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# NICT NEWS

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# Consistent R&D Promotion from Basic Research to Commercialization Support

## — Establishment of Research and Development Promotion Units —

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Executive Director, Strategic Planning Department

## 1. Objective of Research and Development Promotion Units

Already a year has passed since the launch of the National Institute of Information and Communications Technology (NICT) on April 1, 2004. During this period, we have been working to create an efficient support system for R&D of information and communications technology (ICT) for the coming ubiquitous network society, through the consolidation of the tasks of NICT's predecessors: the Communications Research Laboratory (CRL) and the Telecommunications Advancement Organization of Japan (TAO). Based on this system, we intend to accelerate all stages of R&D activities, from basic research through support for commercialization, in an integrated and consistent manner, with the ultimate goal of a safer and more prosperous future society. As shown in Figure 1, we are now focusing on specific programs in four strategic fields.

Last December, we created a system of cross-departmental research and development promotion units. The main objective of these units is to ensure that these programs are carried out in a consistent manner at all stages of R&D, from basic research through support for commercialization.

## 2. Overview and Structure of Research and Development Promotion Units

The table shows an overview of the six research and development promotion units we have established to date. Programs corresponding to these units are underlined in Figure 1. Some of these programs include research fields that were inherited from the CRL or TAO. Other programs were set up as a result of consolidation and streamlining; it was felt that these programs could be carried out even more efficiently through cross-departmental cooperation.

**NICT determines the four strategic areas and concentrates resources on key research subjects, instead of allocating all resources equally**

→ Promotion of various programs activating its overall functions of R&D and stimulating projects

**New ICT**

Building the "foundation" for a new ICT originating from Japan

NICT conducts uniquely Japanese R&D activities with originality and foresight, to realize a "global standard" for the future ICT society.

- Ubiquitous broadband program
- Mobile ICT program
- Content utilization program
- Human communications program
- Photonic network program

**Infrastructure for ICT Society**

Creating the desired "security and safety" for the ICT society

NICT conducts R&D activities seeking to establish "security and safety" for the future ICT society, specifically in the areas of citizens' life, social living, international society, and the global environment.

- Information security program
- Time and positioning measurement program
- Electromagnetic compatibility and radio wave resource development program
- Advanced broadcasting program
- Environment, measurement, and space weather program

**Challenge**

Sowing the "seeds" for Japan in 10 to 20 years to come

NICT conducts advanced R&D activities from a long-term perspective, in order to exploit the future of the citizen's life and to secure the stable growth of Japan's industry and economy.

- Nano-ICT program
- Bio-ICT program
- Optical/quantum communications program
- Space technology program

**Testbed and Promotion**

Creating the "magic wand" that makes technology flourish

NICT actively involves itself in research and business support activities in the private sector and so on, to create new business services through the practical use of technology.

- R&D network program
- Application platform program
- Private-sector basic technology research promotion program
- New business creation and nurturing program

