NICT National Institute of Information and Communications Technology

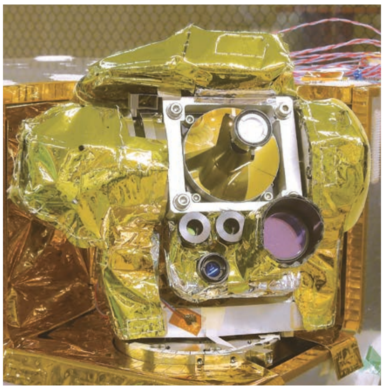
NICT NEWS

No.456 MAR 2016

FEATURE

More Familiar Wireless Technology

NICT NEWS No.456 MAR 2016
National Institute of Information and Communications Technology



CONTENTS

Cover photo
The Small Optical TrAnsponder (SOTA): an onboard ultra-compact laser communication equipment for 50 kg-class small satellites. The goal is to conduct basic research on 1.5 micron band laser communication technology between low earth orbit (LEO) satellites and ground and in-orbit verification of the equipment in a space environment. Telescope diameter is about 5 cm and the mass is about 6 kg.

INTERVIEW

Wireless communication for anything, anywhere, and anytime!

Hiroyuki YANO
Director General,
Wireless Network Research Institute

Joined the Communications Research Laboratory, Ministry of Posts and Telecommunications (currently NICT) in 1992. At the Kansai Branch (Currently the Advanced ICT Research Institute), engaged in research on human communications, and then worked on (the Third Science and Technology Basic Plan) at the Cabinet Office, Government of Japan. Later, also worked at the Strategic Planning Department. Ph.D. (Engineering).

The proliferation of data communication networks around us is ever accelerating, bringing many new conveniences and luxuries into our lives. At the same time, data communication is getting more important, and becoming indispensable in many scenarios in life. We want to have the benefits of data communications readily available no matter where we are, and the core technology for that need is wireless communication. We spoke with Dr. Hiroyuki YANO, who is Director General of Wireless Network Research Institute, at the leading edge contributing to such a smart society.

What is supported by Wireless Networks?

— To begin with can you tell us about the role of wireless network technology, which is part of the name of your laboratory, within the broad field of ICT (Information and Communication Technology)?

YANO Network platform technology is one of the four basic technology research fields being promoted in NICT's third medium term plan. It includes various technologies for building and protecting networks. Wireless Network Research Institute handles research on building wireless networks.

Especially in the past ten years or so, mobile phones and smartphones have become completely established as personal communication devices; they are no longer just for business, and it is now common for PCs to be connected wirelessly, even in the home, by Wi-Fi and other technologies. This is not just to get rid of wires; it is more significant than that. Wireless communications expands potential greatly, enabling connection "by anything", "from anywhere", and "at anytime." We are pursuing R&D following these three targets (Figure 1).

By anything, from anywhere, at anytime

— Specifically, what sort of research are you doing toward these three targets?

YANO Before, one could only get the benefits

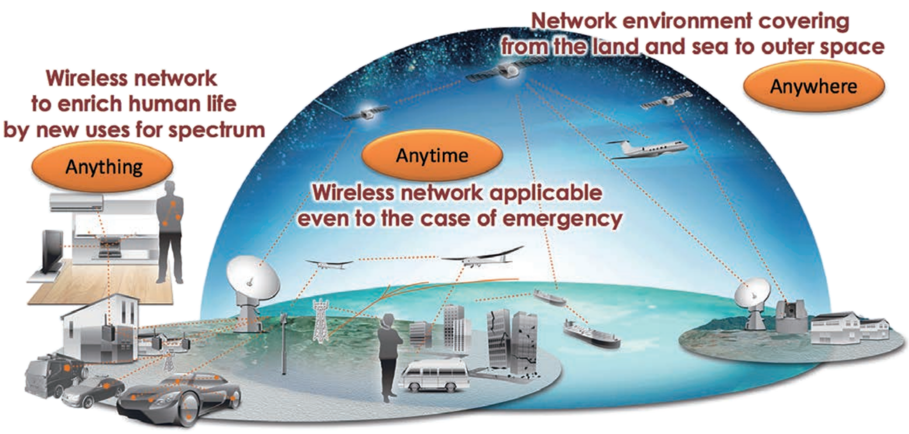


Figure 1　Wireless Network Research Institute R&D Vision

INTERVIEW

Wireless communication for anything, anywhere, and anytime!

of data communications within the range that wires could reach. However, communication is possible "from anywhere" that radio waves can reach. Mobile telephones are a good example of this. And now, it is becoming possible to connect to the Internet, even on airplanes and aboard ships. In the future, there will also surely be demand for more and more places where communication is possible.

The ability to connect "at any time" is also important. For example, there were many problems in the field of data communications during the Great East Japan Earthquake. It was a particularly difficult situation that communication was interrupted in disaster hit areas and people often did not know what the conditions were in surrounding areas. Even just knowing when help or support will arrive changes how situations will be handled and can reduce insecurity. It is important to eliminate communication dead zones in the first few hours, when such information is really needed. Unmanned aircraft relay stations can be used to handle such emergencies.

Finally, we would like to have connection "by anything." As networks have advanced, everyone has a mobile phone or smartphone, and now some people feel insecure when they cannot be in constant connection with someone. Expanding that network further, various items such as household appliances are being given communication functionality and the ability to exchange information. This has been called the "Internet of Things (IoT)," and wireless communication technology is contributing heavily to it. Clearly, wireless devices must be smaller for such applications, and while they will not necessarily use a lot of power, they need to be made to conserve it.

■ The "Right person, Right place" R&D system

── Can you tell us the roles of each of the labs in the Wireless Network Research Institute, and what is the basis of activities in each?

YANO There are three laboratories within Wireless Network Research Institute: "Smart Wireless Laboratory", "Dependable Wireless Laboratory", and "Space Communication Systems Laboratory"; and each of them conducts R&D according to the three targets I mentioned earlier.

In reverse order, Space Communication Systems Laboratory handles mainly technologies for connecting "from anywhere". This Laboratory deals with expanding the transmission area using satellites. Its activities are based mainly at Kashima Space Technology Center in Kashima City, Ibaraki Prefecture, and at NICT headquarters in Koganei City, Tokyo. Kashima Space Technology Center was established 50 years ago as the base station to relay coverage of the 1964 Tokyo Olympics to the USA by satellite, and there is a stone monument commemorating it as the "birthplace of space relay" (Figure 2). This center deals mainly with satellite communication using radio waves. On the other hand, the Koganei location conducts R&D on satellite communication using laser light. It deals with data transmission by optical communication, transmitting and receiving laser light between the satellite orbiting in low-earth orbit (LEO, 600–700 km) and optical ground station, and performing satellite acquisition and tracking (Figure 3). Laser light has excellent convergence and can transmit at high speed, so information security is high and data capacity of satellites can be increased.

Smart Wireless Laboratory and Dependable Wireless Laboratory generally research technologies for connecting "at anytime" and "from anything." They are based in the Yokosuka Research Park (YRP), which has the advantage of

Figure 2 "Space relay ground" monument (Kashima)

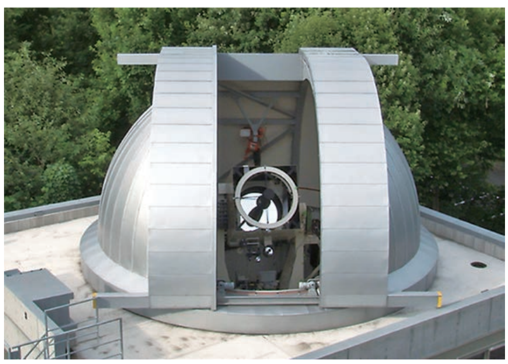


Figure 3 1 m diameter telescope optical ground station (Koganei)

Figure 4　The Institute, in its location sheltered from surrounding radio waves (Yokosuka)

being on the Miura peninsula. It is geographically surrounded by mountains and hills on three sides and open to the sea (Figure 4), reducing radio interference. It is also in a favorable environment next to other closely related facilities such as the NTT Yokosuka R&D Center and the NTT DOCOMO R&D Center, which makes collaboration easier.

