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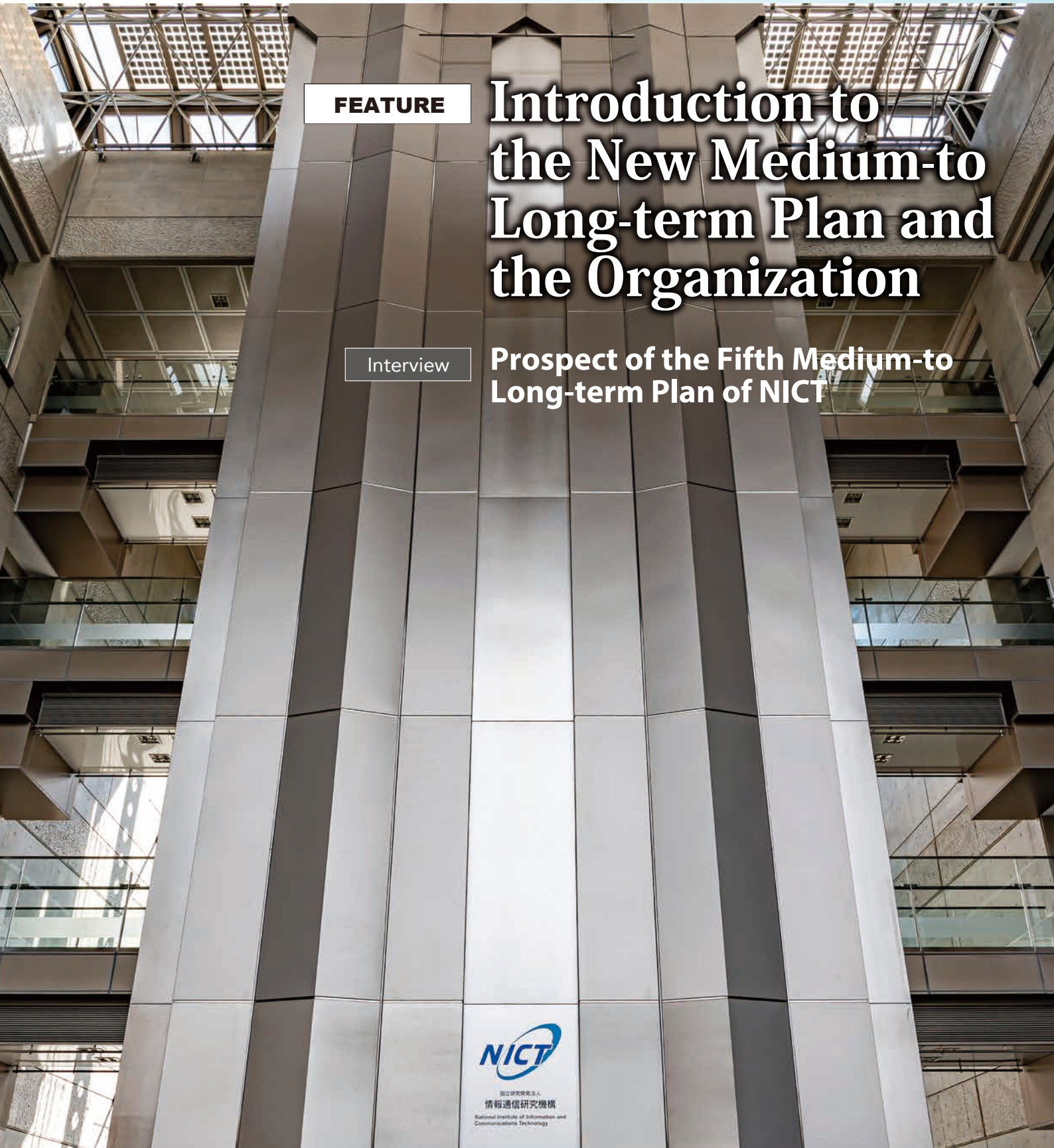

FEATURE

Introduction to the New Medium-to Long-term Plan and the Organization

Interview

Prospect of the Fifth Medium-to Long-term Plan of NICT

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FEATURE

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Cover Photo : Entrance Hall of NICT Headquarter main building

Upper Left Photo : NICT Headquarter(KOGANEI) museum

The museum exhibits the research outcomes and history of NICT more than 100 years since the time of its predecessors.
At present, the museum is open to the public by advance reservation.
Since this February, a virtual exhibition room has also been made available. For more information, scan the following QR code. (Currently, Japanese text and audio only)

Interview

Prospect of the Fifth Medium-to Long-term Plan of NICT

TOKUDA Hideyuki

President, NICT

He obtained a Ph.D. in Computer Science from University of Waterloo, Canada in 1983. After serving as Research Computer Scientist at the School of Computer Science, Carnegie Mellon University, started to concurrently work for Keio University in 1990. Became a professor at the Faculty of Environment and Information Studies in 1996, Thereafter, Executive Vice President of Keio, Dean of the Faculty of Environment and Information Studies, Dean of the Graduate School of Media and Governance and so forth at Keio University.
Engaged in research mainly on ubiquitous computing systems, operating systems, distributed systems, IoT, and cyber physical systems. In 2017, he became the President of the National Institute of Information and Communications Technology (NICT).
At present, serving as professor emeritus at Keio University, member of the Science Council of Japan, fellow of Information Processing Society of Japan, fellow of Japan Society for Software Science and Technology, a board member of IEEE Tokyo Section and the president of Information Processing Society of Japan.

NICT commenced a new Medium-to Long-term Plan, hereinafter, Mid-to-Long term Plan, this April and updated its organizational structure.

Generation change of technology is progressing in the information and communications field, while people have come to have higher expectations and requests for ICT amid the serious COVID-19 pandemic.

Under such circumstances, what challenges is NICT intending to address under what system in its Fifth Mid-to-Long term Plan? President TOKUDA Hideyuki explained the prospect of the plan.

Framework and characteristics of the Mid-to-Long term Plan

——NICT has been operating based on five-year Mid-to-Long term Plan. Could you explain the framework of the Mid-to-Long term Plan, which was commenced this April?

TOKUDA Basically, the fifth plan maintains the five priority R&D areas, which were determined in the fourth plan, and aims to create open innovation for the purpose of feeding research outcomes back to society. The five priority areas are "Watch: Advanced electromagnetic research," "Connect: Innovative networks," "Protect: Cybersecurity," "Create: Universal communication," and "Pioneer: Frontier science." These are the very core for NICT.

In addition, the fifth plan designates four strategic fields of cutting-edge technologies indispensable for the next-generation ICT infrastructure, for which Japan should promote research in particular toward a new decade (Figure 1). These are "Beyond 5G," "AI," "Quantum ICT," and "Cybersecurity."

——What are the changes upon commencing the Fifth Mid-to-Long term Plan or what are the characteristics of the new plan?

TOKUDA We have received substantial financial support from the Ministry of Internal Affairs and Communications upon commencing the Fifth Mid-to-Long term Plan.

Among the four strategic fields, "Beyond 5G" is the field of research with an eye on generations following "5G," whose commercial use has just begun. In relation to this, in the supplementary budget for FY2020, 30 billion yen was allocated for our "Funds for Research under Public Application System to Promote R&D on Beyond 5G," and approximately 20 billion yen was allocated for the development of the "Beyond 5G Shared Research Facilities (i.e., Testbed)."

Regarding AI, the second point, we are developing computing resources for a multi-lingual speech translation system, etc. in the Keihanna Science City, as one of our major projects, by using some 11.3 billion yen allocated in the supplementary budget for FY2020. We have expanded the functions of the AI Science Research and Development Promotion Center and have reorganized it as the Headquarters for AI Research and Development, thereby making a system to accelerate research on AI.

Interview

Prospect of the Fifth Medium-to Long-term Plan of NICT

The third is a center for quantum ICT. The Integrated Innovation Strategy 2019 states that NICT should develop a base for quantum security technologies. We are now constructing that base in the northern side within the premises of the headquarters. For this purpose, nearly 8 billion yen was allocated in the supplementary budget for FY2019.

Regarding cybersecurity, the fourth point, we have been promoting the development of the "Cybersecurity Integrated Intellectual and Human Resources Foundation" (CYNEX) under the supplementary budget for FY2020. As a promoting organization, a new department, Cybersecurity Nexus, was established. We are aiming to strengthen the foundation for collecting and analyzing diverse cybersecurity-related data and enhance human resources development programs, which have so far been developed by the National Cyber Training Center. These are, so to speak, initiatives for increasing the degree of self-sufficiency in cybersecurity for Japan.

——Are there any other organizational changes or newly established organizations?

TOKUDA Additionally, we have newly established the "Beyond 5G Research and Development Promotion Unit" as an organization to promote Beyond 5G R&D in a cross-organizational manner, and the "Quantum ICT Collaboration Center" as an organization to promote R&D and social implementation of quantum ICT.

As the core to facilitate digital transformation of NICT as a whole, the Operation Planning Department was also newly established for the purpose of reforming its R&D processes and operational processes, including those relating to accounting, financial affairs, contracts, etc. This is one of the significant characteristics of the fifth plan, showing NICT's positive attitudes toward operational reform and organizational reform by the use of digital technologies.

