National Institute of
Information and Communications Technology

NICT NEWS

No.458 JUN 2016

FEATURE

Introduction of a new research organization

- Watch Electromagnetic Research Cluster
- Connect Network Research Cluster
- Create AI/Brain Networks and Communications Research Cluster
- Protect Cybersecurity Research Cluster
- Develop Advanced ICT Research Cluster

Open Innovation Promotion Headquarters

NICT NEWS No.458 JUN 2016
National Institute of Information and Communications Technology

CONTENTS

〈Cover description〉

A collaboration agreement with Ishikawa Prefecture Concluded

On June 3, 2016, NICT concluded an agreement with Ishikawa Prefecture on "Collaboration between Ishikawa Prefecture and NICT on utilization of ICT." On the day a ceremony was held at the prefectural offices, with Ishikawa Governor Masanori TANIMOTO and NICT President Masao SAKAUCHI (represented by Vice President Taihei KUROSE). The purpose of this agreement was to contribute to developing local industries through cooperation between Ishikawa Prefecture and NICT, promoting ICT R&D and human resource development.

To achieve this goal, both parties recognize the importance of joint research between NICT and enterprises in Ishikawa and collaboration in cultivating human resources for Ishikawa enterprises. To facilitate this collaboration, NICT's Hokuriku StarBED Technology Center has been named the "Hokuriku ICT Collaboration Base," to act as a center for new R&D in areas such as IoT and security, and for collaboration between industry and academia.

Further discussion with Ishikawa Prefecture on specific collaborative measures through the Collaboration Base in the future is planned.

(Cover photo: The Hokuriku StarBED Technology Center as the "Hokuriku ICT Collaboration Base.")

Sympathy for those who were affected by the 2016 Kumamoto earthquakes

We respectfully pray for the souls of those lost in the 2016 Kumamoto earthquakes, which occurred this past April, and express our heartfelt sympathies to all victims of the disaster. We also want to honor and respect all who are working to support rescue and recovery efforts in the disaster affected areas.

Even now, there is still much anxiety every day in the disaster areas, and we pray that those in the affected regions will regain a sense of security as quickly as possible.

The National Institute of Information and Communications Technology (NICT) has provided support to the affected areas in the following ways. We hope to continue to be able to help and be of use in the future.

Dr. Masao SAKAUCHI
President of National Institute of Information and Communications Technology

■ DISAster information ANAlyzer (DISAANA) – Disaster-related SNS information analysis system

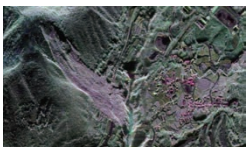
The DISAANA system, which is able to analyze Twitter content related to damage conditions, materials shortages, and other issues in the Kumamoto and Oita regions, was made available free-of-charge.

Search results are selected by automated processing, so the truth and accuracy of the results is not guaranteed.

DISAANA analysis of Twitter content related to damage in the Kumamoto region

■ Observations by the Polarimetric and Interferometric Airborne Synthetic Aperture Radar System (Pi-SAR2)

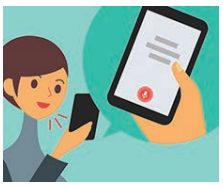
Observations of changes in the ground surface (slope collapse, etc.) were made in the Kumamoto and Oita regions. Some of the images from the observations were sent to relevant organizations as early reports indicating damaged areas.


The Great Aso Bridge, washed away by a landslide

■ VoiceTra – Multilingual Speech Translation Application

The translation features of VoiceTra, a multilingual speech translation application, were made available as a means of communication with foreigners in the disaster area.

It can be downloaded from the following URL: http://voicetra.nict.go.jp/en/

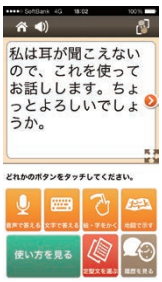


■ KoeTra application supporting communication with the hearing-impaired

This is a smartphone application for supporting communication with the hearing impaired. It utilizes speech recognition and speech synthesis technologies resulting from NICT R&D. It can be used even when an Internet environment is not available after it has been installed, and it can be used free-of-charge as a means of communication with hearing-impaired disaster-affected people.

It can be downloaded from the following URL: http://www.koetra.jp/en/

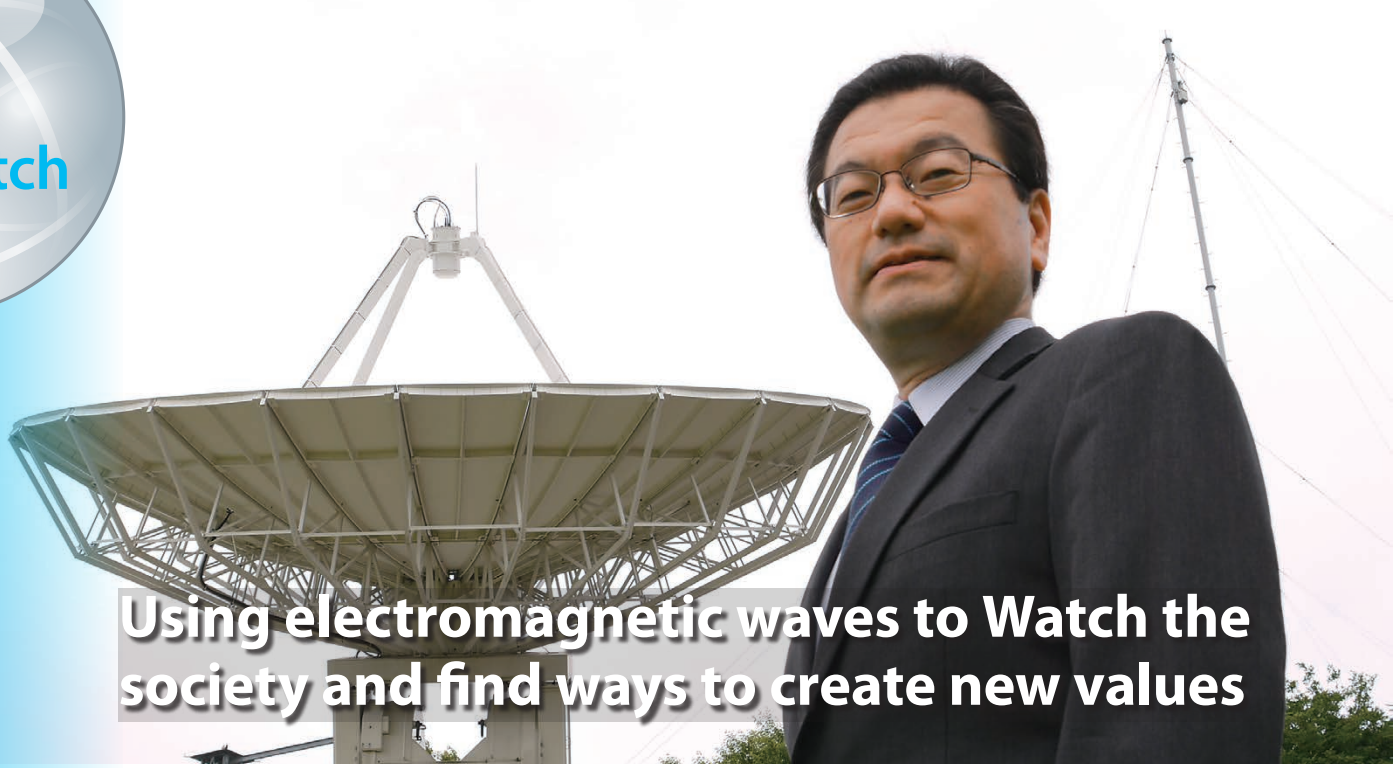
* "KoeTra" is provided by FEAT Limited, and server operations are provided free-of-charge as support for disaster-affected people in the area of telecommunications, t-hrough collaboration between NTT DOCOMO, KDDI Inc., Softbank Corp., NTT East, and NTT West.



■ "SpeechCanvas" - An application supporting communication with the hearing impaired, which is useful for reception desks and other areas

This free application for tablet devices provides strong support for communication between hearing and hearing-impaired people, using NICT speech recognition technology. Spoken words appear successively as text on the screen, and pictures or text can be drawn on the screen with fingers. After it is installed speech recognition works even without an Internet connection, so it can be used confidently in disaster areas where network environments may be unstable.

