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NII Interview

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Two Pillars of the New Service Provided by SINET5

Commentary SINET5

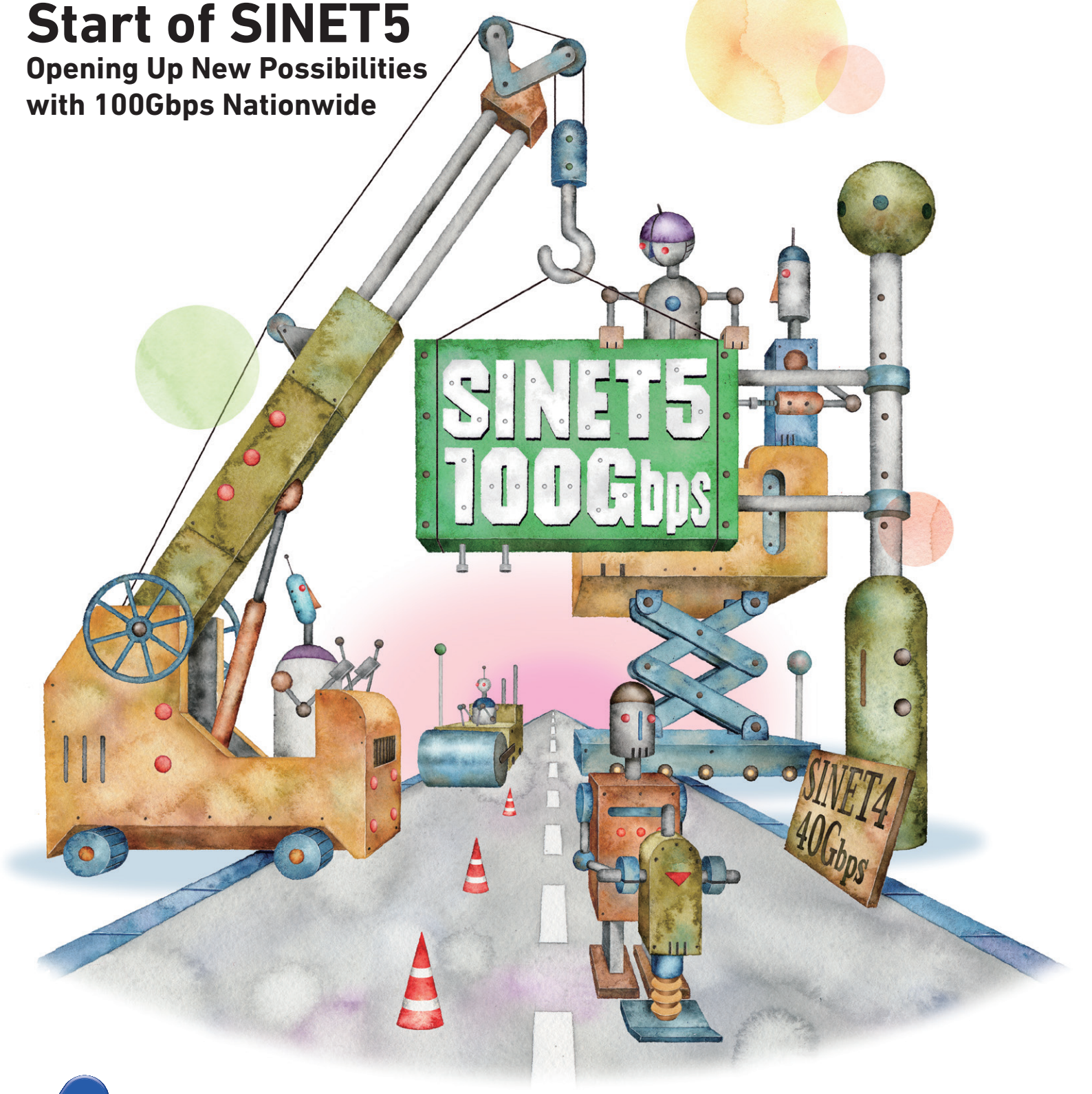
SINET Users Talk About the Significance of Migrating to SINET5

High Energy Accelerator Research Organization/
National Astronomical Observatory of Japan,
National Institutes of Natural Sciences

Feature

Start of SINET5

Opening Up New Possibilities with 100Gbps Nationwide



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Role of Next-Generation Network SINET5

Shigeo Urushidani (Professor, Information Systems Architecture Science Research Division & Director, Cyber Science Infrastructure Development Department, National Institute of Informatics/ Professor, School of Multidisciplinary Sciences, the Graduate University for Advanced Studies)

Interviewer: Waichi Sekiguchi (Editorial Writer, Nikkei Inc.)

