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情報通信研究機構
NICT NEWS
National Institute of Information and Communications Technology

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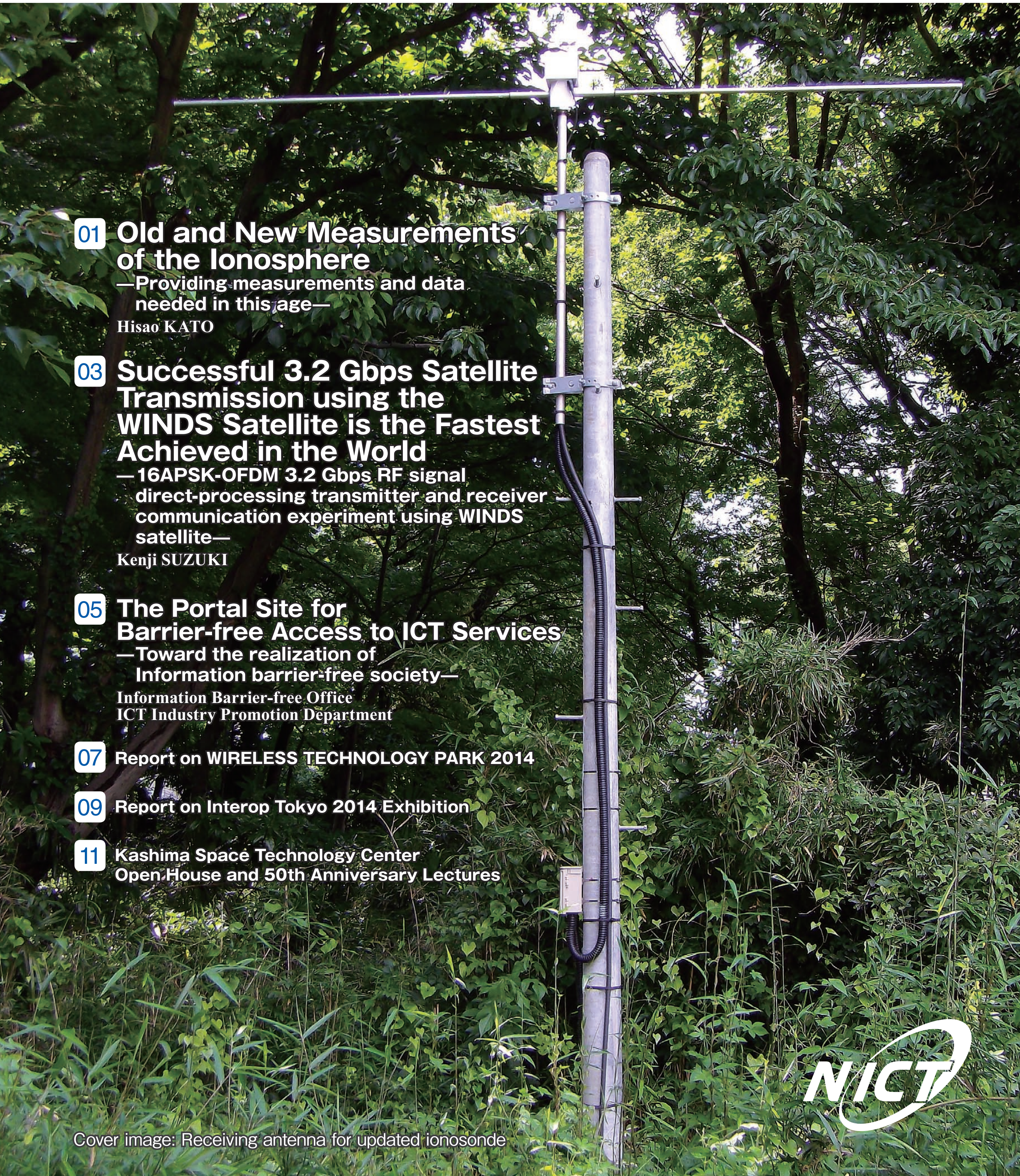
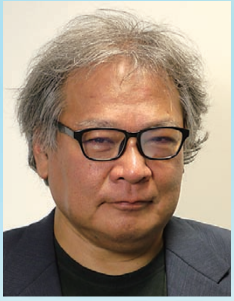


Cover image: Receiving antenna for updated ionosonde

NICT

Old and New Measurements of the Ionosphere

—Providing measurements and data needed in this age—



Hisao KATO

Senior Researcher
Space Weather and Environment Informatics Laboratory,
Applied Electromagnetic Research Institute

Joined the Communications Research Laboratory, Ministry of Posts and Telecommunications (currently, NICT) in 1975.
Engaged in development of ionosonde and observation information systems.

Introduction

The ionosphere is the upper atmosphere, extending from about 60 km to 1,000 km above our heads. It is generated mainly by energy from the sun. NICT and its predecessors have been conducting observations of the ionosphere, gathering and analyzing a variety of characteristic data, for more than 80 years. The published measurement data has been an important source of information for efficient short-wave wireless communication for a long time. Recently, it has also been used as a source of information regarding abnormal behavior in the ionosphere, called ionospheric disturbances, including the following:

(1) Positive ionospheric storms and ionospheric irregularities causing propagation delay and attenuation when GPS and communications satellite signals pass through the ionosphere, causing measurement error and data degradation.

(2) Negative ionospheric storms, Dellinger phenomenon, and winter anomalies cause short-wave signals to be attenuated when reflected by the ionosphere, interrupting marine and aviation radio and overseas broadcasting.

(3) The sporadic E layer can cause short-wave and ultra-short-wave signals to reflect from the ionosphere, resulting in long-distance propagation, and abnormal reception of disaster-prevention and other radio signals.

Understanding of such ionospheric disturbances is becoming more important for predicting their effects on error correction for advanced applications of GPS satellites and short-wave communications, and access to the ionospheric data Web server, operated by this laboratory to provide data outside of NICT, has increased to several tens of millions per year.
(Reference URL: http://wdc.nict.go.jp/IONO/index_E.html)

