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National Institute of Information and Communication Technology
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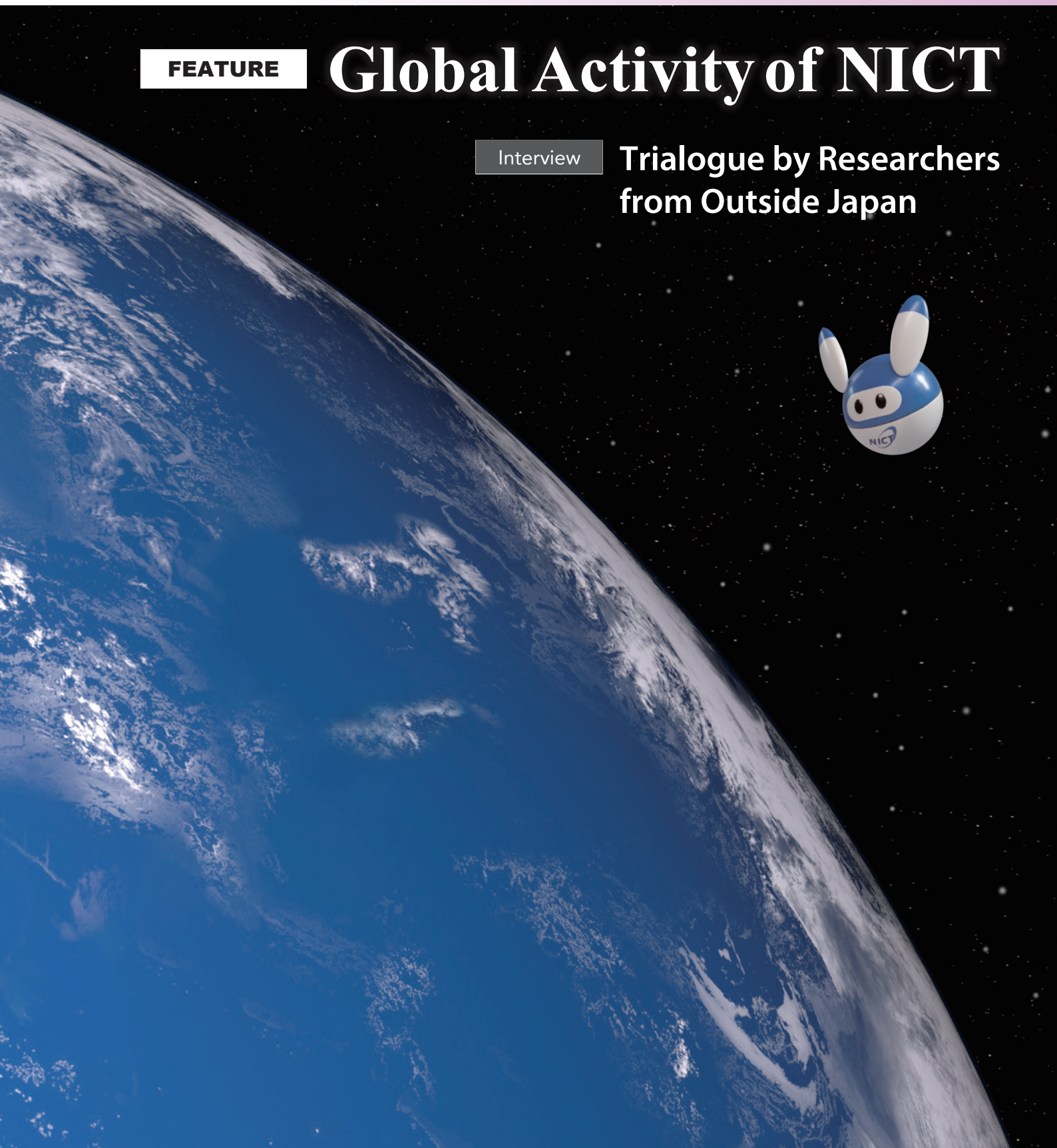
FEATURE

Global Activity of NICT

Interview

Trialogue by Researchers from Outside Japan



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AI robot character "N" observing NICT's global activities from space

Nov. 16 (Thu), 2023

Deputy Vice-Chancellor Anton Middelberg of the University of Adelaide Visits NICT

NICT engages in carrying out the project commissioned by the Ministry of Internal Affairs and Communications titled, "Wide-Area Exploration of Water Energy Resources on the Moon Using Terahertz Waves (Lunar Terahertz SUrveyor for KIlometer-scale MappIng; TSUKIMI)." In order to promote the development of image processing for improving the precision of lunar surface location information, NICT concluded an MOU with the University of Adelaide, Australia, and has been working on research and development toward mounting observation equipment using the university's AI technology on a satellite. Professor Anton Middelberg and Professor Tat-Jun Chin visited NICT as part of the commitment to the MOU and to prepare for the scheduled joint research. They expressed their eagerness to support the future lunar surface exploration project.

From left, Dr. IBARAKI Hisashi, Vice President of NICT, Dr. KASAI Yasuko, Research Executive Director (online), Professor Anton Middelberg (Deputy Vice-Chancellor, University of Adelaide), Professor Tat-Jun Chin (University of Adelaide)

Greetings for 2024

Message from the President

President of the National Institute of Information and Communications Technology
Dr. TOKUDA Hideyuki

The COVID-19 pandemic that overwhelmed the world finally subsided in 2023. However, grave regional conflicts—most notably the Russian invasion of Ukraine and the Israel-Hamas war—have caused global turmoil for which no end is in sight. Amid these tense circumstances, striking information and communications technology (ICT) developments are underway: new revolutionary AIs have been created, including generative AIs (or large language models) such as Open AI's ChatGPT and Google's Bard / Gemini. The advent of these AIs has led to discussion of ways in which humans and AIs can harmoniously coexist.

2024 will mark the fourth year of NICT's Fifth Medium-to-Long-term Plan implementation period. This plan specifies four strategic research areas: Beyond 5G (B5G) technologies, which we aim to put into practical use by 2030; AIs, expected to be the most important technology of the 21st century; Quantum ICT, which may revolutionize current ICT systems; and Cybersecurity crucial to protecting social infrastructure. Our R&D in these areas has made significant progress. We have also acted as a collaboration hub for R&D by Japanese and overseas organizations.

With respect to B5G technologies, NICT has considerable expertise in research on Terahertz technologies, space-time synchronization technologies and non-terrestrial networks. We have therefore been working on international standardization of these technologies through the ITU-R SG5 WP5D and 3GPP (Third Generation Partnership Project) frameworks. In addition, we have made the testbeds for B5G R&D available for use by external researchers and constructed a B5G electromagnetic wave anechoic chamber facility at NICT in efforts to expedite the development of B5G technologies across Japan. We have also provided funding to private companies, universities and other organizations carrying out B5G R&D by launching a Beyond 5G R&D Promotion Project and B5G/6G R&D funding programs. Through these efforts, we aim to accelerate the development of fundamental B5G technologies and their practical use in Japan and overseas.