It can be downloaded from the following URL: http://speechcanvas.nict.go.jp/ (Japanese only)



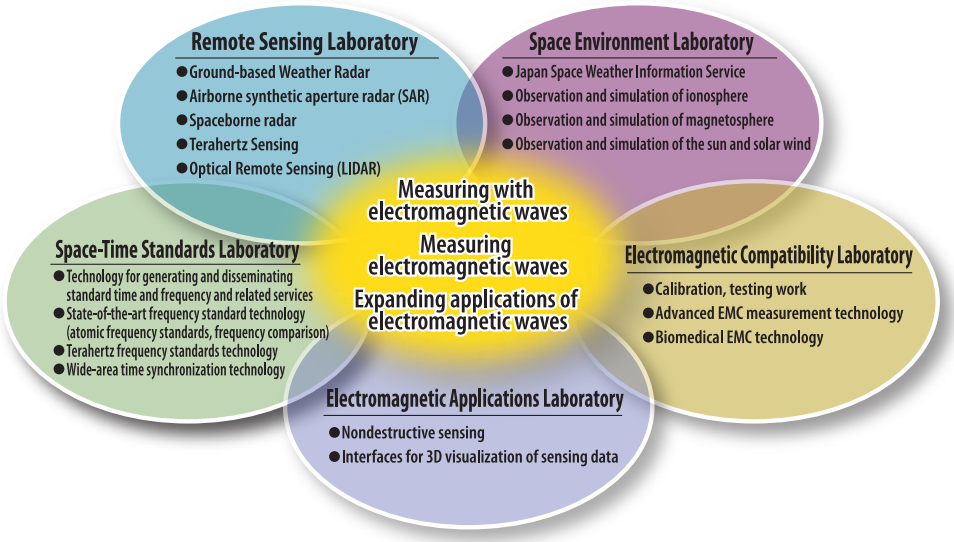
Using electromagnetic waves to Watch the society and find ways to create new values

Kazumasa TAIRA
Director General, Applied Electromagnetic Research Institute
Joined the Communications Research Laboratory, Ministry of Posts and Telecommunications (currently NICT) in 1991. Engaged in R&D in mobile radio propagation, mobile communications systems, and electromagnetic compatibility. Held positions of Director General of Outcome Promotion Department and Director General of the Network Security Research Institute before taking his current position in April this year. Ph.D. (Engineering).

By using electromagnetic waves to observe and measure various phenomena and conditions surrounding us, we can obtain new kinds of information and contribute to a society in which we can create and maintain new values.

To create new values by using information and communications technology (ICT), it is necessary to observe and measure various phenomena and conditions in the environment that surround us and to convert this data into forms that are usable on the Internet. The mission of the Applied Electromagnetic Research Institute is to enable this through using electromagnetic waves. The Institute conducts research on a vast range of subjects that covers those on the atomic level all the way up to those occurring on interplanetary scales. While the information we obtain is used to understand real phenomena, we also put an emphasis on using it for maintaining society. To this end, the Institute has organized itself into five laboratories and pursues R&D within the four technological fields outlined on the next page.

Laboratory structure and fields studied



R&D in Progress

Remote sensing technology	Technologies to observe wind, water vapor, rainfall, and other factors with high space-time resolution and to detect sudden atmospheric phenomena such as localized heavy rainfall early, spaceborne sensors which measure precipitation, cloud, and wind in the atmosphere on a global scale, and airborne synthetic aperture radar which can rapidly determine conditions when disasters such as earthquakes and volcanic eruptions occur. Also R&D on nondestructive, contactless diagnostic techniques that contribute to effective preservation and management of civil engineering infrastructures and cultural heritages.
Space environment measurement technology	R&D on basic technology to measure and predict the condition of the ionosphere, magnetosphere, and radiation belt with high precision, which can have major effects on radio propagation and the operation of aircraft and artificial satellites. Also R&D aimed at building systems contributing to social utility and applying the R&D results to space weather forecasting. Also R&D to implement high-precision early alert systems using observations of solar radio emissions and simulations of solar wind.
Electromagnetic-wave measurement fundamentals (Space-time standards technology)	Accurate frequency and time information, whose importance may not be universally recognized, are indispensable for the information and communications society and advancement of accurate measurement technologies. In R&D on space-time standards technologies, we develop frequency standards (atomic clocks) and time and frequency transfer techniques. The former technologies are the origins of accurate and stable frequencies, while the latter are necessary for their evaluation and application. We also engage in generation and dissemination of the highly reliable Japan Standard Time and in developments to advance this technology.
Electromagnetic-wave measurement fundamentals (EMC technology)	To ensure stability and safety as the uses of electromagnetic waves increase and diversify, we are conducting R&D on advanced EMC measuring technologies and biomedical EMC technologies. Regarding the advanced EMC measuring technology, we are contributing to a clean electromagnetic environment by developing methods to measure unwanted emissions from electric/electronic devices accurately, methods to evaluate the effect of such emissions on communication systems, and calibration technologies enabling radio waves to be measured accurately. In regard to the biomedical EMC technologies, we are contributing to the development of a society in which radio waves are used safely by conducting R&D on technologies to accurately evaluate exposure of the human body to radio waves, and to evaluate conformity of radio devices to technical standards.

■ Remote Sensing Laboratory

We study advanced remote sensing technology and develop instruments that can measure atmospheric wind, water vapor, and precipitation with high temporal and spatial resolutions. One of their applications is to build a system that can detect localized heavy rainfall much earlier than the current operational systems can. We also conduct research on spaceborne radars, lidars, and submillimeter spectroscopic sensors that measure global distributions of precipitation, cloud, and wind in order to improve the accuracy of global climate/weather monitoring and forecasting. In addition, we are engaged in the development of an airborne synthetic aperture radar (SAR) that can produce images of the ground surface and detect small variations in it. Data obtained by SAR are utilized to collect geographical information associated with natural incidents such as volcanic eruptions and earthquakes.

■ Space Environment Laboratory

The Space Environment Laboratory develops technology to make observations of the Sun and of the Earth's magnetosphere and ionosphere and to collect and analyze data. It also develops simulation code to make space weather forecasts and develops the means of early detection of solar storms, which may affect society, as well as alert systems for aircrafts and satellites and the radio infrastructure to provide such information in an easy-to-use way.

■ Space-time Standards Laboratory

The Space-time Standards Laboratory develops highly accurate and robust optical frequency standards and precise frequency transfer techniques for linking frequency standards internationally. It also generates and disseminates Japan Standard Time and researches related technologies for expanding its utilization, including terahertz frequency standard technology, wide-area time synchronization technology, and chip-scale atomic clock technology.

■ Electromagnetic Compatibility Laboratory

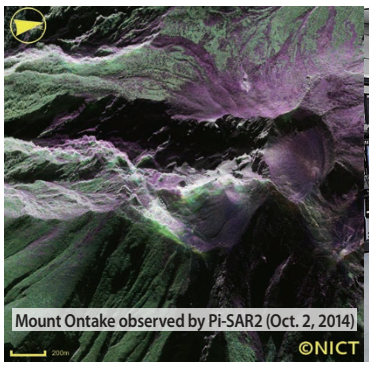
The Electromagnetic Compatibility Laboratory develops RF power standards for frequencies up to 300 GHz in the field of advanced EMC measurements. It also provides the world's first calibration service for such measurements and uses new measurement methods on wideband electromagnetic noise emitted from household appliances and other devices. In the field of biomedical EMC technology, it is working on analyzing interactions between living organisms and electromagnetic waves up to terahertz frequencies, implementing dosimetric technology for measuring the human body's exposure to electromagnetic waves, and technology to evaluate the safety of wireless power transmission systems and 5G wireless terminals using quasi-millimeter-wave and millimeter-wave bands.

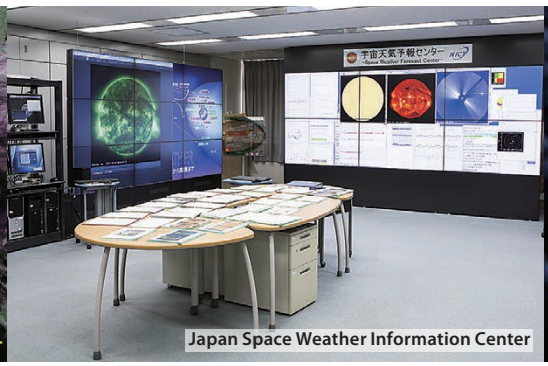
■ Electromagnetic Applications Laboratory

The Electromagnetic Applications Laboratory conducts R&D and technology transfers of electromagnetic-wave applications by collaborating with other departments and organizations within and outside NICT. It began from the following two projects.

The Nondestructive Sensing Project contributes to efficient maintenance and management of civil engineering infrastructures and cultural heritages by conducting R&D on technologies capable of nondestructive, contactless diagnostics and on field testing equipment. It also encourages technology transfers aimed at practical implementations of these technologies.

The Sensing Data Visual Interface Project is developing visualization techniques to display various observation data in ways that are easy to understand, in particular, by using holography technologies developed in imaging research. Holography technology is also being used to develop new optical devices.


Mount Ontake observed by Pi-SAR2 (Oct. 2, 2014) ©NICT


Japan Space Weather Information Center


Calibration technologies in millimeter-wave bands

Network Research Cluster

Network System Research Institute
Wireless Networks Research Center

Connecting people, things, and information with photonics and wireless technologies

Naoto KADOWAKI
Senior Executive Director,
Director General, Wireless Networks Research Center,
Senior Executive Director, Open Innovation Promotion Headquarters
Joined the Ministry of Posts and Telecommunications' Radio Research Laboratory (currently NICT) in 1986. Later, worked as Associate Researcher at AUSSAT Inc. in Australia, at the ATR Adaptive Communications Research Laboratories, and was the Executive Director of the NICT Strategic Planning Department before his current positions. Ph. D. (Information science).