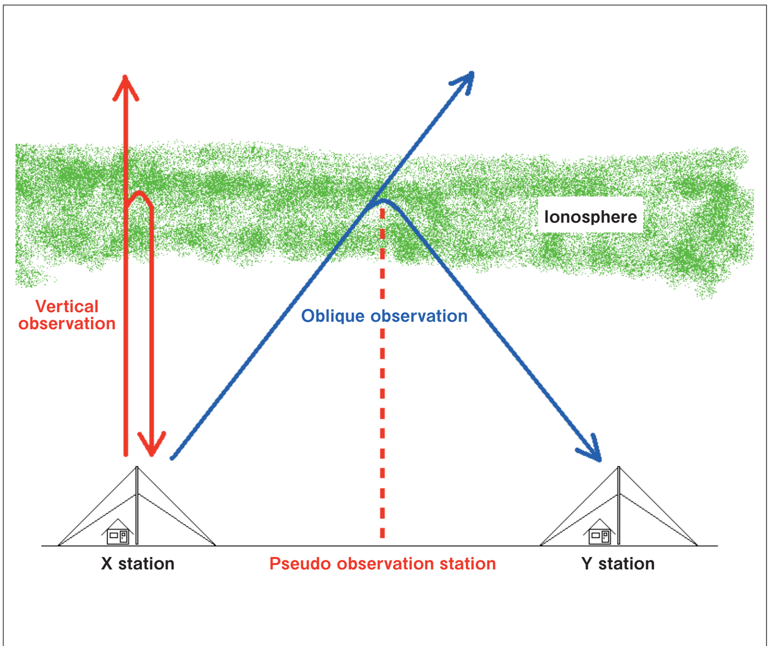


Figure 1 Oblique ionospheric observations between stations

Ionosphere observation changes and existing infrastructure update plans

Ionospheric observation and processing of observed data has undergone many changes through its long history at NICT. Many of those changes have been to automate observation processes that were completely manual (manual observations require time, so correct results cannot be obtained when changes in the ionosphere are intense) or to automate information processing (since observations are more useful if results can be provided quickly). Currently, processes from observation to publishing are mostly automated, except for some detailed analysis and handling device failures, which can only be done manually.

Oblique (passive) observations with other stations, which require precise time synchronization, have also stabilized, and a number of pseudo-observation stations have been successfully added without building additional observation facilities. The principle of oblique observations between stations is shown in Figure 1. Normally, station X receives the signal that it transmits itself to investigate the ionosphere directly above the station, which is called a vertical observation. An oblique observation is when station Y is precisely synchronized with station X and receives its observation signal to investigate the ionosphere above the propagation path. NICT has four observation points throughout Japan, as shown in Figure 2 (red circles), but by using oblique observations, observations from six additional pseudo-observation stations (blue circles) are possible.

Ionosphere observation equipment

Ionosphere observations are done with equipment called an ionosonde. The primary observation data obtained using

Figure 2 Perpendicular and oblique observation points (created on a map from the Geospatial Information Authority)
Red : Four perpendicular observation points in Japan
Blue: Six pseudo observation points from the oblique observations between stations

an ionosonde is called an ionogram. An example of observation data obtained using existing ionosphere observation equipment is shown in Figure 3. The horizontal axis is frequency (1 to 30 MHz), the vertical axis is the apparent ionosphere altitude (0 to 1,000 km), and the color indicates the relative strength of the reflection (0 to 255). The graph shows what signal frequencies are reflected to what degree by the ionosphere at what altitudes at the time of the observations. The ionosphere observation equipment emits radio pulses upward, which are then reflected from the ionosphere and can be received on the ground. The apparent height of the reflection can be determined from the delay in these signals.

However, due to observation with existing equipment, the observation data obtained includes a large amount of interference noise (vertical lines in Figure 3) mixed with the two types of reflection (normal and abnormal) that are the main components of the observation data, so it has been difficult to analyze and understand disturbances in the ionosphere accurately. In Figure 3, the bow-shaped data in the 5 to 10 MHz range is a mix of normal and abnormal signals due to multiple propagation modes in ionospheric plasma.

As such, our laboratory is updating our ionospheric observation equipment and receiver antennas during the period of the third medium-term plan of NICT (FY2011 to FY2015). When this infrastructure update is completed, it will be easier to automatically analyze observation data and highlight the primary components, and this will enable a highly accurate understanding of ionospheric disturbances. An example of the data that can be obtained after updating the observation infrastructure is shown in Figure 4. With the new equipment, interference noise is eliminated, the main components of the data are divided into the normal (red component) and abnormal (green component) signals, and accurate data can be obtained.

Future initiatives and prospects

To organically integrate the accumulated technology cultivated earlier with the features of the updated ionosphere measurement equipment, and to publish current, accurate information at short intervals in near-real-time automatically, is a new change in ionosphere measurement at NICT. It will of course contribute to ionospheric research and space weather forecasting, and we have confidence it will also provide useful information to those actively using reflections of radio waves from the ionosphere, for short-wave communication or broadcasting, as well as those who see the propagation delay and drop in electrical field strength when passing through the ionosphere as a problem, such as GPS or communication satellites.

We are also currently planning to digitize the ionospheric observation data held by NICT on paper and film media, which is an academic and historical cultural inheritance, and publish it widely on the Web. This data can also be used effectively as a basic resource for reading long-term changes in ionospheric phenomena and the global environment in the past.

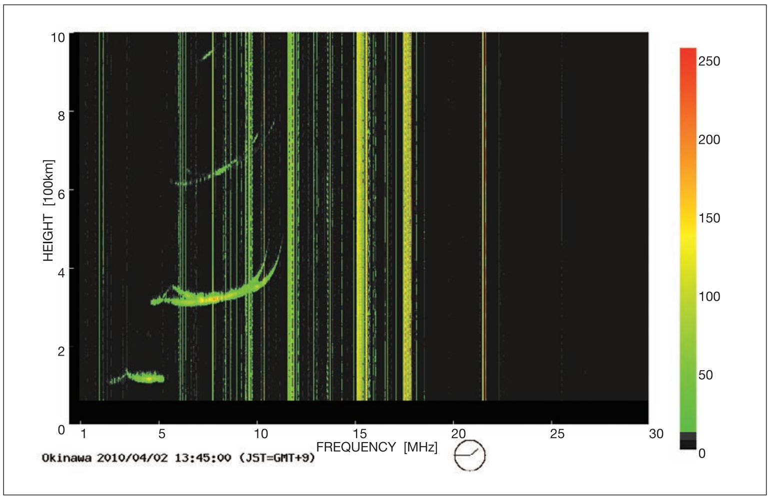


Figure 3 Observation data obtained using existing ionospheric observation equipment