In April 2020, we established a group, "Innovation Design Initiative (IDI)," having a function as a think-tank under the immediate control of the President. The group was reorganized as an official organization at the beginning of this term with the aim of strengthening its function as a think-tank (Figure 2).

Challenges revealed due to the COVID-19 pandemic

——Since the end of 2019, in particular, the spread of COVID-19 has caused significant changes to our daily lives. When considering new lifestyles amid the pandemic and after the end thereof, the roles expected for ICT are likely to become more and more significant. What do you think of this?

TOKUDA Amid the rapid spread of COVID-19 infection, various preventive measures have been taken. People's lifestyles have changed drastically while avoiding the Three Cs and people's activities have shifted to cyber space globally, not limited to Japan. However, there remain many problems concerning information security in the case of teleworking, for example, and online conferences eliminate travel costs but participants may find inconveniences in comparison with face-to-face conferences.

In an ongoing shift from face-to-face analog communications to remote digital communications, a larger number of people have become aware of the advantages of the former and what was lost due to the shift to digital communications. In that sense, the COVID-19 infection has provided us, researchers, with significant opportunities to recognize various challenges, although it almost goes without saying that it is a serious disaster for human society.

Some technologies held by NICT were hoped to have been disseminated earlier amid the pandemic.

One example is a deep ultraviolet (DUV) LED chip, for which research has been conducted by the Advanced ICT Research Institute originally as a next-generation communication device. Light with this wavelength breaks down DNA and RNA. When a single-stranded RNA coronavirus is irradiated with this light, the virus immediately becomes inactivated. As inactivation with ordinary ultraviolet rays takes minutes, this light will significantly reduce the required time. If mass production and commercialization are achieved, DUV LED chips may be utilized for sterilization or disinfection units to be mounted to existing air purifiers or the like.

Additionally, multi-lingual speech translation systems are increasingly being recognized as necessary tools to connect communications in multiple languages seamlessly as more and more people have come to have business communications using remote conference systems.

Under recent circumstances, one of our significant challenges is the technology shaping in order to make our technologies accepted in society in a natural manner.

Great responsibility to support a sustainable society

——This is your second term as the President. Could you explain your own management policies and future vision, and give a message to people in and outside NICT?

TOKUDA I assumed the office of President four years ago, and at that time, the goals for the term for the fourth plan had almost been decided. However, fortunately, in the latter half of the fourth term, a taskforce to discuss themes for the fifth term was set up and I was able to participate in discussions. Therefore, I have been emotionally involved in the goals for the fifth term.

Cross-sectoral collaboration is becoming more and more important and the most significant reason therefor is the need to create a total system. Since its foundation, NICT has introduced splendid elemental technologies that we can boast to the world. However, in the fifth term, we will be tested as to whether we can properly link those technologies and organize them into a total system with excellent architecture.

The key is whether we can make NICT's organizational culture more flexible and creative. For that purpose, we launched the basic policy, "COC2.0."

The original COC, which I launched when starting to serve as the President, was made up of the initial letters of "Collaboration," "Open Mind & Open Innovation," and "Challenger's Spirit." Maintaining these three concepts, COC2.0 includes new key concepts, namely Digital Transformation (DX) of NICT itself and "Computing & Communication for Carbon Neutral."

I talked about NICT's research themes earlier, but I think that NICT needs to serve as a model in efforts for decarbonization toward a sustainable future society where diversity is respected, not merely creating ICT technologies as needed by society. Also in this respect, the fifth term plan contains challenging themes and is well worth pursuing.

—— Thank you very much for your time today.

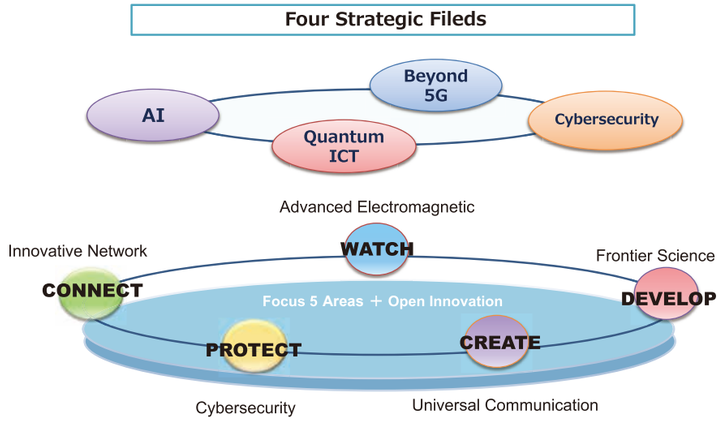


Figure 1 The New ICT Strategy in Beyond 5G Era
From Technology Strategic Committee, Information and Communication Council MIC

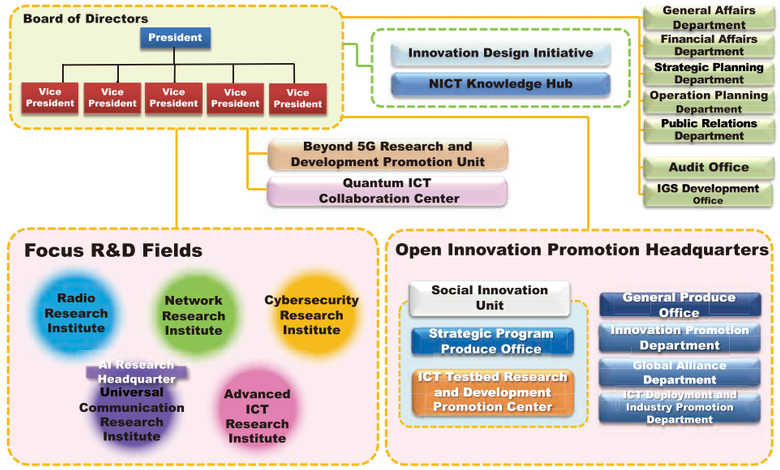


Figure 2 NICT's Organization in the Fifth Mid-to-Long-term Plan

Make Our Future Safer and Richer Using Electromagnetic Waves

TAIRA Kazumasa

Director General, Radio Research Institute

Since joining the Communications Research Laboratory (currently NICT) in 1991, he has engaged in research on mobile radio propagation channels, mobile communication systems, and electromagnetic compatibility. He was appointed to his current position in 2016. Ph. D (Engineering).

We promote R&D for utilizing various characteristics of electromagnetic waves in society so that we can identify changes in weather and the space environment promptly and precisely, and assess social conditions correctly. Highly accurate predictions for the future smart life in the real world will be enabled by using the identified results.

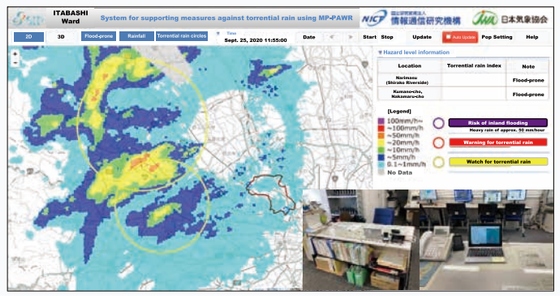


Figure 1 System for supporting measures against torrential rain using observation data obtained by a multiparameter phased array weather radar (Remote Sensing Technology)

"Society 5.0" has been proposed as a future society that Japan should aspire to. Society 5.0 is defined by the Cabinet Office as "a human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space." By achieving Society 5.0, various knowledge and information will be shared in society, and required information will be provided at proper timings. As a result, unprecedented new values will be created, and wide-ranging social issues and difficulties will be overcome. In this context, there are ever-growing expectations for further sophistication of information and communications technology (ICT) because of its potential to bring about drastic social and economic changes.

The Radio Research Institute engages in R&D of various technologies related to "electromagnetic waves", such as radio waves and light, and promotes activities for utilizing such technologies in society. We aim to realize Society 5.0 through utilization of electromagnetic waves, and are committed to playing the following three roles:

■A role to realize the function of "sensing (measurement/observation)" for aggregating information from physical space into cyberspace using various sensors

■A role to realize the function of "processing (information processing)" for creating "future visions" in cyberspace by analyzing various kinds of data

■A role to realize the function of "actuation (operation/action)" for creating physical space by utilizing data in cyberspace

Moreover, we will effectively coordinate the results obtained through each of these roles. As a result, we will be able to identify changes promptly and precisely in weather and the space environment, and correctly assess social conditions, including emergency situations such as disasters. We will also be able to make highly accurate predictions of the future to realize a smart life in the real world.

During the five years of the Fifth Medium-to Long-term Plan, we will conduct R&D on the following: technologies using electromagnetic waves for acquiring, collecting, visualizing, and providing information relating to a variety of targets in society; technologies to ensure electromagnetic compatibility (EMC) of various devices and systems; core technologies for generating, supplying, and utilizing high-quality time and frequencies, which serve as a basis of efficient social and economic activities; and core technologies for developing low-cost and highly efficient optical elements. We will also conduct standardization and dissemination activities that lead to diffusion and social implementation of R&D results inside and outside Japan. In addition, we will exert effort in developing R&D personnel who will lead the field of electromagnetic wave technologies in the future. In order to carry out these activities, we have established three Research Centers, five Laboratories, and the General Planning Office which effectively promotes our overall activities.

●Radio Propagation Research Center：Remote Sensing Laboratory, Space Environment Laboratory

●Electromagnetic Standards Research Center：Electromagnetic Compatibility Laboratory, Space-Time Standards Laboratory

●Applied Electromagnetic Research Center：Digital Optics Laboratory

For the details of R&D conducted by each laboratory, please see the table above.