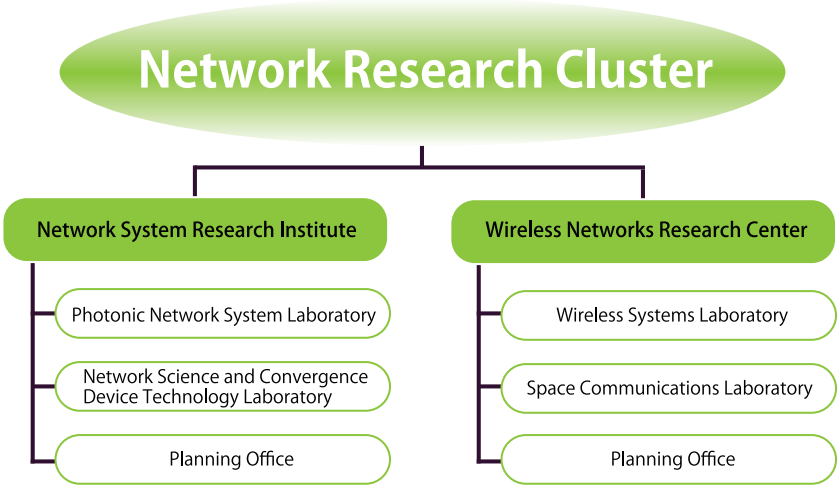
Naoya WADA
Director General, Network System Research Institute
Joined the Ministry of Posts and Telecommunications Communications Research Laboratory (currently NICT) in 1996. Since then, engaged in research related to photonic networks and optical transmission systems. Ph.D. (Engineering).

The era in which communication is used not only among people, but is also for connecting devices for use in sensing and machine control is developing. Devices connected to networks are diversifying, and the number of such devices is increasing explosively.

"Connection" technologies that can meet the communication needs of such diversification and explosive growth, and can do so flexibly, reliably, and quickly, are being implemented using photonics and wireless technologies.

To create new value, realize a society safer than ever, and develop innovative social systems through world-leading ICT, with a focus on "Connecting Society", we are conducting fundamental R&D on network technologies to meet the recent explosive growth in data traffic and to support the diversification of communication quality and network services.

The Network Systems Research Institute has two laboratories advancing three projects: Photonic Network System technologies, Optical Access Device technologies, and Innovative Network Architecture technologies. The Wireless Network Research Center is also conducting R&D on wireless communications technologies for the next-generation IoT and for mobile communication systems beyond the 5th generation and on satellite communication technologies for maritime, aeronautical, and space broadband networking.



R&D in Progress

Photonic Network System technologies

Research on ultrahigh-capacity multi-core fiber network systems, all optical switching technologies for packet processing without converting optical signals into electrical signals, optical transmitter and receiver technologies for multi-core fibers, optical switching and transport nodes supporting differing baud rates, communication schemas and protocols, and 1-Tera bps-per-channel class optical switching technologies.

Optical Access Device technologies

Research on efficient convergence of optical fiber and ultrahigh frequency radio waves; "Parallel Photonics" ICT device technologies with high-integration and high-precision for signal transmission, reception, and data-exchange; and high speed, low-delay 100 Gbps-class data transmission technologies such as "100G Access" and "Sensor on Fiber".

Innovative Network Architecture technologies

Research on automatic and distributed control technologies for resource arbitration among multiple services, for registration and update management of connected devices, and for reconfiguration against network disconnection and/or congestion, and information dissemination and sharing technologies based on information-centric networking concepts, which provide content-dependent control and routing and resolution of privacy/security issues.

Wireless network control/management technology

Flexible wireless network technologies for 5G and beyond mobile communication systems such as effective frequency sharing and traffic dispersion, millimeter-wave/terahertz-wave technologies, technologies for building wireless networks combining these technologies, and application technologies to meet social requirements such as ITS (Intelligent Transport Systems).

Adaptive wireless networking technology

Adaptive implementation technologies for terminal functions suited to network scale and usage environment, adaptive routing technologies suitable for high-capacity data gathering, techniques for dynamic power-saving operation, and technologies for coverage expansion by combining different wireless systems, etc.

Highly reliable wireless networking technology

Wireless network technologies enabling provision of highly reliable service in terms of connectivity and real-time performance, even in environments where there is no communications infrastructure, in enclosed areas, or in the sea.

Global optical satellite communication network technology

Technologies for global optical satellite communication networking and on-board devices and components to realize 10-Gbps-class optical satellite communications that meet the need for the increased satellite channel capacity required for high-resolution remote sensing, the increasing use of aeronautical satellite communications, etc.

Maritime/space broadband satellite communication network technology

Technologies for providing the broadband communication links required by increasing maritime and aeronautical applications in the Ka band. Development of technologies for broadband communication systems covering wide areas and compact and lightweight mobile terminals. Development of technologies that will contribute to the development of the "next-generation engineering test satellite" (tentative name).

Overview of Network System Research Institute

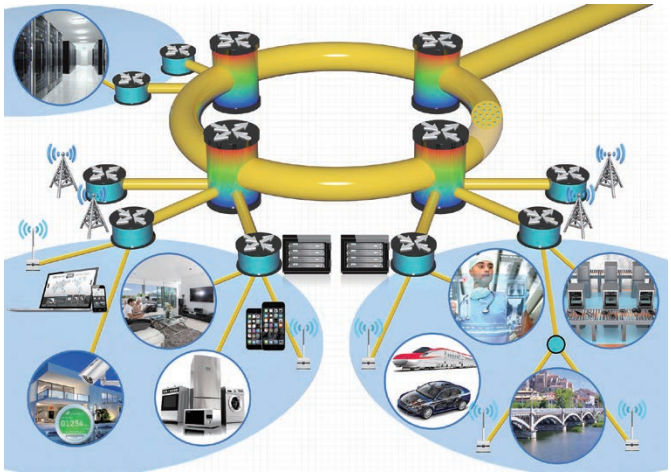
The Network System Research Institute is conducting R&D to meet the increasing demand for data services (more than 1000 times today's level). Research includes ultrahigh-capacity multi-core fiber network systems technology and optical integrated network technology that will be able to flexibly accommodate rapid traffic fluctuations and diversification of data services. The Institute is also establishing basic technologies for optical access networks to enable these high-capacity networks to reach increased numbers of subscribers at greater distances and with more power efficiency than currently possible.

To realize an optical access network capable of accommodating a huge amount of data traffic in 5G mobile communication systems (5G) and in networks beyond 5G, research is being conducted to achieve seamless convergence technology for optical access and core networks that support high-capacity communications to end users.

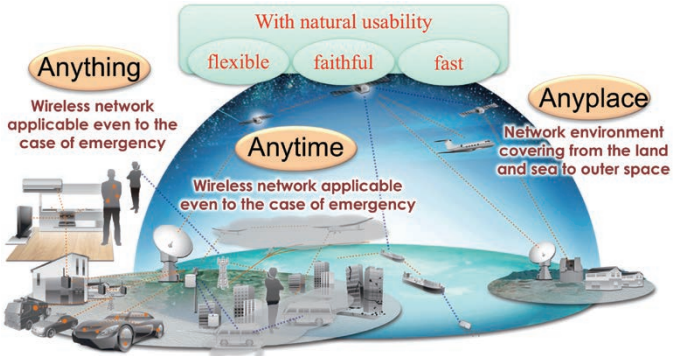
In other areas, to lead advances in new network architectures and key enabling technologies that will bring about innovative networks, research is being done on technologies for (i) automation of dynamic, on-demand network configuration and control and (ii) information dissemination and sharing based on information-centric networking concepts.

Overview of the Wireless Network Research Center

It is necessary to connect any place on land and sea and in the air as well as where we live to support the emergence and advancement of IoT and 5G. To provide such a communications environment, further advances in wireless network technology are needed. The Wireless Network Research Center is developing technologies to augment existing wireless communication technologies and surpass 5G mobile communications systems, such as use of millimeter-wave and terahertz waves, access control that can handle unstable traffic, linking coverage of different types of wireless networks, and adaptive terminal function technologies, which will be able to handle diversifying and increased communication demands. High reliability wireless communication technologies that can be used where it has previously been difficult to use radio waves, such as in enclosed spaces and in the sea, are also being developed. Ka-band satellite communications technologies to provide mobile broadband communications with very compact terminals on small vessels or aircraft are also being developed. Furthermore, R&D is also being performed on optical satellite communication technologies to handle the ultrahigh-capacity communication required in applications such as data transmission for more-advanced, higher-resolution remote sensing applications.



Network innovation technology transporting vast amounts of information encompassing the whole world



R&D vision of the Wireless Networks Research Center

AI/Brain Networks and Communications Research Cluster

Universal Communication Research Institute
Center for Information and Neural Networks
Advanced Speech Translation Research and Development Promotion Center

Renewing ICT Society with Intelligent systems

Toshio YANAGIDA

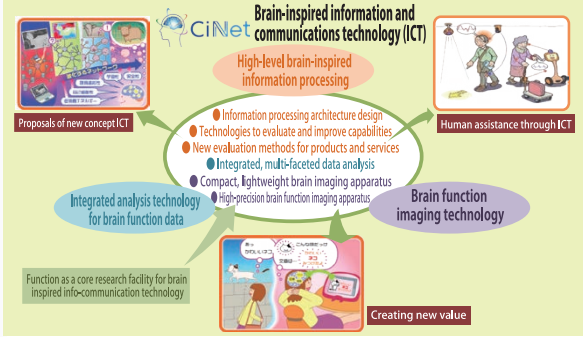
Center Director, Center for Information and Neural Networks
After partially completing a doctoral program, he worked as a Professor at Osaka University, Distinguished Researcher at NICT, and then took his current position in 2013. He is also Director of the RIKEN Quantitative Biology Center. He researches "Yuragi" (fluctuation) as a basic mechanism of life. Awarded Person of Cultural Merit in 2013. Ph. D. (Engineering).