As a research institute, it is spread out over several bases, but each of the laboratories is in a good environment, enabling them to pursue good research.

Research results attracting global attention

── For each of the labs, are there any particular recent results, or themes that they have been focusing on?

YANO Smart Wireless Laboratory has been conducting R&D and standardization on the Wireless Smart Utility Network (Wi-SUN), which is a core technology of the IoT. It is true for all research at NICT, but we do not simply finish the research required and stop; as we work, we always keep in mind how research results can be utilized in society. Research on Wi-SUN originally began in response to the need for a low-power wireless system for smart gas meters, but it was proposed to the Institute of Electrical and Electronics Engineers, USA IEEE802.15.4g task group as an international standard, and was accepted. We also formed alliances with manufacturers and worked to deploy it as a widely used technology.

It is adopted in the smart meters of ten electricity providers in Japan, with plans for introduction in approximately 80 million households in the future. It also has prospects for being the key technology to the home area network (HAN), which will be installed on various other devices in homes (Figure 5). By having sensors in various devices linked, they can also contribute to utilizing big data technologies.

Dependable Wireless Laboratory is conducting R&D on a relay station for unmanned aircraft. An emergency aerial base station must be able to stay aloft for a relatively long time, so a fixed wing aircraft with wingspan of 2.8 m, which has a longer flight time than a multi-copter design, was used. This R&D is being done in collaboration with Disaster Resilience ICT Research Center in Sendai.

A major theme at Space Communication Systems Laboratory is development of small optical communication devices for satellites. Especially recently, satellites are being made smaller and launched in groups to keep launch costs low, so it has been imperative to make communication devices smaller and lighter. We have actually developed a small optical transponder of 50 cm square, with mass of about 6 kg, compared to earlier devices which were several tens of kg. It is gathering worldwide attention, and we have received proposals from space agencies in the USA and Europe, eager to conduct tests together.

Through these technologies, we will contribute even more to networks that connect anywhere in the world, at any time and from anything. We see this as our mission at Wireless Network Research Institute.

Figure 5　Wi-SUN radio module (left) and Wi-SUN radio device (right)

R&D, Standardization, and Promotion Activities on Smart Wireless Technologies that Evolve Radio Communication Infrastructure Performance

Fumihide KOJIMA
Director of Smart Wireless Laboratory, Wireless Network Research Institute
Joined the Communications Research Laboratory in the Ministry of Posts and Telecommunications (currently NICT) in 1999. Since then, engaged in R&D and standardization for Intelligent Transport Systems (ITS), ad-hoc wireless networks for disaster prevention, and smart utility networks, mainly at the physical and MAC layers. Ph.D. (Engineering).

With current communication demand, wireless communication has become indispensible. Further R&D, standardization, and deployment in society are needed for more advanced wireless communication technologies, connected to the Internet and other core communication infrastructure, in order to improve quality of life, solve societal issues such as environmental protection and disaster prevention and mitigation, and have effective flow and control of information.

In the third medium term plan, the Smart Wireless Laboratory has been conducting R&D on two projects related to wireless communication systems: "Scalable Wireless Network Technology," which is creating entirely new wireless communication systems, and "Broadband Wireless Network Technology," which is improving on conventional wireless communications systems.

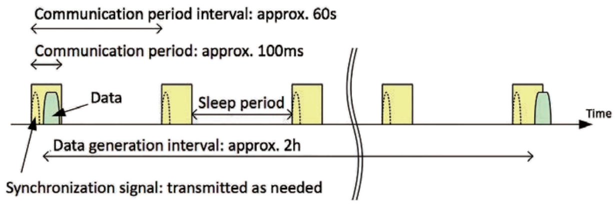
Activities in Scalable Wireless Network Technology

Smart Utility Networks (SUN) are wireless networks for electricity, gas and water meters and various types of sensors in applications such as agriculture and disaster prevention. It is expected that power supply for such networks will be inadequate. We have conducted R&D on a low-power, bi-directional control wireless network that will collect data from the various meters and sensors using multi-hop communication with a narrow area network and a medium or wide area network (MAN/RAN), organize the data, and control the various meters through the network. As a specific application, we decided the lower-layer specifications for the communication protocols supporting the Home Area Network (HAN) used in Home Energy Management Systems (HEMS), which were accepted as Wi-SUN Alliance certified specifications. We also successfully created the first-ever implementation and certification as a standard device.

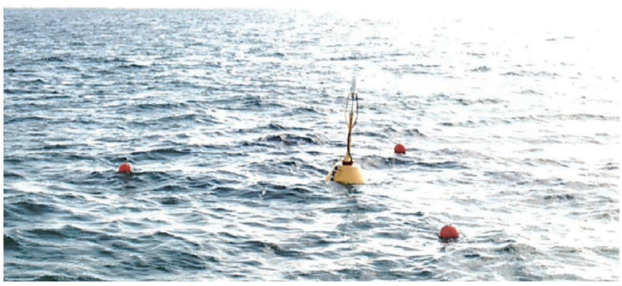
We also proposed a mesh building technology capable of supporting larger-scale networks, and this was accepted in the IEEE 802.15.10 draft.

Regarding power savings, we are conducting R&D on battery-operated low energy technology and have demonstrated the ability to operate devices for over 10 years on three AA-sized batteries. We have also demonstrated it successfully in a mozuku seaweed farm in Okinawa Prefecture (Figure 1).

We are also conducting R&D on Public Broadband (PBB) technology, which can be



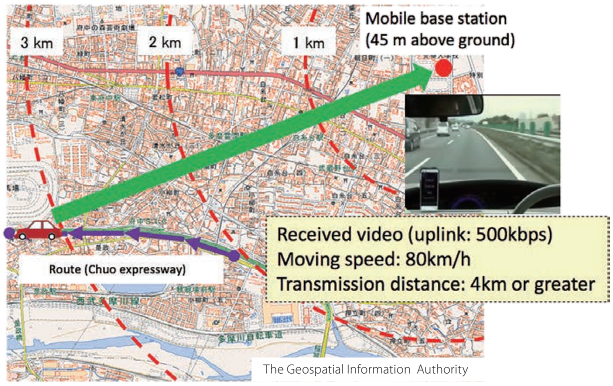
Overview of low-power operation



Wi-SUN oversea buoy in mozuku seaweed farm

Figure 1 Wi-SUN verification test

Developed ARIB STD-T103 compliant equipment



High-speed (80 km/h) video transmission demonstration

Figure 2　Development and verification test of ARIB STD-T103 compliant equipment

effective in eliminating radio blind spots. Assuming a medium to wide range service area, we conducted R&D on medium-to-wide area wireless mesh communication systems that can collect data efficiently from the many environmental monitors and other sensors equipped with radio devices in various narrow-area meshes, even when dotted throughout areas covered by narrow-area mesh networks such as SUN, as described above. Even though propagation distances for narrow range meshes are only several hundred meters, this system is able to maintain transmission distances of 10 km or more. In addition, transmission speeds are several Mbps or more, so content such as video can be transmitted, and the technology is promising for applications with relatively large amounts of data, such as collecting data from large numbers of monitors as described above. We also developed radio devices suitable for systems and performed the first ever demonstrations of applications assuming practical operating environments, using diversity communication technology and marine transmission technology (Figure 2). We are studying high-speed transmission using the 200 MHz band and white spaces, and plan to demonstrate applications that integrate them. We will also continue to study mesh networks, which are expected to be effective for applications such as IoT and Machine to Machine (M2M) in the future.

Activities in Broadband Wireless Network Technology

In Broadband Wireless Network Technology, we are studying technology for efficient use of frequency resources, which is a serious issue common to all existing radio access and mobile communications systems.

White space technology is intended to improve frequency utilization rates by using idle frequency bands effectively. We have established a broadband communication network technology, which uses frequencies above the VHF band and transmission speeds from several tens of Mbps up to 10 Gbps between radios in a range of up to several hundred meters, and can re-build the wireless network among radio devices adaptively, according to the conditions and requirements of use.

