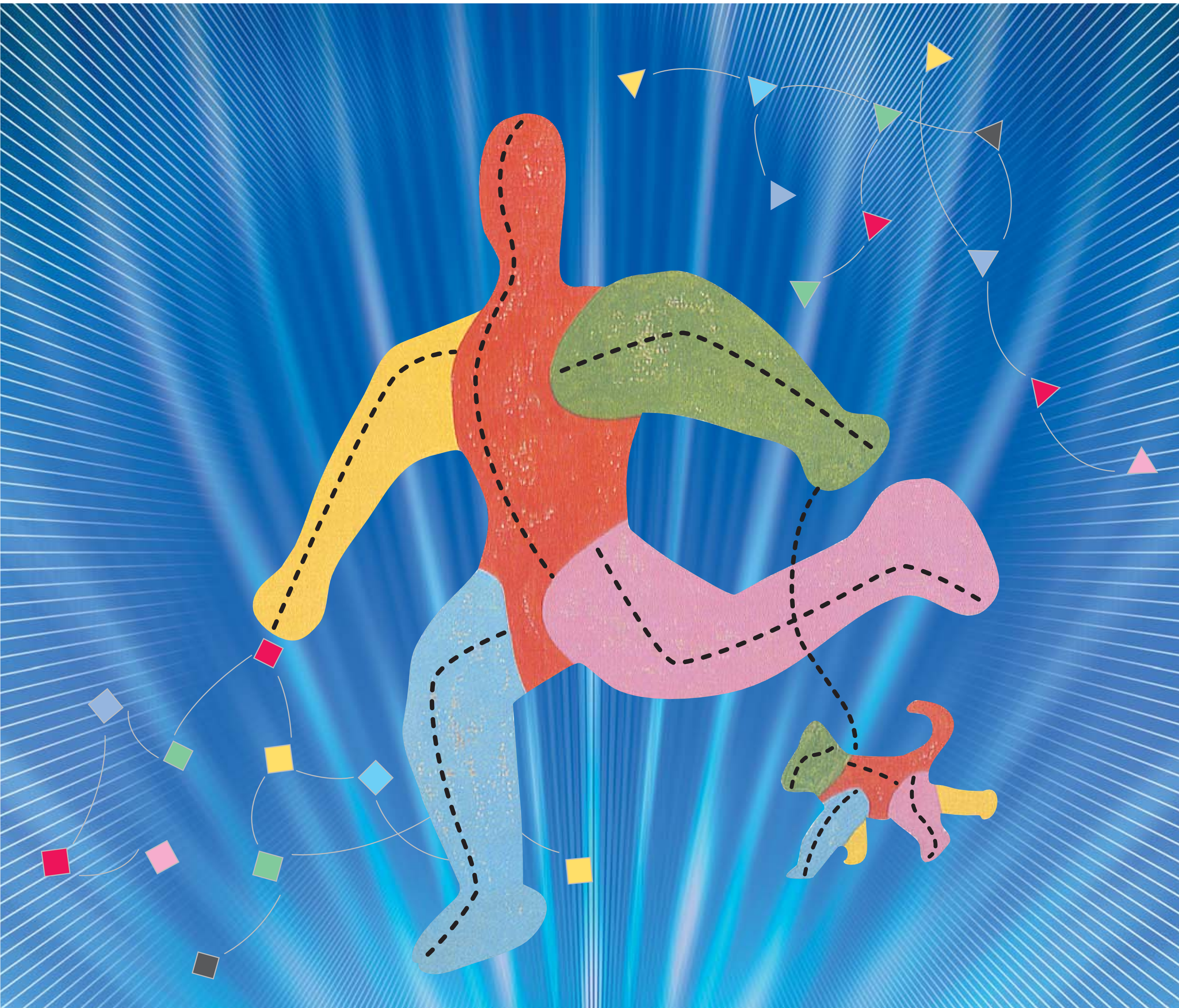
NICT NEWS

National Institute of Information and Communications Technology



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Using ICT in Disaster Mitigation

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Joined the Radio Research Laboratory (currently NICT) in 1987. Engaged in R&D into security for application to natural languages and other fields and information communication technology (ICT) for use in disaster-prevention activities. He has a Ph.D. in engineering.