Focuses in R&D

Remote Sensing Technology	Identify with high accuracy the distribution of water vapor, clouds, and rainfall in the atmosphere, which greatly affect propagation of electromagnetic waves and the land cover conditions. R&D on technologies to observe targets from the ground, from aircraft, or from satellites and on advanced technologies to analyze the obtained information are conducted. With the results of these activities, we contribute to disaster prevention and mitigation, monitoring of global climate variations, improvement of prediction accuracy in weather forecasts, etc., and elucidation of the mechanisms of global warming and water circulation (Figure 1).
Space Environment Technology	Conduct R&D for monitoring and predictions/warnings of space environment for contributing to ensure stable use of space systems, such as high-accuracy satellite positioning and manned activities in space, and use of radio waves in agriculture, maintenance of social infrastructure, and disaster monitoring. We also develop technologies required for stable operation of space weather forecasts (Figure 2).
Electromagnetic Compatibility Technology	Conduct R&D for improving electromagnetic compatibility (EMC), which is essential for coexistence of advanced communication devices and electric/electronic devices and for secure and safe use of new radio wave systems. In addition, we acquire and accumulate data on the level of exposure of a human body to radiofrequency radiation. We also play the role of Japan's core research institute concerning EMC technologies, and contribute to international standardization activities and formulation of domestic and international technical regulations based on the knowledge and experience acquired through our R&D (Figure 3).
Space-Time Standards Technology	Develop atomic frequency standards and robust atomic-clock systems in order to set national frequency standards, to emit long-wave standard frequencies, and to notify the standard time. The study for portable atomic clocks and wireless two-way interferometry aims for a novel technique to provide a reference time and reference frequency in the era of Beyond 5G. We study optical and THz frequency standards not only for time keeping, but also for other applications such as geodesy and THz calibration service, respectively (Figure 4).
Digital-Optics Technology	Conduct R&D on optical elements using diffraction of light by digital hologram printing technology, and promote technology transfer for promoting applications, such as highly efficient and inexpensive optical communication modules that support the Beyond 5G era, head-up displays, and next-generation AR systems. We also conduct R&D on precision optical measurement technology using digital holograms, and push forward its industrial application through use of the technology in microscopes, etc. (Figure 5).

Figure 3 Large-size electromagnetic anechoic chamber (Electromagnetic Compatibility Technology)

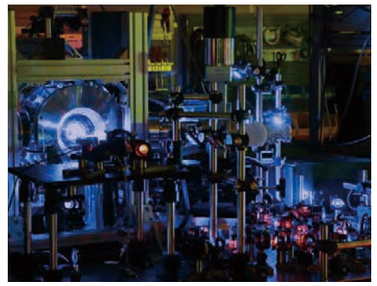


Figure 4 Strontium optical lattice clock (Space-Time Standards Technology)

Figure 2 Space Weather forecast room (Space Environment Technology)

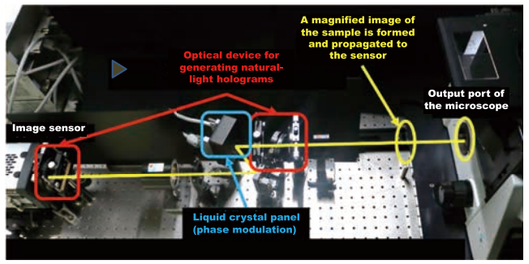
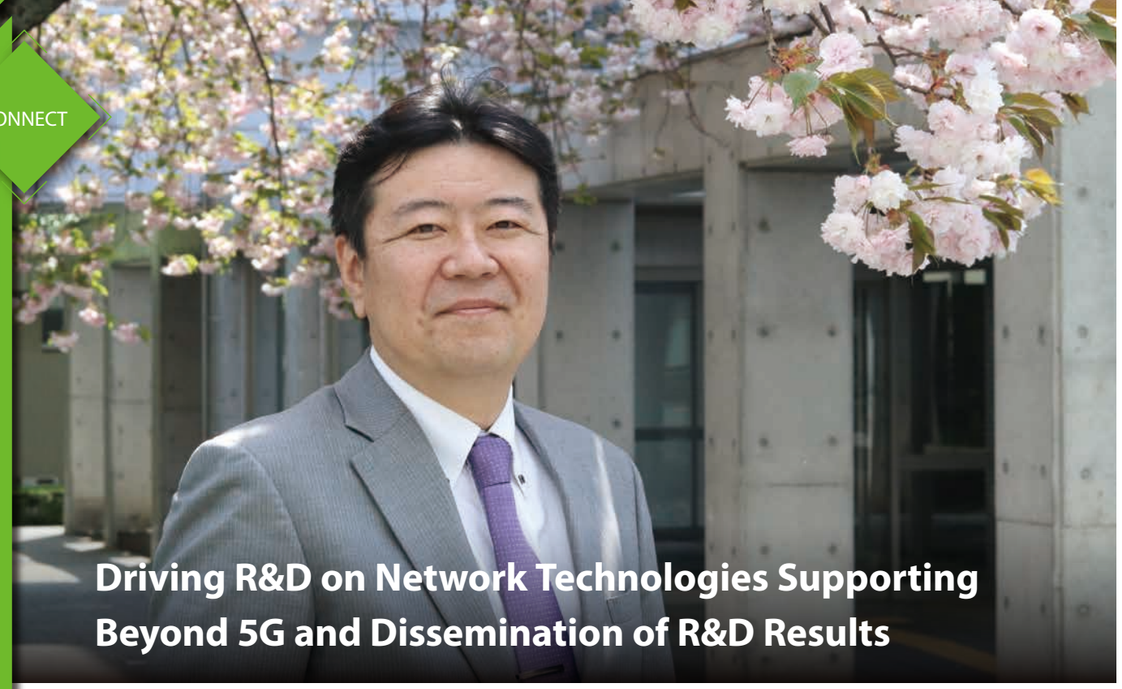


Figure 5 Hologram Microscope by natural light (Digital-Optics Technology)



Driving R&D on Network Technologies Supporting Beyond 5G and Dissemination of R&D Results

HARAI Hiroaki

Director General, Network Research Institute

In 1998, he joined the Communications Research Laboratory, (currently NICT) after he received a Ph.D. in information and computer science. He has engaged in R&D and promotion thereof in the field of networking technologies such as network architecture, optical networks, and mobile networks. Prior to the current position, he served as Director of the Network Architecture Laboratory and Director General of the ICT Testbed Research and Development Promotion Center.

In the coming Beyond 5G era, to realize the transformation of advanced social systems, it is required to build innovative networks capable of responding to the rapid increase in communication traffic, securing communication quality, and diversifying services. The Network Research Institute will conduct R&D on works on establishing network technologies that will support the future of our society with network architecture that fits with the times, through the sophistication of wireless, optical, and space communication technologies and combination with optical and radio convergence technologies and resilient ICT technologies for severe physical environments. The Institute will also aim to promote standardization activities, disseminate R&D results, and implement them in society.

For the purpose of realizing the transformation of social systems through the advancement of Society 5.0, the Network Research Institute, by operating associated research centers and laboratories, conducts R&D on computing and AI-enabled networking technology,[*1] next-generation wireless technology,[*2] photonic network technology,[*3] optical and radio convergence technology,[*4] space communications fundamental technology,[*5] and resilient ICT technology,[*6] as key technologies for this purpose. The Institute also aims to drive standardization activities, disseminate R&D results, and implement them in society (Figure 1). It also operates an advanced ICT device laboratory, thereby contributing to the progress of ICT platform technologies that harmoniously integrate ultra-high frequency waves such as light waves and terahertz waves (Figure 2).