We established technology to utilize digital television white space, created a WLAN system using white space and conforming the international standard IEEE 802.11af, which this laboratory played a leading role in establishing, and also researched, developed and implemented an LTE system that also uses white space in a similar way (Figure 3).

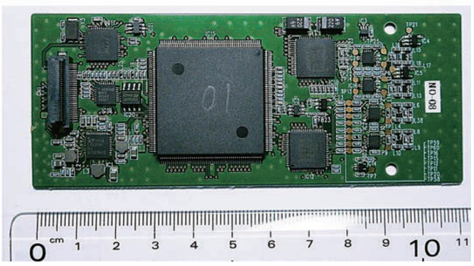
We also participated in experiments using white space, organized by the Office of Communications (Ofcom) in the UK, transmitting at over 2 Mbps between fixed points over 3.7 km, using the IEEE 802.11af system mentioned earlier, and demonstrated the world's first operation of 40 Mbps high-speed communication using an LTE system.

In millimeter-wave technology, which uses frequencies in the 60 GHz band and above that have not been used much earlier, we built a wireless network that achieves transmission speeds from several tens of Mbps up to 10 Gbps between radio devices within a range of up to 10 m (in and out of line-of-sight), depending on the conditions and circumstances of use. We studied implementations of high-capacity wireless systems using the 60 GHz band and conforming to international standard IEEE802.11ad, implemented an LDPC coder/decoder able to achieve data transmission rates extremely close to the Shannon limit, which is the theoretical upper limit, and successfully developed equipment capable of transmitting HDMI and other signals, even in non-line-of-sight conditions. For wide-band, high capacity wireless schemes using the 300 GHz band, we also studied effective implementation of antennas on a semiconductor chip and their propagation characteristics (Figure 4).

In the above initiatives, we emphasized effective development of R&D results in society through standardization and certification.

In the future, we will continue to study next-generation mobile telephone systems and other mobile terrestrial communication and radio access systems, diversifying and developing them further.

LTE Femto base station supporting white space



IEEE 802.11af PHY/MAC on-chip integration

Figure 3　Examples of white-space technology development

Figure 4　Equipment for measuring terahertz-band propagation characteristics

R&D on Wireless Communication Technologies Focusing on the Resilience

Ryu MIURA
Director of Dependable Wireless Laboratory, Wireless Network Research Institute

After completing a Master's degree, joined the Radio Research Laboratory, the Ministry of Posts and Telecommunications (currently NICT) in 1984. Has conducted research in areas including satellite communications, stratospheric radio relay platforms, and Intelligent Transport Systems (ITS) and is currently engaged in research on technology to ensure communications using unmanned aircraft and peer-aware communication between terminals, as well as radio technologies for robot control, and ultra-wideband (UWB) applications. Ph.D. (Engineering).

The Dependable Wireless Laboratory aims to promote economic activity and save lives by realizing disaster resilience in society through autonomous distributed wireless network technology. This involves initiatives in three areas: resilient wireless mesh networks, a radio relay system using small unmanned aircraft that can secure communication after a large scale disaster, and a peer-aware communication (PAC) network that does not depend on any infrastructure. We are also conducting R&D on an ultra-wideband (UWB) indoor positioning system that expands the potential for radio use in environments with poor propagation conditions, and sheet-medium communication that can supply power and communication without a wired connection.

Resilient wireless mesh networks

We have installed a wireless mesh network testbed on a Tohoku University campus. It is based on a regional distributed network architecture technology called NerveNet and is composed of nearly 30 base-station nodes. We then conducted a large-scale demonstration in March, 2013, presuming a disaster in which the Internet became inaccessible.

Radio relay using small unmanned aircraft

In the program, small unmanned fixed-wing aircraft able to fly circuits for over two hours are used as a virtual radio towers in developing a system that can rapidly secure communication channels in areas isolated by a disaster, immediately after the disaster occurs. Successful demonstrations were conducted in Sendai, Miyagi Prefecture; Taiki, Hokkaido; Shirahama, Wakayama Prefecture, and other locations from March, 2013 into 2014, linking the system to the resilient wireless mesh network described earlier and satellite channels on Wideband InterNetworking engineering test and Demonstration Satellite "KIZUNA" (WINDS) ultra-high-speed Internet satellite (Figure 1).

We also conducted research contracted from the Ministry of Internal Affairs and Communication in FY2013–2015, related to improving utilization of frequencies for unmanned aircraft and technologies for increased radio reliability, and contributed to international standardization activities at the ITU and ICAO.