Introduction

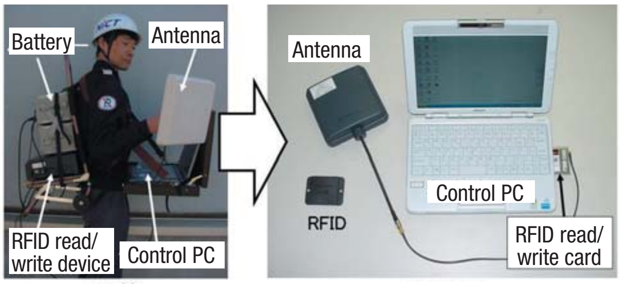
It is important to remain constantly prepared for a disasters, as they may strike at any time. However, to maintain this preparedness, a realistic approach is essential: we must work to minimize damage to the full extent possible given the available resources. The term "disaster mitigation" has become more and more frequently used, as opposed to "disaster prevention," to describe this realistic approach in anti-disaster measures as well as in the context of relief and recovery operations. In this article I will introduce some of the R&D activities carried out by NICT in view of this concept of disaster mitigation.

Using RFID tags in collection of disaster information

In 2002, 32 organizations jointly launched an R&D project dubbed the "Special Project for Earthquake Disaster Mitigation in Urban Areas: Development of Next-Generation Anti-Disaster Basic Technologies such as Rescue Robots" (referred to below as the "DDT Project"; see Figure 1). This five-year plan has now reached its halfway point, and the participating organizations have moved on to the newest phase: integration of the systems they have been developing individually. One such system, involving robotic technology, is expected to be of particular use in rescue operations. Researchers in this area are pursuing these technical studies from a very practical point of view. For example, just after the Chuetsu Earthquake in Niigata Prefecture on October 23, the principal organization of the DDT Project traveled to the disaster area with rescue robots to investigate the damage, in cooperation with DDT Project researchers at the Nagaoka University of Technology, which was also hit by the quake. Subsequently the project members received inquiries from a number of local governments concerning the use of the robots in the inspection of sewer pipes.

NICT has been working on the development of terminals to collect information at the time of a disaster using RFID tags (non-contact IC, RF, or electronic tags) situated in the disaster

Figure 1: Conceptual Drawing of Rescue Operations and Information-collection Using Robots
(Courtesy of International Rescue System Institute)



Present model　　New model under development

Photo 1: RFID Terminal for Collection of Disaster Information (Under Development)

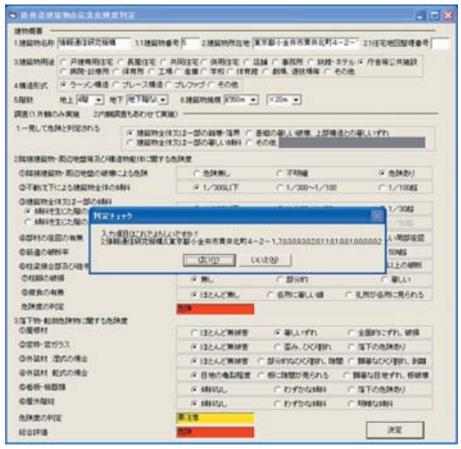


Figure 2: Application Screen for Entering Results of Provisional Risk Assessment

Q & A
I see.
Please explain in simpler terms.

Q What is the "Special Project for Earthquake Disaster Mitigation in Urban Areas"?

A This research project was set up by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) to establish scientific and technological bases for anti-earthquake measures with the aim of greatly reducing casualties and property damage when an earthquake comparable in scale to the Great Hanshin Earthquake occurs in the Tokyo metropolitan area, Keihanshin area, or other large urban area.

Q What are "multi-hop" and "ad hoc" communications?

A A "multi-hop" network performs wireless communications between adjacent terminals, as opposed to distant wireless transmission. "Ad hoc" (a Latin term) means "only for a particular purpose" or "temporary." In ad hoc mode, wireless communications are performed over a temporary network.

area. We have already developed a terminal that can read and write data from or to a battery-less RFID tag at a distance of one meter or more. Although this terminal is still large, as shown in the left-hand side of Photo 1, we are currently making modifications to reduce its size, as shown in the right-hand side of Photo 1. This terminal uses RFID tags as temporary storage media. If the amount of data exceeds the capacity of a single tag, the system automatically divides the data for storage on several tags in the vicinity. This new system thus enables extended applications of RFID technology.