In the area of AI research, we have been conducting R&D in line with the Global Communication Plan 2025 . We are making steady progress in developing a multilingual simultaneous interpretation system with the aim of demonstrating it at the World Expo 2025 in Osaka. As part of our generative AI R&D, NICT has developed an original large language model designed specifically for use by Japanese speakers. In addition, we incorporated AIs—including newly developed AI technologies—into a number of research projects related to space weather forecasting, network control, privacy-preserving federated learning, interdisciplinary research on information and neural networks and other subjects.

Our Quantum Security Innovation Hub is also now fully operational. We succeeded in experimentally demonstrating that quantum keys can be exchanged between the International Space Station and a ground station via optical communications. Moreover, we launched the NICT Quantum Camp program to train talented young people which we call Quantum Natives.

Finally, in Cybersecurity research, we established the Cybersecurity Nexus (CYNEX) in 2021, a system intended to coordinate cybersecurity efforts by the industrial, academic and public sectors. We then launched the CYNEX Alliance in October 2023 to intensify CYNEX activities. Through these efforts, we aim to strengthen Japan's Cybersecurity R&D by private companies, government organizations and educational institutions using CYNEX as a means of cross-sectoral collaboration.

NICT is Japan's sole national research institute specialized in ICT. In line with its missions, we prepared an NICT Brand Statement in 2023 in non-technical terms to convey our aspiration to expand the potential of ICT and publicized an ICT Report to inform the public of the latest trends in and future prospects for ICT R&D.

We invite public comments and suggestions about our activities. We will continue making efforts to advance ICT by cooperating and engaging in friendly competition with other ICT-related organizations in Japan and overseas and collaborating with the industrial, academic and public sectors. We appreciate your continued support and cooperation.

I'd like to end my New Year's greetings by offering a heartfelt prayer for peace in the regions affected by the current conflicts.

Interview

Trialogue by Researchers from Outside Japan

As a world-leading research institute, NICT is dedicated to cultivating an international environment, both within and outside its walls. NICT's researchers actively contribute globally through publications, collaborations, and standardization efforts.
Moreover, a substantial number of experts from around the world are currently working at NICT.
A recent discussion featured three researchers from diverse international backgrounds, each specializing in different areas.
Guiding this dialogue was YAMAGUCHI Norifumi, Executive Director of the Global Alliance Department at NICT.
Let's now hear their candid perspectives on NICT.

Juan LIU

Senior Researcher,
Advanced Reality Technology Laboratory,
Universal Communication Research Institute

Dr. Liu joined NICT in 2006 after receiving her Ph.D. in China and working as a researcher at ATR Labs. Her main areas of interest are the intersection of multisensory perception mechanisms, human-machine interfaces, and artificial intelligence.
Ph.D. (Engineering)

Benjamin J. Puttnam

Chief Senior Researcher,
Photonic Network Laboratory,
Photonic ICT Research Center,
Network Research Institute

Dr. Puttnam joined NICT in 2010 after receiving the Ph.D. from University College London, UK and spending post-doctoral research stays at NICT and Chalmers University of Technology in Sweden. He works on high data-rate optical transmission and networks as well as optical signal processing technologies. Ph.D.(Engineering)

LE TRIEU PHONG

Senior Researcher,
Security Fundamentals Laboratory,
Cybersecurity Institute

Dr. PHONG studied at Vietnam National University. He joined NICT in 2009 after obtaining his Ph.D. from the Tokyo Institute of Technology. His primary areas of interest lie at the intersection of cryptography and machine learning. Ph.D.(Doctor of Philosophy)

YAMAGUICHI Norifumi

Executive Director,
Global Alliance Department

He joined Ministry of Post(Currently Ministry of Internal Affairs and Communication(MCI)) in 1992. After getting MS of Management Science and Engineering at Stanford University,he has been working on International Standardization and Policy Promotion at MIC, JAIST and ITU. Current position from 2023.

YAMAGUCHI Happy new year, everyone. First of all, please explain your current research briefly.

Puttnam I'm working in photonic network technologies and in particular on systems with new types of fiber such as multi-core, multi-mode fibers, also including network operation and switching

PHONG My research is in the intersection of cryptography and machine learning, with a particular emphasis on privacy-preserving federated learning. This area has shown potential for transformative applications in preserving data privacy while enabling collaborative machine learning.

LIU I am working on tele-presence, an interdisciplinary project using virtual reality, computer vision and AI technologies to bring remote people to one place in a virtual-physical merged world.

YAMAGUCHI What is the first key event that you would like to engage in research activities in NICT? Please recall the period before you join NICT. Any motivation and important decision-making points?

Puttnam I first came to Japan under a JSPS fellowship, and was keen to work and travel in a different country. I heard about NICT from a Professor at Nagoya University, who was friends with my Ph.D.supervisor. The professor recommended me to try NICT and put me in touch with the head of NICT Network research, at that time WADA-san. After talking with him I was able to spend my fellowship period at NICT.

PHONG After I finished my PhD, my professor talked to me about NICT. She said it's a great place to keep doing research. It sounded like the perfect fit for me because I enjoy doing research, so I went for it.

LIU Before joining NICT, I was at ATR and working on AI and robotics. At that time I heard that NICT would start a ultra-realistic project from 2006, and the project was recruiting researchers from different fields. For me, it was a very interesting project and a chance to cooperate with many researchers. So I joined that project.

YAMAGUCHI What are the attractive points of NICT? ex. research environment? working condition?

Puttnam For me, my research needs a good laboratory and NICT lab conditions are very good. Also NICT's position and connection to Japanese industry are very important. In my fields, many of the big fiber makers are Japanese companies. We can work with them and get access to their fibers. I would also say, "Working environment is good and convenient."

PHONG I think NICT's commitment to a medium- to long-term research perspective provides stability and room for in-depth research. It also offers a conducive atmosphere where researchers can concentrate on their R&D pursuits. In addition, the assistant staff is very supportive, ensuring a smooth experience for researchers.

LIU Until 2006, I was working on intelligent systems and felt like in a narrow field. Researchers discussed about how to make robots as intelligent as human being. But we did not have enough knowledge about what intelligence is or how humans actually process various information. At NICT, I tried to cooperate with researchers working on humans, such as neuroscientists, and other researchers working on displays and virtual reality systems. We can exchange many fresh ideas and knowledge in different fields. It is a very nice place to conduct research. I like the environment. With adequate budget for our project, we could do a lot of experiments.

YAMAGUCHI Thank you, You can have discussion with other teams researchers that is nice.
What are the advantage or achievement of NICT? (Budget, research facilities, talented researchers, number of papers approved or others)

Puttnam I like people leading research in this, and resources of a lot of facilities.

PHONG In my field of research, NICT stands out for its robust computing infrastructure, which includes powerful servers. This resource is pivotal for my research efforts, making it a distinctive advantage of being affiliated with NICT.

LIU As for the advantage of working in NICT, I would like to mention three points. One is budget support from Japanese government that allows us to concentrate on our research. Second, we receive a lot of support from administrative people and engineers that we can make whole research efficiently. The third is we have freedom of managing our time. We have well-established regulations so that we feel safe and secure. With telework we obtain more flexibility.

YAMAGUCHI I am from global alliance department, and we make support of MOU or other research agreements.

Puttnam It is another positive point. We can have many students from Europe.

YAMAGUCHI What do you think is the world leading or world class level point of your research? What can you appeal to the world?