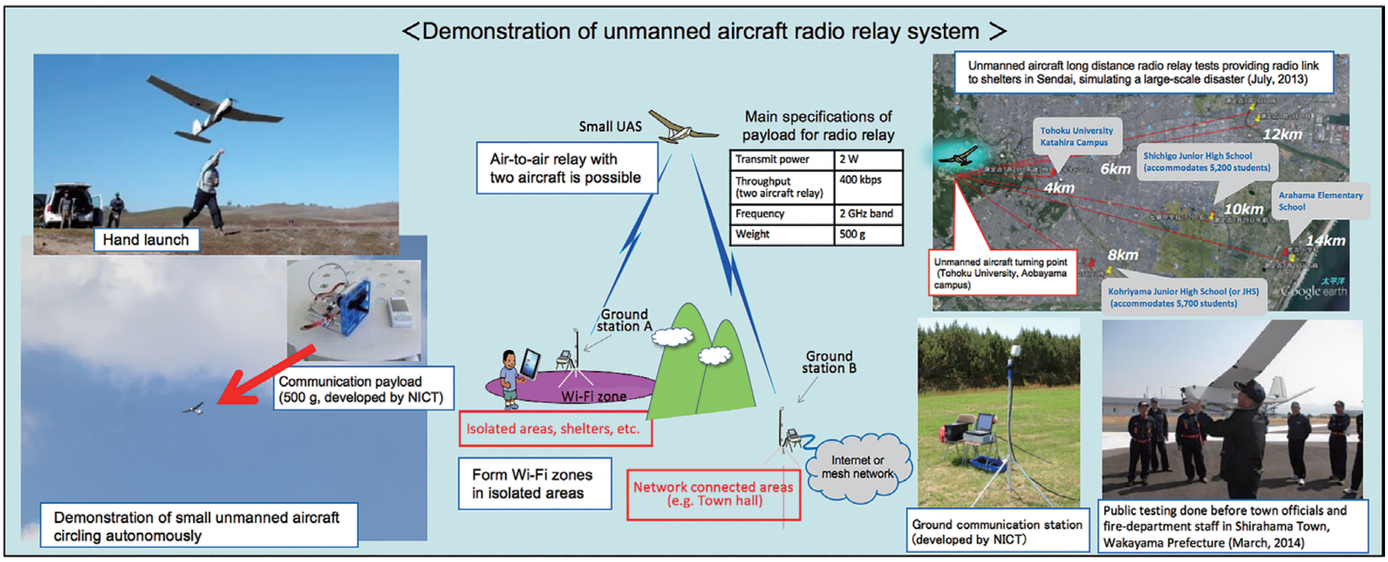


Figure 1 Disaster radio relay system using small unmanned aircraft

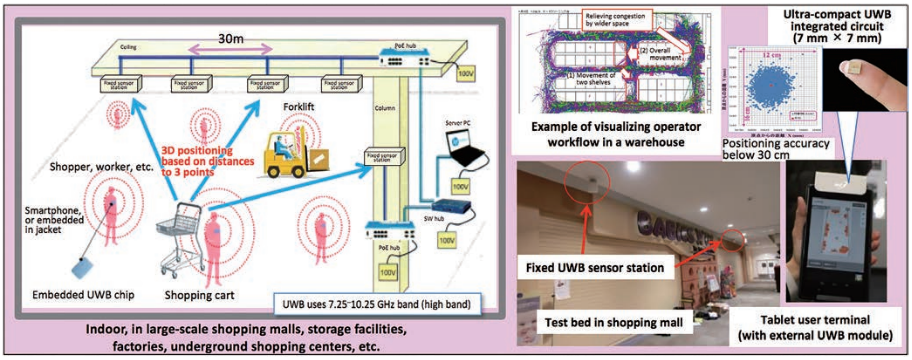


Figure 3 Indoor positioning system using UWB

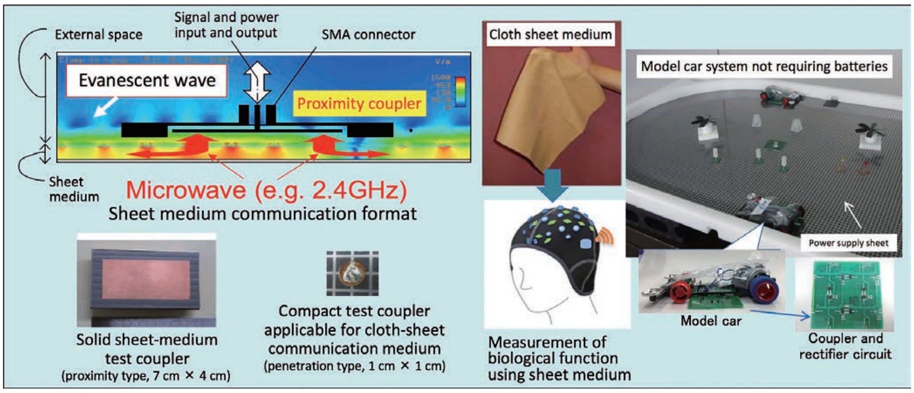


Figure 4 Communication/power supply system using a sheet medium

Infrastructureless peer-aware communication network

We have developed a distributed autonomous network using the 920 MHz band, which is able to distribute and gather publicity, sensor data or other information over time, and in environments where real-time communication is not possible. It uses only the movement of people or vehicles carrying mobile terminals and communication between terminals and does not use base stations (Figure 2). We installed testbeds in the Odaiba area of Tokyo and the Keihanna area of Seika, Kyoto, and have been conducting demonstrations since March, 2014 in cooperation with bus companies and local governments. This network is not suitable for large-capacity data, or communication on a national or global scale, but it is suitable for regionally-based information such as disaster data, local publicity, bus locations, and gathering and watching sensor data. It should contribute to building community by providing low-cost support to the life and activities of residents and visitors.

Members of our laboratory are providing leadership, as Vice chair and leader in discussion within IEEE802.15.8, toward international standardization in FY2016 and is working to have the scheme proposed by NICT adopted.

UWB indoor positioning system

We have developed an indoor positioning system using impulse-radio UWB that is able to detect positions accurately (to within 30 cm) in indoor environments such as underground areas where GPS signals do no reach. We implemented it in shopping malls and warehouses and have been conducting demonstrations since March, 2014, mainly with applications to improve economic efficiency by understanding the flow of people (Figure 3). This system is more accurate than other indoor positioning methods, and in parallel with our R&D, we have contributed as Vice chair and working group leader in deliberations on revising regulations on UWB use.

Sheet medium communication technology

Sheet medium communication technology is able to simultaneously transmit data and supply power without a connection, to a device placed anywhere on a sheet that is only several mm thick (a 2D sheet). It uses evanescent waves that are confined, radiating only near the surface. We have developed technologies including a coupler that realizes efficient input and output of data and power between the sheet and device, and a technology for concentrating power and the communication signal on an arbitrary location on the sheet (Figure 4). For the third medium term plan, we are developing a compact, high-efficiency coupler that will be particularly applicable for wearable cloth sheets, and we are conducting R&D on applications in health care, electroencephalography. We are also cooperating with manufacturers on small toys, contactless power supplies for mobile phones, and eliminating wiring around point-of-sale registers and other devices. In December, 2015, we were also successful with the standardization in Japan of one of the regulations for wireless power transmission (ARIB STD T113).

Future prospects

In the future, we will continue to improve the reliability, efficiency, and accuracy of each of the technologies described above, and to expand R&D to cover drones and other robots and vehicles, and autonomous and decentralized compact radio terminals. This will contribute to implementing M2M and IoT that is available anywhere, whether indoors or out, on the ground or in the air, urban or rural, in the mountains or on or in the sea, to the elemental technologies essential for implementing this in society, and to interconnection among all of these.

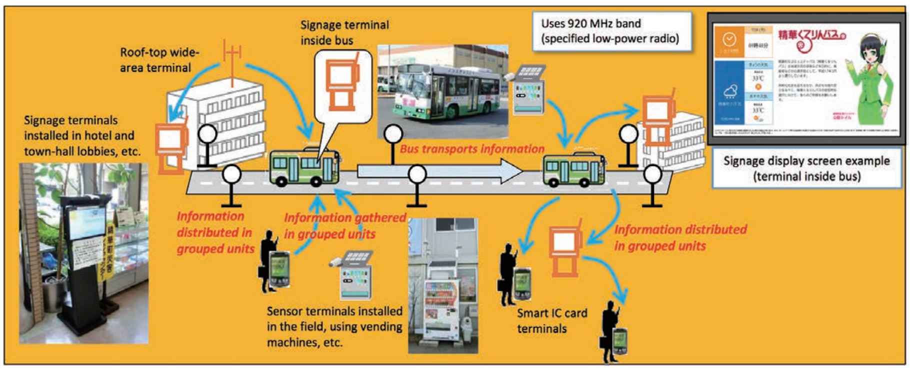


Figure 2 Infrastructureless peer-aware communication network

R&D Activities on New Generation Satellite Communications Technology for RF and Optical Frequency Bands

Morio TOYOSHIMA
Director of Space Communication Systems Laboratory, Wireless Network Research Institute
Joined the Communications Research Laboratory, Ministry of Posts and Telecommunications (currently NICT), in 1994. After engaging in ETS-VI laser communication experiments, was transferred to NASDA (currently JAXA), and after doing research at Vienna University of Technology, worked on OICETS and SOTA, satellite onboard equipment development, and laser communication experiments. Ph. D (Engineering).

The Space Communication Systems Laboratory aims to build satellite communication networks that provide flexible and mobile broadband communication, able to connect from anywhere, whether on the ground, at sea, in flight, or in space, and even during disaster, in areas where emergency terrestrial communication networks are congested or communication is interrupted. We are conducting R&D on next generation satellite communication technology using radio and laser frequencies. NICT's third medium term plan indicated two major R&D themes using both radio and lasers, to be promoted: "Research and Development on Broadband Satellite Communication System Technology" and "Research and Development on Ultra Large-capacity Satellite Laser Communication/Free-space Laser Communication Technologies."

Research and Development on Broadband Satellite Communication System Technology

In the third medium term plan, we conducted the world's fastest demonstrations using the Wideband InterNetworking engineering test and Demonstration Satellite "KIZUNA" (WINDS) as a testbed. We also developed mobile satellite communications earth stations capable of tens of Mbps for use in aircraft and other vehicles, and we participated in projects contributing to society, such as a survey of ocean resources. With all of these R&D results, we endeavored to develop them into practical systems.

In the WINDS experiments, we successfully tested the world's first high-speed, automated operation using an earth station mounted on an ocean survey vessel. We also performed many satellite communication tests that showed the utility of satellite communication in times of emergency, by securing communications for regional governments and other organizations. This included participation in many disaster prevention drills and cooperation with a medical triage system (Figure 1). We also completed an airborne earth station for mobile satellite communication from aircraft, measured antenna tracking characteristics when mounted in an actual aircraft, and conducted tests transmitting imagery measured by the Polarimetric Interferometric Airborne Synthetic Aperture Radar System. This enabled aerial photographs taken during disaster to be transmitted in real time. We also used WINDS satellite channels and 16APSK-OFDM modulation to successfully conduct the fastest-ever communication tests, at 3.2 Gbps.