Using this terminal, we are developing a function to write the results of provisional risk assessment to RFID tags; this development takes place in collaboration with the Department of Architecture at Kogakuin University (Figure 2). This function will allow investigators to use small terminals to assess the level of damage swiftly and to write the results electronically to RFID tags when a large-scale disaster occurs. As a result, those involved in recovery operations will be able to share information, avoiding unnecessary duplication of investigation, reducing the amount of work in the compilation of databases, and expediting procedures for financial assistance. As it is expected that sharing information over existing communications networks will be difficult or impossible in times of disaster, this concept of on-site information-collection and communication will represent an essential component in the establishment of a highly disaster-resistant communications system.

Expansion of use into sensor and ad hoc networks

With their electric power supply and a combination of RFID with computing and communications capabilities, damage-monitoring sensors will be able to be used for automatic investigation in the event of an earthquake. In the DDT Project we are jointly developing a common-platform microserver incorporating this advanced RFID technology. We intend to create a mechanism to verify the conditions within a disaster area through the collection of information from numerous microservers situated throughout the area (Figure 3).

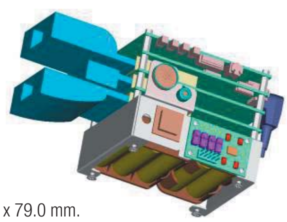


Figure 3:
Microserver for Rescue Operations Jointly Developed in DDT Project
(Outer dimensions: 87.5 mm x 92.0 mm x 79.0 mm. In this figure, three CompactFlash cards are inserted in the server.) (Courtesy of Mitsubishi Electric Corporation)

To enable communication among microservers, “multi-hop” and “ad hoc” communications functions must be implemented. The “multi-hop” function establishes a connection by relaying wireless access points in the event that radio waves cannot reach the target directly. The “ad hoc” function maintains the connection by automatically bypassing failed access points. In 2003, NICT conducted experiments in voice communications using wireless LAN access points equipped with these functions, in collaboration with the National Research Institute of Fire and Disaster (Figure 4). These functions have the potential for use in fire-department radios capable of high-speed data communications from inside a damaged building, in communications between mobile stations in a disaster area in which the communications infrastructure has broken down, and in temporary LAN systems at emergency headquarters.

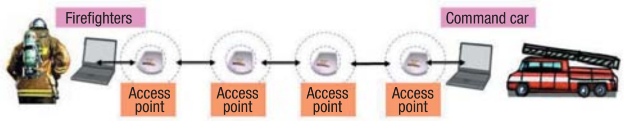


Figure 4: **Experiment on Multi-hop Voice Communications Using Numerous Ad Hoc Wireless LAN Access Points (Photo and Conceptual Drawing)**

Conclusion

The United Nations World Conference on Disaster Reduction will be held in January 2005 in Kobe, a city hit by the Great Hanshin Earthquake exactly ten years ago. This will represent the first time in seven years that Japan has hosted a major UN conference, since the 1997 Third Conference of Parties (COP3) to the United Nations Framework Convention on Climate Change, during which the Kyoto Protocol was adopted. Those involved in disaster prevention in Japan and throughout the world will attend the plenary session and related events. In the context of this conference, we have lately witnessed a growing movement to convey the importance of disaster mitigation to the world, a message from a city that itself experienced a large-scale disaster. The main research fields related to disaster mitigation include seismic observation, disaster countermeasures, and construction. However, with the exception of a small number of university research labs, currently no organization has studied the use of ICT in disaster mitigation as a primary focus. In addition to the activities described in this article, NICT is actively conducting R&D into wireless communications and electromagnetic wave measurement for use in disaster mitigation. ICT will prove useful not only in emergency communications in the event of large-scale disaster but also in disaster mitigation in general. I believe that in its capacity as an institute in charge of ICT from basic to applied levels, NICT should lead the research into disaster-mitigation technology.

Life & Technology

● RFID is expected to lead to a breakthrough in disaster mitigation.

Using RFID to confirm the safety of residents and to provisionally assess residential damage, it will become possible to avoid unnecessary duplication of investigation, to reduce the amount of work in the preparation of disaster databases, and to expedite recovery operations. Moreover, RFID has the potential for use in fire-department radios that require high data transmission speeds and in temporary LAN systems set up at emergency headquarters. In these ways and others, ICT will play an essential role in future disaster mitigation.

Japan Standard Time and Time Business

Haruo Saito

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Applied Research and Standards Department

Joined the Radio Research Laboratory (currently NICT) in 1984. Engaged in research on atomic standards and satellite communications. Currently engaged in time business and frequency calibration.