Puttnam We will show the limit of optical data transmission and networking using new optical fibers. We also do research for new amplifiers and components. It is not just transmission, but also how to build network with new switching technologies more efficiently in order to reduce energy consumption.

YAMAGUCHI It is a tradeoff between speed and length of transmission.

Puttnam Yes, of course. Optical amplifiers are the key device.

PHONG In my research, a significant milestone that attests to its global significance is the extensive recognition garnered by one of my works on privacy-preserving federated learning. This particular paper has accumulated over a thousand citations, as documented by Google Scholar. This substantial citation count is a testament to the impact my research has had within the academic community and underscores its world-class standing in the field. Additionally, this work has sparked further investigations and discussions, contributing to the advancement and evolution of privacy-preserving techniques in federated learning.

LIU The field of VR is very competitive now. We focus on what information humans need during communication, using our knowledge about human perception to transmit the necessary information and reduce the amount of data during communication. We take advantage of the multidisciplinary composition of neuroscientists, engineers, and AI researchers in our team. We are working on multi-sensory, cross-modal effects of human beings. We have made a system that can provide four kinds of modality, i.e. vision, audio, haptics and olfaction at the same time. We also developed devices for haptic force-feedback inside MRI chamber. The cooperation among different kinds of skill is very precious in our project.

YAMAGUCHI Please tell us about future. What is your future prospect or dream of your research from the viewpoint of global contribution?

Puttnam The dream of researchers I think is to see the technologies of research topics being used. In our case, it would be that Multi-core fiber (or space-division multiplexing, SDM) networks becoming common and being used after many years of research. In last conference (ECOC 2023), there was an announcement that a new technology had deployed in the cable by the Google, and simple multiple fiber produce by Sumitomo Electric. Those are the first signs that the industrial community is starting to adopt this new technology commercially.

PHONG I'm dedicated to delving deeper into the fusion of cryptography and machine learning. I'm also dedicated to staying up-to-date with emerging technologies and methodologies that align with my research interests, to ensure the continued relevance and impact of my research globally.

LIU We hope our technology will be used by people and make their life better. So we hope somehow to change people's life, change the way of working. They can get more choices and more freedom. They can have better experiences during their life.

YAMAGUCHI Lastly, Please give any comment, or your invitation to researchers in the world to join NICT,

Puttnam I recommend NICT is good place to work for, particularly for recent graduates to start their careers to take advantage of the unique facilities. It is a good opportunity to do important reserarch early in one's career.

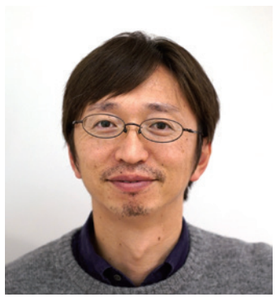
PHONG NICT offers a unique opportunity to conduct cutting-edge research while experiencing the rich culture of Japan. Come and join us in this vibrant research community!

LIU I have similar feelings. NICT is a good place for research. There are not many other things disturbing you, like political issues or human relations. We all like the lifestyle in Japan, safe environment, beautiful sceneries. We can enjoy Japanese culture. But you also need to be aware of the rules and regulations in NICT. People who understand them and are willing to follow them will easily adapt here. If your research topics are in ICT, it is very likely that you will find a good team in NICT.

YAMAGUCHI Thank you all, I try to keep my mind that researchers in NICT could concentrate on research. Thank you for joining the interview.

Puttnam PHONG LIU Thank you very much.

Re-designing Natural Biomolecular Motors: Development of Nanomachines That Walk on DNA Nanostructures



FURUTA Ken'ya
Research Manager,
Bio-ICT Laboratory,
Kobe Frontier Research Center,
Advanced ICT Research Institute
After completing graduate school, became a Research Fellow of the Japan Society for the Promotion of Science, and then joined NICT in 2009. Engaged in research on design and fabrication of protein nanomachines. Ph.D. (Science).

Our research group has developed molecular machines capable of being programmed via DNA sequences to move along DNA nanostructure tracks. This world-leading achievement was made possible by combining several functional modules composed of naturally occurring biomolecules and redesigning the assembled modules using our original techniques. DNA nanotechnology has been advancing since the 2000s. Although recognized to have great potential for use in nanomedicine and materials science, difficulty in controlling the movement of molecular machines and an inability to create high-speed molecular motors had made practical application elusive. Our recent success in creating molecular machines capable of rapidly moving on the surface of DNA nanostructures may shift DNA nanotechnology into a more dynamic phase, significantly impacting industry. This success may also lead to the creation of new industries able to develop technologies with novel working principles, such as a biomimetic information processor that uses fluctuations in biosystems and molecular recognition of specific intermolecular interfaces.

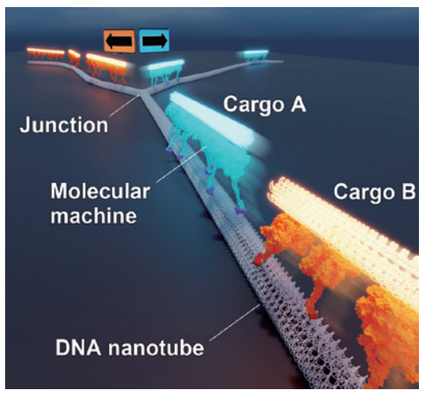


Figure 1 Schematic diagram illustrating molecular machines transporting different molecular cargos to separate locations

This research was published in Science, a journal of the American Association for the Advancement of Science (AAAS).
(Reprinted with permission from AAAS.)

Background

The concept of nanoscale molecular machines capable of performing complex tasks with great precision is considered to have originated from a 1959 lecture by Richard Phillips Feynman. Many nanotechnology scientists have made pioneering efforts to research fully-manipulable nanoscale molecular machines with the vision that this technology could be useful in medicine, materials science and many other fields. Organic synthesis chemists mainly led molecular machine R&D starting in the 1980s and the field has grown in popularity in recent years due to a number of achievements. Pioneering work on the design and synthesis of molecular machines (e.g., nanocars capable of moving unidirectionally and molecular switches) won the 2016 Nobel Prize in Chemistry[1]. These molecular machines have potential as minute power sources and in memory and communications devices.

However, currently available artificial molecular machines are unsuitable for practical use due to a number of issues, including poor energy efficiency. Also, because molecular machines in principle need to be controlled externally, it is difficult to separately control individual ones. Living organisms have achieved "practical use" of molecular machines through evolution. These biomolecular machines autonomously sustain cellular functions with great efficiency, consuming only about 20 times the amount of thermal energy. Inspired by these machines, our group began a research project in around 2015 to develop artificial molecular machines with similar mechanisms.

Modifying Biomolecular Motors to Make Them Controllable

A biomolecular motor—a type of molecular machine—is a group of molecules composed of proteins able to move unidirectionally along an actin filament or microtubule track by changing its structure while hydrolyzing ATP—an energy source molecule. Naturally occurring biomolecular motors play diverse roles in sustaining cellular functions. They have inspired many attempts to develop technologies with similar mechanisms. However, these projects failed due to the poor stability and controllability of naturally occurring actin filaments and microtubules used as tracks. To address these issues, our group attempted to replace these natural tracks with more flexibly designed, stable and controllable DNA nanostructure tracks by developing a new DNA-based molecular motor system. After a period of trial and error, we developed an original technique able to create new molecular machines by combining several functional modules composed of naturally occurring biomolecules [2]. We then finally succeeded in developing biomolecular motors capable of moving unidirectionally along DNA nanostructure tracks in 2022 (Figure 2)[3].