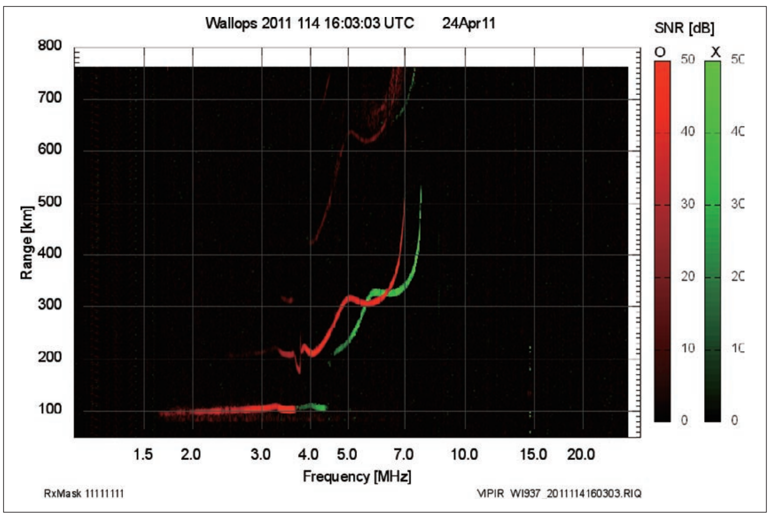


Figure 4 Observation data obtained after updating the observation infrastructure

Successful 3.2 Gbps Satellite Transmission using the WINDS Satellite is the Fastest Achieved in the World

—16APSK-OFDM 3.2 Gbps RF signal direct-processing transmitter and receiver communication experiment using WINDS satellite—

Kenji SUZUKI

Senior Researcher, Space Communication Systems Laboratory
Wireless Network Research Institute

He joined the Radio Research Laboratories (RRL), Ministry of Posts and Telecommunications (currently NICT) in 1983. Since then, he has engaged in research on satellite control technology, mobile satellite communication, the Multimedia Virtual Laboratory, development of JEM/ICS, research using a small satellites, and research on optical and millimeter-wave multi-feeder links.
He transferred to National Space Development Agency of Japan (NASDA; currently JAXA) from 2001 to 2004.

Introduction

NICT is conducting R&D on high-speed satellite communications using Wideband InterNetworking engineering test and Demonstration Satellite KIZUNA (WINDS), which was launched in 2008. Four years ago, single-carrier transmission at 1.2 Gbps was achieved by maximizing use of the 1.1 GHz bandwidth of KIZUNA's Ka-band bent-pipe relay mode. Later, we further developed a 16APSK 750 Mbps RF signal direct-processing transmitter and receiver to make the reconfigurable communication equipment smaller and lighter, with the goal of implementing broadband transmissions using KIZUNA.

16APSK-OFDM 3.2 Gbps RF signal direct-processing transmitter and receiver

We have developed a 3.2 Gbps RF signal direct transmitter and receiver using multi-level modulation and orthogonal frequency-division multiplexing, and more specifically, 16-ary amplitude and phase modulation/orthogonal frequency division multiplexing (16APSK-OFDM). Specifications are shown in Table 1.

16APSK modulation maps a signal onto two concentric circles with four points on the inner circle and 12 points on the outer circle, as shown in Figure 1. Data values are determined by their position, so one of 16 values (4 bits or 4 symbols) of information can be sent at a time. With a single carrier, the bandwidth spreads out and equalizer coefficients must be adjusted to cancel the effects of group delay due to the earth station communications equipment, satellite channel and satellite transponder characteristics, but with OFDM, the bandwidth of each carrier is narrow, so these effects are small.

16APSK-OFDM 3.2 Gbps RF signal direct-processing transmitter and receiver communication experiment using "KIZUNA" (WINDS)

We used the KIZUNA large-scale in-vehicle earth station (Figure 2) to conduct satellite communication experiments, directly modulating an RF signal with 16APSK-OFDM. Figure 3 shows the experimental concept. MOD (modulator) and DEMOD (demodulator) in Figure 3 are high-performance FPGA processing boards which are the core of the 16APSK-OFDM 3.2 Gbps RF signal direct-processing transmitter and receiver equipment that we developed.

In this experiment, the data transmission rate of 3.2 Gbps was achieved using frequency multiplexing of 16 50-Mbps signals as shown in Figure 4 (50Msps × 4 symbols × 16 carriers).

The spectrum of the signal received by the large-scale in-vehicle earth station in the KIZUNA loop-back satellite communication experiment is shown in Figure 5. The total bandwidth is approximately 900 MHz. The I/Q constellations (signal arrangement diagrams) for each of the 16 carriers in the demodulator are shown in Figure 6. The signal points in the received signal spread out due to the effects of the amplitude and frequency characteristics of the transmission path, but even though variation can be seen in the demodulation characteristics of the 16 carriers, each of them show concentrations near the 16 points in Figure 1, and it is clear that they are being demodulated correctly. In this case, the bit error rate (BER) of the signals was 6.12×10^{-3}. Quasi error free transmission (BER of 1.0×10^{-11} or less) can be achieved by adding LDPC error correction, successfully achieving the fastest broadband transmission in the world, at 3.2 Gbps. The data transmission

Table 1 16APSK-OFDM 3.2 Gbps RF signal direct-processing transmitter and receiver

Modulation	: 16APSK-OFDM (radius ratio γ = R2/R1 = 2.73205), GI = 2.5 ns
Signal Mapping	: DVB-S2 conformity
Data Rate	: 3200 Mbps =50 Msps × 4 bit/symbol × 16 channels
Error Correcting Code	: LDPC code
Interleave	: Interleave between subcarriers (every eight subcarriers)
Randomizer	: Generating polynomial h(x) = x8+x7+x5+x3+1(CCSDS)
10GbE external interface	: 10 GbE SFP+ interface
Protocol	: UDP/IP
Bit Rate	: 3200 Mbps (after adding error correction)