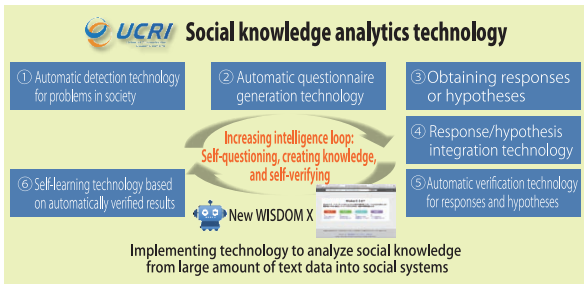
Yutaka KIDAWARA

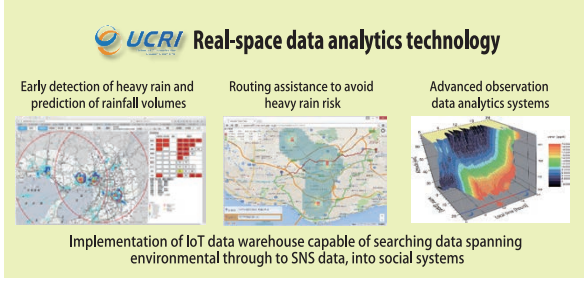
Director General, Universal Communication Research Institute, Director of the UCRI Information Services Platform Laboratory, Director General of the Advanced Speech Translation Research and Development Promotion Center (ASTREC).
He joined NICT (formerly Communications Research Laboratories) in 2001 and has been engaged in R&D on technologies including multilingual speech translation, speech processing, information analysis, information services, and universal communication based on ultra-realistic presence technologies. Ph.D. (Engineering).

The AI/Brain Networks and Communications Research Cluster promotes a wide range of R&D on next generation artificial intelligence technology to realize an intelligent ICT society, from advanced basic research to applied research for implementation in society. The research cluster is composed of the Universal Communications Research Institute (UCRI), the Center for Information and Neural Networks (CiNet), and the Advanced Speech Translation Research and Development Promotion Center (ASTREC).

UCRI has newly established the Data-driven Intelligent System Research Center (DIRECT) and is conducting R&D on new artificial intelligence technologies to analyze large-scale text, image, and sensor data. CiNet focuses on the human brain, which acts as a sender and receiver of information, and is enabling accurate imaging of brain activities, that is perception, cognition, and constant generation of motions. It develops decoding technologies that decipher the information resulting from the brain activities and designs information processing architectures inspired by brain function.







R&D in Progress

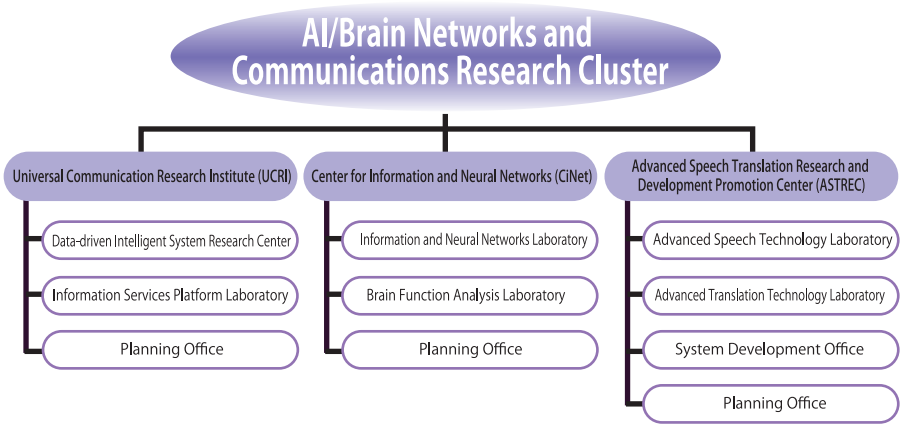
ASTREC Advanced speech translation and dialogue system technologies	R&D on speech communication and multilingual translation technologies to implement these technologies into society. Overcoming language barriers to realize obstacle-free communication by promoting R&D	on basic technologies for the world in 2020 and beyond.
UCRI Social knowledge analytics technology	Developing technologies to analyze knowledge circulating in society (social knowledge) in various types of documents such as text on the Internet, scientific and technical papers, and white papers, providing	easy access to specialist information regarding issues in society for non-specialists, and implementing ways to obtain information useful for various types of decision making.
UCRI Real-space data analysis technology	R&D on data analytics technologies to gather and analyze appropriate real-space data that is closely related to life in society, such as localized torrential rain or environmental change data, and to make such	information useful for society. By doing this, optimized social systems, which recognize high-level conditions and support actions to be taken, can be realized.
CiNet Brain-inspired information and communications technology	R&D on high-level brain information processing technologies such as brain information processing architecture design, technologies to estimate or improve acting or perceptual capabilities, and R&D on technology to evaluate products based on brain information. Also developing precise brain	imaging technologies on which the above are based, and conducting R&D on smaller, lighter imaging equipment and on new imaging methods. Also conducting R&D on imaging databases and information processing technologies for comprehensive, multifaceted analysis of the data.

Driving progress in communications

During the 3rd medium and long term target period, the Universal Communications Research Institute (UCRI) developed the WISDOM X and DISAANA systems as basic technology R&D results in advanced natural language processing, in collaboration with the Resilient ICT Research Center. WISDOM X is a data analysis system capable of analyzing data from over four billion Web pages and use them for various purposes. DISAANA is a disaster prevention information analysis system that analyzes Twitter data in real time. In the 4th medium and long term plan, progress toward thinking technology, that is to have its own questions and to find answers to those questions using large amounts of text information, will be made with DIRECT. This technology will be used to implement entirely new information and knowledge analysis systems and implementation in society will be promoted through open innovation.

The Information Services Platform Laboratory not only promotes R&D on big data processing platform technologies used for analysis of sensor data other than language, it is also attempting to establish research in image processing.

The Advanced Speech Translation Research and Development Promotion Center (ASTREC), putting together a team with NICT researchers and those in industry, has developed platform technologies such as new language analysis algorithms and translation algorithms, and has conducted R&D on applied technologies and systems with the goal of implementing a multilingual speech translation technology in society by 2020. NICT speech recognition technologies using deep learning techniques, which are a type of artificial intelligence technology, have achieved very high recognition accuracy, but the latest AI technologies are being developed and expanded into much higher performance multilingual speech translation technologies. These will be implemented into more-advanced versions of VoiceTra, TextTra, and KoeTra. In 2020, which is the year of the Tokyo Olympics and Paralympics and the final year of the 4th medium and long term plan, a new generation of ICT society will be realized in which technologies such as the multilingual speech translation technology developed by ASTREC and the question answering technology developed by UCRI are used through terminals and robots throughout Japan.



Understanding the brain is the shortest route to AI platform development

Focusing on the brain, which acts as a transmitter and receiver of information, brain activities are actually quite varied, including cognition, thought, emotion, and generation of motions. The brain also has characteristics that a computer does not, such as low energy consumption and flexibility. The Center for Information and Neural Networks (CiNet) believes that conducting multi-modal brain imaging, building databases, and performing integrated, multi-faceted analysis of them is a first step toward understanding the principles that produce these functions and characteristics. By imaging the brains of many people, from young to old and including healthy as well as those with disabilities, it will be possible to understand both universal and individual brain characteristics, to design information processing architectures based on the brain and to develop technologies to, for example, estimate the capabilities of individuals, effectively improve capabilities, and evaluate products and services based on brain information.

As for AI, a popular research area right now, we focus on developing AI platform technology that consumes low energy and has highly generalized capabilities, inspired by the brain, and contributing to realizing robots with more affinity to people. If we are doing attractive or "Omoroi" research, we will naturally attract people from industry, academia, and government, and we can expect to produce more "Omoroi technology" that will help improve daily life and welfare.

Ensuring security against increasingly sophisticated cyberattacks has become a pressing global issue

Tetsuya MIYAZAKI
Director General, Cybersecurity Research Institute
Dr. Miyazaki has been with NICT since 2002 and has been engaged in research on ultra-fast and multi-level modulation techniques. Dr. Eng.

The Cybersecurity Research Institute aims to become a global center for research and development in cybersecurity through close collaboration with industry and academia by taking advantage of NICT's neutral position between the two as much as possible, in order to protect Japan from increasingly sophisticated cyberattacks.