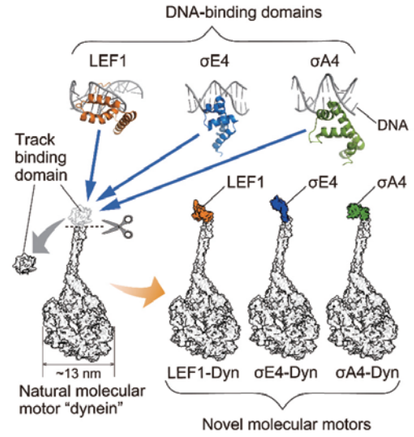


Figure 2 Conceptual diagram illustrating how a new molecular machine can be created by fusing a DNA-binding protein to dynein, a naturally occurring molecular motor

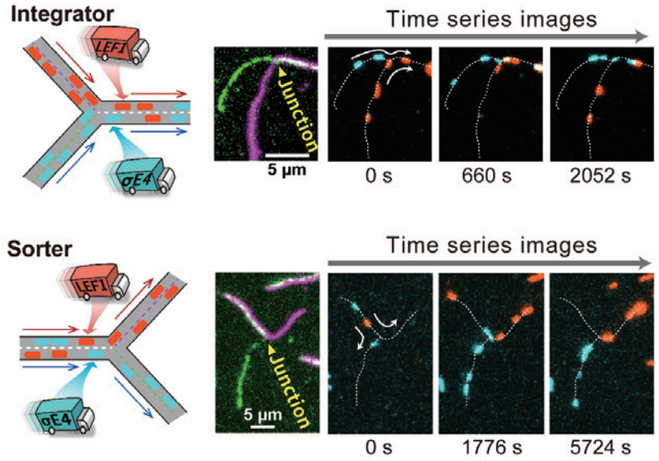


Figure.3 (Left) Schematic diagrams showing two types of molecular machines transporting different types of cargo from two different segments of a Y-shaped track to another segment (i.e., cargo integration; top) or from one segment of the Y-shaped track to two other segments (i.e., cargo sorting; bottom). (Right) Fluorescence microscopy images of Y-shaped DNA tracks (top and bottom images at far left) and time series images of two types of molecular machines transporting different cargos from two different segments of a Y-shaped track to the other segment (three upper images) or from one segment of the Y-shaped track to two other segments (three lower images).

Working Molecular Machines

We have since constructed precisely controllable molecular transport systems designed to enable molecular machines to transport molecular cargo. The system includes a Y-shaped track created by connecting three DNA nanotubes into a Y-junction using the DNA origami technique, and different types of molecular machines that bind to specific DNA nanotube track segments. The types of molecular machines and the directions in which they move were preprogramed into the DNA sequences embedded in the tracks. By using two types of mobile molecular machines capable of moving along the Y-shaped track, we were able to have them perform sophisticated tasks, including transporting two types of cargo from two different segments of the Y-shaped track to the other segment (i.e., cargo integration) and then conversely having them transport the two types of cargo from one segment of the Y-shaped track to the two other segments (i.e., cargo sorting) (Figure 3).

Molecular Machine Stability

Biomolecular machines are composed of proteins. While proteins are often seen merely as food ingredients and assumed to be unstable and fragile, they can be designed to be as strong as steel—like spider threads—or they can be designed to be fragile. Molecular machines for use in the human body need to be moderately fragile rather than resistant to degradation because persistent foreign molecules can be toxic to the body. Protein-based molecular machines with great design flexibility potentially have a wide range of applications, including in the industrial and medical fields.

Future Prospects

We are currently the only research group in the world able to design biomolecular machines that can move rapidly on the surface of DNA nanostructures. Using this unique DNA nanotechnology, we hope to develop stable, highly functional sensors, processors and actuators that can be controlled by their users. Naturally occurring biomolecular machine systems are believed to be able to perform sophisticated information processing (e.g., complex parallel computing and temporal pattern recognition) in a very energy efficient manner by using fluctuations in biosystems and molecular recognition of specific intermolecular interfaces. By combining these molecular machines, technologies with novel working principles (e.g., molecular computers, molecular synthesis, high-sensitivity detectors, smart materials and molecular robotics for medical use) may be developed in the near future, potentially leading to the creation of new industries.

Reference

[1] PEPLOW, M. 2015. The tiniest Lego: a tale of nanoscale motors, rotors, switches and pumps. Nature, 525, 18-21.
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[3] IBUSUKI, R., MORISHITA, T., FURUTA, A., NAKAYAMA, S., YOSHIO, M., KOJIMA, H., OIWA, K. & FURUTA, K. 2022. Programmable molecular transport achieved by engineering protein motors to move on DNA nanotubes. Science, 375, 1159-1164.

NICT's International Standardization Activities in 3GPP towards B5G

NAKAMURA Kazuo
Managing Expert,
Standardization Promotion Office,
Innovation Promotion Department

After completed his master's degree, He entered a telecommunications company, where worked for projects such as expansion of international networks, overseas (Geniva and Paris), responding to ITU, secretariat of an industry organization for cyber security measures, and the Radio Industries & Businesses Association (secretariat of international partnership projects for telecommunications standardization, etc.). Since 2021, he has been working at NICT for telecommunications standardization.

Mobile communications systems previously varied greatly between countries and regions, making network commercialization on a global scale difficult. The Third Generation Partnership Project (3GPP) was launched in 1998 to enable standards organizations from major countries and regions to collaborate in setting international standards for mobile communications. As a result, the mobile communications systems advocated by 3GPP were adopted internationally, advancing network commercialization.

Standardization statuses of 5G and 5G-advanced

In 2018, 3GPP released the stage one specifications (known as Release 15) for fifth-generation mobile communications systems (5G). This release included standard specifications focusing on enhanced mobile broadband (eMBB)-based new radio (NR) access technology and advanced LTE (long-term evolution) technology. 3GPP then issued its Release 16 specifications in 2020 to support the creation of new, more advanced technologies, including ultra-reliable, low-latency communications (URLLC) and industrial internet of things (IIoT). Release 17 specifications completed in 2022 supported the widening of frequency bands available for 5G to enable further expansion of the technologies mentioned above and to address new use cases (i.e., potential scenarios in which a system needs to receive and respond to external requests, such as user input). They also supported non-terrestrial networks (NTNs), sensor devices for use in factories, low-cost NR terminals, roaming technologies for use during disasters and other technologies.

3GPP is currently finalizing Release 18, the stage one specifications for the upcoming 5G-Advanced standard scheduled to be frozen in March 2024. In addition, Release 18 protocol coding (ASN.1) is expected to freeze in June 2024.

NICT's Contribution to 3GPP

NICT has long participated in 3GPP international standardization activities. It is actively involved in formulating the Release 18 specifications and in suggesting and selecting issues to be addressed in Release 19 (Table 1).

Release 18 (the first release for 5G-Advanced—an advanced version of 5G) is intended to be compatible with a wider range of applications outside the communications sector by offering new functions in addition to improved connectivity.