Introduction

Japan now boasts the world's fastest and lowest-priced network infrastructures, and is enjoying rapid progress toward a fully "digitized society." Accordingly we have seen a marked increase in the amount of information transmitted over networks and in the number of business transactions conducted online. Given these developments, a variety of measures have been implemented to ensure safe use of electronic information on networks, including encrypted communications, server authentication, and electronic signatures. However, none of these measures takes the concept of unified, reliable time into consideration. To ensure further accuracy and safety of electronic information, there is an increasingly apparent need for the distribution of accurate time over networks and for time-stamping measures to certify the presence of data at a certain time and its subsequent integrity.

The Ministry of Internal Affairs and Communications (MIC) established the Time Business Forum in June 2002 (including 98 members from industry, academia, and the government as of August 2004). This forum defined the new term "time business" to refer to time-related matters in general in the context of today's IT society, and has since been working toward the establishment of a comprehensive time business. The e-Document Law, scheduled to take effect in April 2005, will make it mandatory to certify the integrity of electronic information (of documents, for example). It is anticipated that with these and other developments the importance of time business will only increase.

According to the "Guidelines Concerning Time Business" drafted by the MIC, "the difference between time information and the standard time distributed by NICT must be within a certain range," highlighting the further importance of the role NICT will play in future time business.

Japan Standard Time and time business

(1) Time business

The Time Business Study Group, forerunner of the Time Business Forum, envisioned four types of time-business services (Figure 1):

1) Standard time distribution service for reception: Standard time distribution service by the National Time Authority (NTA)
   Examples: Production of radio-controlled clocks
2) Standard time distribution service for certification: Standard time distribution service by time authorities
   Examples: Distribution of standard time and issuance of certificates to Internet data centers (IDCs), Internet service providers (ISPs), and online game operators, etc.
3) Time-stamping service for storage: Standard time distribution service (for storage) by time-stamping authorities
   Examples: Provision of time information, long-term archival and certification of integrity for electronic charts, business documents, intellectual property, etc.
4) Time-stamping service for transfer: Standard time distribution service (for transfer) by time-stamping authorities
   Examples: Assurance of time in online trading, electronic bidding, etc.

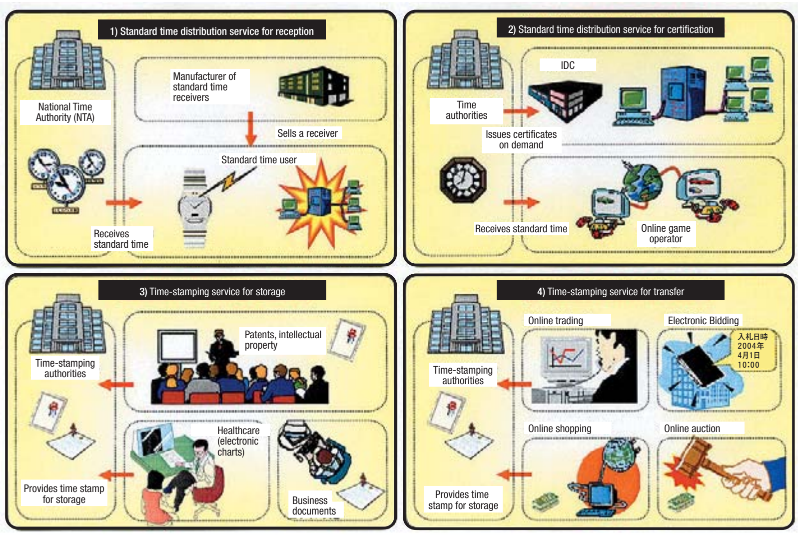
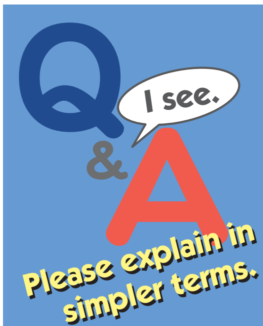


Photo 1: Conceptual Drawing of Time-Business Services
(From Report by Time Business Study Group, MIC)

It would be fair to say that the widespread growth in service 1) in Figure 1 is linked to the sale of more than 15 million radio-controlled clocks to date. Services 2) to 4) are provided in some parts of the country, but they have not yet become established in a busi-



Q What is "time stamping"?