In the era of the Internet of Things (IoT), various objects and sensors and other devices in our surroundings will be connected to networks. This will enable us to enjoy more convenience and live smarter; however, security protection for IoT devices is becoming a pressing issue behind the scenes. The scope to be covered by cybersecurity is expanding day by day and now includes protecting against information leaks and privacy violations related to using big data collected by IoT devices. We are conducting R&D aimed at dealing with such tasks and at addressing issues in the coming information society.

Cybersecurity Laboratory

Daisuke INOUE, Director

- World-leading advanced research based on large-scale data → Research team
- In-house development from monitoring systems to visualization technology → Development team
- Analysis team: Large-scale, cross-sectional analysis of heterogeneous data in response to internal and external demands

Security Fundamentals Laboratory

Shiho MORIAI, Director

- Security Evaluation of Cryptographic Technologies: - Constructing and maintaining safe and secure ICT systems; - Contributing to promotion and standardization of new cryptographic technologies
- Functional Cryptographic Technologies: - R&D on cryptographic primitives with new functionalities and lightweight cryptography
- Privacy Enhancing Technologies: - R&D on privacy protection technologies contributing to use of personal data

R&D in Progress

Cybersecurity technologies	R&D on cyberattack monitoring, analysis support technologies for thwarting the increasingly sophisticated and evolved cyberattacks against government and other institutions providing important infrastructure. Also, research on collecting and analyzing huge amounts of data from these	diversifying cyberattacks, and using it for automatic cyberattack countermeasures. Furthermore, quick deployment of R&D outcomes by applying our R&D to and verifying its outcomes in NICT's own cyber incident response system for verification and strengthening of the technology.
Security testbed development and operations technology	Researching and developing technologies for emulating cyberattacks in a safe environment, constructing a security verification platform (which is indispensable for verifying newly developed protection technologies), and verifying cyberattack	countermeasure technologies in an emulation environment.
Cryptographic technology	Meeting new social needs accompanying IoT evolution by conducting R&D on functional cryptographic technologies providing new functionality, evaluating security of cryptographic technologies, contributing to promotion and standardization of new cryptographic technologies, and construct-	ing and maintaining safe and secure ICT systems. Also, conducting R&D on privacy protection technologies for practical utilization of personal data, as well as engaging in technical support activities for appropriate privacy measures.

Continually advancing cybersecurity technologies

The Cybersecurity Laboratory, directed by Dr. Daisuke INOUE, has been concurrently operating and developing systems including the "Network Incident analysis Center for Tactical Emergency Response" (NICTER), a cyber attack monitoring, analysis, and countermeasure system, the "Direct Alert Environment for Darknet And Livenet Unified Security" (DAEDALUS), a cyber attack alert system, and "NIRVANA Kai," an integrated cyber attack analysis platform able to handle advanced persistent threats. These systems will be further improved by daily operation and simultaneous R&D for creating more active and comprehensive cyberattack observation technologies and for collecting, analyzing, and sharing huge amounts of comprehensive cyberattack data. Consequently, the Cybersecurity Laboratory will accelerate R&D of cybersecurity.

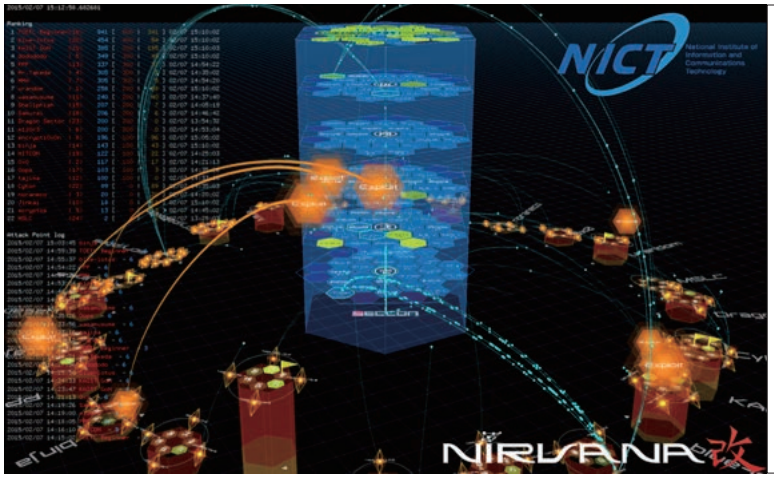
The Laboratory conducts R&D on cybersecurity by emulating testbed technology that can also be used for cybersecurity training of a growing security personnel resource. It is also co-organizing contests for the next generation of top-class cybersecurity engineers, such as the SECCON global security contest, by providing an engine for real-time visualization of the Capture The Flag (CTF) cyber-exercise.

Research on security fundamentals supporting the IoT era

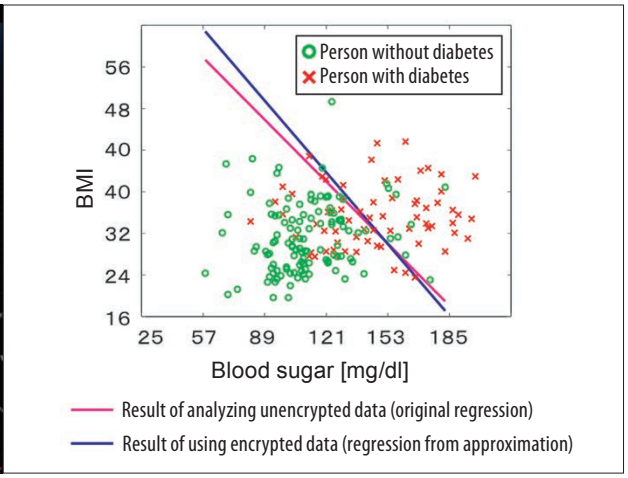
The Security Fundamentals Laboratory, directed by Dr. Shiho MORIAI, conducts R&D on lightweight cryptography and authentication technologies applicable in IoT networks, such as functional cryptography, which provides new functionality to meet future social needs, and sensors that have severe constraints such as circuit size, power consumption, and delay allowance.

It also does research on safety analysis of cryptographic technology and continues to operate the "Cryptography Research and Evaluation Committees" (CRYPTREC) project in collaboration with external organizations. This project focuses on safety and evaluates implementations of e-government recommended ciphers. The Laboratory is also conducting R&D on methods of using data while in encrypted form, contributing to use of personal data while protecting privacy.

As the 2020 Tokyo Olympic/Paralympic games approach, cybersecurity in the IoT era will become increasingly important, extending beyond borders between countries, industries, and academia. We will continue to promote international standardization and deployment of research outcomes in society through close ties with industry and academia.



The "NIRVANA Kai SECCON Custom Mk-II" real-time visualization engine developed by NICT for the SECCON Capture The Flag (CTF) competition



Data analysis protecting privacy by using data in encrypted state (logistic regression analysis)

Creating new information and communication paradigms on the frontiers of ICT

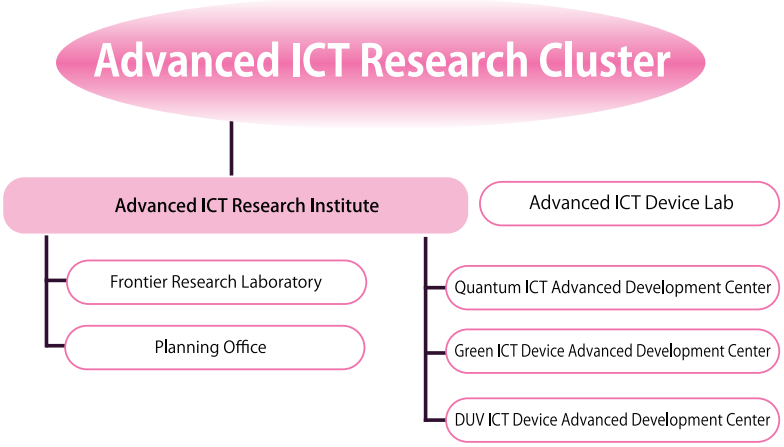
Iwao HOSAKO
Director General, Advanced ICT Research Institute,
Director General, Social Innovation Unit, Terahertz Technology Research Center Joined the Communications Research Laboratory in the Ministry of Posts and Telecommunications (currently NICT) in 1996. Since then, engaged in the study of Terahertz Technologies such as semiconductor emitters and detectors. Ph.D. (Science).

There are various issues with existing technologies in the field of information and communication technology that are foreseeable in the future, such as explosive growth in communications speeds, data capacity, and power consumption. In order to find innovative solutions to such issues, it will be necessary to create new value using technologies such as quantum info-communications, high-performance devices integrating photonics and high-frequency electronics technologies at a high level, novel ICT devices based on new principles and materials, advanced process technologies to fabricate those devices, and bio-ICT technologies.

Our objectives are to find innovative solutions to future technical issues and to formulate new concepts and frameworks underlying ICT that will support an affluent, safe and secure society in the future. We are conducting leading-edge and basic R&D on each of our Frontiers in ICT research areas, including: Quantum info-communications technology, based on the most basic physical principles; Novel ICT devices, based on new principles and materials; and Bio-ICT, which is informed by living organisms and their billions of years of history. We sow the seeds, nurture the sprouts, incubate the small saplings, and develop the basic/fundamental results of such frontier research so they can be implemented in society.