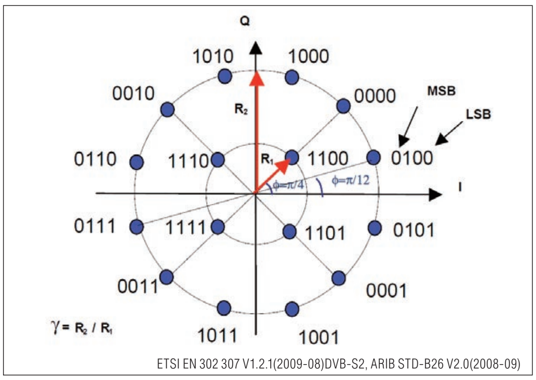


Figure 1 16 APSK signal mapping I/Q constellation

Figure 2 Large-scale in-vehicle earth station

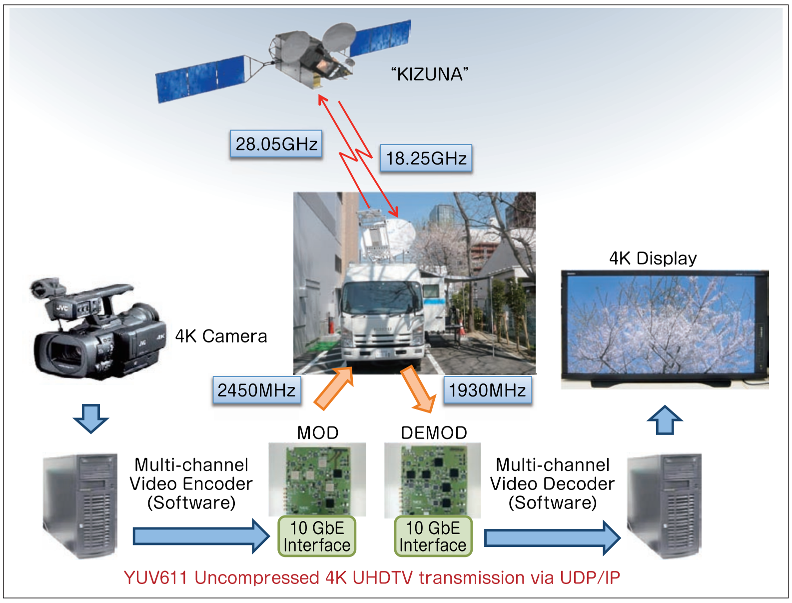


Figure 3 Experimental concept

rate is approximately 2.8 Gbps, which is approximately five-times the capacity of KIZUNA, 622 Mbps, when it was launched.

In this experiment, a multi-channel video transmission codec from earlier NICT R&D was used, successfully transmitting uncompressed 4K UHDTV (Ultra High Definition Television (Video)) via IP network through a 10 GbE interface for the first time. This codec is a scalable video transmission system able to transmit multiple synchronized channels of video (multiple Hi-Vision signals) at the same time. It is implemented completely in software using ultra-high-speed, multi-channel parallel processing on a multi-core PC. For this experiment, four synchronized video channels (four HDTV video signals) were used for IP transmission of uncompressed 4K video.

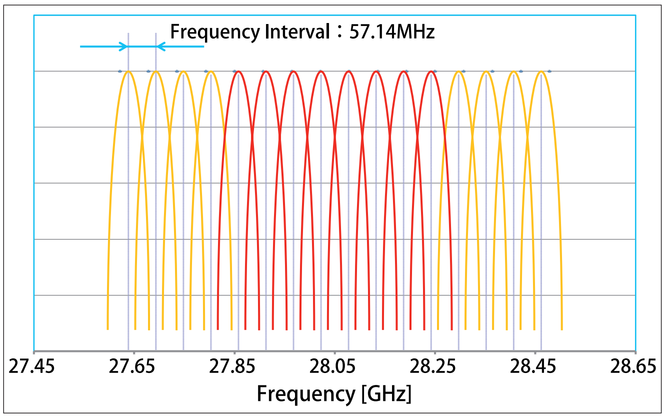


Figure 4 Frequency placement

Figure 5 Received frequency spectrum

Future prospects

The 3.2 Gbps satellite transmission, made possible at this time through the KIZUNA large-scale in-vehicle earth station, is anticipated for use in remote medicine, to accurately convey medical information from remote locations to a specialist doctor. If disaster should occur, it will be possible to transmit 4K UHDTV of the affected areas or of victims' wounds to the disaster response center quickly.

Next, we will consider increasing from 16 to 32 carriers and doubling the size of the guard intervals to reduce the effects of group delay and improve the characteristics, and will study the feasibility of expanding the bandwidth further (e.g. to 4.8 Gbps) through simulation. In the future, we will study mounting the technology we have developed in a satellite, and using it for broadband feeder links in communications and remote sensing satellites. It may also be a candidate technology for uncompressed IP satellite transmission of 4K and 8K contributions for the 2020 Olympics in Tokyo, or for simultaneous transmission of approximately 50 channels of compressed 4K video.

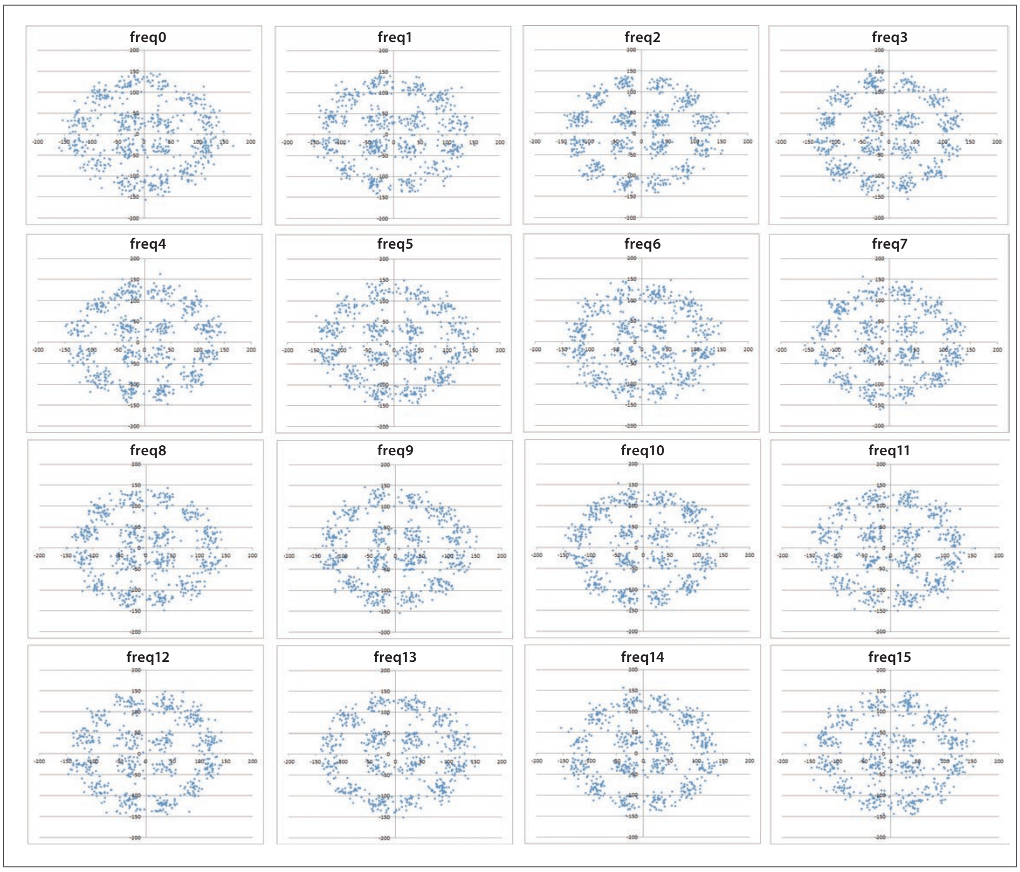


Figure 6 16-carrier I/Q constellations

The Portal Site for Barrier-free Access to ICT Services

—Toward the realization of Information barrier-free society—

Information Barrier-free Office, ICT Industry Promotion Department

Purpose

Since 2002, NICT (then the Telecommunications Advancement Organization (TAO)) has been operating the "Portal Site for Information Barrier-free" (http://barrierfree.nict.go.jp/ (Japanese only)), providing information useful to people with physical disabilities and the aged, to those providing them with support, and further, to those developing and providing communications services and devices, in order to promote a barrier-free environment in the field of information and communications technology.