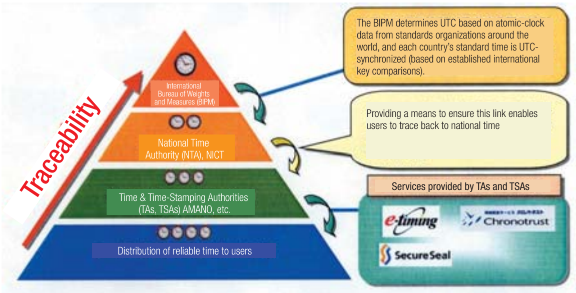
A Time stamping is a means of combining an electronic document or other types of electronic data with time information to certify that the data existed at that time and has subsequently remained intact. A time stamp is an item of information that proves this existence and integrity of data.

Q What is a "low-frequency standard time and frequency signal"?

A NICT determines Japan Standard Time and the national standard frequency, and disseminates these values throughout the country via radio waves, telephone lines, and electronic networks. The standard time and frequency signal is transmitted from two stations: the Ohtakadoya-yama LF Standard Time and Frequency Transmission Station (located in Fukushima Prefecture) and the Hagane-yama LF Standard Time and Frequency Transmission Station (located between Saga and Fukuoka Prefectures). This signal encodes hours, minutes, total number of days elapsed from January 1, Western year (last two digits), day of the week, etc., and is used in super-accurate radio-controlled clocks.

ness sense due to the lack of defining laws or regulations. However, service 3) is likely to grow rapidly after the e-Document Law takes effect in April 2005, as mentioned above.

Figure 2: **Ensuring Traceability**
Users require reliable time linked to national standard time and universal time (UTC).



(2) How to ensure reliable time

When users are provided a time-business service, it is important that they be able to assess the reliability of the time provided by that service.

To prove the reliability of time distributed by a time authority (TA) or a time-stamping authority (TSA), both commercial organizations, it is necessary to ensure the traceability of time to the upper strata shown in Figure 2. It is also important to ensure that users are able to trace the provided time back to the top stratum, representing Coordinated Universal Time (UTC), which is managed by the International Bureau of Weights and Measures (BIPM).

In connection with ensuring this traceability, the "Time-Stamp Protocol RFC3161," a standard for time distribution, stipulates "use of a trustworthy source of time." Additionally, the ETSI TS 102 023 standard applicable to TSA management policy stipulates "synchronization with UTC within the accuracy defined." However, there are no existing standards that include a specific description as to how to ensure traceability.

Future developments

NICT communicates standard time in accordance with Article 13, Paragraph 1.3 of the Law on the National Institute of Information and Communications Technology (Law No.162 of 1999). We are now distributing standard time (Japan Standard Time) using a low-frequency signal for standard time and frequency, Telephone JJY, and experimental NTP Internet servers. JST is used as the source of reference time in time-signal services received by NTT, various television and radio stations, and radio-controlled clocks; JST is thus recognized as an essential component of the Japanese social infrastructure.

Since this is the first time worldwide that standard time will be distributed commercially through TAs and TSAs, various candidate methods have been discussed in the Time Business Forum. It is likely that the Forum will decide on the development of a reliable-time program based on NICT's Japan Standard Time, which is synchronized with UTC with high accuracy. We are thus now working with the MIC and the Forum in the preparation of equipment and various services—for example, provision of observation data for time comparison using GPS satellites (see "*GPS common-view data" below).

With its increasing importance as the National Time Authority (NTA), NICT will shift to a new system for its JST operation after completing an evaluation of both the new and old systems. The

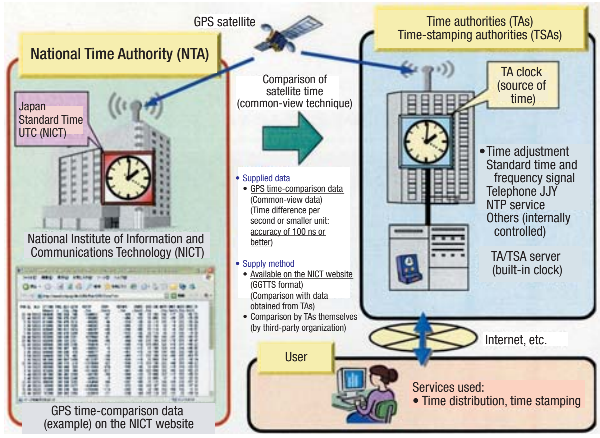


Figure 3: **Method for Distributing Japan Standard Time (Planned)**
UTo distribute reliable time to users, NICT is developing a time-distribution program based on Japan Standard Time, which is synchronized with UTC with high accuracy.

new facility (New No.2 Building) meets strict requirements for installation, operation, and maintenance of equipment, including security measures and anti-earthquake protection. We are also preparing for time distribution from the Kansai Region as a precaution against breakdown of the time distribution system at the NICT Koganei Headquarters.