■ Advanced ICT Device Laboratory

In order to establish higher-speed, higher-capacity ICT and the very sensitive sensors and precision measurement techniques to support construction of an IoT society, it will be necessary to realize advanced device technologies capable of high-level integration and use of photonic and electronic device technologies applying new materials and concepts, and the technologies to fabricate such devices. This device laboratory is a base for open innovation, promoting R&D on such advanced and revolutionary basic device technologies and uniting knowledge through collaborative research among industry, academia, and government.



R&D in Progress

Quantum info-communications technology	R&D on quantum optical network technologies using the quantum-mechanical properties of light and electrons, including quantum encrypted communication, which is absolutely safe and efficient. Also advancing quantum info-communications technology supporting R&D on a quantum node technology, which will realize ultra-high-efficiency node processing. Particular effort is	placed on developing quantum network technology, capable of high transmission and energy efficiency, and providing perpetual security with no danger of interception or decoding in the future; and quantum node technology, which will bring multifunctional node processing, ultra-low losses, and energy savings to node processing in data center and other networks.
Novel ICT devices	Comprehensive development of basic technologies for electronic devices such as transistors and diodes using the excellent properties of new semiconductor materials. This encompasses bulk and thin film crystal growth, device processes, circuit technologies, packaging and module technologies.	Also promoting development of efficient, high-output, deep-ultraviolet ICT devices that will revolutionize daily life and societal infrastructure, and implementation of such results in society.
Frontiers in ICT	Conducting R&D to realize high-speed, low power optical communications and wideband highly sensitive sensing systems; to implement compact, ultra-high-speed optical modulators with technologies that manifest new functions by controlling structure or integrating functions at the atomic and	molecular level; to use 100 Gbps-class wireless communications and develop unexplored frequency ranges; and to realize sensing technologies based on biological senses and accurate processing and analysis technologies utilizing responses from biological materials.

■ Advanced technologies from incubation to implementation

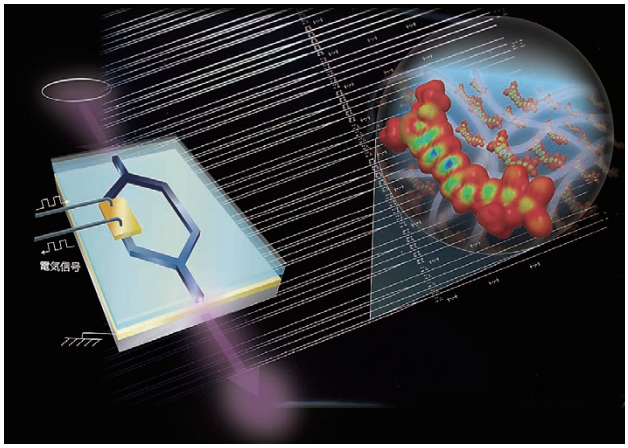
There are various issues that are manifesting with current information and communication technologies. Examples include rapidly increasing amounts of information flowing on networks, security vulnerabilities, increased power consumption, insecure supplies of scarce resources, low information literacy, and the limitations of strict controls on increasingly complex networks. The mission of the Advanced ICT Research Laboratory is to promote development of innovative ICT to solve these types of issues in ways that are not just extensions of existing technologies. We have built a research system able to nurture breakthrough information and communication technologies; producing seed technologies, germinating them, and growing them into seedlings that can be deployed in society.

In seed technology research (frontier research), we are conducting R&D on technologies such as highly-stable THz-frequency comb sources, superconducting single-photon detector (SSPD) applications, nano-hybrid materials and devices, next-generation sensing technologies, biological-organic hybrid-type information recognition technologies, and creating new value using cell and molecular capabilities. Through development and collaboration using these various sensor and control technologies, we hope to discover new information and communication paradigms in unexplored areas of ICT. Also, in research in the phase toward more practical implementations in society, we are verifying quantum optical network technologies, which will provide absolute safety and high efficiency through quantum information and communications technology, ultra-high-efficiency node processing technologies, which will break through information and communication volume barriers, and we are promoting implementation and deployment of entirely new ICT devices using oxide semiconductors and deep ultraviolet light.

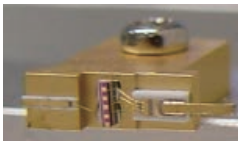
■ Opening of the Advanced Laboratories

As a base for open innovation, the Advanced ICT Device Laboratory opens its resources, including clean room and apparatus for device processing and evaluation to researchers from internal and external organizations; it promotes collaboration among industry, academia, and government to unify knowledge and advance basic device technologies, and solve manifesting issues using information and communication networks and precision measurement and sensing technologies, and it promotes R&D on ICT hardware base technologies to create a more innovative and advanced information society. Specifically, we hope to contribute to establishing high-utility wired and wireless network technologies and advancing measurement and sensing technologies supporting construction of an IoT society by promoting R&D and implementing very convenient device technologies that integrate and apply light and high-frequencies, and applying new materials and concepts.

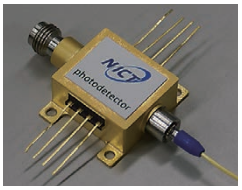
Clean room device process equipment



New materials/Ultra-high-speed optical modulator devices



Quantum dot optical gain chip for coherent optical communications



Optical/high frequency conversion devices for airport surveillance radar systems

Realizing an Open Innovation environment harmonized with society and the world

Naoto KADOWAKI
Director General, Wireless Networks Research Center,
Senior Executive Director, Open Innovation Promotion Headquarters
Joined the Ministry of Posts and Telecommunications' Radio Research Laboratory (currently NICT) in 1986. Later, worked as associate Researcher at AUSSAT Inc. in Australia, at the ATR Adaptive Communications Research Laboratories, and was the Executive Director of the NICT Strategic Planning Department before his current positions. Ph. D. (Information science).

Motoaki YASUI
Executive Director of Unit, Social Innovation Unit,
Managing Director of Office, Strategic Program Produce Office
Joined the Ministry of Posts and Telecommunications' Communications Research Laboratory (currently NICT) in 1996. Subsequently worked as an assistant manager in the MIC Technology Policy Division, Research and Development Office, was Director of the NICT Remote Sensing Fundamentals Laboratory, and was Managing Director of the NICT Strategic Planning Office before assuming his current positions. Ph. D. (Science).

Following the trend of open innovation, NICT, as a National Research and Development Agency, is expected to implement environments in which various players will be able to produce innovation of ICT, or innovation by using ICT. The Open Innovation Promotion Headquarters meets those needs through facilitation of strategic collaboration, technical verification, and effective demonstration in society, while contributing to development of ICT in society as a whole.

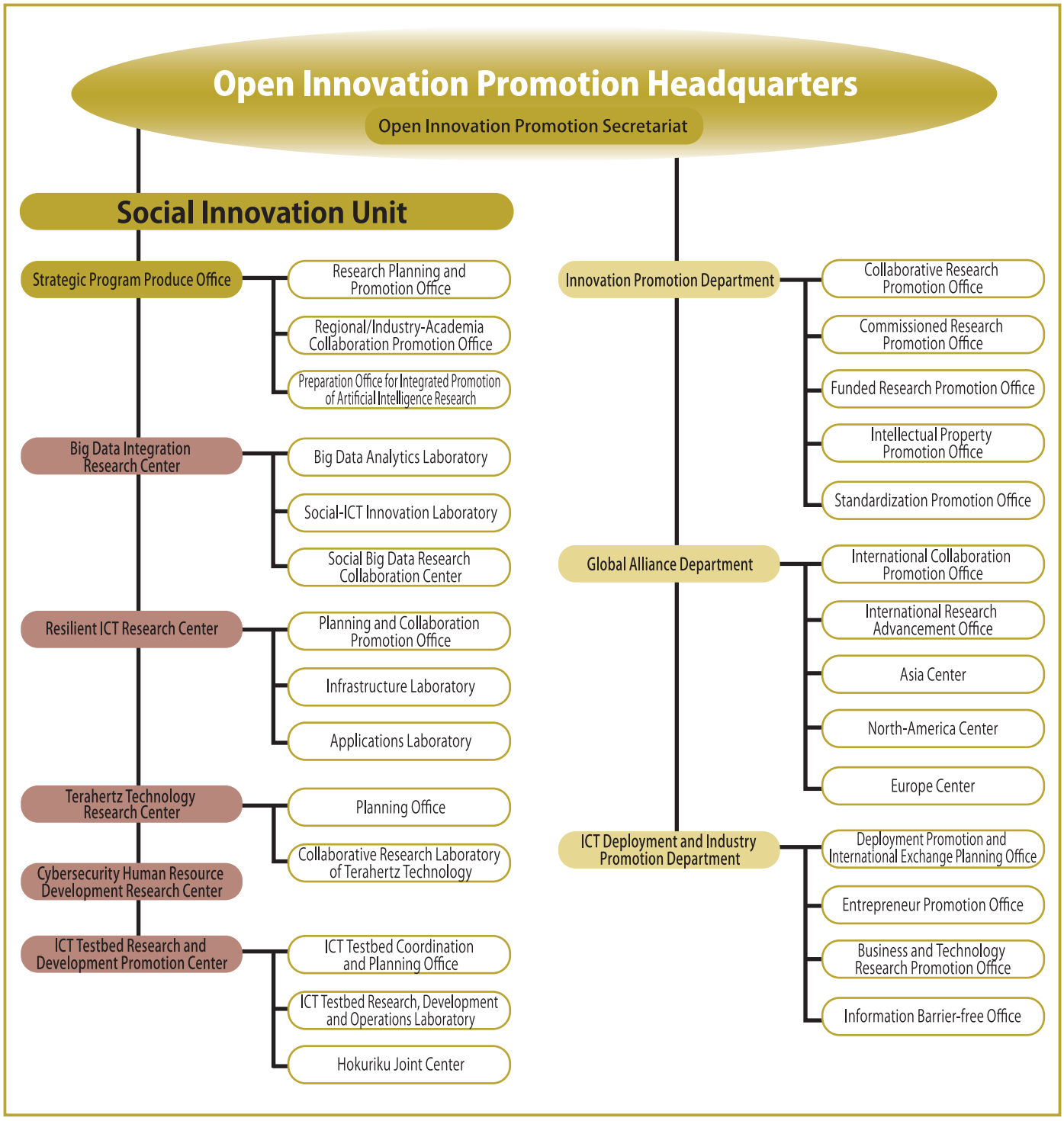
■ "Watch," "Connect," "Create," "Protect," and "Develop" society