Figure 1: NICT's four strategic fields and their associated programs

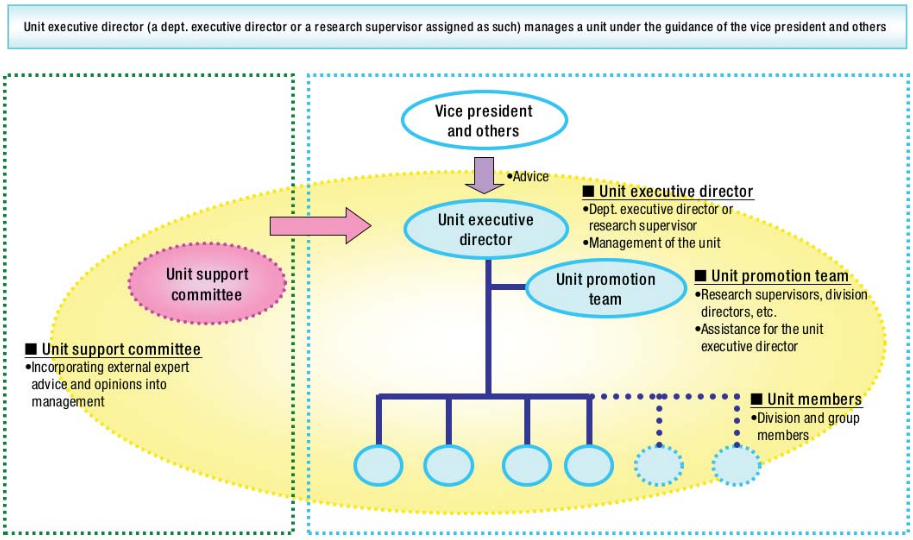



Figure 2: Structure of research and development promotion unit

Figure 2 shows the structure of a single promotion unit. Each unit is managed by its executive director, who is a department executive director or research supervisor. The unit executive director is assisted by a unit promotion team consisting of research supervisors, division directors, and group leaders. Unit members are assigned from various divisions and groups across multiple departments. To incorporate external knowledge and advice, a given unit may be provided with a support committee of external experts. Based on this structure, we are working to increase the openness and relevance of these research and development promotion units.

In addition, vice presidents or other senior management members oversee certain units closely and directly, providing advice and guidance.

## 3. Plans for the Future

To carry out NICT activities in an even more integrated and efficient manner, we are planning to establish new promotion units to carry out additional programs based on our experience in operating the six current promotion units. Applying the external advice and opinions we have received, and based on NICT's second medium-term plan, we intend to operate these units such that their objectives can be achieved more effectively.

Table: Overview of research and development promotion units

| Unit name | Role/objective | R&D subjects | Main departments in charge |
|---|---|---|---|
| New-Generation Mobile Unit | • Promotes development of technologies for next-generation mobile communications systems<br>• Working toward society-wide ease of use in wireless communications services | Devices and constituent technologies for: media handover, wireless security platforms, ultrawideband mobile transmissions, and software-defined radio | Wireless Communications Dept.<br>Research and Development Promotion Dept. |
| Photonic Network Unit | • Promotes development of technologies to perform all processing of network information transmission within the optical domain<br>• Working toward an ICT infrastructure for a broadband, ubiquitous society, using even higher capacity optical communications network technology | Ultrahigh-speed photonic network technology such as high-density WDM and all-optical nodes; control and management of terabit-class networks; and basic technologies for petabit-class networks | Information and Network Systems Dept.<br>Research and Development Promotion Dept. |
| Information Security Unit | • Promotes R&D of cryptography, authentication, and other technologies for protecting networks against disasters or cyber attack<br>• Aims to enhance security in Japan | Measures against various incidents; ICT for: disaster prevention and mitigation; content security; and information security (cryptographic evaluation, verification, etc.) | Information and Network Systems Dept.<br>Research and Development Promotion Dept. |
| EMC Unit | • Promotes development of technologies for an electromagnetic environment that is safe both for people and for communications systems, within a ubiquitous network society featuring a great number of wireless terminals<br>• Aims to solve EMC (electromagnetic compatibility)-related problems in Japan | Assessment of biological effects of electromagnetic waves; electromagnetic security technology; technology for precise measurement of electromagnetic waves; EMC technology between communication systems | Wireless Communications Dept.<br>Collaborative Research Management Dept. |
| Optical and Quantum Communications Unit | • Promotes development of technologies for next-next-generation optical communications and undeveloped research fields such as quantum cryptography and quantum information communications<br>• Working to open up pioneering possibilities in optical communications in Japan | Optical device technology conducive to dramatic improvement in performance of optical communications; constituent technologies for quantum cryptography and quantum information communications | Research and Development Promotion Dept.<br>Basic and Advanced Research Dept. |
| R&D Network Unit | • Promotes development of network and application technologies with an R&D network involving collaboration between network operators and researchers<br>• Working to upgrade next-generation networks | Maintenance and operation of R&D networks such as JGNII; promotion of R&D; academic contributions through international collaboration; support for commercialization; and support for research on new network applications | Collaborative Research Management Dept.<br>Information and Network Systems Dept. |