In experiments using the Engineering Test Satellite VIII (ETS-VIII, nickname: KIKU No. 8), in joint research among five facilities (the Kochi National College of Technology (KNCT); Earthquake Research Institute, the University of Tokyo; Hitachi Zosen Corporation; Japan Aerospace Exploration Agency (JAXA); and NICT), we tested data transmission from ocean buoys in tsunami-detection

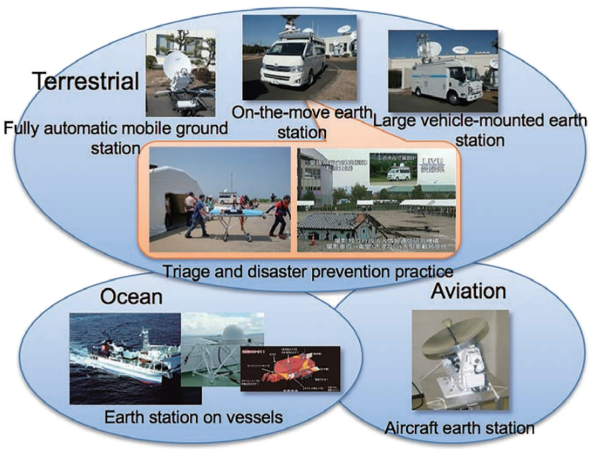


Figure 1　Satellite communication experiments using WINDS

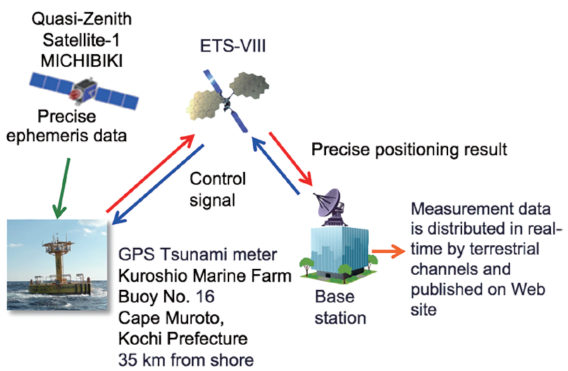


Figure 2　Experiments transmitting data from an ocean buoy using ETS-VIII

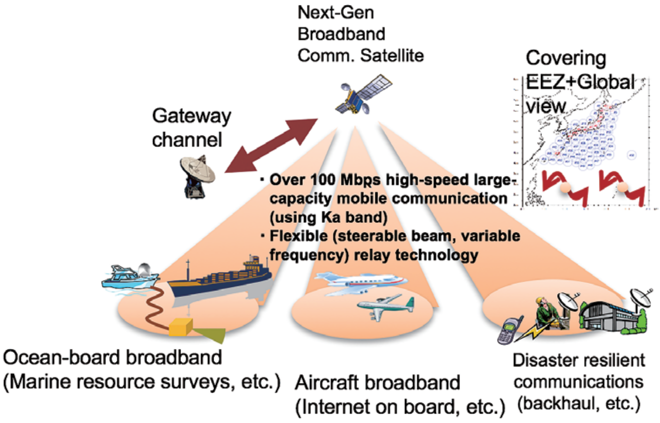


Figure 3 Overview of next generation satellite communications

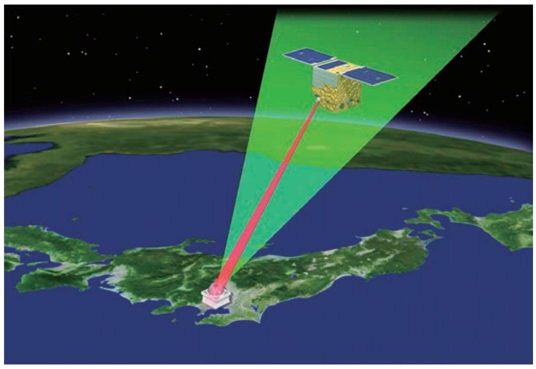


Figure 4 Laser communication experiments using SOTA onboard a 50 kg-class micro-satellite

experiments as a satellite sensor network, and showed that it can be used in the future for early detection of tsunamis. This result will be very useful in technology that will save lives when a tsunamis strike (Figure 2).

In R&D on next-generation communications satellites, we established a user consortium to identify the needs of communication satellite users in the future, studied satellite communication system concepts covering those needs, and settled on technical issues for increasing communication speeds. We also created a conceptual design of a next-generation large-capacity satellite communication system (Figure 3) and began development of communication device prototypes. Our goal is to realize 100 Mbps per user, high-speed large-capacity mobile communication using the Ka band, and to implement flexible (steerable beam, variable frequency) relay technology that can handle traffic fluctuations. This R&D is related to the next medium and long term plan, starting in FY2016, under R&D topics for applying technologies to the next engineering test satellite. This is also described in the future prospects in the Basic Plan on Space Policy.

Research and Development on Ultra Large-capacity Satellite onboard Laser Communication/Free-space Laser Communication Technologies

There are two main themes in recent R&D on laser satellite communications technology. One is developing several-Gbps-class high-speed, large-capacity communications, and the other is developing low complexity laser communication equipments that may not be high-speed, but can be used onboard micro-satellites or in other applications where onboard resources are limited.

Regarding large-capacity, high-speed communication, the third medium-term plan set targets of establishing elemental technologies for a laser communications infrastructure capable of several tens of Gbps, which will be essential for high-volume data transmission from earth observation satellites, and to lead the world leader in developing high-speed laser communication systems for space laser communication. Regarding low complexity, laser communication equipments, we developed a small laser communication terminal for use onboard 50 kg-class micro-satellites and conducted the world's first laser communication experiments using micro-satellites, aiming to contribute to a commercial micro-satellite product through timely demonstrations in space.

In development of the Small Optical TrAnsponder (SOTA, see cover photo) for use onboard micro-satellites, we completed development of an engineering flight model (EFM) and a micro-satellite carrying a SOTA was launched by an H-IIA (H2A) rocket in May, 2014. After checking-out the onboard equipments in orbit, we conducted satellite-to-ground laser communication experiments, which were the first ever for a 50 kg-class micro-satellite, and transmitted imagery from an onboard-camera, achieving a mission with full success (Figure 4).

In site diversity technology, which uses several antennas and selects the one with the best reception conditions, we developed networked optical ground stations at Koganei, Kagoshima, and Okinawa as a testbed. We studied site diversity technology to examine how to increase visibility of the optical ground stations from the satellite using meteorological and other data. This relates to increasing accessibility to satellites (Figure 5). We also conducted successful international collaboration experiments with space agencies around the world, working to establish global site diversity technology.

Regarding large capacity laser communication, we collaborated with JAXA to establish the Japanese Data Relay System (JDRS) project, and initiated High speed Communication with Advanced Laser Instrument (HICALI), in which NICT will develop the onboard ultra-high-speed laser communication component (Figure 6). The objective is to develop ultra-high-speed laser communication equipments in the 40 Gbps class for satellites in low-earth orbit (LEO) and 10 Gbps class for geostationary earth orbit (GEO). Future prospects are to test them in space, contributing to future data relay satellites and the next engineering test satellites.