In modern society, a variety of scenarios and elements in daily life and economic activity are supported by information and communications technology (ICT), and that tendency becomes broader and deeper day by day. To realize a better society under these circumstances, ICT must be made more convenient, safe, and secure throughout society as a whole. In the interim findings of its information and communications commission, published by the Ministry of Internal Affairs and Communications on July 28, 2015, the phrase, "Watch, Connect, Create, Protect, and Develop society," expressing an important role of ICT in the future, was the basis for deciding priority strategies for solving social issues and for pursuing social implementation. Thus a goal of realizing a "Social ICT revolution" was set, promoting implementation of leading-edge ICT, deploying it throughout society, emphasizing ICT in solving problems, and in doing so, creating new value.

In aspiring to this sort of social ICT revolution, it is important to demonstrate practically applications of the latest R&D results in various scenarios in society, while also filling-out technologies to be very socially acceptable. Making the latest technologies acceptable in society quickly is necessary to accelerate creation of new value in society.

To provide such practical promotion, it is important to conduct R&D and cultivate the latest technologies, and at the same time, demonstrate results with respect to concrete issues in society and in concert with relevant people, organizations, and activities. This requires various players (from industry, academia or government, and who want to create new value) to share the latest R&D results in an open environment, to apply the results to their various efforts, and to initiate a new style of technical demonstration.

Considering this, in April 2016, NICT established internally the Open Innovation Promotion Headquarters as a central organization to plan, promote, and support R&D focused on verification of technologies for implementation in society. This is intended to contribute to



creating ICT leading to creation of new value in society.

■ Realizing the Social ICT Revolution

A strategic program office was established inside the Social Innovation Unit of the Open Innovation Promotion Headquarters, to strategically propose and execute collaboration organically on various activities within NICT, domestically and overseas, and to promote strategic and practical collaboration in research and related activities among industry, academia, and government, internally, regionally, and internationally. The aim of this is to realize the Social ICT Revolution by implementing practical R&D activities and taking the results wider and deeper. Testbeds will also be planned based on collaboration among industry, academia, and government, providing environments in which the various players can conduct technical verification and trial demonstration in society using the latest ICT. By incorporating up-to-date new and large-scale technologies in these testbeds, we will realize the most advanced demonstration environment in the world.

We are also promoting practical R&D based on the idea of open innovation, establishing research centers to accelerate work on topics emerging in society under intensified global competition, such as artificial intelligence (AI), Big Data and IoT, and technologies utilizing new frequencies. They will also work on concrete issues in a quick and timely manner, such as improving cybersecurity literacy and contributing to human resource development. An overview of these centers is given below.

Big Data Integration Research Center

Director General, Yutaka KIDAWARA

The Big Data Integration Research Center conducts ICT R&D using big data to create new value and demonstrate it in society. This includes R&D on technologies that integrate diverse data from the environment and human activities, using it to mitigate risk in living environments due to air pollution, heavy rainfalls, or other natural disasters. Sensor data technologies that form the basis of building a safer and more secure society, are another example, such as ITS (Intelligent Transport Systems) or other social monitoring systems that use wireless sensor networks. The Center also conducts technology verification in society through collaboration among industry, academia, and government and contributes technically to international scientific data utilization activities, such as administration and operation of the World Data System (WDS), which consolidates platforms for use of large-scale scientific data on the global environment and other topics.

Resilient ICT Research Center

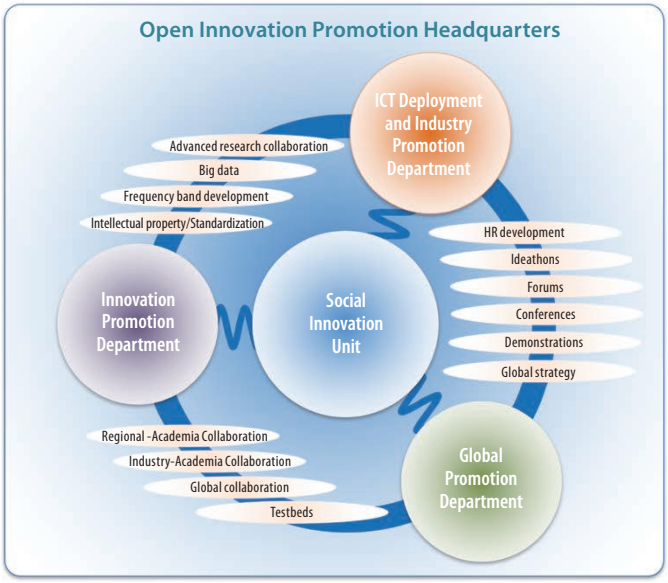
Director General, Hiroshi KUMAGAI

The Resilient ICT Research Center advances R&D on new ICT needed to build disaster resilience in Japan. In particular, it works to develop results from infrastructure R&D all the way through to deployment in society. To ensure that R&D results are used reliably in society, the Center acts as a base for collaboration, having built structures for collaboration among industry, academia, and government as well as regionally, while also conducting practical research. It also participates in disaster prevention and disaster medical training run by government agencies and regional public organizations and works to use research results in disaster-affected areas. These collaborative structures are intended to understand user needs and establish systems for implementing the results in society.

Terahertz Technology Research Center

Director General, Iwao HOSAKO

The Terahertz Technology Research Center advances R&D on technologies that use the terahertz frequency band (frequencies higher than millimeter-waves) effectively, for which utilization technologies have not yet been established, and to build infrastructure that will enable use of high-frequency wireless technology more conveniently, safely, and securely. To achieve this, it is important to have a comprehensive approach, establishing underlying technologies such as stable terahertz frequency transmitters, receivers, signal processors, and instruments to measuring frequency and power accurately; and establishing international standards to ensure that radio signals in these frequencies can be used safely and conveniently. It is also necessary to plan and implement measurement infrastructure to ensure these technologies and standards are implemented properly. NICT is conducting R&D on technologies needed to develop these terahertz frequencies, to prepare the infrastructure, and to contribute to improving Japan's technical capabilities through collaboration among industry, academia, and government.



Cybersecurity Human Resource Development Research Center

Director General, Michio SONODA

The Cybersecurity Human Resource Development Research Center works to improve the security environments for various people and organizations in the face of cyberspace threats that are increasingly advanced and intelligent year by year, and to improve overall cybersecurity countermeasure skills in Japan. This is done by building cyberattack training environments and conducting practical training. We implement the most advanced training programs and contribute to nurturing security personnel with very advanced skills by incorporating NICT R&D results, which are continually advancing, into our training environments.

ICT Testbed Research and Development Promotion Center

Director General, Makoto IMASE

The ICT Testbed Research and Development Promotion Center handles testbeds including the R&D testbed network, the wireless testbed,

the large-scale emulation platform, and the multiple services accommodation platform. This provides a platform to promote integrated testing of the latest IoT-era technologies, both technically and for deployment in society. It also functions as a place for creating new technologies and creating new value using ICT, through collaboration among industry, academia, government, and regionally using these resources. It also contributes to the vitality of ICT in Japan by meeting various technical testing requirements at an advanced level and enabling the latest R&D results from NICT and other research facilities to be tested.

Innovation Promotion Department

Executive Director, Shinji IDE

The Innovation Promotion Department has formed a broad network in industry, academia, and government, concentrating industrial and academic research potential and strategically promoting R&D through multifaceted R&D schemes using commissioned, collaborative, and funded research, and by using external research resources effectively. As part of building collaboration structures among industry, academia, and government, it also works to deploy and expand the use of R&D results in society by actively promoting standardization activities and appropriate protection of intellectual property. These initiatives are intended to maximize R&D results and create open innovation with NICT at the center.