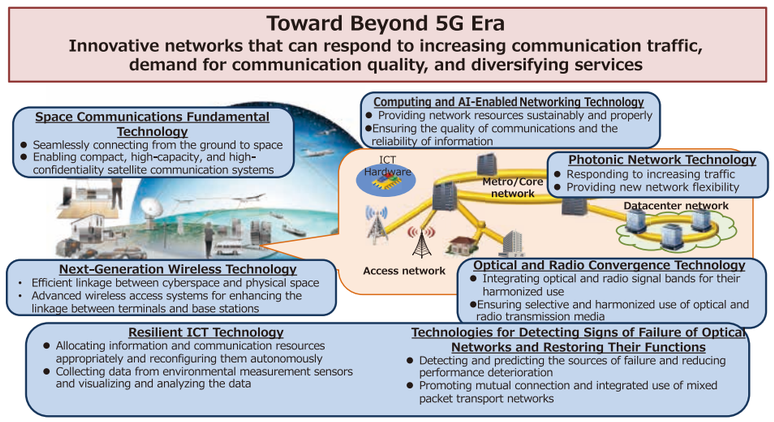


Figure 1 Key technologies targeted by the Network Research Institute

Focuses in R&D

Computing and AI-Enabled Networking Technology	We ensure the quality of communications and the reliability of information in various network services available simultaneously in the Beyond 5G era, and provide network resources sustainably and properly. We conduct R&D on telemetry-based large-scale network control automation technology and a router framework for deterministic latency, which will contribute to services conducive to socioeconomic transformations in the new normal era. We also conduct fundamental research on information-attribute centric communication technology utilizing a distributed information management mechanism toward applied R&D.
Next-Generation Wireless Technology	We establish technologies that will contribute to diversification and expansion of terrestrial wireless communication systems based on specialized technical review and the general usage needs with the aim of realizing socioeconomic transformations in the new normal era and Beyond 5G infrastructure technology. We conduct R&D on wireless system assessment technology for verification of efficient linkage between cyberspace and physical space, advanced wireless access systems for enhancing the linkage between terminals and base stations, and mobility control and wireless area expansion technologies.
Photonic Network Technology	We conduct R&D on: massive channel optical network technology to extend the capacity limit and cope with ever-increasing communication traffic sustainably in the Beyond 5G era; dynamic and flexible reconfiguration technology of optical network resources to efficiently provide core and access networks that can meet various demands; and technologies for detecting signs of network failure and other incidents and restoring functions of networks so that photonic networks can serve as infrastructure for any kind of information.
Optical and Radio Convergence Technology	We drive the use of access/short-reach networks in 2030 and thereafter and enhance network flexibility. We conduct R&D on massively-integrated all-band ICT hardware technologies for high-precision mutual conversion of optical and radio frequency bands and broadband parallel waveform processing, and harmonized and seamless transmission medium access technologies for ultra-high-speed and high-availability next-generation optical fiber wireless communications, scalable bandwidth control, mutual conversion and reference signal distribution of transmission media, and short-reach links.
Space Communications Fundamental Technology	We drive realization of advanced information and communication networks that seamlessly connect the terrestrial and space environments as the growing use of satellite and other non-terrestrial networks and communication systems. We conduct R&D on satellite flexible network technologies for efficient data distribution via a network composed of satellites, aircrafts, and drones, and technologies for high-capacity optical satellite communications, flexible communications, and high-confidentiality communications.
Resilient ICT Technology for Severe Physical Environment	We drive realization of ICTs for supporting sustainable supply of services in the event of sudden changes caused by a large-scale disaster or network failure. We conduct R&D on technologies for building information and communication infrastructure that will allocate information and communication resources appropriately and reconfiguring them autonomously in severe physical environments where network partition and reintegration take place. We also engage in R&D on resilient technologies for natural environment measurement for collecting data from environmental measurement sensors and visualizing and analyzing the data comprehensively so that sudden changes in natural phenomena can be detected.

Network Architecture Laboratory[*1]

The Network Architecture Laboratory conducts R&D leading to the advancement of network architecture and fundamental technologies that enables stable and quality communications and data processing in order to support diverse network services in the Beyond 5G era sustainably.

Photonic ICT Research Center [*3*4]

The Photonic ICT Research Center conducts R&D on ultra-high-capacity photonic networks to support rapidly increasing communications traffic, access technologies that harmoniously integrate optical fiber and wireless communications, and flexible network technologies, all of which will be essential for the Beyond 5G era.

Wireless Networks Research Center [*2*5]

In anticipation of the coming Beyond 5G era, the Wireless Networks Research Center conducts R&D and disseminates results thereof, targeting wireless network technology that will globally extend three-dimensional seamless communication networks including the ocean and space through the integration of terrestrial networks and non-terrestrial networks (NTN), and realize "connected" under any circumstances or in any environments.

Resilient ICT Research Center [*3*6]

The Resilient ICT Research Center engages in conducting R&D on information and communication technologies (ICTs) that contribute to the improvement of disaster resilience on a global scale, and implementing R&D results in society. The center targets resilient ICT technologies against disasters and ICT useful at the time of a disaster, ranging from resilient ICT technology for severe physical environments where communications are difficult and natural environment measurement technology to technologies for detecting signs of failure of optical networks and restoring their functions.

Advanced ICT Device Laboratory

The Advanced ICT Device Laboratory is an open innovation hub supporting and driving R&D on enabling technologies for innovative information and communication devices that can be used through combination of all frequency bands including light-wave and ultra-high frequency, based on advanced hardware development technologies applicable for designing, trial manufacture, implementation, and assessment of devices. As of the end of FY2020, 35 organizations use this laboratory.

In order to achieve broadband, ultra-reliable, and ultra-low latency communications that are desired in the Beyond 5G era, the Network Research Institute enhances fundamental and system technologies for optical, wireless (terrestrial and satellite), and networking. Keeping in mind the basic premise that the resources on the earth and in space that human beings can use are finite, we engage in establishing fundamental technologies for controlling and managing communication, computation, storage and sensing resources that are highly scalable and flexible in terms of numbers and dimensions, and for providing various network services simultaneously. Flexibility of networks is also required in severe physical environments such as in a disaster or amid a network failure. For the management and operation of these resources, orchestration through the division of roles allowing distributed and independent control and loose coupling is required. We at the Network Research Institute will work together to integrate fundamental technologies and drive the dissemination of R&D results, thereby supporting society in the Beyond 5G era.

Figure 2 High-definition device processing machines in the Yellow Room of the Advanced ICT Device Laboratory

To Be a Nexus Connecting the Government, Industry, and Academia through R&D and Human Resources Development Broadly in the Cybersecurity Area!

MORIAI Shiho

Director General , Cybersecurity Research Institute

After graduating from university, MORIAI worked for Nippon Telegraph and Telephone Corporation and Sony Corporation, and then entered NICT in 2012. She has engaged in R&D on cryptography, information security and privacy protection technologies. Ph.D. (Engineering).

The Cybersecurity Research Institute has been carrying out basic research to practical technological development and social implementation broadly based on expectations and requests from society as a national top-class research institute in the cybersecurity area, with the aim of enhancing the national capacity to deal with cyberattacks and promoting secure data utilization. At the same time, the Institute conducts cybersecurity training, develops a government-industry-academia cybersecurity base, and carries out survey of IoT devices with improper setting of passwords, etc. based on the national government's policies.

Figure 1 Organization of Cybersecurity Research Institute

In order to strengthen innovation capability that will create unprecedented value and transform social systems in Japan, it is indispensable to sophisticate technologies in the cybersecurity area for protecting social systems against rapidly increasing cyberattacks as the national capacity to protect society (life, property and information). Countermeasures against those cyberattacks are urgent challenges for the nation as a whole and societal demand for NICT in this area is further increasing. Against such background, the Cybersecurity Research Institute will carry out R&D as shown in the Table below under the Fifth Medium-to Long-term Plan.

The reorganized structure of the Institute is shown in Figure 1.

The Cybersecurity Laboratory carries out R&D on visualization techniques to monitor cyberattacks from multiple aspects and support the assessment of the situation, techniques for automatic analysis and measures utilizing AI technologies, data-driven cybersecurity technologies that will lead to the establishment and enhancement of techniques for large-scale aggregation and cross-cutting analysis of diverse cybersecurity-related information. Furthermore, the Laboratory carries out R&D on emerging security technologies to establish techniques to verify the security of the latest communication devices, IoT devices, connected cars, etc.

The Security Fundamentals Laboratory endeavors to work on technologies for secure data utilization that ensure security and privacy at each stage of provision, collection, storage, analysis, and development of data and promote data utilization including that through cross-organizational collaboration, as well as contribute to solving social problems such as those relating to teleworking. Additionally, the Laboratory carries out R&D concerning security evaluation of next generation cryptographic schemes, including post-quantum cryptography, and the cryptosystems used for the e-Gov system, etc. to establish the cryptographic infrastructure for the quantum computing era.

The Cybersecurity Nexus, which was newly inaugurated, aims to formulate a government-industry-academia cybersecurity base and collect, store, analyze and provide cybersecurity-related information domestically, and to create a common platform for fostering cybersecurity experts as society-wide efforts. It will be open to the public as a nexus connecting the government, industry, and academia (see Figure 2).

The National Cyber Training Center provides Cyber Defense Exercise with Recurrence (CYDER), a practical cyber defense training program based on the latest scenarios in an environment simulating an individual organization's network, targeting security operators at national and local government offices and critical infrastructure businesses. From FY2021, the Center is planning to start providing a training program called Response Practice for Cyber Incidents (RPCI) targeting Registered Information Security Specialists. Furthermore, the Center carries out SecHack365, a program to foster young security innovators through a one-year hackathon targeting those aged 25 or younger during which guidance is provided taking advantage of the latest monitoring data and R&D knowledge.

The National Cyber Observation Center will continue performing duties concerning survey of IoT devices with improper setting of passwords, etc. and information provision to internet service providers using technological knowledge held by NICT until the end of FY2024 for the purpose of making a contribution to measures for IoT devices to prevent their exploits for cyberattacks.

The Cybersecurity Research Institute will create a system to promptly carry out technological development in response to changes in trends of cyberattacks and will facilitate dissemination of developed technologies and data in society. At the same time, the Institute will apply technologies resulting from R&D to its cybersecurity trainings and surveys, etc. for their verification, thereby improving the effectiveness of those technologies based on feedback.