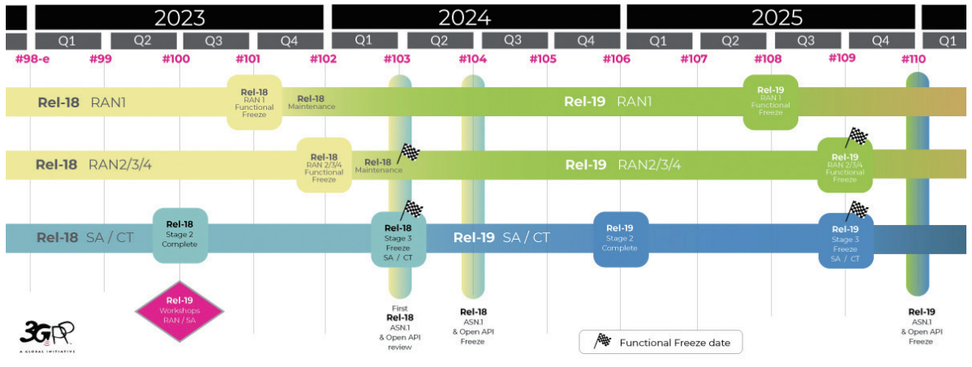


Figure 1 Timelines for 3GPP Releases 18 and 19
The three 3GPP Technical Specification Groups (TSGs) below have been developing specifications for different aspects of 5G-Advanced technologies.
- TSG RAN (Radio Access Network): terminal equipment and base stations
- TSG AS (Service and System Aspects): services and service provision architecture
- TSG CT (Core Network and Terminals): specifications for the elements between core networks and terminal equipment

Table 1 NICT's 3GPP activities

Working Group	Corresponding Laboratory in NICT		
SA WG2 (to develop the overall 3GPP System architecture and services including User Equipment, Access Network, Core Network, IP Multimedia Subsystem)	Space-Time Standards Laboratory	・5G Timing Resiliency and TSC&URLLC enhancements (FS_5TRS_URLLC、TR23.700-25)	Participation in discussions on Release 18 issues listed here
	Wireless Systems Laboratory	・enhanced support of Non-Public Networks phase2 (FS_eNPN_Ph2、TR23.700-08) ・Access Traffic Steering, Switching and Splitting support in the 5G system architecture Phase3 (FS_ATSSS_Ph3、TR23.700-53)	
RAN WG1, RAN WG2, RAN WG3	Sustainable ICT System Laboratory	・NR Network-controlled Repeaters (NR_netcon_repeater)	Participation in discussions on Release 18 issues listed here

From proposal document for SA Rel-19 workshop（June, 2023）
・Local reference in space & time

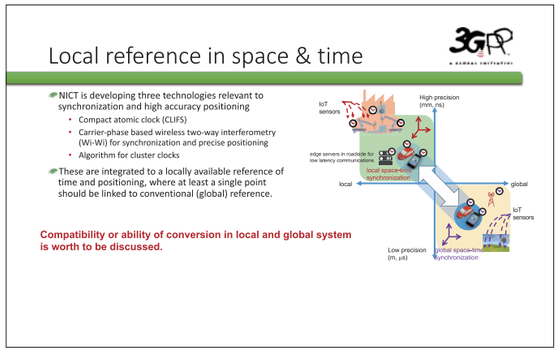
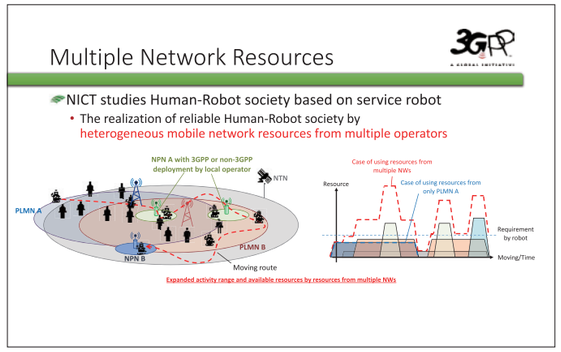


Figure 2【Space-Time Standard Laboratory】
Issues proposed by NICT concerning the development of next-generation synchronous radio networks using technologies developed by NICT (i.e., atomic clock chips, wireless two-way interferometry and time-series clustering)



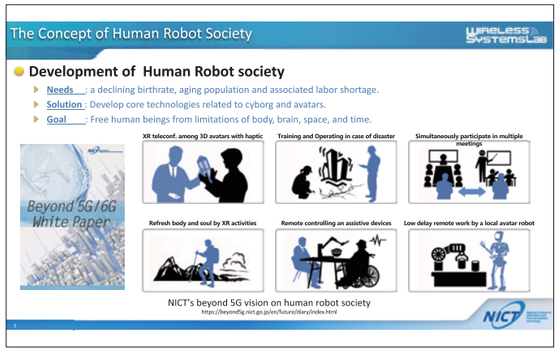


Figure 3【Wireless System Laboratory】
(Left) From proposal document for SA Rel-19 workshop（June, 2023）・Multiple Network Resources Multilink access to heterogeneous mobile network resources by multiple operators—a Release 19 issue proposed by NICT for SA.
(Right) From proposal document for RAN Rel-19 workshop（June, 2023）・The Concept of Human Robot Society Achieving higher-data-rate optical fiber communications and ultra-reliable, low-latency communications (URLLC)—a Release 19 issue proposed by NICT for RAN. These issues need to be addressed in order to bring the human-robot society concept into reality.

3GPP has also been studying a range of issues to be taken into account when formulation of Release 19 (the stage two specifications for 5G-Advanced) begins in 2024. Workshops to discuss these issues were held in June 2023. 3GPP member organizations, including NICT, proposed various issues, including about 65 issues identified during the SA (Service and System Aspects) workshop and about 480 issues identified during the RAN (Radio Access Network) workshop. These issues were then categorized and subjected to revision, consolidation and other processes by the relevant working groups. Release 19-related issues proposed by NICT are described in Figures 2 and 3.

NICT's involvement in 3GPP Standardization Activities and Efforts to put its Technologies into Practical Use

3GPP's research and standardization targets are determined based on mutual agreement among its growing and diversifying member companies and organizations around the world. The issues recently proposed by NICT will be discussed during the Release 19 or 20 standardization activities before they are reflected in future 3GPP specifications. Through these activities, NICT aims to put its technologies into practical use and make them available to vendors, operators and other interested parties.

NICT's space-time synchronization technology can be used to provide more accurate time synchronization services than are possible using conventional GNSS (global navigation satellite system)-based time synchronization systems. This technology may also be used to develop positioning systems for use in areas where GNSS signal reception is unavailable and systems able to provide high-precision time synchronization to terminal equipment—including in-vehicle equipment. In addition, NICT's multilink access technology enables multiple operators to access heterogeneous mobile network resources. This technology is expected to be an effective tool for efficiently coordinating different mobile networks (e.g., terrestrial/non-terrestrial networks and public/non-public networks).

3GPP previously formulated the 3G, 4G and 5G specifications. It is now preparing standard specifications for more advanced 6G networks while envisioning their use in mission-critical sectors and services, including telecommunications, agriculture, automobiles, aviation, healthcare, factory automation, mining/mineral exploration, public safety and railways. NICT has been participating in this specification development project to help put 6G technologies into practical use.