Information Barrier-free Society is a society in which obstacles (barriers) to using information and communications technology for those with disabilities and the aged are eliminated, so that all people can use communications and broadcast services equally.

This portal site for information barrier-free

Access the site here (Japanese only)

This site can provide notifications when information is updated. Please make use of this service. Register using the following link:
http://barrierfree.nict.go.jp/others/infomail.html (Japanese only)

Figure 1 Screen shot and contents of the Portal Site for Information Barrier-free

provides a wide range of information, including activities of NICT, in a format that takes web accessibility into consideration, using techniques including substitute text for image data, correct tags on headings so they are displayed correctly, and avoiding spaces or line breaks in the middle of words.

Background

Policies regarding disabled persons have changed greatly in recent years in Japan. In particular, the Law for "Elimination of Discrimination toward Persons with Disabilities" was established in June last year, and in December, the "Convention on the Rights of Persons with Disabilities" was ratified (received Diet approval). The Law for "Elimination of Discrimination toward Persons with Disabilities," imposes a legal duty on the government, to prohibit discrimination on the basis of disability and to give reasonable consideration to requirements for eliminating barriers within society.

Regarding specific measures needed in the information and communications technology field, the basic direction was decided in the "Basic Programme for Persons with Disabilities" (3rd Council Decision, Sept., 2013), stipulating concrete items in the three categories of information accessibility: "improving accessibility of information in information and communications technology," "enriching provision of information," and "enriching communication;" and mandating these issues to be addressed in society.

See the [Reference] for details.

Content

The portal site for barrier-free provides relevant information in eight sections (Figure 1).

The access data for each of these content categories is shown in Figure 2.

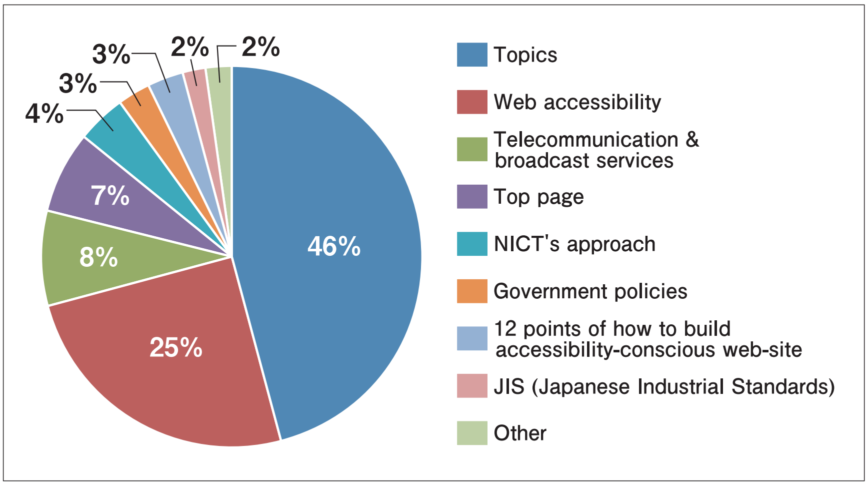


Figure 2 Number of page views (FY2013)

Request to all Readers

There is also strong demand in society to promote information barrier-free, so we ask all of our readers to consider, when you are developing, providing or using communication/broadcast services, whether those services can be designed by persons with disabilities or not, and what could be done to enable people with disabilities to use those services. We also intend to enrich the content on this portal site to be helpful in just such cases.

Accordingly, if any of our readers have needs, such as services or devices you feel would be good (that do not exist yet), or services that this portal site should have (that exist somewhere else), we encourage you to contribute your ideas to the following address:

kakusa@ml.nict.go.jp

[Reference] Basic Programme for Persons with Disabilities (3rd Council Decision) (Excerpt)

＊ The basic direction for measures the government must undertake with respect to persons with disabilities as applies to the overall five-year plan for the period from FY2013 through FY2017.

6. Information Accessibility

[Basic Concept]
Generally, improve accessibility in use of information, including improving information accessibility in information and communications, enriching provision of information, and supporting communication so that persons with disabilities can retrieve and use information, make known their intensions and communicate unhindered.

(1) Improving information accessibility in information and communications
- ○ Maintain, improve, and spread the accessibility of information and communications devices and services for persons with disabilities by promoting consideration for them in the planning, development and provision of information and communication devices and services.

(2) Enriching provision of information
- ○ Assist with production costs for broadcasters based on laws promoting industries that facilitate use of communications and broadcasting by persons with physical disabilities and contribute to increase convenience for them. Also implement and strengthen initiatives based on the "Policy guidelines for promoting broadcasts for persons with audio or visual disabilities," enabling persons with disabilities to use broadcasts easily by expanding closed-caption programs (including commercial programs), narrated broadcasting, and sign language broadcasting.
- ○ Produce and circulate a library of video with closed captions (or sign language) for persons with hearing disabilities, hire sign-language interpreters and summary writers and promote consolidation of information and communication technologies (ICT) that facilitate provision of information for persons with disabilities, while also covering their changing requirements as they develop.
- ○ Promote private enterprise to provide services and undertake technology R&D to improve access to communication and broadcasting services such as television and telephones, for those with difficulty using them due to disability, through support based on laws promoting industries that facilitate more convenient use of communication and broadcasting by persons with physical disabilities.
- ○ Electronic publishing is widely anticipated to expand the ability to use published materials, of persons having difficulty in reading paper publications due to visual or learning disabilities. Promote initiatives to spread electronic publishing that gives consideration to accessibility and use them practically in education.

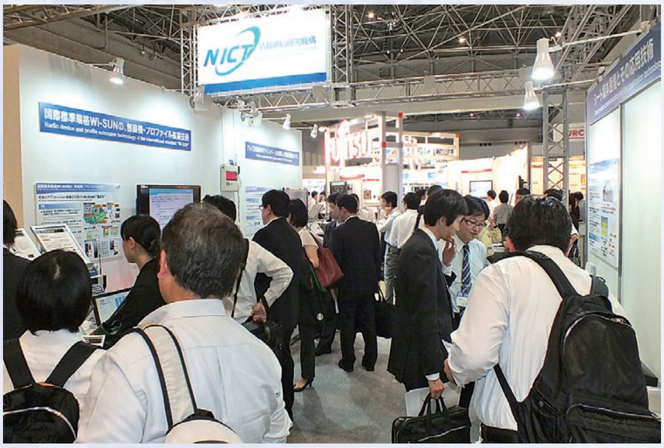
(3) Enriching support for communication
- ○ Provide support for persons with disabilities causing communication difficulties through facilities and by hiring sign-language interpreters, summary writers, interpreters and support people for blind or deaf persons. Also provide training for sign-language interpreters, summary writers, interpreters, Braille translators and other people supporting people that are blind or deaf, to develop and maintain the human resources needed to enrich support for communication.
- ○ Promote development of assistive devices related to information and communication and build awareness of them, and also support persons with disabilities that need these devices to obtain and use them.