# Stratospheric Wireless Platform

## – Gigantic ICT Base Floating at an Altitude of 20 km
## – Communications and Broadcasting Missions –

**Communications and Broadcasting Team, Yokosuka Stratospheric Platform Research Center**

The Yokosuka Stratospheric Platform Research Center and the Wireless Innovation Systems Group (Yokosuka Radio Communications Research Center) are jointly conducting this project, with the cooperation of many other organizations and experts. The following team members are engaged in R&D and demonstration experiments: Mikio Suzuki, Yoji Morishita, Yozo Nakamura, Hitoshi Kida, and Masaaki Maruyama (of the Yokosuka Stratospheric Platform Research Center); and Ryu Miura, Hiroyuki Tsuji, Mamoru Nagatsuka, Masayuki Oodo, and Takayuki Morisaki (from the Wireless Innovation Systems Group).

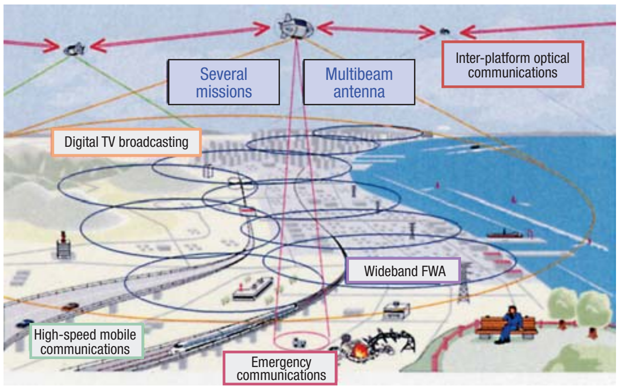



Figure 1: Stratospheric platform wireless system

## Introduction

Efforts are underway in Japan and other countries to build stratospheric platforms. The concept is to have a large communications structure that can remain below satellite altitudes for extended periods of time covering a wide service area. Such platforms have yet to reach practical deployment, with technology currently under development for the production of the requisite film materials, batteries, and other components. In this article, we will describe the Stratospheric Platform Project in Japan, which began in FY 1998, and provide an overview of the progress, results, and future direction of R&D in communications and broadcasting.

## What is a stratospheric platform?

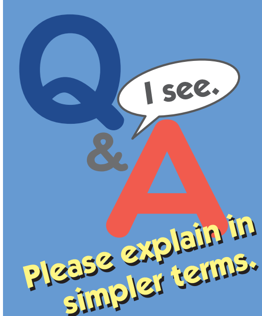
A stratospheric platform (SPF) is built on an unmanned airship or airplane that flys in the stratosphere at an altitude of about 20 km. This platform can be moved to desired positions as necessary for use as a wireless/optical base for communications and broadcasting as well as Earth observation and monitoring. It is believed that the entire area of Japan could be covered using 10 to 20 platforms, depending on the application. Figure 1 is a conceptualization of an SPF wireless system. Such a system has the following advantages:

(1) High visibility and small propagation delay;
(2) Outstanding EMC performance (low-power transmission)
(3) Cost-effective and low-risk (possible in temporary operation, low launch risks)
(4) Flexibility (movable, recoverable, relaunchable)

With these advantages over conventional satellite and ground-based systems, SPFs have the potential to form an innovative infrastructure for communications and broadcasting. These features will permit the establishment of a high-capacity optical backbone between platforms, enabling simultaneous provision of services ranging from fixed/mobile communications to TV broadcasting, through the use of radio links at various frequencies between platforms and users. Moreover, SPFs can be applied to radio-wave monitoring and observation of the Earth's environment and weather.