Open Innovation Platform Construction for International Collaboration and Deployment

– ICT Collaboration Promoting with Institutes of ASEAN Region under ASEAN IVO Global Alliance –

EMOTO Hiroshi

Director of International Research Development Office, Global Alliance Department

After completing a doctorate course, he worked as a assistant professor of a university. Then he joined CRL(currently NICT) in 1996. He has made research on image processing, pattern recognition and medical diagnosis system using medical images.
He has been engaging in international collaboration from 2008. Ph.D. (Engineering)

In February 2015, NICT jointly established a global alliance called ASEAN IVO (ICT Virtual Organization of ASEAN Institutes and NICT) with research institutes and universities, etc. in the Southeast Asian region. ASEAN IVO aims to construct an open innovation platform closely connected to the region, with a mission to share views on cooperation for addressing important themes common to the respective countries and to resolve common issues through formation of joint research projects in the ICT field. ASEAN IVO, which initially had 25 member institutes from nine countries, grew every year to have a membership of 85 institutes from 10 ASEAN countries and Japan as of the end of November 2023.

Meanwhile, to solve social and regional problems from a global standpoint, NICT is driving efforts which leverage a diverse range of collaborative R&D projects with international organizations to develop its technologies into actual solutions for society, both in Japan and abroad. ASEAN IVO is one platform essential for furthering those efforts and provides the necessary environment for international development in the ASEAN region.

ASEAN IVO has a steering committee consisting of experts from universities and national research institutes in 10 ASEAN countries and from NICT, which serves to set the overall activity policies and R&D topics, determine the adoption and execution of collaborative projects, and more. The steering committee holds meetings twice every year, in principle, and can also hold extraordinary meetings upon the proposal of committee members. The committee members frequently conduct activities such as raising issues, having discussions, and summarizing the outcome by using a mailing list. At a steering committee meeting in November, the members decide the themes for projects to be publicly solicited and activity policies for the next fiscal year, while at a meeting in March, the members decide collaborative R&D projects to be launched in the next fiscal year, among other matters.

Figure 1 Photos at ASEAN IVO Forum 2023（November 15, 2023 @ Vientiane, Lao People's Democratic Republic）

ASEAN IVO also holds a forum in the ASEAN region each year for the purpose of forming collaborative R&D projects by giving researchers from ASEAN countries a channel for proposing ideas and networking with other researchers. At the forum, information on the host country's policies and initiatives is shared through invited talks by government officials of the country, and ASEAN IVO also conducts activities such as making joint proposals on collaborative R&D projects to cooperate with the government in addressing local issues. For example, at ASEAN IVO Forum 2023, 20 presentations (including posters) were given on five topics (ICT for food; ICT for environment protection and disaster prevention; ICT for secure and smart community; ICT for health and welfare; and ICT for advanced technologies and applications), and Director General of the Digital Government Center, Ministry of Technology and Communications, Lao PDR, introduced the digital government initiatives and other efforts implemented in Laos in an invited talk (Figure 1).

In addition, ASEAN IVO has established and promoted around five collaborative R&D projects each year since 2016 under the support of NICT. One feature of ASEAN IVO's projects is that at least two countries from the ASEAN region are required to participate in each project. This ensures that projects have ties across multiple countries and regions. By November 2023, a total of 43 projects (including those that have been completed) have been promoted. With NICT researchers participating in 28 of these, NICT has greatly contributed to the technological development of the ASEAN region in a wide range of ICT fields, including construction of a water quality control system for prawn farming (Figure 2), construction of a monitoring system for preventing natural disasters such as forest fire by using Visual IoT (Figure 3), development of spoof detection technology using multi-lingual processing technology (Figure 4), development of a technique for disaster mitigation through sharing of disaster information by using wireless mesh communications technology (Figure 5), and development of a wearable device for health management of indigenous people in the region (Figure 6). Moreover, in order to raise the level of ICT-related R&D in the overall ASEAN region, ASEAN IVO selects one project proposal submitted from three countries—Laos, Cambodia, and Myanmar—every two years.

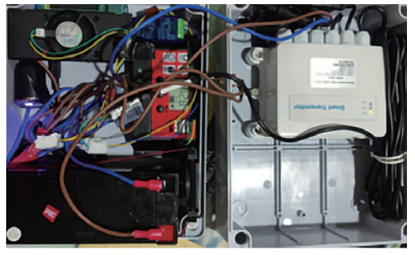


Figure 2 Project Example
Construction of a water quality control system for prawn farming

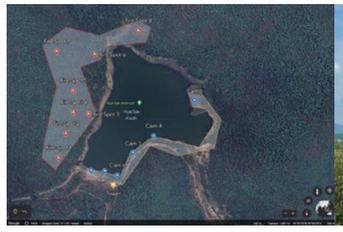


Figure 3 Project Example
Construction of a monitoring system for preventing natural disasters such as forest fire by using Visual IoT

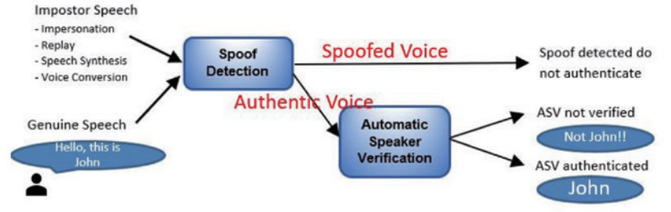


Figure 4 Project Example
Development of spoof detection technology using multi-lingual processing technology

Figure 5 Project Example
Development of a technique of disaster mitigation through sharing of disaster information by using wireless mesh communications technology

Figure 6 Project Example
Development of a wearable device for health management of indigenous people in the region

The ASEAN region's population size exceeds that of other regional cooperative organizations, and it is said that the number of people equivalent to the number of internet users in Japan newly become internet users in the region every year. Therefore, there is no question that the ICT industry is being regarded as increasingly important by countries, societies, regions, and communities as one element of social infrastructure, and that ASEAN IVO is playing a major part in this. While gaps still remain between ASEAN countries in terms of ICT infrastructure and R&D, ASEAN IVO hopes to help eliminate those gaps, as we move into the future. As 2023 is an important milestone year marking the 50th Year of ASEAN-Japan Friendship and Cooperation, which calls for further strengthening of the Japan-ASEAN relations, NICT, as an institute operating ASEAN IVO, is determined to contribute to deepening the Japan-ASEAN relations and bilateral relations with ASEAN countries with a sense of mission.

ASEAN IVO Secretariat:
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asean_ivo_sc_nict@ml.nict.go.jp

https://www.nict.go.jp/en/global/overseas_centers/asia

Asia Center

NISHINO Hisanori
Director of Asia Center

The NICT Asia Center strives to strengthen relationships with research institutes,universities, and others, to support the R&D activities of NICT, and to disseminate information on NICT activities, primarily in Southeast Asia. Over more than 20 years, including those of the former CRL Asia Research Center, which was established in Bangkok in 2002, the NICT Asia Center has advanced various initiatives while adapting to changes in the region's information and communications R&D environment.