Wireless network exhibition and seminar expanding use in business, industry and as social infrastructure

Report on WIRELESS TECHNOLOGY PARK 2014

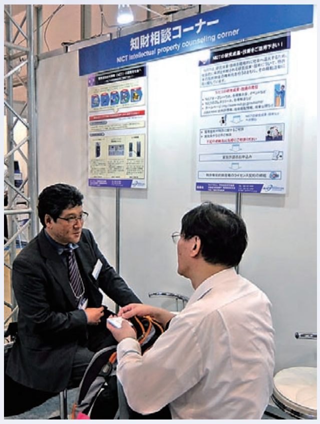
Planning Office, Wireless Network Research Institute

From May 28 to 30, NICT hosted the Wireless Technology Park 2014 (WTP) at Tokyo Big Sight in collaboration with the YRP R&D Promotion Committee and the YRP Academia Collaboration Network.



NICT booth crowded with many visitors

WTP consisted of three main components: an exhibition of the latest wireless technology, seminars centered on trends in wireless communication, and academic sessions for university laboratories to present their research. It was one large event specializing in R&D on wireless technology and providing a venue for engineers, researchers and developers related to wireless technology to gather and meet with businesses. This year is the ninth time it has been held, and approximately 80 organizations participated with exhibits. There were many exhibits in the M2M field related to the main theme, which was "Wireless Technologies Supporting a Smart Society," as well as other topics that were part of the program for the first time this year and attracted much interest from attendees. These included "Location information technology essential for a smart society—Indoor positioning and Quasi-Zenith Satellite Systems—," and the "Wireless power transfer exhibit zone," which is increasingly anticipated in the wireless market. Also new and popular this year were the historical exhibit and the industry-academia collaboration corner.



NICT intellectual property staff (left) discussing technology transfer with a visitor

NICT included nine exhibits of a wide range of the latest research results in wireless and other fields from the Wireless Network Research Institute, the Resilient ICT Research Center, and the Applied Electromagnetic Research Institute. Wi-SUN attracted particular attention, including visits from Ms. Yoko KAMIKAWA, the State Secretary for Internal Affairs and Communications, and from foreign embassies in Japan. There were many other visitors and we received questions and comments from a wide range of perspectives.

There were 14 courses of seminars, according to theme, with 63 lectures from specialists in industry, academia and government. NICT contributed seven presentations, including "NICT Session: Wireless communication technology initiatives at NICT," which was very successful, with visitors crowding in and filling up the venue as soon as it opened. In addition, presentations by exhibiting companies, results announcements, and "Industry-Academia Research Creating the Future with Wireless," and academic sessions were held. There were more presentations than last year, attracting much attention and many attendees.

When combined with Wireless Japan 2014, which was held at the same time, approximately 45,000 people attended WTP2014, and at times the NICT booth was overflowing with visitors, making it a big success. We will work hard to make the event even richer next year, with content that is even more interesting.

NICT Seminars

■NICT session: "Wireless communication technology initiatives at NICT" (May 29, 10:00–12:40)

Lecture 1	**Overview of wireless communication technology initiatives by NICT** Dr. Hiroyuki YANO, Director General, Wireless Network Research Institute
Lecture 2	**R&D on wireless communication technology supporting social infrastructure** Dr. Hiroshi HARADA, Managing Director, Social ICT Research Center
Lecture 3	**Initiatives for dependable wireless communication technology** Dr. Huan-Bang LI, Senior Researcher, Dependable Wireless Laboratory, Wireless Network Research Institute
Lecture 4	**Recent R&D activities on space/satellite communication** Dr. Morio TOYOSHIMA, Director of Space Communication Systems Laboratory, Wireless Network Research Institute

Dr. YANO, Director General of the Wireless Networking Laboratory (above) and Dr. TOYOSHIMA, Director of the Space Communication Systems Laboratory (below) lecturing at the NICT sessions

NICT Exhibits

● **Research and demonstration platform for Wi-SUN to support social ICT**

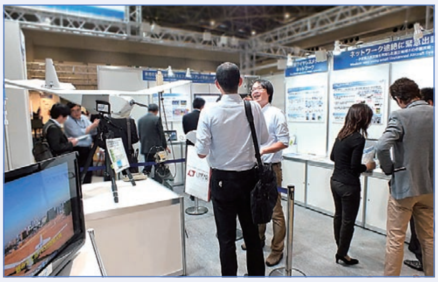
The sensor network platform, which enables to implement control, analysis and administration through the cloud with Wi-SUN radio devices incorporated in various monitoring sensors, was introduced. Wi-SUN radio devices are low-power and can be used to expand coverage areas easily.

● **Radio device and profile extension technology of the international standard "Wi-SUN"**

Various applications were introduced, including a wireless sensor network with small-sized low-power 920-MHz radio devices implementing the international standard Wi-SUN and ECHONET-Lite, the standard for Home Energy Management Systems (HEMS).

● **Mobile communication system utilizing TV White Spaces**

A system that improves communication speed during congestion by using white spaces in the TV broadcasting band in addition to current LTE services was introduced.

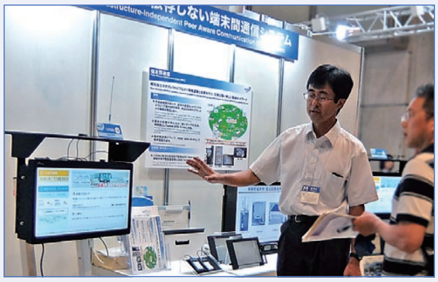


● **Emergency dispatch for network interruptions! —Wireless relay using small unmanned aircraft systems—**

Areas can be isolated from the network when disaster interrupts communication. NICT R&D on a wireless relay system using small unmanned aircraft to address this issue was introduced.