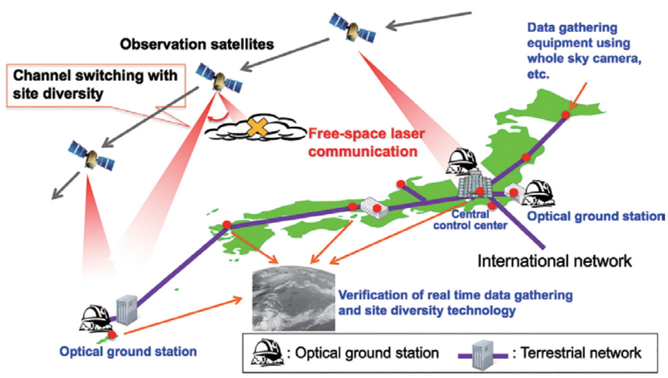


Figure 5 Networked optical ground stations and sensor stations

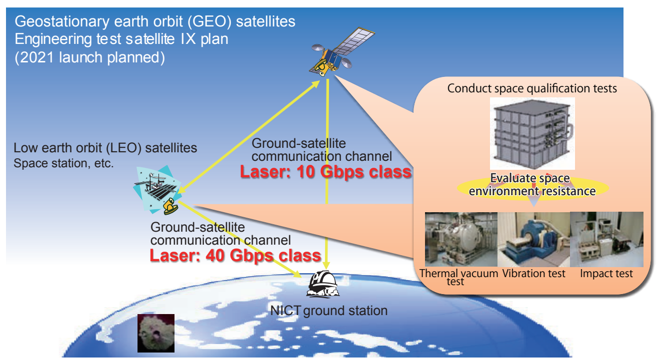


Figure 6 Development of the onboard ultra-high-speed laser communication component "HICALI"

Awards

Kenji SUZUKI[*1] Takashi TAKAHASHI[*4] Yoshiki ARAKAWA[*2] Ryutaro SUZUKI[*5] Toshio ASAI[*3] Morio TOYOSHIMA[*6]

＊1 Senior Researcher, Space Communication Systems Laboratory, Wireless Network Research Institute
＊2 Managing Expert, Commissioned Research Promotion Office, Collaborative Research Department
＊3 Space Communication Systems Laboratory, Wireless Network Research Institute
＊4 Research Manager, Space Communication Systems Laboratory, Wireless Network Research Institute
＊5 Managing Director, Applied Electromagnetic Research Institute
＊6 Director, Space Communication Systems Laboratory, Wireless Network Research Institute

Masatomo YAHATA, Tetsuya WATANABE, Kenichi HOSHI, Shiro YOSHIKAWA , Tamio OKUI, Midori KATO (NEC Corporation), Masayoshi YONEDA (NEC Toshiba Space Systems, Ltd. (currently NEC Space Technologies, Ltd.))

Technical Committee on Satellite Communications, IEICE

Satellite Communications Research Award 2014 (May 14, 2015)

16APSK-OFDM 3.2Gbps RF Signal Direct-Processing Transmitter and Receiver Communication Experiment with Uncompressed 4K UHDTV for Reconfigurable Communication Equipment Using "KIZUNA" (WINDS)

We developed an RF signal direct modulator/demodulator using 3.2 Gbps 16APSK-OFDM multi-value frequency-division multiplexing, and realized wide-band transmission using the WINDS satellite Ka band bent-pipe transponder (bandwidth: 1.1 GHz). We also successfully transmitted uncompressed 4K ultra-high-definition video through a 10 GbE interface using the WINDS satellite. This paper received the FY2014 Satellite Communications Research Award, and we would like to express deep gratitude to all involved. We will continue our efforts in research activities related to the results we have developed here.

From the left: Morio TOYOSHIMA, Kenji SUZUKI, Yoshiki ARAKAWA

From the left: Takashi TAKAHASHI, Toshio ASAI

Kazuyoshi KAWASAKI / Senior Researcher, Space Communication Systems Laboratory, Wireless Network Research Institute

Shin-ichi YAMAMOTO (former Senior Researcher of NICT), Yukihiro TERADA (Kochi National College of Technology), Teruyuki KATO (Earthquake Research Institute, The University of Tokyo), Gousei HASHIMOTO (SPACE ENGINEERING DEVELOPMENT Co., Ltd.), Osamu MOTOHASHI (Japan Aerospace Exploration Agency), Yuichi SAIDA, Ryo MATSUZAWA (Hitachi Zosen Corporation)

Technical Committee on Satellite Communications, IEICE

Satellite Communications Research Award 2014 (May 14, 2015)

Data transmission experiment from the buoy using the Engineering Test Satellite VIII (ETS-VIII) : The aim of early detection of TSUNAMI

We have conducted data transmission experiments of a tsunami early-detection system using ocean buoys via the Engineering Test Satellite VIII in collaboration with five organizations. This prize was awarded for a paper reporting on these results. The damage from the Great East Japan Earthquake is still fresh in our memory, and we continue this research in the hopes of reducing such damage, even by a little. In receiving this award, we feel the importance of this research even more strongly, and will continue with renewed effort. We would also like to thank all those involved in activities leading to this award.

Yuuki TAKANO[*1] Yuu TSUDA[*3] Ryosuke MIURA[*2] Takashi TOMINE[*4] Shingo YASUDA[*1]

＊1 Researcher, Cyber Range Laboratory, Cybersecurity Research Center
＊2 Limited Term Technical Expert, Cyber Range Laboratory, Cybersecurity Research Center
＊3 Researcher, Cyber Tactics Laboratory, Cybersecurity Research Center
＊4 Limited Term Technical Expert, Cyber Tactics Laboratory, Cybersecurity Research Center

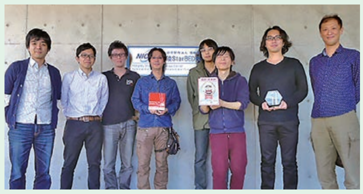
Tomoya INOUE, Kunio AKASHI, Satoshi UDA (Japan Advanced Institute of Science and Technology)

Interop Tokyo 2015

Best of Show Award "Science Category, Grand Prize" (June 10, 2015)

SF-TAP：Scalable and Flexible Traffic Analysis Platform

SF-TAP is an application-level traffic analysis tool and a product of R&D work at CYREC. We are very pleased that the innovativeness and utility of this basic technology have been highly evaluated at Interop Tokyo, the largest networking business show in Japan. Network analysis technology is essential for security, so we expect to continue this R&D in the future.



From the left: Shingo YASUDA, Yuu TSUDA, Kunio AKASHI, Yuuki TAKANO, Tomoya INOUE, Ryosuke MIURA, Takashi TOMINE, Satoshi UDA

Naoto NISHIZUKA / Researcher, Space Weather and Environment Informatics Laboratory, Applied Electromagnetic Research Institute

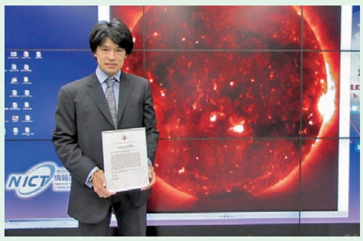
Hinode Extreme Ultraviolet Imaging Spectrometer (EIS) team, approx.
25 members (Representative: L.K.Harra (Mullard Space Science Laboratory), an international team from UK, Japan, USA, and Norway)

Royal Astronomical Society, UK

Group Achievement Award 2015 in geophysics (July 8, 2015)

Discovery of solar phenomena using the Hinode Satellite Extreme UV Imaging Spectrometer

The Extreme Ultraviolet Imaging Spectrometer (EIS) on the Hinode solar observation satellite has made great contributions to the understanding of "space weather" and its popularization in society, regarding coronal heating, the source and acceleration of solar wind and other issues. Working with the international team was an extremely good learning experience, and together with the others, I am very honored and happy to receive this award. I will continue to concentrate my efforts, and would like to express my deep gratitude to all who gave their support.



Tomoyuki KOBAYASHI / Specialist, Network Testbed Research and Development Laboratory, Network Testbed Research and Development Promotion Center
Satoshi KIKUCHI / Limited Term Technical Expert, Network Testbed Research and Development Laboratory, Network Testbed Research and Development Promotion Center
Toshiyuki MIYACHI / Associate Director of Network Testbed Research and Development Laboratory, Network Testbed Research and Development Promotion Center
Shinsuke MIWA / Senior Researcher, Network Testbed Research and Development Laboratory, Network Testbed Research and Development Promotion Center
Kenichi CHINEN (Japan Advanced Institute of Science and Technology)

Multi-cast Disk Image Distribution on a Testbed

Multimedia, Distributed, Cooperative, and Mobile Symposium (DICOMO2015) Best Paper Award

(August 24, 2015)

IPSJ Multimedia, Distributed, Cooperative, and Mobile Symposium (DICOMO2015) Program Committee

When starting an experiment on a testbed, the OS must be installed, but on a scale of 100 machines, this cannot be done manually. As such, we created a multicast disk image distribution program. This idea has been around for a long time, but actually creating such a program raises various constraints, which we measured in detail. This research was done in between everyday operations and development, but we will continue it in the future.