In 2015, the center was relocated inside Chulalongkorn University, and we are advancing research collaboration with the university primarily in the photonic networks field. We held the CU-NICT Workshop on Photonic Network Research 2023 jointly with the university in November 2023. After opening addresses by Dr. Supot Teachavorasinskun, Dean of the Faculty of Engineering, Dr. Naebboon Hoonchareon, Head of the Electrical Engineering Department, Dr. YASUI Motoaki, Vice President of NICT and Mr. NISHINO Hisanori, Director of Asia Center, NICT, research presentations were given about technologies related to photonic networks as well as a wide range of technologies with the aim of expanding collaboration, including optical wireless communication, and optical fiber sensors for biomarker detection.

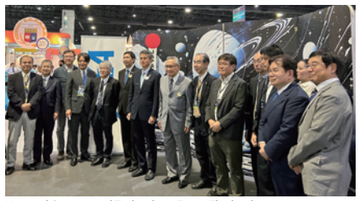
For the dissemination of information, we are also actively participating in exhibitions and related events. At the National Science and Technology Fair hosted by the Government of Thailand in August every year, we hold exhibits where we present an overview of NICT activities and our research collaboration with the universities and public research institutes of Thailand. Thai dignitaries also tour the venue and during the tour by (then) Deputy Prime Minister and Minister of Foreign Affairs Don Pramudwinai in August 2023, NICT Vice President YANO Hiroyuki gave him an explanation about our research collaboration activities in Thailand. We also gave explanations in the Thai language to a wide range of visitors to the fair in cooperation with the professors and students of Chulalongkorn University and King Mongkut's Institute of Technology Ladkrabang (KMITL), our research collaboration partners.

Together with KMITL, we held an exhibit at the KMITL Innovation Expo (April 2023) concerning our research collaboration in the space weather forecasting field (observations and forecasting concerning solar flares and ionospheric variations, etc.) and had an opportunity to explain the exhibit to Privy Council President Surayud Chulanont. We are advancing various other collaborative activities with KMITL as well, including the KMITL Space Hub Thailand (September 2023), where NICT Space Environment Laboratory Director TSUGAWA Takuya participated as a panelist.

Moreover, we have actively engaged in various events toward research collaboration, such as reporting our activities at the APT Telecommunication/ICT Development Forum (October 2023) and the IEEE Thailand Section Annual General Meeting (November 2023).

Our center will continue to strive to support research collaboration in the post-COVID-19 era, primarily in Southeast Asia, not only through online meetings but also by providing onsite research support and holding in-person workshops, among other efforts.

Group photograph at the CU-NICT Workshop on Photonic Network Research 2023
(Dr. Supot Teachavorasinskun, Chulalongkorn University's Dean of the Faculty of Engineering (center right), Dr. Yasui Motoaki, NICT Vice President (center left))


National Science and Technology Fair in Thailand
(Group photograph of Mr. Don Pramudwinai, Deputy Prime Minister and Minister of Foreign Affairs (middle), and members of the Japanese booth)

National Science and Technology Fair in Thailand
(Dr. YANO Hiroyuki, NICT Vice President (left), explained the content of the NICT exhibit to Mr. Don Pramudwinai, Deputy Prime Minister and Minister of Foreign Affairs(middle))

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A New Oasis in Bangkok

Benchakitti Forest Park is a newly opened park in central Bangkok, an area with rows of high-rise office buildings. A long skywalk stretches throughout the park, which forms an integrated landscape with the high-rise buildings in the background, and it provides a place of rest and relaxation for the local community.


Benchakitti Forest Park in central Bangkok

https://www.nict.go.jp/en/global/overseas_centers/north_america

North-America Center

MAEDA Kyotaro
Director of North America Center

The North-America Center was established in October 2000. Its office is located near the center of Washington, D.C., within walking distance of the White House and federal government agencies. It is also quite close to the offices of other National Research and Development Agencies of Japan. For example, it is only a few minutes away on foot from the Washington, D.C. offices of the Japan Science and Technology Agency (JST) and Japan Agency for Medical Research and Development (AMED).

The work of the North-America Center is centered on the following three activities:

(1) Promotion of joint research with U.S. research institutes

(2) Information collection, analysis, and reporting of various U.S. government policies including budgets and regulations related to R&D in the field of telecommunications and of R&D trends at research institutes, universities, and private companies

(3) Publicizing and promoting NICT R&D results by participating in exhibitions and meetings

In particular, we have been putting much effort into Beyond 5G/6G and quantum science and technology. The outcome document of the Japan-U.S. Summit Meeting held on April 16, 2021 made specific mention of these fields and a Japan-U.S. Joint Leaders' Statement issued on May 23, 2022 announced the acceleration of their R&D. To strengthen Japan-U.S. cooperation in research, we have been making progress in exchanging opinions with agencies and organizations associated with the U.S. government and in participating in related meetings in the United States.

Startup companies are players having a significant impact not only in the field of information and communications technology but also on society and the economy overall in the United States. We have, therefore, been conducting surveys on venture capital and startup companies on an ongoing basis and have been collecting and analyzing trends in startups that use diverse advanced technologies including Beyond 5G/6G and quantum science and technology.

The rapid development of generative AI and its spread throughout society are bringing about significant transformations not only in information and communications technology and related industries but also in all economic activities and people's lives worldwide. Furthermore, the increasingly complex international environment significantly impacts a range of government policies and R&D policy in the United States. In addition, the United States will have a presidential election in 2024. Even under such circumstances, the North-America Center will strive to accurately understand the situation in the United States, as well as contribute to advancing R&D in information and communications technology in Japan and the United States by sharing the situation in Japan in an easy to understand manner and serving as a bridge between the research communities in Japan and the United States.

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At the Center of World Economy

Many international exhibitions and conferences in the field of information-communications are held in the United States, since it is the center of the global economy. The North-America Center also attends and makes presentations at these meetings as part of its activities. For example, at CES (whose official name was changed from "Consumer Electronics Show" previously to "CES" now), which is held at the beginning of every year, representatives from digital device and service businesses, as well as related industries, get together from around the world, seeking the latest movements and trying to generate such movements themselves. Meanwhile, at the NAB Show, which is held in April every year with the National Association of Broadcasters (NAB) playing a central role, participants exhibit the latest broadcasting-related devices and services and have extensive discussions with the aim of overcoming a wide range of broadcasting issues and further developing this industry. Participating in these events is highly effective for both gathering and disseminating information. In addition, we believe these events are also valuable opportunities for experiencing the tremendous enthusiasm that organizers and participants have and to remind ourselves that this enthusiasm is likely the source of the US economy's great strength.

Japan's startup booth at CES 2023

NAB Show 2023, the centennial meeting


(left) No vegetables no source Hamburger with price around 1,500 JPY
(right) Chinese noodle with price around 4,000 JPY

https://www.nict.go.jp/en/global/overseas_centers/europe

Europe Center

FUJINUMA Koichi
Director of Europa Center

The NICT Europe Center is located in the business district near the Champs-Elysées, a street that is constantly crowded with tourists all year round. It is conveniently located close to the airport and major train stations in Paris, making it easy to travel within France and the European region from here.

The mission of the NICT Europe Center is to (1) promote and support international

joint research through participation in international conferences and other events and deepen networks with European research institutes, government agencies, and industry organizations to promote collaboration,

(2) support the international deployment of NICT R&D achievements in the European region through information dissemination and public relations, and (3) collect, analyze, and report information on R&D trends and policies in the ICT field at research institutes, government agencies, universities, and companies in the European region.