Focuses in R&D

Cybersecurity technologies	In order to contribute to steady enhancement of national capacity to deal with cyberattacks and countermeasures against diversifying cyberattacks, we carry out R&D on techniques for monitoring, analyzing, visualizing and addressing cyberattacks that are becoming more and more sophisticated and complicated, techniques for cross-cutting analysis of diverse large-scale cybersecurity data, and techniques for verification to enhance security for new network environments.
Cryptographic technologies	In order to surely ensure security and privacy for information indispensable for sustainable development of society, we carry out R&D on cryptographic technologies, including post-quantum cryptography, privacy protection technologies, and their security evaluation. We also promote secure data utilization and endeavor to disseminate these technologies to various systems supporting the lives of the citizenry.
Cybersecurity trainings	Targeting security operators (personnel in charge of information systems) of administrative organs and private companies, we provide exercises with the aim of developing their practical ability to take proper initial responses to cybersecurity incidents. Additionally, we train young people aged 25 or younger into high-level experts who can research and develop innovative security software, etc. by themselves.
Development of a government-industry-academia cybersecurity base	In order to contribute to the enhancement of Japan's cybersecurity capacity and to sustainably foster security experts as society-wide efforts, we develop a core base for government-industry-academia collaboration for information analysis and human resources development. We aggregate cybersecurity-related information on a large scale and conduct cross-cutting analysis to provide domestic information on cyber threats to relevant organizations, and develop an environment to enable equipment manufacturers and operators to verify security technologies made in Japan. We also create a platform for exercises to foster human resources and support autonomous efforts in the private sector.
Surveys of IoT devices with improper setting of passwords, etc.	In order to make a contribution to cybersecurity measures for IoT devices, we will continue performing duties concerning surveys of IoT devices with improper setting of passwords, etc. and information provision to internet service providers using technological knowledge held by NICT until the end of FY2024 in light of the national government's policies, such as its cybersecurity strategies, based on the provisions of Article 8, paragraph (2) of the Supplementary Provisions of the Act on the National Institute of Information and Communications Technology.

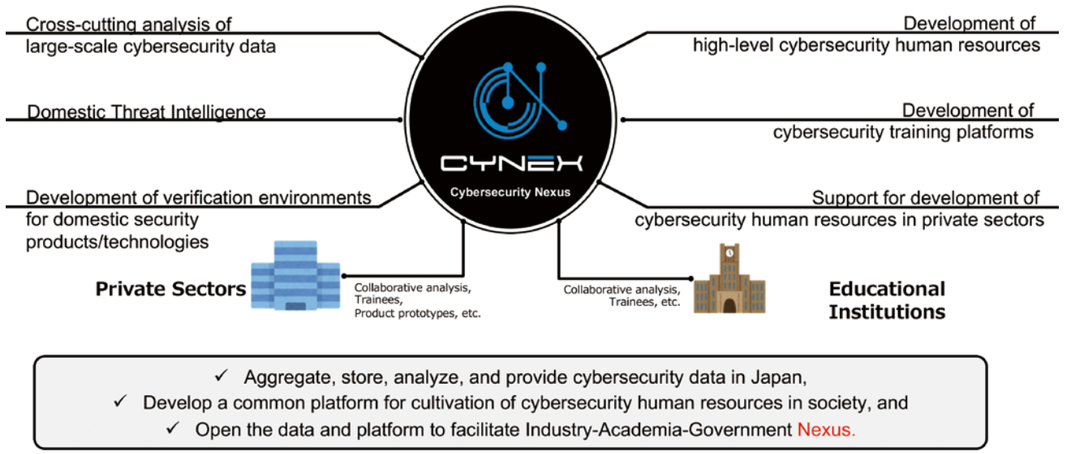


Figure 2 Development of Industry-Academia-Government Cybersecurity Nexus

Creating a New Normal

To achieve universal communication and to establish mutual understanding among the people

UCHIMOTO Kiyotaka

Director General, Universal Communication Research Institute

He entered the Communications Research Laboratory, Ministry of Posts and Telecommunications (currently NICT) in 1996. He has engaged in R&D of natural language processing and speech translation as well as social implementation activities to return the research outcomes to society. Ph.D. (Informatics).

As one of the leading research institutes of Japan in the AI area, the Universal Communication Research Institute aims to develop an AI research platform and carry out R&D and social implementation of the 3 core technologies utilizing this platform. We hope to contribute to solving social issues and creating new values by balancing "research" and "dissemination" of the core technologies; by removing the barriers of language, knowledge, and data utilization in global businesses, elderly care, environmental risk reduction, etc.

The Universal Communication Research Institute (Figure 1) aims to achieve universal communication and to establish mutual understanding among the people. We will create an AI research platform using high-quality, large-scale database mainly in Japanese and specialized for specific fields and carry out R&D of the 3 core technologies by taking advantage of this platform. The technologies include: multilingual communication technology which enables low-latency AI simultaneous interpretation that can be used in business scenes; data-driven intelligent communication technology which enables users to interact with virtual personalities based on their interests and backgrounds; and smart data analytics technology which enables real-world analysis and predictions by connecting public and private data, as well as technology to improve the quality of communication that is required for social implementation of these technologies.

In terms of R&D, we will create the most unprecedented, unique, and greatest core technologies and hone them into universal technologies to be used broadly. We will develop and expand demonstration and commercialization systems utilizing those technologies in an industry-government-academia collaboration for their social implementation and will feed knowledge sources created in society back to R&D activities. We aim to create a positive spiral of R&D and social implementation to disseminate the core technologies as those normally used in society.

Figure 1 Organizational Structure of Universal Communication Research Institute

Focuses in R&D	
Multilingual Communication Technology	Based on the Global Communication Plan 2025, we will promote R&D of a practical automatic simultaneous interpretation technology that can be used for businesses and international conferences, by using diverse information sources including contexts, speakers' intentions, and surrounding circumstances, etc. We will also expand the number of supported languages in consideration of the government's policies on the acceptance and coexistence of foreign workers, as well as on tourism strategies, etc., and will promote social implementation of a simultaneous interpretation system that incorporates various user interfaces and meets new social needs toward the Osaka-Kansai Japan EXPO 2025.
Data-driven Intelligent Communication Technology	We will promote R&D and social implementation of 1) technologies to obtain an enormous amount of knowledge (social knowledge) from the internet, etc. in an easy-to-understand form for humans and make various hypotheses by combining them; 2) a system which enables users to interact with virtual personalities based on their interests and backgrounds; and 3) technologies to reduce operational costs in advanced AI services which use the above technologies, by elastically following changes in users' requests, both qualitatively and quantitatively.
Smart Data Analytics Technology	We will promote R&D of distributed and federated machine learning techniques and data mining techniques to appropriately collect sensing data in diverse areas, adjust predictions and analyses of mixed set-ups to individual environments and mutually connect them at the same time and thereby achieve total optimization. This would enable us to make predictions and analyses using private data in addition to the conventional public data and accelerate social implementation of technologies by effectively using model cases regarding data collection, predictions, and analyses for the purpose of solving various issues

The keys for successfully creating this positive spiral are the following three. The first is to provide ready-to-use software such as multilingual speech translation engines externally by granting licenses or other means. Through this, we aim to create new industries. The second is to continuously make systems and data open to the public. For example, by publishing large language models, we aim to contribute to bottoming up Japan's research infrastructure. The third is to provide a highly secure environment or to demonstrate that it is possible to develop highly secure services. Through this, we aim to help create a safe and secure society.

Enhancement of data, the computing environment, and collaboration among foreign and Japanese organizations support the positive spiral, and we will make efforts for that purpose and develop an AI research platform responsively as one of the representative R&D institutes of Japan in the AI area. The institute already has large-scale diverse databases, including web-crawled data from about 30 billion webpages, speech data, translation data, and various sensor data, a large number of GPGPUs and a group of around 1,000 servers, and is planning to further increase these data and computing resources, which are the largest held by a public research institute in the relevant area in Japan.

Under the current mid- to long-term plan, we will strengthen the AI research platform and promote "research" and "dissemination" of the technologies in a balanced manner using this platform, and will help remove the barriers of language, knowledge, and data utilization in global businesses, elderly care, environmental risk reduction, etc. and contribute to solving social issues and creating new values (Figure 2).

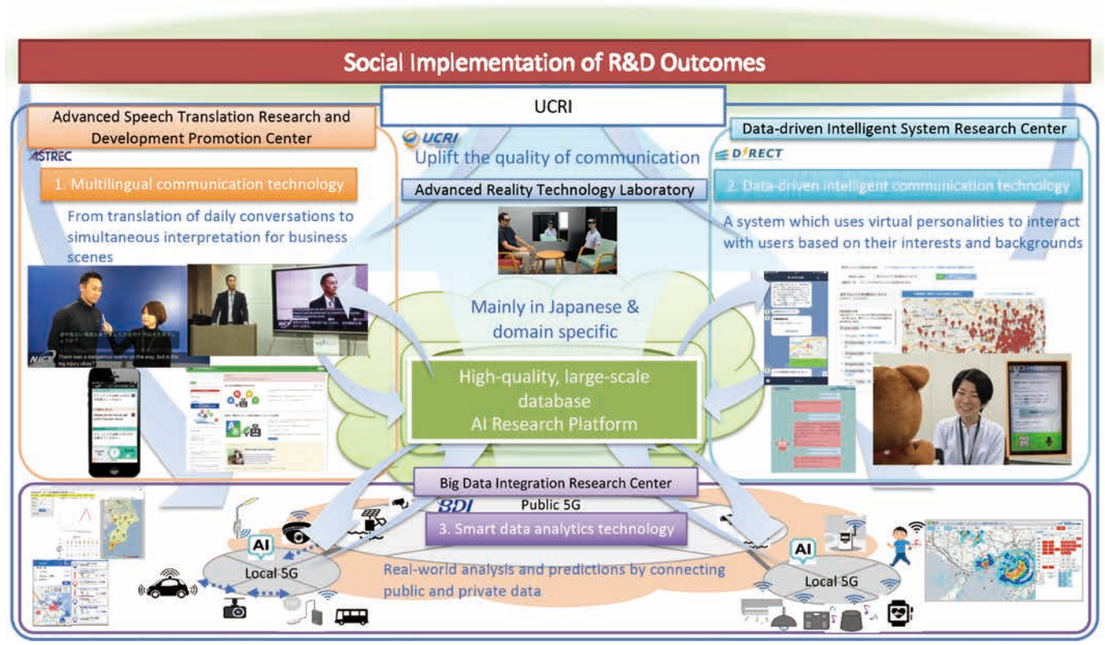


Figure 2 Positive Spiral of R&D and Social Implementation by the Universal Communication Research Institute

Creating and Developing Innovation beyond Conventional Concepts

WADA Naoya

Director General of the Advanced ICT Research Institute

Wada joined the Communications Research Laboratory (NICT's predecessor, then under the Ministry of Posts and Telecommunications) in 1998. He previously served as a Director of the Photonic Network Laboratory and then as a Director General of the Network System Research Institute before assuming his current position in 2020. He has a Ph.D. in engineering.