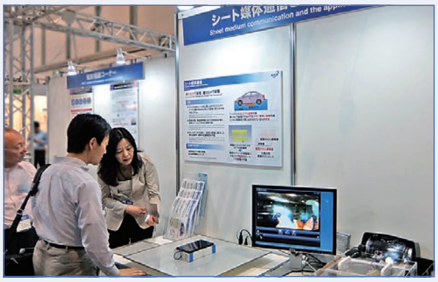
● **Indoor navigation system co-operated with UWB positioning and smart devices**

Demonstration of indoor navigation linked with smart terminals, using a UWB indoor positioning system developed by NICT and implementing accurate range and position measurements within 30 cm.



● **Infrastructure-independent peer aware communication (PAC) system**

Introduced a new communication system composed of independent regional wireless networks that do not depend on mobile-phone networks or the Internet, and treat fixed terminals, mobile stations and mobile terminals the same, as just "terminals."



● **Sheet medium communication and application technologies**

Introduced application technologies utilizing the characteristics of sheet medium communications, such as efficient power transmission for contactless charging in applications such as electric automobiles, and human body sensing through a sheet communication medium.

● **Phased array weather radar that captures three-dimensional structures of torrential rain**

To implement monitoring and prediction of natural disasters that occur suddenly and locally, such as tornados and so-called guerrilla rainstorms, NICT has developed a phased array weather radar. The detailed 3D structure of a heavy rainstorm observed with this radar was introduced.

● **Resilient wireless mesh network**

Wireless mesh network that is resistant to disaster, with wireless terminals operating autonomously over wide areas, linked to mobile wireless systems such as satellite communications and small unmanned aircraft systems, was introduced.

■ Course D "Wireless Technologies for Safety and Security" (May 29, 10:00–12:50)

"Phased-array weather radar that captures three-dimensional structures of torrential rain"

Dr. Shinsuke SATO, Senior Manager, Radiowave Remote Sensing Laboratory, Applied Electromagnetic Research Institute

■ Wi-SUN Alliance Seminar "Wi-SUN Alliance Overview and Deployment Examples" (May 29 13:00–17:10)

"Overview and Status of the Wi-SUN Alliance ECHONET Working Group"

Dr. Hiroshi HARADA, Executive Manager, Social ICT Promotion Research Center

■ Course F "Indoor Positioning and it's Increasing Importance" (May 29 13:10–17:00)

"The UWB indoor positioning system and the applications"

Dr. Huan-Bang LI, Senior Researcher, Dependable Wireless Laboratory, Wireless Network Laboratories

Report on Interop Tokyo 2014 Exhibition

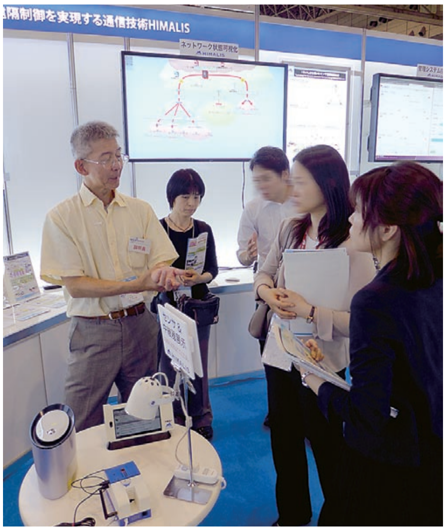
NICT exhibited at Interop Tokyo 2014, an Internet and digital media special event held June 11 to 13, 2014 at Makuhari Messe.

This year, we exhibited the research results described below, on the theme "Opening the Big Data Era with New-Generation Network Technology" and related to technologies in new-generation networks, advanced testbeds, network security, and wireless networks. In one corner of our booth, we also held 15-minute mini-lectures, and many visitors stopped to hear presentations from our researchers.

Mini-lectures

Exhibit Details

●New-generation Network Technology



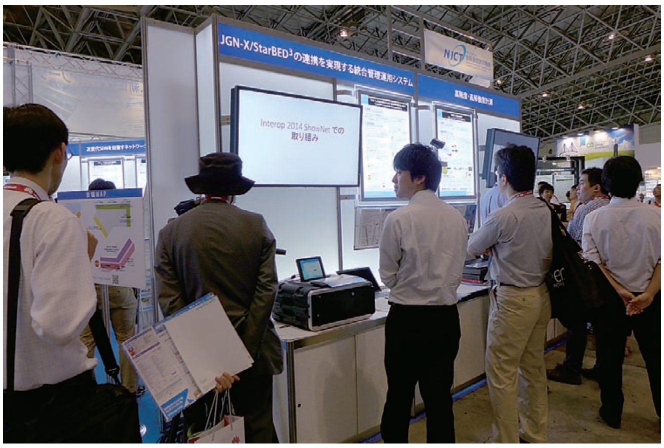
●HIMALIS communication technology implementing remote control of mobile sensors with communications functionality

We gave a demonstration using the HIMALIS, remotely controlling mobile sensors and relays located at NICT headquarters (Koganei City) from the Interop venue. HIMALIS manages terminals using IP addresses (locators), which are network location information, and unique identifiers (ID), and sensors and relays were equipped with HIMALIS communication.

●Social ICT and the JOSE large-scale open testbed

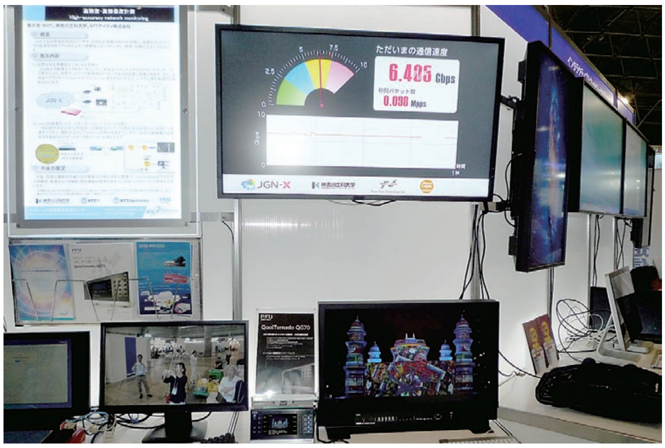
We demonstrated reception and display of real time river measurements (water level, rainfall) as an example of a sensor network operating on JOSE (Japan-wide Orchestrated Smart/Sensor Environment).

●Testbed Technology



●Integrated management and operations system implementing cooperation between JGN-X and StarBED³

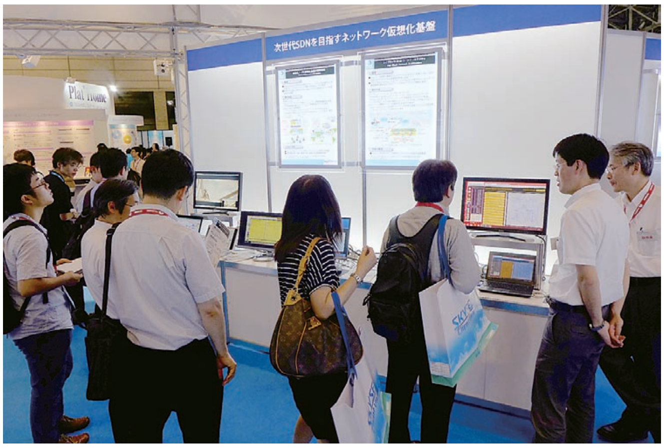
We introduced an integrated management and operations system intended to be developed on the JGN-X and StarBED³ testbeds, and a mechanism used to link the testbeds. These testbeds have expanded leading-edge technologies to a large scale.