From the left: Toshiyuki MIYACHI, Tomoyuki KOBAYASHI, Satoshi KIKUCHI

Shinsuke HARA / Senior Researcher, Terahertz and Millimeter wave ICT Laboratory, Advanced ICT Research Institute
Issei WATANABE / Senior Researcher, Terahertz and Millimeter wave ICT Laboratory, Advanced ICT Research Institute
Norihiko SEKINE / Research Manager, Terahertz and Millimeter wave ICT Laboratory, Advanced ICT Research Institute
Akifumi KASAMATSU / Director, Terahertz and Millimeter wave ICT Laboratory, Advanced ICT Research Institute
Kosuke KATAYAMA, Kyoya TAKANO, Takeshi YOSHIDA, Shuhei AMAKAWA, Minoru FUJISHIMA (Hiroshima University)

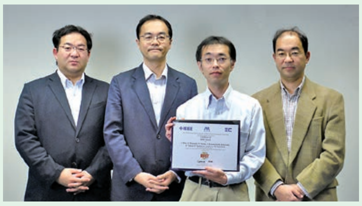
2015 IEEE International Symposium on Radio-Frequency Integration Technology

RFIT Award

(August 27, 2015)

"Compact 138-GHz Amplifier with 18-dB Peak Gain and 27-GHz 3-dB Bandwidth"

We are very honored to receive this IEEE International Symposium on Radio-Frequency Integration Technology (RFIT2015) Award. This research reports on a revolutionary silicon integrated circuit technology that makes possible semiconductor amplifiers that are smaller and have higher performance than ever before, for use in millimeter wave and terahertz wave radio equipment. Upon receiving this award, I would like to offer sincere thanks to my co-authors and others who were involved.



From the left: Issei WATANABE, Akifumi KASAMATSU, Shinsuke HARA, Norihiko SEKINE

Ryutaro OI *1
Kenji YAMAMOTO *4
Yasuyuki ICHIHASHI *2
Takanori SENOH *1
Hisayuki SASAKI *3
Koki WAKUNAMI *5

*1 Senior Researcher, Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute
*2 Planning Manager, Strategic Planning Office,Strategic Planning Department (now on loan to Cabinet Office, Government of Japan)
*3 Research Expert, Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute
*4 Director, Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute
*5 Researcher, Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute

IDMC'15&3DSA2015

Outstanding Paper Award

(August 27, 2015)

"Viewpoint number reduction in Integral photography for real scene large size electronic holography using multiple SLMs"

This publication is regarding the resolution required for people to view electronic holograms. NICT is conducting research on capturing, computing, and display of the hologram, and I am very happy that this research has been evaluated highly at this time. Receiving this award is strong encouragement for my research, and I would like to thank everyone involved. Prompted by the award, I will continue research in holography.

Ryutaro OI (right)

Koki WAKUNAMI *1
Ryutaro OI *4
Yasuyuki ICHIHASHI *2
Takanori SENOH *4
Hisayuki SASAKI *3
Kenji YAMAMOTO *5

*1 Researcher, Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute
*2 Planning Manager, Strategic Planning Office, Strategic Planning Department (now on loan to Cabinet Office, Government of Japan)
*3 Research Expert, Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute
*4 Senior Researcher, Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute
*5 Director, Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute

IDMC'15&3DSA2015

Outstanding Poster Paper Award

(August 27, 2015)

"Wavefront Printer by Using Cell Overlapping Technique"

This publication is regarding a new printing technology for 3D holographic images. I am very happy that these results from two years ago have now been recognized. I would like to express deep gratitude to those within and outside NICT for their support in developing this printing equipment. I will continue devoting my effort to contributing in the field of 3D image display research.

Koki WAKUNAMI (right)

Awards

Sadanori ITO / Researcher, Multisensory Cognition and Computation Laboratory, Universal Communication Research Institute

Yuichi SAKANO / Researcher, Multisensory Cognition and Computation Laboratory, Universal Communication Research Institute

Hiroshi ANDO / Director, Multisensory Cognition and Computation Laboratory, Universal Communication Research Institute

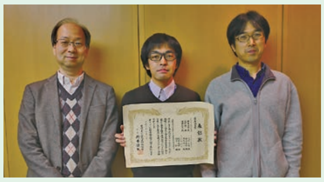
Masaharu MOTEKI, Akihiko NISHIYAMA, Kenichi FUJINO (Public Works Research Institute), Shigeo KITAHARA, Hitoshi OKAMOTO (Kumagai Gumi Co., Ltd.)

Council for Construction Robot Research (CCRR)

Best Paper Award of The 15th Symposium on Construction Robotics in Japan (September 8, 2015)

"Remote control of construction equipment by using high-resolution stereoscopic display"

This paper discusses practically, changes in machine operation efficiency due to differences in the imaging environment when using construction equipment in response to disaster. Based on a basic evaluation of video conditions and the visibility of what is being worked on, we showed that work time can be reduced by about 20% by using a high-quality video communication environment for construction workers. This research is a result of collaboration with the Public Works Research Institute. Sincere thanks go to all who provided support in this endeavor.



From the left: Hiroshi ANDO, Sadanori ITO, Yuichi SAKANO

Ben PUTTNAM *1 **J.-M. DELGADO MENDINUETA** *2 **Werner KLAUS** *1 **Yoshinari AWAJI** *3 **Jun SAKAGUCHI** *1 **Naoya WADA** *4

*1 Senior Researcher, Photonic Network System Laboratory, Photonic Network Research Institute
*2 Researcher, Photonic Network System Laboratory, Photonic Network Research Institute
*3 Research Manager, Photonic Network System Laboratory, Photonic Network Research Institute
*4 Director of Photonic Network System Laboratory, Photonic Network Research Institute

Ruben S. LUÍS (Former Researcer of NICT), Yoshiaki TAMURA, Tetsuya HAYASHI, Masaaki HIRANO (Sumitomo Electric Industries, Ltd.), John MARCIANTE (RAM Photonics, LLC)

41st European Conference on Optical Communications (ECOC2015)

Nature Photonics Best Postdeadline* Paper Award (October 1, 2015)

"2.15 Pb/s Transmission Using a 22 Core Homogeneous Single-Mode Multi-Core Fiber and Wideband Optical Comb"

Thanks to the effort and team work of the NICT researchers and successful collaboration with RAM photonics (wide band comb source) and Sumitomo Electric Company (22-core fiber) who contributed the key components, we were able to expand the capacity limits of optical fiber transmission. We had to overcome many challenges to achieve such high-capacity transmission and are happy that our work was recognized by the award.

* Postdeadline papers give conference attendees the opportunity to hear new and significant research in rapidly advancing areas at the earliest possible opportunity. The postdeadline session highlights only those papers judged to be truly excellent and compelling in their timeliness. The winner of this award was only one institute among several parallel sessions by the reason of top scored evaluation.

Ben PUTTNAM (left)

Ved Prasad KAFLE / Senior Researcher, Network Architecture Laboratory, Photonic Network Research Institute

Tomoji TOMURO / Technical Expert, Network Architecture Laboratory, Photonic Network Research Institute

Yusuke FUKUSHIMA / Researcher, Network Architecture Laboratory, Photonic Network Research Institute

Alexandre MANOURY / former NICT Internship Trainee

IEICE Technical Committee on Network Systems

Best Paper Presentation Award at English Session (October 15, 2015)

"Design and Implementation of Legacy Application Adaptation Tools for ID-based Communication"

This paper presented the design and implementation of software tools to enable existing Internet applications to run without any modification in the new ID-based communications environment known as HIMALIS, developed by NICT. HIMALIS introduces terminal identifiers in the communication process to realize mobility and multi-homing. We are pleased and humbled to have our paper selected for this award as one of the best three papers among sixty papers presented at IEICE General Conference 2015 English session symposium, organized by the Technical Committee on Network Systems.