## Progress in communications and broadcasting R&D

NICT, the Japan Aerospace Exploration Agency (JAXA), and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) are jointly pursuing R&D of stratospheric platforms in Japan. NICT (through its Yokosuka Stratospheric Platform Research Center and Wireless Innovation System Group) is in charge of communications and broadcasting R&D. We completed development of on-board and ground-based equipment before the end of FY 2001. In FY 2002, we conducted basic experiments on digital broadcasting and other experiments on IMT2000 mobile communications from the stratosphere at an altitude of 20 km, using a solar plane instead of an airship. We also conducted pre-flight tests using a helicopter hovering at an altitude of 3 km and a jet plane flying at an al-




**Q** Why did the test flights take place in Taiki, Hokkaido?

**A** For airship takeoffs and landings, we had to select a site with a large, airport-like area and stable weather conditions, particularly winds. In this sense, Taiki was an ideal location. Although this town is located in Hokkaido, it has light snowfall and moderate winds. We used a vast test facility featuring a multipurpose aero park with an area of 470,000 m2 and a 1,000-meter runway. Research institutes and private companies have been using this facility for flight tests of prototype planes because its airspace is a suitable distance from commercial flight routes.

**Q** Are stratospheric platform tests also being carried out in other Asian countries?

**A** South Korea and China are actively conducting research in this field. For example, a group of organizations led by the Korea Aerospace Research Institute (KARI) succeeded in flying a 50-m-class airship at an altitude of 150 m in November 2003. In China, a group of organizations led by Shanghai Jiao Tong University also succeeded in flying a 50-m-class airship. Moreover, it has been reported that the Advanced Technologies Group in the UK has proposed a stratospheric flight project to the Malaysian government and that the latter has already begun construction of an airship factory.

titude of 12 km. Then, in FY 2004, we conducted a station-keeping test flight using an airship. Table 1 shows the development schedule for the communications and broadcasting missions.

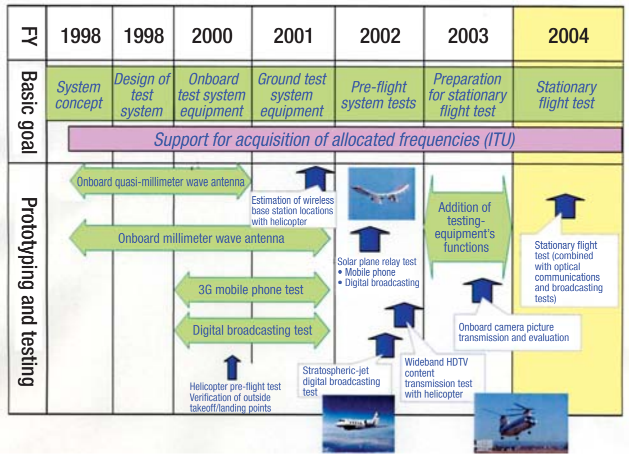



Table 1: Development schedule for communications and broadcasting missions

**• Verification experiments using a solar plane**

In collaboration with a US team consisting of NASA, AeroVironment, and SkyTower, we conducted the world's first tests of UHF digital high-definition TV broadcasting and a third-generation mobile communications system, using NASA's Pathfinder Plus high-altitude solar plane (see Photo 1) in the stratosphere. This test took place at a US Navy facility at the west end of Kauai, Hawaii in June and July 2002. We succeeded in video transmission (64 kbps) using a commercial W-CDMA mobile terminal and reception of HD TV broadcasting on the ground using only 1 W of power in the onboard transmissionequipment. We were thus able to demonstrate the practicality and efficiency of stratospheric platforms.

Photo 1: Pathfinder Plus

**• Demonstration experiments with station-keeping test flight**

We conducted a stationary flight test using a stationary flight test model (unmanned airship with an overall length of 68 m) developed by JAXA at the aero park in Taiki, Hokkaido from September to November 2004. Along with this test, we conducted three experiments on communications and broadcasting: terrestrial digital broadcasting, estimation of wireless base station locations, and optical communications. Photos 2 and 3 show this station-keeping test flight. The airship that carried the communications and broadcasting equipment performed three test flights ((1) a basic flight at 600 m on Sept 24; (2) a high-altitude flight at 4 km on Nov 19; and (3) station-keeping flight at 4 km on Nov 22). On the second and third flights, we successfully conducted the three demonstration experiments, obtaining valuable data in the process.