●Highly accurate, high-resolution measurement

As an example utilizing JGN-X, we introduced a system using instruments supporting 10G Ethernet at multiple points to monitor the state of traffic on a virtual network accurately and in real-time. The system also analyzes and provides visualization of the results.

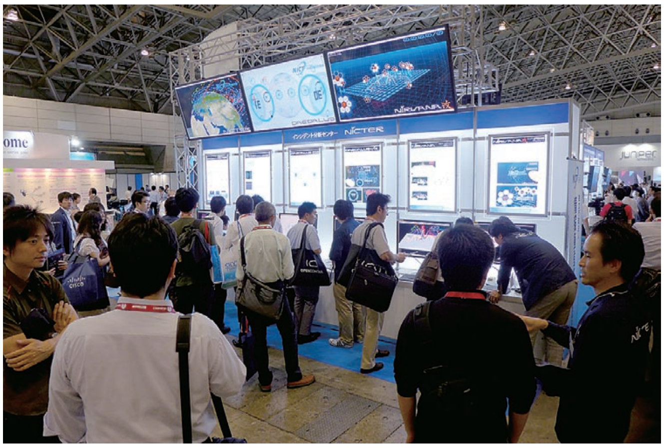
Overall view of the NICT booth



● Network virtualization infrastructure for next-generation SDN

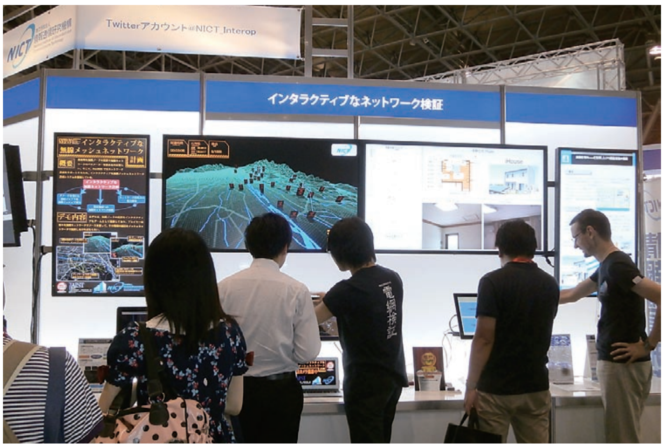
We demonstrated a virtual node able to perform data processing functions not possible with conventional SDN/OpenFlow and network functions that can be programmed in a graphical interface, by just combining blocks as with toy blocks.

●Network Security Technology



● Incident Analysis Center NICTER

We demonstrated NICTER (Network Incident analysis Center for Tactical Emergency Response), together with spin-out technologies, NIRVANA, DAEDALUS, and NIRVANA Kai.

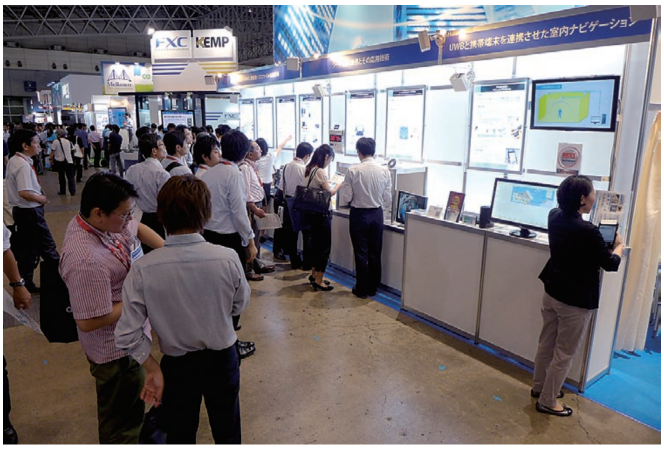


● Interactive network verification

(Received the "Best of Show Award 2014" a jury special award for exhibitors in the ShowNet Demonstration category)

We demonstrated an interactive user interface for operating an emulation environment built using the large-scale emulation environment StarBED^3 (starbed cubic) and the iHouse advanced testing home network.

●Wireless Network Technology



The following technologies were exhibited.

- **● Mobile communication system utilizing TV White Spaces**
- **● Wireless device and profile extension technology for the international standard Wi-SUN.**
- **● Indoor navigation system co-operated with UWB positioning and smart devices**
- **● Sheet medium communication and application technology**

Kashima Space Technology Center Open House and 50th Anniversary Lectures

Facility Open House

Admission Free

Theme: Getting Familiar with Space!

◯ Date/Time: **August 30, 2014 (Sat.)**
10:00-16:00 (No admittance after 15:00)

◯ Location: Kashima Space Technology Center,
893-1, Hirai, Kashima City, Ibaraki Prefecture
http://ksrc.nict.go.jp/index_e.html

◯ Details

- Introduction to satellite communications research using Wideband InterNetworking engineering test and Demonstration Satellite "KIZUNA" (WINDS)
- Introduction to research on orbits of satellites and other astronomical objects using optical telescopes and other instruments
- Introduction to research using a 34 m parabolic antenna

Scene from the open house last year: The most popular attraction, climbing and touching the 34 m parabolic antenna

50th Anniversary Lectures

Admission Free

May 1, 2014, was the 50th anniversary of the Kashima Space Technology Center. These Anniversary Lectures are being held to express gratitude for all the support from the people of the Kashima region and all others related to the Center.

◯ Date/Time: **August 31, 2014 (Sun.) 13:30-16:00**

◯ Venue: Kashima Kinro Bunka Kaikan
325-1, Kyuchu, Kashima City, Ibaraki Prefecture
http://cs-kashima.jp/kinbun/pdf/map.pdf (Japanese only)

◯ Lectures:

- Prof. Kosuke HEKI, Department of Earth Sciences, School of Science, Hokkaido University
"Development of Space Geodetics and New Possibilities
— From VLBI to GNSS —"
- Dr. Makoto YOSHIKAWA, Leader, HAYABUSA-2 Project Preparation Team
"The Challenge of Space — From 'Hayabusa' to 'Hayabusa-2' and the Future —"


The Kashima Space Technology Center in its 50th year

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