The Advanced ICT Research Institute was launched as a frontier science R&D organization during the current Medium-to Long-term Plan implementation period.
The Center for Information and Neural Networks (CiNet) was recently incorporated into the Institute. We will research and develop advanced base technologies through interdisciplinary collaboration to facilitate technological breakthroughs.

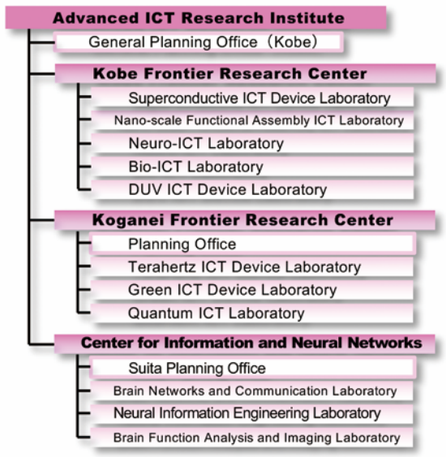


Figure 1 Organization of Advanced ICT Research Institute

NICT has been engaged in R&D in five strategic areas characterized by five keywords: observe, connect, create, protect and pioneer. Five research institutes lead these R&D efforts. The Advanced ICT Research Institute is carrying out advanced basic research with a pioneering spirit, aiming to open up new horizons in ICT research.

The Fifth Medium-to Long-term Plan has been adopted in April 2021. The Advanced ICT Research Institute underwent two major changes.

First, our area of R&D focus changed from frontier research to frontier science research. The term "science" is added to heighten expectations for us to make significant breakthroughs by performing cutting-edge R&D. We view ourselves as pioneers exploring the frontiers of science.

The second change, CiNet in Suita, Osaka is transferred to our institute in Kobe, Hyogo and Koganei, Tokyo. This arrangement has made the Advanced ICT Research Institute the largest research organization within NICT and has expanded our R&D capabilities. As a result, we expect to work closely with four other leading research institutes with different R&D focuses (i.e., observing, connecting, creating and protecting) and may therefore potentially make contributions in these areas.

The Advanced ICT Research Institute—consisting of the Kobe Frontier Research Center, the Koganei Frontier Research Center and CiNet (Figure 1)—will work to create and develop innovation beyond conventional concepts (Figure 2).

Table 1 shows an overview of R&D projects the Advanced ICT Research Institute will carry out.

Focuses in R&D

Superconductive ICT Technology	Develop superconducting integrated circuit technologies applicable to the creation of extremely sensitive photodetectors and superconducting quantum dots.
Nano-scale Functional Assembly ICT Technology	Develop nano hybrid technologies that can be used to fabricate organic molecule-silicon hybrid materials with controlled nanostructures. These materials may be used to significantly enhance communications systems.
Neuro-network ICT Technology	Develop intelligent information processing technologies using information processing algorithms employed by living organisms as models. We hope to use these technologies to create new, advanced ICT.
Bio-ICT Technology	Develop novel ICT using soft materials, including biomaterials, and biological molecular technologies capable of measuring and evaluating information.
DUV ICT Technology	Develop deep ultraviolet (DUV) devices and technologies applicable to solar blind optical communications and microbial disinfection/sterilization, etc.
Terahertz ICT Technology	Develop super-high-frequency (i.e., millimeter and terahertz waves) technologies and apply them to the creation of super-high-frequency communications devices, advanced sensing systems and highly stable light sources, etc.
Green ICT Device Technology	Develop oxide semiconductor devices which can be used to fabricate high-frequency devices, ICT devices for use in extreme environments and highly efficient power semiconductor devices, etc.
Quantum ICT Technology	Develop quantum ICT applicable to the creation of unbreakable quantum cryptography, quantum-secure networks and full-scale quantum networks capable of processing quantum signals.
Brain-inspired ICT	Develop brain-machine interface technologies, technologies designed to improve human performance based on brain function analyses, technologies designed to enhance human motor functions using digital twins and technologies for controlling and modifying the human senses of space and time.
Brain-inspired engineering technologies	We will develop AI-based technologies capable of decoding brain information, applied technologies used to monitor the brain functions of humans engaged in social activities and applied technologies used to analyze the brain's information processing networks.
Brain function analysis technologies	We will develop applied technologies to evaluate the brain waves of humans engaged in daily activities, MRI/MEG techniques, advanced measurement techniques using MRI/MEG and perception/cognition data management technologies.

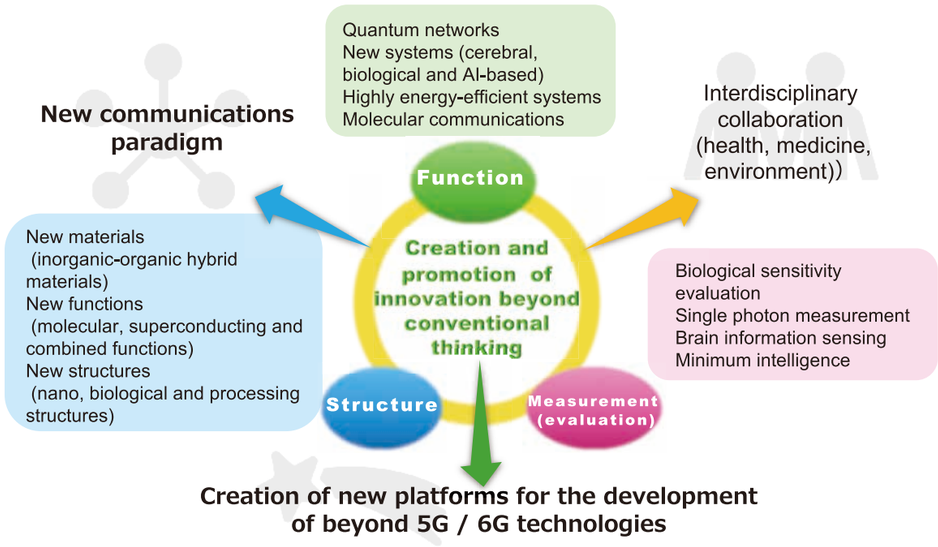


Figure 2 Research Area and Outcome of advanced ICT Research Institute

Leading NICT's Development of Beyond 5G / 6G Mobile Communications Technologies

HOSAKO Iwao

Executive Director of Unit, Beyond 5G Research and Development Promotion Unit

Dr. Hosako joined the Communications Research Laboratory (NICT's predecessor), which was then under the Ministry of Posts and Telecommunications, in 1996. He has promoted R&D on terahertz technologies, including devices, cameras and communications systems, and has worked to achieve standardization of these technologies. He has a Ph.D. in science.

Practical implementation of fifth-generation mobile communications systems (5G) has only recently begun. Meanwhile, competition on the development of beyond 5G / 6G technology is already underway because the importance of communications networks as social infrastructure is expected to significantly increase in the future. The Beyond 5G Research and Development Promotion Unit will ensure that NICT carries out effective R&D leading to socially beneficial technologies.

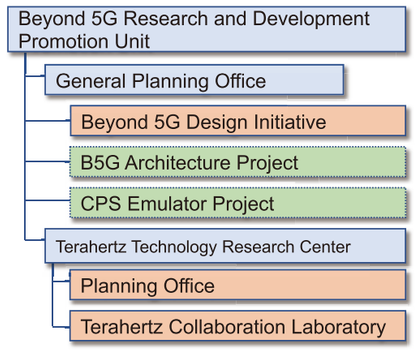


Figure 1 Organization of Beyond 5G Research and Development Promotion Unit

Mobile communications systems have evolved at an amazing speed. They have progressed beyond earlier communications infrastructure (1G to 3G) to the more robust information infrastructure (4G) vital to the public. 5G communications—which began to be introduced around 2020—not only allow people around the world to communicate and interact with each other but are also capable of connecting distantly located devices. Wider adoption of digital transformation (DX) has increased the significance of interactions between people, between people and devices and between devices mediated by mobile communications systems, which are supported by core networks, servers on the internet and cyberspace. These interactions occur across organically integrated physical and cyber spaces (i.e., cyber-physical systems (CPSs)). Development of CPS technologies is therefore important.