Photo 2: Test equipment (antennas)

Photo 3: Flight test

## ITU-related activities

As part of our efforts toward the establishment of stratospheric platforms, we are currently focusing on the international allocation of frequencies for wireless communications. In 1997, the ITU World Radiocommunication Conference (WRC) defined a stratospheric wireless station as a "high-altitude platform station (HAPS)" and allocated millimeter-wave bands (47/48-GHz bands) for the first time. Under the guidance of the Ministry of Internal Affairs and Communications, Japan has been active in submitting proposals to the WRC and as a result has secured a number of quasi-millimeter and other frequency bands for HAPS use.

## Conclusion

To date we have undertaken development efforts toward the ambitious goal of establishing a system of airships floating in the stratosphere, powered by a clean energy source, to be used in next-generation information communications as well as in Earth observations and monitoring. Through these efforts we have succeeded in performing demonstration experiments not only in communications and broadcasting but in other fields of application as well. In the United States, the Missile Defense Agency (Department of Defense) is developing a stratospheric airship in collaboration with Lockheed Martin Corporation. Similarly, in Europe, a group of organizations led by the University of York (UK) is undertaking the CAPANINA project. In the future , we will work with NASA and other organizations in the US and Europe to increase the global potential of our wireless technologies. We are also planning to carry out R&D to investigate possible new applications for SPF, notably disaster-prevention activities.

**Life & Technology**

### ● Significant advantages of stratospheric platforms at times of disaster

Stratospheric platforms are expected to form the third major infrastructure for communications and broadcasting, after terrestrial and satellite systems. SPFs are also expected to be useful in the event of an earthquake or other large-scale natural disaster. As with satellites, SPFs will be completely isolated from the effects of disasters on the ground. Moreover, SPFs will enable wideband transmission using more compact devices and fewer base stations. With superior flight endurance relative to airplanes and helicopters, SPFs have the potential for a variety of uses at the time of a natural disaster—such as monitoring of the disaster area, data transmission, traffic control and guidance for emergency vehicles, provision of search-related information, mobile communications, and emergency broadcasting.

Mamoru Ishii
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Applied Research and Standards Department

# NICT Outreach Activities


Lecture using the Internet (Maebashi High School)


Discussion with young researchers (Maebashi High School)


Fabrication of electronic circuitry (Tatebayashi High School)


Training in Internet use (teacher training)

NICT is currently educating tomorrow's leaders as part of its various educational campaigns in science and technology. Today we can witness a range of outreach activities such as the Science Partnership Program (SPP) of the MEXT (Ministry of Education, Culture, Sports, Science and Technology). The phrase "outreach activity" has recently been used to refer to any activity through which researchers or research institutes communicate their research results to young people and educators in an understandable way. In this article, I'll report on some of the outreach activities carried out by NICT in FY 2004.

Through the efforts of the Society of Geomagnetism and Earth, Planetary and Space Sciences (SGEPSS), our group formed a partnership with the Gunma Prefectural Education Board to carry out outreach activities targeting schoolteachers in FY 2003. We then included high school students in the target audience and carried out five sets of these activities in FY 2004.

In November 2004, 45 sophomore students from the Maebashi High School took a bus trip to visit NICT. At their request, we had prepared a program with an emphasis on exchanges with our young researchers. Following a NICT overview presentation in the Exhibition Room, the students attended a lecture I delivered on measurements of the arctic environment. They were then divided into small groups and had free discussions with our researchers specializing in upper-atmosphere research and space weather. Finally, together we summarized these discussions.