Global Alliance Department

Executive Director, Takahiro YOKOYAMA

Increased work on "Global Development" of NICT R&D results is an objective in the current medium and long term plan. The Global Alliance Department is working to form open innovation centers on the world stage. It is actively promoting international collaborative research and providing leadership for international development of research results through collaboration with foreign organizations. Beyond conventional activities of international data gathering and research collaboration, it is also utilizing collaboration centers in Asia, North America, and Europe to disseminate research results and to implement them into society in partner countries. These initiatives contribute to strengthening Japan's international competitiveness in the ICT field.

ICT Deployment and Industry Promotion Department

Executive Director, Kazutaka NAKAMIZO

The ICT Deployment and Industry Promotion Department promotes initiatives such as ICT business development and research support in ICT enterprises, along with support for commercialization related to development of NICT research results. It provides support for business development and research in ICT for regional ICT startups in particular, for preparing testbeds and data centers to create new technologies and services in the IoT era, for promotion of information barrier-free environments for the digitally disadvantaged, for promotion of private communications and broadcasting infrastructure technology, and for inviting foreign researchers to private research facilities. It also works to develop NICT technologies and results by supporting startup of NICT ventures and commercialization of NICT research results.

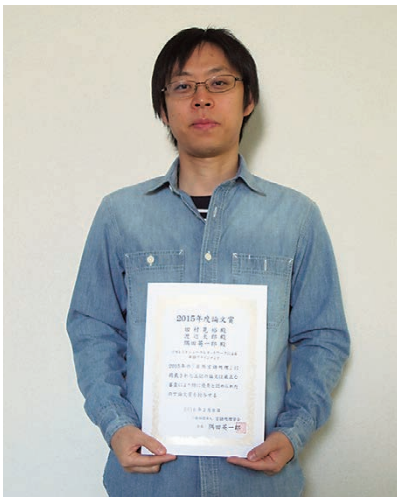
Awards

The following introduces the recipients of the 2015 Best Paper award for the Natural Language Processing Journal, given in recognition of outstanding papers, and of the Maejima Award, given in recognition of advancements in information, communication, and broadcasting technologies in memory of Hisoka Maejima, one of the founders of the telecommunications industry.

The Association for Natural Language Processing
Best Paper Award 2015

Akihiro TAMURA
Researcher, Advanced Translation Technology Laboratory,
Advanced Speech Translation Research and Development Promotion Center

Eiichiro SUMITA
Associate Director General,
Advanced Speech Translation Research and Development Promotion Center


Akihiro TAMURA

Comment from the Recipients

In this paper we used neural networks, which have attracted much attention recently, to make improvements in word alignment, a process that is important for statistical machine translation. We are extremely happy that this paper was selected for the Natural Language Processing Association Best Paper Award in 2015. With this award as encouragement, we will continue to put every effort into contributing to further advances in machine translation.

data

- Co-recipient: Taro WATANABE (Google Inc.)
- Date: March 9, 2016
- Description: In recognition of an outstanding paper in the 2015 issue of the Natural Language Processing Journal

Tsushinbunka Association
61st Maejima Award

Kiyonori OTAKE
Executive Researcher, Data-driven Intelligent System Research Center, Universal Communication Research Institute

Kentaro TORISAWA
Director of Data-driven Intelligent System Research Center, Universal Communication Research Institute

Junta MIZUNO
Researcher, Data-driven Intelligent System Research Center, Universal Communication Research Institute

Masahiro TANAKA
Senior Researcher, Data-driven Intelligent System Research Center, Universal Communication Research Institute

From the left: Kentaro TORISAWA, Jun GOTO (co-recipient), Kiyonori OTAKE, Junta MIZUNO, Masahiro TANAKA

Comment from the Recipients

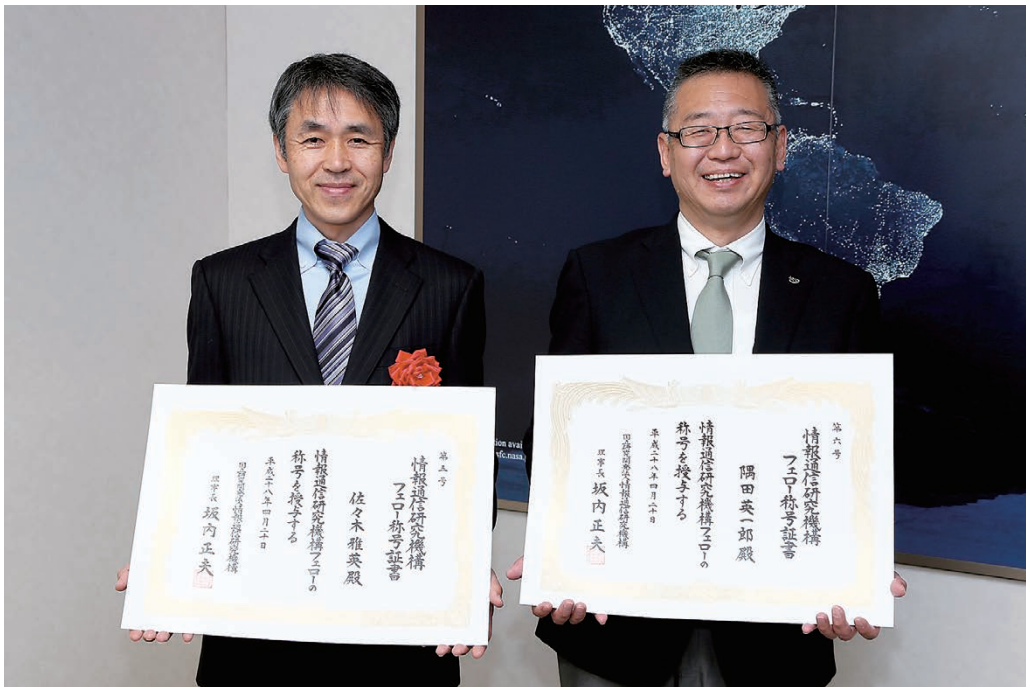
This award is all about DISAANA, an SNS data analysis system for disaster prevention that we have developed and opened to the public. DISAANA uses numerous advanced technologies and, thanks to the support of numerous contributors, we made it available to the general public to help protect against the threat of unpredictable disasters. We would like to take this opportunity to offer sincere thanks to all those who helped in DISAANA's development.

data

- Co-recipient: Jun GOTO, Japan Broadcasting Corporation (NHK)
- Date: March 18, 2016
- Description: In recognition of achievements in R&D on the DISAster information ANAlyzer (DISAANA), a system that analyzes SNS information related to disasters

Introduction of Fellows

NICT awards the designation of Fellow to individuals recognized as having achieved particularly remarkable results in the course of their R&D work. On April 20, 2016, the designation was awarded to Dr. Masahide SASAKI, Distinguished Researcher in the Advanced ICT Research Institute, and to Dr. Eiichiro SUMITA, Associate Director General of the Advanced Speech Translation Research and Development Promotion Center.



Masahide SASAKI (left), Eiichiro SUMITA (right)

Masahide SASAKI

Distinguished Researcher
Advanced ICT Research Institute

After joining the Posts & Telecommunications Ministry's Communications Research Laboratory (at the time) in April, 1996, Distinguished Researcher, Dr. SASAKI engaged in R&D on quantum info-communication.

Quantum info-communication is a revolutionary technology based on quantum physics. It will be used to implement absolutely secure quantum cryptography and quantum communications, which will overcome capacity limitations in the future. In 2003, Dr. SASAKI proved that the Shannon limit of conventional theory could be overcome by using quantum communication with small-scale quantum computers in optical receiver circuits. This opened up new areas of quantum communication R&D. He later demonstrated many new technologies in optical quantum control, led industry - academia - government projects, dramatically improved the performance of the quantum key distribution (QKD), and in 2010, built the Tokyo QKD Network, transmitting absolutely secure video for the first time in the world, among other remarkable basic and applied results in quantum info-communications. Dr. SASAKI, has had 236 articles published in major academic journals, producing many research results with international influence. In addition, he has actively promoted technology transfers in collaboration with industry, developed absolutely secure mobile communication applications for smartphones and drones and conducted demonstrations in a national strategic economic zone of regional revitalization.

Eiichiro SUMITA

Associate Director General
Advanced Speech Translation Research and Development Promotion Center

Dr. SUMITA, by putting "generality and accuracy" as the ultimate goal of machine translation, has consistently advanced the field for over 30 years. Under his overarching concept of an ecosystem involving translation buyers, translators, and machine translation developers, he has steadily, "like a tortoise," gathered the large-scale multi-lingual data needed to reach this goal. He conducted basic research on rule-based translation, example-based translation, statistical translation, and neural network translation. He implemented accurate machine translation systems between Japanese and multiple other languages, including the "VoiceTra" speech translation smartphone applet in 2010, and the "TexTra" text translation public Website in 2014. As the lead manager of the U-STAR speech translation consortium, he expanded it to 32 participating organizations, and on the executive of the IWSLT, he expanded the workshop's international recognition, establishing it as the canonical conference on speech translation. He also initiated the WAT international conference in 2014 and has been promoting research on machine translation of Asian languages.

In addition to this R&D, he has also shown leadership in nurturing junior researchers and in research management.

NICT NEWS No.458 JUN 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/

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ISSN 2187-4050 (Online)