From the left: Alexandre MANOURY, Ved Prasad KAFLE, Tomoji TOMURO, Yusuke FUKUSHIMA

Kentaro TORISAWA *1 **Jonghoon OH** *4 **Julien KLOETZER** *5 **Kiyonori OTAKE** *2 **Masahiro TANAKA** *4 **Takuya KAWADA** *5 **Chikara HASHIMOTO** *3 **Junta MIZUNO** *5 **Hideaki FUJII** *6

*1 Director of Information Analysis Laboratory, Universal Communication Research Institute
*2 Director of Information Distribution Platform Laboratory, Resilient ICT Research Center
*3 Research Manager, Information Analysis Laboratory, Universal Communication Research Institute
*4 Senior Researcher, Information Analysis Laboratory, Universal Communication Research Institute
*5 Researcher, Information Analysis Laboratory, Universal Communication Research Institute
*6 Research Expert, Planning Office, Universal Communication Research Institute

Jun GOTO (Japan Broadcasting Corporation), Kentaro INUI, Naoaki OKAZAKI (Tohoku University)

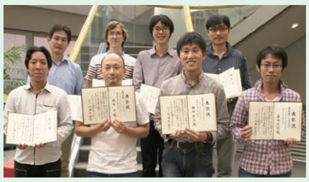
Mobile Communication Fund

The Award for Excellence in the Advanced Technology Division of the 14th (for 2015) Docomo Mobile Science Award (October 16, 2015)

Research on technologies for semantic analysis of social text big data

We were awarded this prize for the two following systems, the large-scale web information analysis system WISDOM X and the disaster information analysis system DISAANA, which we have developed and released to the general public. We shared the prize with Prof. Kentaro Inui's group of Tohoku University. Since WISDOM X and DISAANA are combinations of a variety of advanced technologies for which many researchers and developers are involved, the number of recipients is large. Our achievements are owing to the support of many people. We would like to take this opportunity to deeply appreciate their understanding and cooperation.

Kentaro TORISAWA



From upper left: Kiyonori OTAKE, Julien KLOETZER, Takuya KAWADA, Jonghoon OH
From lower left: Junta MIZUNO, Chikara HASHIMOTO, Masahiro TANAKA, Hideaki FUJII

NICT's Shinichi YOSHIDA qualifies to go to the 2016 Rio Paralympics!

NICT's Shinichi YOSHIDA participated in International Para Table Tennis Tournaments and has won gold medals in the Belgium Open in October, 2015, and the Copa Costa Rica Open in December, 2015, in both individual and team competitions.

These results raised him to 15th on the ITTF PTT World Ratings List, qualifying him to participate in the 2016 Rio de Janeiro Paralympics.

This will be the first time Mr. YOSHIDA has participated in the Paralympics.

The 2016 Paralympics will be held from September 7 to 18, 2016, in Rio de Janeiro, Brazil.

Please give Mr. YOSHIDA your strong support!

ITTF PTT (International Para Table Tennis) Ranking Lists
http://www.ipttc.org/rating/2016-01-01/M3.htm

ITTF PTT Official Shinichi YOSHIDA profile
http://stats.ipttc.org/profiles/1186

Belgium Open 2015

Copa Costa Rica Open 2015

Memorandum of Understanding on Collaboration signed with GÉANT (EU)

National Institute of Information and Communications Technology (NICT) and GÉANT have signed a Memorandum of Understanding on Collaboration in the field of R&D communication network and Advanced Internet Technologies on 26 January 2016. The signing ceremony was held during the 41st Asia Pacific Advanced Network Meeting (APAN) in Manilla, Philippines. Dr. Makoto IMASE, Vice President of NICT, attended the ceremony to sign the MOU.

GÉANT is the organization interconnecting National Research and Education Networks (NRENs) across Europe, with 36 national members and one representative member (NORDUnet) which participates on behalf of the 5 Nordic NRENs. They have started the activities in 1986 and are currently managing and operating the NREN's interconnecting networks across Europe as well as providing ID management, security and cloud services. GÉANT headquarters are located in Amsterdam, the Netherlands, and Cambridge, the United Kingdom.

NICT has been collaborating with GÉANT (formerly Delivery of Advanced Network Technology, DANTE) since 2008 under the MOU. GÉANT and NICT have promoted this research collaboration making use of networks for the Japan-Europe collaborative R&D projects. This renewed MOU specifies the collaborations on Ethernet services and Software Defined Networking (SDN) infrastructures and so on.

**After the MOU signing ceremony
(The fourth person from the right is NICT Vice President IMASE)**

Announcement

Disaster Resilient ICT Research Symposium 2016

—Implementation of disaster-resilient ICT R&D and establishing a resilient society—

Date: March 14, 2016 (Mon.)
Symposium: 13:00 –16:00 Hagi Conference Hall
Exhibition: 12:00 –17:00 Tachibana Conference Hall

Venue: Sendai International Center, Conference Bldg. 2F
Aobayama, Aoba-ku, Sendai
http://www.aobayama.jp/english/access/

Organized by : National Institute of Information and Communications Technology
Supported by: Ministry of Internal Affairs and Communications, Resilient ICT Forum
Japanese-English simultaneous interpretation

Admission Free

◆ Objectives

NICT has established the Resilient ICT Research Center in Sendai City, being aware as a lesson that damage to the information communication networks was a hindrance to understanding disaster situations and initiating restoration activities during the Great East Japan Earthquake. Together with the Resilient ICT Forum, with participants from government, academia, and industry, we are conducting R&D to strengthen disaster resistance in information and communication networks and to implement those results in society.

We are now nearing five years since the Great East Japan Earthquake and four years since the center was established. This “Disaster Resilient ICT Research Symposium and Demonstration 2016” is being held to discuss R&D activities so far, directions in the future, and plans to implement them in society. It will also contribute to implementing a disaster-resilient society, prepared to withstand large-scale disasters using disaster resilient ICT. We hope many of you will attend.

◆ Symposium: 13:00–16:00

Opening Address

Part 1 Lecture: Development and future of disaster-resilient ICT R&D

Mr. Masahiko TOMINAGA, Director-General for International and Technology Policy Coordination, Minister's Secretariat, Ministry of Internal Affairs and Communications
Dr. Nobuyoshi HARA, Executive Vice President for Earthquake Disaster Reconstruction, Tohoku University
Yoshiaki NEMOTO, Director General of Resilient ICT Research Center, NICT

Part 2 Panel discussion: Enhancement of Societal Resiliency against Natural Disasters through ICT R&D

Moderator: Hiroshi KUMAGAI, Associate Director General of Resilient ICT Research Center, NICT
Panelists: Dr. Nei KATO, Executive Director, Research Organization of Electrical Communication, Tohoku University
Dr. Hiroshi TOJO, Vice President, Senior Manager of Media Innovation Laboratory, NTT Network Innovation Laboratories
Dr. Hironori ABE, Head of Section, Reconstruction Support Office, KDDI Corporation
Mr. Kazuhiro SAKAMOTO, Chief Examiner, Administration Division, Shirahama Town
Dr. Sopheap Seng, President, National Institute of Posts, Telecommunications and ICT (NIPTICT), Cambodia

Closing Address

◆ Exhibition: 12:00–17:00

Exhibits of disaster-resilient ICT R&D results

Applications: http://www.nict.go.jp/en/reict/symposium2016/
Inquiries: Secretariat, Planning Office, Resilient ICT Research Center, NICT
TEL: +81-22-713-7511 FAX: +81-22-713-7587
E-mail: resil-sympo2016@ml.nict.go.jp

Next issue (April, 2016) will introduce NICT's fourth medium and long term plan, which will begin in April.

NICT NEWS No.456 MAR 2016
Published by
Public Relations Department,
National Institute of Information and Communications Technology
<NICT NEWS URL> http://www.nict.go.jp/en/data/nict-news/

4-2-1 Nukui-Kitamachi, Koganei, Tokyo
184-8795, Japan
TEL: +81-42-327-5392 FAX: +81-42-327-7587
E-mail: publicity@nict.go.jp
URL: http://www.nict.go.jp/en/
Twitter: @NICT_Publicity

ISSN 2187-4034 (Print)
ISSN 2187-4050 (Online)

〈Recycled Paper〉
R70