The COVID-19 pandemic has forced many people to rely on cyberspace resources, such as remote conferences, as their primary means of communication. As a result, remote communications tools are now widely accepted not only in business but also for many other purposes. People have realized the many advantages of these tools. Cyberspace-mediated remote meetings, for example, allow distant people to participate in meetings in real time. In addition, these meetings can be attended by significantly larger numbers of individuals than traditional on-site meetings. People can now enjoy various forms of businesses and entertainment using cyberspace tools. However, many users are not fully satisfied with the tools currently available because they fail to give users the feel of actual face-to-face meetings and conversation. I believe that this issue can be technically improved upon by resolving current network issues (i.e., communications delays, frequency bands currently used, insufficient numbers of access points and inadequate human interface quality).

Focuses in R&D		
	Development of beyond 5G / 6G concepts and architecture	Oversee beyond 5G / 6G R&D at NICT and formulate a beyond 5G / 6G concept in partnership with other NICT functions and external organizations. We will then study ways in which beyond 5G / 6G technology can benefit users and businesses. Based on this research, we will then propose strategies for effective beyond 5G / 6G R&D and ways in which the R&D results can be converted into socially beneficial technologies. NICT will follow these guidelines to develop beyond 5G / 6G architecture and core technologies.
	Development of cyber-physical system emulator (e.g., radio emulator)	Evaluating a complex, large-scale wireless communications system in an actual operational environment has several disadvantages: it is enormously costly and time-consuming, experiments cannot be repeated under consistent conditions and accurate comparison of a wireless communications system before and after enhancement is difficult. To resolve these issues, we will promote NICT's efforts to develop a wireless system emulator in partnership with other NICT functions and external organizations. Such an emulator is expected to enable large-scale, accurate simulation and evaluation of wireless communications systems and radio propagation within cyberspace in real time.
	Development of key technologies for terahertz communications and their application to practical systems	Research and develop technologies for taking measurements from terahertz band communications systems and terahertz material evaluation technologies. We will also create an environment conducive to the development and sharing of terahertz band ICT platforms. In addition, we will develop means of accurately characterizing terahertz waves and terahertz band devices/materials based on terahertz frequency/power standards with the goal of helping improve Japan's radio station licensing regulations. Moreover, we will work to establish international standards for the use of terahertz frequencies and help put terahertz bands into practical use.
	Terahertz remote sensing technologies	Develop very small, lightweight satellite sensors by leveraging terahertz bands, construct and verify the performance of a model designed to simulate long-distance propagation of terahertz-frequency electromagnetic waves in outer space and develop basic technologies for outer space terahertz communications. In addition, we will create new values from big data collected from satellites and other sources using our own algorithms, indices and other tools and promote social and industrial use of these values.

Table. List of projects to be overseen by the Beyond 5G Research and Development

Although practical use of 5G technology has only recently begun, competition in the development of beyond 5G / 6G is already ongoing. This is because communications networks are important social infrastructure today and their importance is expected to increase significantly in the future. This expectation is shared not only by ICT researchers, developers and engineers but also by the general public as it experiences the ongoing pandemic. The Beyond 5G Research and Development Promotion Unit, which consists of the groups shown in Figure 1, will work to achieve United Nations Sustainable Development Goals (SDGs) and bring Japan's Society 5.0 concept into reality. For these objectives, we will first formulate a beyond 5G / 6G concept (Figure 2) to facilitate NICT's R&D on beyond 5G / 6G architecture and core technologies, including terahertz technologies capable of significantly speeding up communications network access and a wireless system emulator (a tool for creating CPSs).

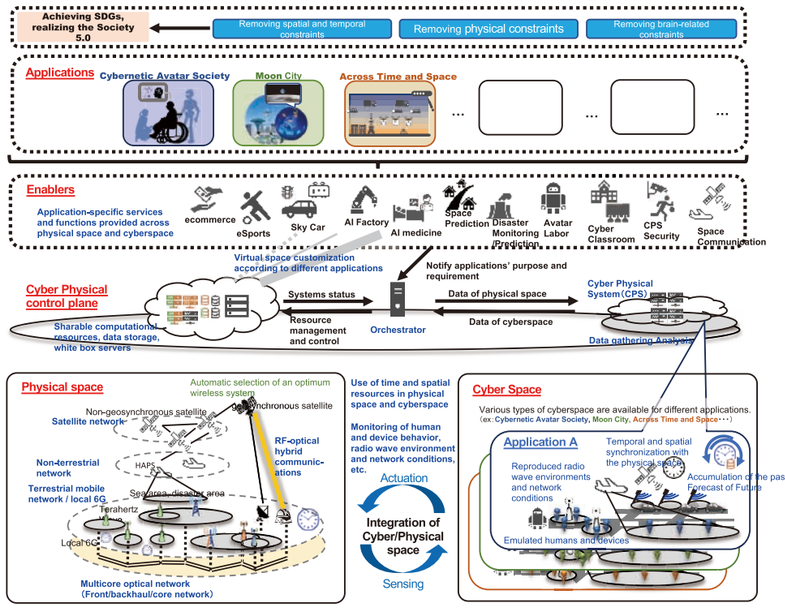


Figure 2. Conceptual diagram describing ways in which beyond 5G / 6G technology can help achieve United Nations SDGs and bring Japan's Society 5.0 concept into reality
※ From NICT Beyond 5G/6G Whitepaper (released on 2021.3.31)

Accelerating Open Innovation and Leading Social and Economic Reform to Achieve a "New Normal"

Amid intensifying international competition in the development of advanced technology, Japan is committed to leading social and economic reform using information and communications technology (ICT) to achieve a "new normal" characterized by great hope, enormous potential and a bright future. Expectations are growing for NICT—Japan's sole public organization specialized in ICT—to take the lead in this initiative. The Social Innovation Unit works to transform R&D results produced by NICT into socially beneficial products and accelerates open innovation in a variety of ways, including commissioned research and collaboration with industry, academia, the public sector and international ICT communities.

NOZAKI Masatoshi

Headquarters Chairman of Open Innovation Promotion Headquarters

KUBOTA Minoru

Director General of Social Innovation Unit

* The affiliations and positions are as of April 2021.

● Social Innovation Unit

The Open Innovation Promotion Headquarters established the General Produce Office in April 2021 to enhance coordination within the headquarters and with external parties. In addition, the headquarters will promote the development of beyond 5G (B5G) component technologies and advance international standardization efforts by encouraging participation in B5G R&D projects using NICT's third supplementary budget for FY2020.

The Social Innovation Unit has been working to expedite open innovation since NICT's previous Medium-to Long-term Plan implementation period. Specifically, this unit established the Strategic Program Office, which works to transform R&D results produced by NICT into socially beneficial products, and the ICT Testbed Research and Development Promotion Center, which develops and operates testbed platforms for cutting-edge ICT technologies. Envisioning that B5G technology will be put into practical use by around 2030, the unit is taking comprehensive, strategic action in close coordination with the Innovation Promotion Department, the Global Alliance Department and the ICT Deployment and Industry Promotion Department. The specific activities being carried out by these offices, centers and departments are described below.

NISHINAGA Nozomu, Director, Strategic Program Office

This office developed a network of collaborators within local communities, industry and academia during the previous NICT Medium-to Long-term Plan implementation period. Using this network, we work to transform NICT's R&D results into socially beneficial products and facilitate interactions between various NICT components and external parties.

This office manages two subordinate offices: the Research Planning and Promotion Office, which oversees ethical and regulatory aspects of NICT's activities, and the Regional/Industry-Academia Collaboration Promotion Office, which facilitates NICT's collaboration with local organizations, industry and academia. These offices work together in close coordination. The Research Planning and Promotion Office actively addresses issues associated with rapidly changing research environments, such as the handling of personal data and ethics concerning biological research. For these purposes, this office organizes various committees, develops web portals to make selected data open to the public and holds review sessions before publicizing data.

The Regional/Industry-Academia Collaboration Promotion Office facilitates NICT's collaboration with local organizations, industry and academia. In a continuing effort from the previous Medium-to Long-term Plan implementation period, this office works to identify locally important issues by hosting hack-a-thons and idea-thons, widely publicizes R&D results produced by NICT and carries out commissioned research to resolve local ICT-related issues, thereby helping transform NICT's R&D results into socially beneficial products.

KOJIMA Fumihide, Director General, ICT Testbed Research and Development Promotion Center

NICT develops advanced ICT technologies for users with diverse needs in collaboration with industry, academia and the public sector. This center facilitates the development and effective operation of testbeds used in evaluating the technical validity and usability of these technologies. As a public research organization, this center provides testbeds suitable for R&D activities, experimental verification and usability testing. In addition, the center invites research organizations from Japan and overseas to forums and other events it hosts in an effort to create a collaborative ecosystem of innovative ICT service providers. When 5G communications technology is replaced with B5G/6G technology, it is presumed that diverse, cyber-physical system-based communication services developed using 5G technology will be preserved and that more complex communication services and systems will be built to offer integrated services. NICT previously developed the JGN High Speed R&D Network Testbed and a large-scale emulation testbed (StarBED). Based on this experience, we will facilitate the construction of a testbed for designing service layers and a next-generation testbed for developing B5G software for edge cloud infrastructure. To accomplish these objectives, we will enhance the following functions: the Data Centric Cloud Service (DCCS), widely distributed testbeds for developing B5G software, an emulation testbed capable of testing real-world performance and an autonomous mobility testbed used to form an ecosystem of ICT service providers.