*GPS common-view data: A technique to measure the time difference between two points by comparing time received from a reference GPS satellite in common view of these points. The BIPM specifies observation schedules on a region-by-region basis and a format

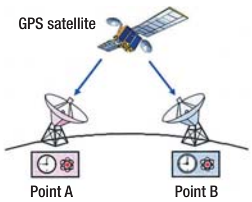


Figure 5: **GPS Common-view Technique**
First, determine the time difference between the GPS and a local clock at two points: A (A to - GPS t) and B (B to - GPS t). Then compare these differences to obtain the time difference between the points A and B: Dto = B to - A to.

Photo 1: **GPS Receiver**

Life & Technology

● Widespread use of electronic documents highlights need for time-stamping and time business

Electronic documents are rapidly becoming more widely used. Time stamping allows you to certify the existence of a document at a certain time and the subsequent integrity of the data. It is likely that electronic documents will gradually come to be viewed as accurate formal instruments based on the increase in time-business services or commercially available time-stamping services. Time stamping is also expected to play an important role in electronic charts, online trading, patent and intellectual property applications, and more.

7th International Symposium on Wireless Personal Multimedia Communications (WPMC'04)

Hiromitsu Wakana
Director of Yokosuka Radio Communications Research Center
Wireless Communications Department

Photo 1: Inaugural Address by President Makoto Nagao at Galileo Great Hall, University of Padova

Photo 2: Opening Ceremony at Galileo Great Hall

Photo 3:
WPMC'04 Logo Modeled after Galileo's Portrait

Photo 4: Symposium Venue

The Seventh International Symposium on Wireless Personal Multimedia Communications (WPMC'04) took place from September 12 to 15 in Abano Terme, Padova, Italy. This symposium was organized by NICT and the YRP R&D Promotion Committee. Sponsors included the University of Padova, the University of Rome, Regione Veneto, and Provincia di Padova. Every year, the WPMC is the first to address the hottest topics in wireless communications technology. The theme of this symposium was "Reconfigurable Heterogeneous Multimedia Wireless Networks and Applications." A heterogeneous wireless network consists of different types of networks, such as mobile-phone networks and wireless LANs. Attention is now being focused on technologies that can flexibly switch among these networks as needed. The symposium dealt with a wide range of issues related to leading-edge wireless technologies—for example, wireless ad hoc networks; wireless IP and QoS (quality of service); seamless connection and mobility management; wireless LANs and PANs; antenna technologies such as MIMO; UWB (ultra-wide band communications); and optical wireless communications.

The symposium consisted of 55 technical sessions. In total, 414 research papers had been submitted and 320 (78%) were presented: 211 oral presentations and 109 displays. The quantity of papers and high adoption rate (78%) attest to the growth of the WPMC as an international symposium. The number of presentations by region was as follows: Asia-Pacific: 108; Europe: 202; North America: 11; and South America: 1. A notable feature of this symposium is seen in the large number of participants from Europe. Compared to 120 participants from Japan, there were 59 attendees from Italy, 27 from Denmark, 22 from Great Britain, 20 from Germany, and 15 from France.

There were three tutorial sessions and a reception on the first day (12th). On the 13th, an opening ceremony was held at Galileo Galilei Great Hall, University of Padova, located 30 minutes from the venue by bus. From 1592 to 1610, Galileo taught in this very hall as a professor of mathematics.

At the opening ceremony, Mr. Makoto Nagao, President of NICT, delivered the inaugural address as the event's organizer (Photo 1). Following a number of guest speakers, Mr. Tatsuo Kito, Director-General for Technology Policy Coordination, MIC, delivered a speech entitled "u-Japan: New Endeavor of Japan." He outlined the u-Japan Initiative, which establishes a future direction for information communications in Japan. In the afternoon, we moved to the symposium venue (Photo 4) for technical sessions. The WPMC gives awards to outstanding research papers. This year, three people received an Outstanding Paper Award, and two received Outstanding Student Awards. An awards banquet was held in the evening of the 14th at Ristorante Relais Golf Montecchia. Consort Veneto, a world-famous medieval music group, played more than ten pieces, including a number of songs based on poems by Petrarch. The songs, narrations, and the sound of medieval instruments enlivened the banquet.