In November and December 2004, we also carried out outreach activities at Tatebayashi High School. In collaboration with the Space Weather Group, we had prepared a three-day program with an emphasis on hands-on learning (first day at NICT; second and third days at the high school). In accordance with SPP, the objective of this program was to provide high-school students with hands-on experience at leading-edge research sites. On the first day, 25 sophomore students took a bus to the NICT Koganei Headquarters. In the morning, they attended a space-weather class that consisted of a lecture by Dr. Nagatsuma (Senior Researcher) and a number of activities. In the afternoon, the students visited the Exhibition Room, the Space Optical Communication Research Center, and learned about ground-based cloud profiling radar. I then gave a lecture mainly dealing with remote-sensing technology. On the second day, the students practiced network-based space weather forecasts in the high school's Internet Lab Room. On the third day, students practiced making ultrasonic sensors, as they learned the basic principles of remote sensing. After making sensors, the students enthusiastically performed experiments (e.g., using these sensors to measure distances, and observing signals using an oscilloscope).

To develop a training program for high-school teachers, Dr. Kubota (Senior Researcher) and other group members prepared programs designed for ready use as teaching materials. In collaboration with the Gunma Prefectural Education Board, in December 2004 at NICT we held a training session on observing auroras and the arctic region using the Internet, inviting teachers who had applied in advance. The participants were eager to learn these programs, and we were struck by the educators' enthusiastic expectations of their NICT experience.

To date individual research groups have been carrying out these activities independently. Starting in FY 2005, however, the Public Relations Division will serve as the primary contact for NICT outreach activities, a move that is expected to promote these activities even further.

Shinichi Watari
Group Leader
Space Weather Group, Applied Research and Standards Department

# Space Storm in January

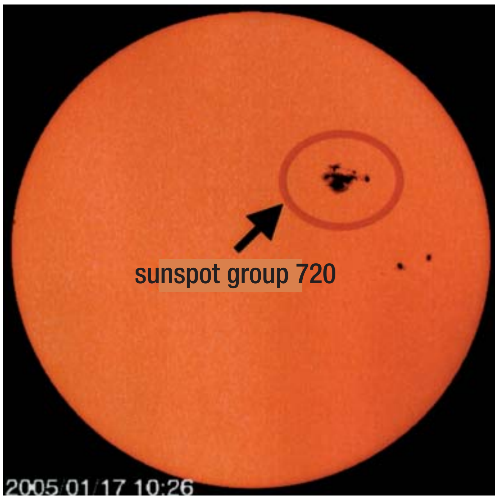


Figure 1: Sunspot group 720 observed by the SOHO Satellite (Courtesy of NASA/ESA)

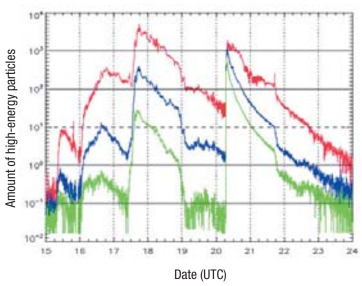


Figure 2: Amount of high-energy particles observed by GOES Satellite between January 15 and 23, 2005 (Courtesy of NOAA/SEC)

The red, blue, and green lines show the amounts of particles with energy levels not less than 10 MeV, 50 MeV and 100 MeV, respectively. Due to solar flares, the amount of high-energy particles increased 10,000 to 50,000-fold on January 17, 18 and 20, relative to quiet periods.

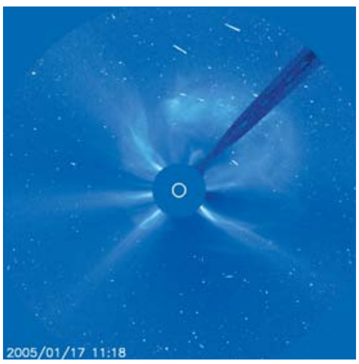


Figure 3:
Coronal mass ejection (CME) observed by SOHO Satellite (Courtesy of NASA/ESA)

Solar activity waxes and wanes in an 11-year cycle. The most recent solar maximum was in 2000, and there will be a solar minimum from 2006 to 2007. This means that activity is currently decreasing toward a minimum. However, major space environmental disturbances (space storms) have occurred with some frequency in the past few years: in late October 2003, early November 2004, and mid-January 2005. There are various types of space storms, with parallels in the way some typhoons cause heavy rainfalls while in other cases damage is caused mostly by strong winds. In the case of the space storm in November 2004, the amount of high-energy particles did not increase significantly, but a south-pointing strong magnetic field within the solar winds interacted with the Earth's magnetic field to cause a large geomagnetic storm. As a result, a reddish low-latitude aurora was observed at night on November 8 and 10, even in Japan. In contrast, the space storm in mid-January of this year did not cause a large geomagnetic storm, but the amount of high-energy particles was large.