This department facilitates joint research by NICT and external organizations (e.g., private companies and universities), helps dispatch NICT researchers and assists external researchers visiting NICT. The department also effectively conducts commissioned research by coordinating NICT's R&D efforts with its collaborators in industry and academia. We view commissioned research as an opportunity for NICT to leverage its full R&D capabilities and strengthen its collaborative relationships with industry, academia and the public sector. We also engage in active standardization efforts with industry, academia and the public sector and transform R&D results into socially beneficial products by acquiring and effectively using intellectual property licenses. Through these activities, we aim to maximize the benefits of NICT's R&D results and promote NICT-led open innovation.

SHIOZAKI Mitsuhiro, Executive Director , Innovation Promotion Department

Amid the increasing globalization of social and economic activities, international collaboration is becoming increasingly important in ICT R&D and in publicizing R&D results. To promote open innovation on a global scale, the Global Alliance Department facilitates NICT's joint research with overseas research organizations and universities, promotes international interaction between researchers and collects relevant information through NICT's Overseas Centers.

Security has become a major concern when transferring people, materials and technologies across national borders due to the increasingly complex international environment. We will ensure safe and smooth international collaboration and international publication of R&D results by providing proper information and support to NICT researchers.

FUKABORI Michiko, Executive Director , Global Alliance Department

ICT is often the main focus of R&D and is an important component of our social and economic infrastructure. This department helps overseas researchers visit research organizations in Japan by offering international exchange programs and organizing international researcher meetings. We also support young entrepreneurs considering launching businesses in the ICT industry by providing them with helpful information on business start-ups and creating opportunities for them to meet ICT industry representatives. In addition, we have been working to narrow the information accessibility gap between people with and without access to advanced ICT by supporting the production of broadcast programs with subtitles, sign language interpreters and commentary and working with providers of communications and broadcast services designed to help people with disabilities. We also disseminate information useful to the elderly and people with disabilities. We hope that these efforts increase ICT accessibility in these communities.

HIROSHIGE Kenji, Executive Director ,ICT Deployment and Industry Promotion Department

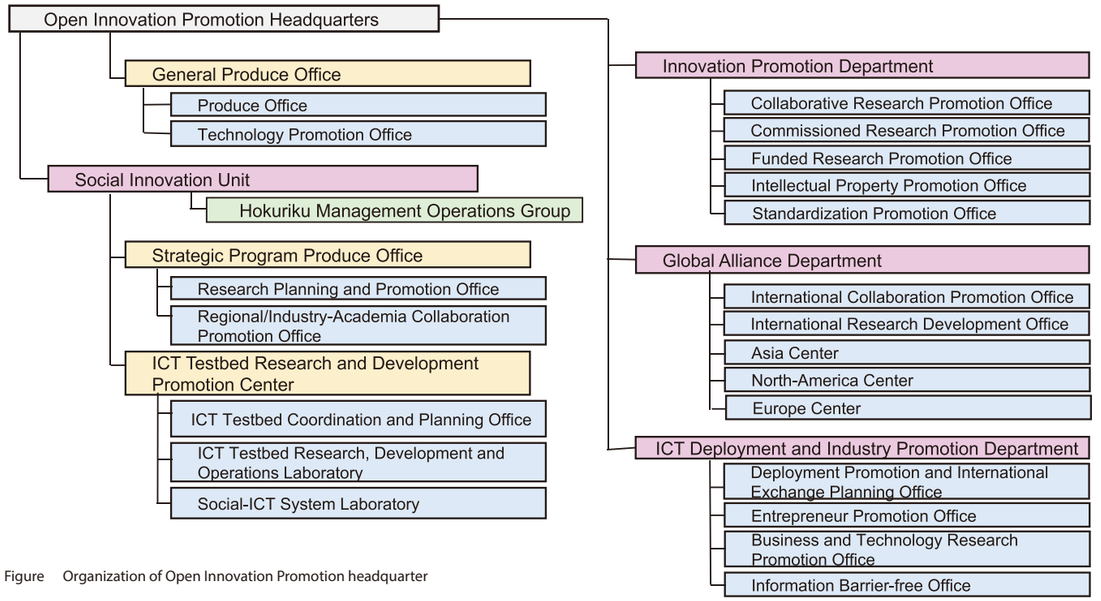


Figure Organization of Open Innovation Promotion headquarter

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Awards

The Maejima Hisoka Award was established in memory of Mr. Maejima, one of the founders of Japan's telecommunications industry, and to pass on and promote his spirit. The award is presented to those who have made outstanding contribution to the advancement of the information and communications industry (including postal services) or the broadcasting industry. Three parties of NICT researchers received this award in FY2021.
The Minister of Education, Culture, Sports, Science and Technology Award is given to persons who have made remarkable achievements in the research, development, and understanding of science and technology.

* The affiliations and positions are those at the time of winning the awards

66th Maejima Hisoka Award presented by the Tsushinbunka Association

● **TERAI Hirotaka,** Advanced ICT Research Institute
● **MIKI Shigehito,** Senior Researcher, Advanced ICT Research Institute
● **YAMASHITA Taro,** Associate Professor, Graduate School of Nagoya University (Co-receiver)

● Achievement recognized: Joint research and development of a superconducting nanowire single-photon detector
● Award reception date: April 9, 2021

Summary: Our detector achieved detection efficiencies higher than 80% at the telecommunication wavelength, significantly higher than those achieved with semiconductor photon detectors. The detector has been used by various advanced technologies, greatly contributing to the outstanding research results in quantum communications, biology, and so on.

From left YAMASHITA Taro(Nagoya University), MIKI Shigehito, TERAI Hirotaka

Group Award

NICT Terahertz International Standardization Team

● **OGAWA Hiroyo (Team representative),** Terahertz Technology Research Center
● **HOSAKO Iwao,** Director General, Terahertz Technology Research Center
● **KASAMATSU Akifumi,** Terahertz Technology Research Center
● **KANNO Atsushi,** Research Manager, Network Science and Convergence Device Technology Laboratory, Network System Research Institute
● **INAGAKI Keizo,** Senior Researcher, Network Science and Convergence Device Technology Laboratory, Network System Research Institute
● **SAWADA Hirokazu,** Research Manager, Wireless Systems Laboratory, Wireless Networks Research Center
● **FUJII Katsumi,** Senior Researcher, Terahertz Technology Research Center
● **SEKINE Norihiko,** Director of Collaborative Research Laboratory of Terahertz Technology, Terahertz Technology Research Center

● Achievement recognized: Standardization efforts achieving practical use of terahertz frequency communications
● Award reception date: April 9, 2021

Summary: We have been collaborating with the US Institute of Electrical and Electronics Engineers (IEEE) and the Radiocommunication Sector of the International Telecommunication Union (ITU-R) for over a decade to put communications at frequencies of 275 GHz or higher into practice. These efforts greatly helped the establishment of the world's first de facto standard for the use of the 300 GHz band and the revision of the radio communications regulations.

Promotion Award

● **INOUE Masugi,** Director of International Collaboration Promotion Office, Global Alliance Department
● **OWADA Yasunori,** Senior Researcher, ICT Testbed Coordination and Planning Office, ICT Testbed Research and Development Promotion Center

● Achievement recognized: Joint research that led to the practical implementation of disaster-resistant network systems for the first time in the world
● Award reception date: April 9, 2021

From left OWADA Yasunori, INOUE Masugi

FY2021 The Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology Prizes for Science and Technology

Prizes for Science and Technology, Promotion Category

● **ETO Masashi,** Director of Cyber Training Laboratory, National Cyber Training Center
All persons beneath are member of National Cyber Training Center
● **KANAHAMA Nobuhiro,** Senior Technical Researcher ● **HANADA Tomohiro,** Senior Technical Researcher
● **SATOH Hironobu,** Senior Researcher ● **ISHIKAWA Hiroki,** Senior Technical Researcher

● Achievement recognized: Training the public in defense procedures against cyberattacks using a Japan-made simulation program
● Award reception date: April 14, 2021

Summary: We developed CYDERANGE, an automated cyberattack simulation program, as a tool to efficiently and effectively train large groups of people and develop cyber security experts to meet Japan's urgent demand in this area. The training we offered using this technology helped improve Japan's overall cyber security capabilities.

From upper left ETO Masashi, KANAHAMA Nobuhiro, HANADA Tomohiro, SATOH Hironobu, ISHIKAWA Hiroki

Prizes for Young Scientist

● **AONO Yoshinori,** Researcher (Tenure-Track), Security Fundamentals Laboratory, Cybersecurity Research Institute

● Achievement recognized: Pioneering research on assessing the security of lattice-based cryptography ● Award reception date: April 14, 2021

Summary: He has researched the security of lattice-based cryptography, one of the most emerged post-quantum cryptographies.
In particular, he theoretically bound the computing time to break the cryptosystem, and also demonstrate it for the parameter selection method to make lattice-based cryptography secure over a long time. These achievements are expected to facilitate research on lattice algorithms used in cryptography.