The success of WPMC'04 owed a great deal to the cooperation of those involved. The next symposium, WPMC'05, is scheduled to be held in Aalborg, Denmark.

Report on Thailand Science-Tech

— King Bhumibol and Princess Sirindhorn visit the NICT booth —

Shigetoshi Yoshimoto
Director of Asia Research Center, International Alliance Division
Strategic Planning Department

Visit by King Bhumibol and Princess Sirindhorn

Opening ceremony

NICT booth

NICT attended the Thailand Science-Tech 2004 held from October 15 (Fri) to 23 (Sat) in Bangkok, Thailand, where we has the privilege of explaining our exhibits to the King of Thailand.

With the aims of promoting education and development in science and technology, Thailand Science-Tech takes place in October (during school holidays) every year at the IMPACT exhibition hall in a suburb of Bangkok. This exhibition, which is organized by Thailand's National Science and Technology Development Agency (NSTDA), is equivalent to the events held during Science and Technology Week in Japan. Since this year marks the bicentennial of the birth of King Mongkut (Rama IV), viewed as the father of science and technology in Thailand (The King Mongkut Institute of Technology Ladkrabang, or KMITL, a successful example of Japanese ODA, is named after him), the opening ceremony was a grand event, attended by none other than King Bhumibol (Rama IX).

After the opening ceremony on Tuesday, October 19, King Bhumibol and Princess Sirindhorn toured the exhibition hall with Thai Prime Minister Thaksin, Science and Technology Minister Korn, and Dr. Pairash, Permanent Secretary of the Ministry of Science and Technology. At the NICT booth, our exhibits described NICT, the NICT Asia Research Center, and the Thai Computational Linguistics Laboratory (TCL). We also conducted demonstrations of an "IP Controlled Car" based on innovative network technology. We had prepared a track with a total length of 25 meters, occupying more than half of our booth area of 160 square meters. We demonstrated a 1/10-scale remote-controlled model car using Internet Protocol technology. If you manipulate this car from a remote console, watching the images sent from the car-mounted camera, you feel as if you were actually driving. King Bhumibol came to our booth accompanied by Mr. Ozu, First Secretary of the Embassy of Japan, and others. While Mr. Yasunari, Vice President of NICT, explained our exhibits briefly, I conducted a demonstration. Dr. Virach, Co-Director of TCL, served as interpreter. His Majesty asked us questions about the applicability of the exhibited technologies, and Mr. Yasunari answered that these technologies held great practical potential.

Thailand is implementing a policy to enrich the country through the promotion of education and science and technology. Not just students but many ordinary citizens show a remarkably high interest in science and technology. This exhibition, held at a vast site of 47,000 square meters, drew nearly 1.03 million people, including 130,000 during four days devoted to students prior to the actual event. There were nearly 300,000 visitors on the final day alone. This was partly because it took place on a Saturday, but the enthusiasm of the people in Thailand for this event was, I believe, in clear evidence.

Report on 3rd e-VLBI Workshop

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Kashima Space Research Center, Applied Research and Standards Department

On October 6 and 7, the third e-VLBI Workshop took place at Makuhari Prince Hotel. Sixty-seven people from 13 countries attend this workshop to present their research results and to exchange views. This was the first time that this annual workshop was held in Japan. The first of these workshops was held in 2001 at the Haystack Observatory at the Massachusetts Institute of Technology in the US. NICT served as the Secretariat of this year's workshop. e-VLBI is a technique to transmit enormous amounts of VLBI observation data (used in space geodesy and radio astronomy) over a high-speed network. This eliminates the need to transport the data otherwise and greatly reduces processing times. e-VLBI is also designed to improve sensitivity dramatically relative to conventional observation techniques. This is a typical example of a breakthrough in scientific observation and measurement as a direct result of revolutionary progress in information communications technologies. This workshop made me realize afresh the importance of NICT's role in developing leading-edge technologies for information communications as well as for scientific observation and measurement. In closing, we would like to express our gratitude to all of the participants and those who offered their assistance in this event.

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