Figure 1 shows sunspot group 720, which caused this space storm. Around January 13, this group started to grow rapidly, accompanied by frequent explosions (flares) on the sun's surface and coronal mass ejection (CME). Around January 22, the group moved to the other side of the sun. Figure 2 shows the amount of high-energy particles observed by the US satellite, GOES. Due to a flare on January 17, the amount of high-energy particles increased nearly 50,000-fold relative to quiet periods. Figure 3 shows the CME caused by this flare, observed by the SOHO Satellite. Along with this CME, very fast solar winds with a velocity of nearly 1,000 km/s were observed near the Earth. However, because of the direction of the magnetic field within the solar winds, there was little interaction with the Earth's magnetic field, and therefore no large geomagnetic storm was observed. Due to a solar flare on January 19, the amount of ultrahigh-energy particles increased for the first time in 15 years (since October 1989). In addition, the ground-based observation network observed one of the largest increases in cosmic rays in the current solar activity cycle. Some satellites were adversely affected by this space storm. For example, NASA's ACE Satellite became unable to observe solar winds because the amount of high-energy particles had increased beyond peak observation levels.

As the space weather forecast center of the International Space Environment Service (ISES), NICT provides forecasts on a daily basis. When the space storm occurred in January, we issued an alert to users through the Internet and via fax. For more information on space weather forecasts, visit the Space Environment Information Service (http://hirweb.nict.go.jp/index-j.html) or Space Weather News (http://swnews.nict.go.jp/).

# Phuket International ICT Conference
## — Global Warning and Disaster Recovery Management Based on Tsunami Experience —

Kiyoshi Igarashi
Director, International Alliance Division,
Strategic Planning Department

From February 17 to 19, 2005, the First International ICT Conference took place in Phuket, Thailand, an area hit by the massive tsunamis last year. NICT Vice President Shiomi was invited to this conference by the organizer, the Thai ICT Ministry. Although this conference was an opportunity for the ICT community and various experts to discuss solutions for global warning systems and management of recovery from disasters such as tsunamis, another significant aim was to demonstrate the extent to which Phuket had recovered, in its ability to host tourists and international events. Sponsored by private ICT companies, this conference was a large one, with some 1,000 participants. On February 18, the conference began with a welcoming address by Thai ICT Minister Surapong. Along with eminent guest speakers such as Mr. Houlin Zao, Director of ITU-T, and Mr. William (Bill) H. Gates, Chairman of Microsoft (videotaped), Dr. Shiomi, Vice President of NICT, gave a keynote speech on the ICT's role in anti-disaster measures. He presented specific examples of communications systems for disaster warning, forecast, and relief in Japan, as well as an explanation of NICT remote-sensing technology R&D aimed at disaster monitoring and a description of communications technologies R&D for application in disaster.

Dr. Shiomi also mentioned the commitment of the Japanese government and NICT to information sharing and analysis, network test beds, and international cooperation, and emphasized the importance of establishing a system for international coordination and cooperation against disasters like tsunamis. Since these topics were obviously of significant relevance to Thai citizens, Dr. Shiomi was interviewed by a number of major local newspapers after his speech. The Thai TV station Ch5 also requested our cooperation in planning programs featuring ICT. The conference session featured presentations by sponsor company representatives and lively discussions on the subject of IT solutions in disaster management and emergency communications.

Dr. Shiomi's keynote speech

Interview by major Thai papers after speech

ICT Minister Surapong presenting commemorative gifts to the keynote speakers

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