In Europe, green and digital transitions are positioned as top priority policies, and large-scale programs are going forward to support their policies. These include Horizon Europe as a research innovation framework program, the Digital Europe Programme to promote implementation and expansion of digital technologies, and the Connecting Europe Facility to promote investment in network infrastructures across Europe. These programs include NICT's four strategic research fields of Beyond 5G/6G, quantum ICT, cybersecurity, and AI as priority fields, so it is an important mission of the NICT Europe Center to collect and analyze information on these European R&D trends and policies.

Furthermore, given a changing geopolitical situation and increasingly complex world affairs, there are many institutions in Europe that consider Japan to be an excellent partner that they can trust. Based on the above European trends, the NICT Europe Center acts as the main bridge between NICT headquarters and overseas institutions. With the aim of internationally expanding R&D such as Beyond 5G and quantum ICT, we are making an effort to discuss and exchange views with European research institutes, government agencies, and related parties, actively participate in related events, and network with concerned individuals.

The NICT Europe Center will continue to proactively build mutually beneficial relationships

between NICT and European research institutes and related organizations by using the knowledge and networks that we have built up here in Europe.


NICT president Dr.TOKUDA's speech at 6GMES in Germany


Visit to RWTH Aachenn Univetsity


Participation to Multinational dialogue on Quantum technology area

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Inside and Outside Paris

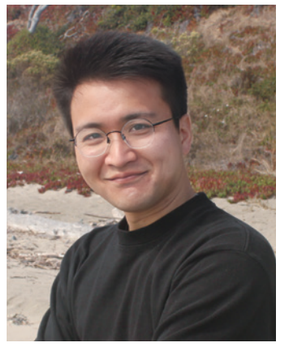
With fewer restrictions on COVID-19, everyday life has returned to France. Tourists are returning to Paris, and hotel prices are soaring across the board. Since my assignment to Paris this summer, the city has hosted a variety of events every week, including Paris Fashion Week, Paris Art Week, the European Heritage Days, and the Grape Harvest Festival in Montmartre. Paris never stops.

On a day off, I travelled around the Normandy region, including Mont-Saint-Michel. If you drive out of Paris, views of the peaceful countryside stretch on and on. I realized that France is not all urban. Then I encountered sheep relaxing at the foot of Mont-Saint-Michel at sunset, but shortly afterwards, I watched them all return to their house as they were chased by dogs along the road and recalled the mutton and lamb dishes at the local restaurants and thought to myself that the life of sheep is not that easy either.


Sheep at the foot of Mont-Saint-Michel at sunset


Sheep returning to their cage along the road

Seeing NICT though a Different Lens, Rethinking the Lens through which We See NICT



ISHIDA Ayumu
Assistant Chief
International Collaboration Promotion Office,
Global Alliance Department

Biography

1994 Born in Kyoto Prefecture
2017 Graduated from Faculty of Letters, Kyoto University
2019 Graduated from Graduate School of Letters, Kyoto University
2019 Joined NICT
2019 Public Relations Planning Office, Public Relations Department
2020 Press Office, Public Relations Department (concurrent position)
2021 Innovation Design Initiative (concurrent position)
2021 Operation Design Office, Operation Planning Department
2022 Current position
2024 Graduate from San Francisco State University Master of Public Administration Program (Planned)

Q&As

Q What are good point(s) for you to join NICT?

A I enjoy the opportunity to learn about state-of-the-art research discoveries. I also enjoy supporting R&D through the various tasks assigned to me.

Q What you are interested in besides your job?

A I like to visit new places and try their local foods and drinks.

Q Message to the prospects who are interested in joining NICT

A Newcomers are very welcome! I would like to work with new people to improve the working environment and help make society a better place through ICT.

Currently I study abroad in the Master of Public Administration Program at San Francisco State University through the NICT overseas study program, aiming to acquire knowledge and skills for my future career. I have been learning about federalism in the U.S., public organization management, public service delivery, and the policy process in terms of several important values of public administration, such as citizen engagement, accountability, social justice, and equity. In the program I explore policy formulation and implementation across different levels of governments, shedding light on a variety of concrete examples of social problems. Many students in the program work for public or non-profit organizations in the Bay Area.

Learning about public administration and its role in society presents a great opportunity to revisit my responsibilities at NICT that I have engaged in so far, including public relations, digital transformation, and facility utilization. I have gained new tools and perspectives to consider what we do and what we should do at various levels of the organization to achieve the goal of creating an inclusive and sustainable society.

In addition, being in an unfamiliar environment and using a different language has allowed me to realize the differences between me and others in a unique way. The collision of different ideas is an essential process to identify the problems that we really should address and to create effective and satisfactory solutions. Through day-to-day life in San Francisco, I have come to understand the significance of designing a participation platform where we can gather diverse perspectives, encouraging us to articulate and constructively discuss problems.

Even after completing the MPA program and returning to my job at NICT, it is important for me to regularly assess and update the newly acquired knowledge by applying it to real-world situations, where we are required to tackle complex organizational challenges with limited resources. Utilizing the experiences and takeaways from my study abroad, I am looking forward to collaborating with diverse stakeholders within and outside NICT to solve the difficult problems that we face that we face today and to create a better future.


Many students and local residents enjoy spending time in the open space of San Francisco State University campus.

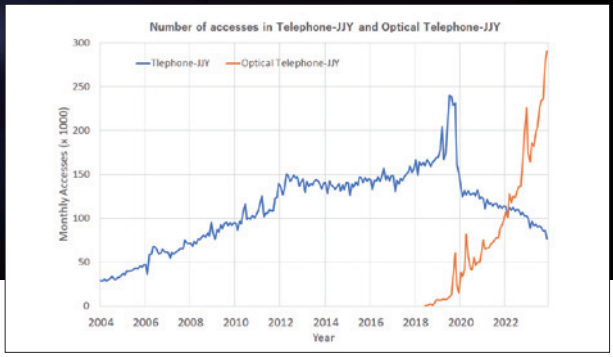
Telephone JJY

Telephone JJY to be fully migrated to Hikari Telephone JJY on March 31, 2024

Hikari Telephone JJY

https://www.nict.go.jp/en/sts/hikari_tel_jjy.html

Telephone JJY is a dissemination service of Japan Standard Time provided by NICT which uses analog public telephone lines. This conventional system is currently difficult to maintain, and in addition, due to increasingly replacing analog telephone lines with Internet Protocol (IP) ones in Japan, it is no longer able to keep its original accuracy. For these reasons, Telephone JJY service is scheduled to be terminated on March 31, 2024, and to be completely replaced by Hikari Telephone JJY service, which was launched in 1995. Hikari Telephone JJY transmits Japan Standard Time via optical fiber telephone networks. This system serves as a reliable time source for users who cannot or do not want to connect the internet, but also want to avoid the uncertainties of radio wave receptions of GPS, standard radio waves and other signals (typical user are broadcasting stations). Users can synchronize their clocks to Japan Standard Time with a margin of error less than 1 millisecond.



The number of Hikari Telephone JJY users has steadily grown since it was launched in February 2019. As of the beginning of 2022, the number of monthly accesses to this new service exceeded 100,000, surpassing the conventional Telephone JJY service for the first time.

Inquiries regarding Hikari Telephone JJY

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