Japan's Science Information Network (SINET), built and operated by NII, has been updated to SINET5, and operation of this highly advanced network began in April. The network is used by approximately 850 universities and research institutes. Its communication speed, which previously varied from region to region, has been increased to 100 Gbps* nationwide. The network's security and information sharing functions have been greatly improved, and it is now capable of accommodating cloud computing, the use of which is increasing. The United States and Europe have led the way in speeding up academic information networks, and this migration to SINET5 finally brings Japan's network up to a comparable level. Professor Shigeo Urushidani, Director of the Cyber Science Infrastructure Development Department, has been responsible for operating SINET for many years. I asked him about the aim of the migration to SINET5 and how the network will be used from now on.

Shigeo Urushidani

Sekiguchi: First, please tell me about the background of SINET.

Urushidani: Operation of SINET as a network to support Japan's academic infrastructure began in 1992. With the establishment of NII in 2000, the network was transferred over to NII from its predecessor organization, the National Center for Science Information Systems (NACSIS), and Japan's universities and research institutes became increasingly connected via the network. Also, in 2002, a network called Super SINET was launched for cutting-edge research, such as high-energy physics and astronomy.

Sekiguchi: Similar to a conventional train line and a Shinkansen (bullet train) line?

Urushidani: Yes, that's right. But after five years, the two networks were integrated because it was inefficient to use them separately, and the integrated network was called SINET3. SINET3 also diversified the communication services. SINET4 was launched in 2011, and it extended the network to every prefecture of Japan. The reliability of the network was also improved, and it withstood the Great East Japan Earthquake. However, although Japan led the world with SINET3 by increasing the communication speed to 40 Gbps, there were some regions where the network speed was only 2.4 Gbps. Meanwhile, Internet2 in the US and GÉANT in Europe increased communication speeds to 100 Gbps across the board, and the aim of SINET5 was to bring Japan's network into line with these trends.

Sekiguchi: What are the differences?

Urushidani: First, the communication quality has improved with the increase in communication speed. SINET provides the network for the High Performance Computing Infrastructure (HPCI) that connects supercomputers located at universities across Japan, centered on the K computer at RIKEN in Kobe. The faster the communication

speed, the quicker processing can be carried out. The use of cloud computing technology has spread in recent years, and SINET5 will also play an important role in facilitating the use of the cloud.

Sekiguchi: How has the increase in speed been achieved?

Urushidani: One way is the use of dark fiber. Up to and including SINET4, the infrastructure was built by using leased lines of communications companies, and this inevitably resulted in a star-like network topology. Spare lines prepared in parallel could only be used in emergencies. This time we aimed to increase speed and reliability as appropriate for an optical fiber network topology, and connecting the entire country in a mesh-like configuration enables full use of the network resources while providing high reliability. It is also possible to easily change network configurations for applications that require large amounts of communication capacity. This technology is known as software-defined networking (SDN).

Sekiguchi: What is SDN technology used for specifically?

Urushidani: For example, in astronomy research, object observations are sometimes made by connecting multiple antennae to form "virtual radio telescopes". This requires a stable, high-speed communication environment of 8 Gbps, and in the near future, 32 Gbps. Also, for cloud computing, on-demand circuit configuration and bandwidth guarantees are necessary. SDN technology is very useful in such cases.

Sekiguchi: I've heard that security and performance have also been greatly improved with SINET5.

Urushidani: SINET has always employed virtual private network (VPN) technology to increase security, but by further improving its function, it has become possible to provide a safer network environment. It is thought that the security improvements will result in the network also being used as infrastructure for open science; for example, storing and transmitting experimental data and other research resources. Also, so-called "low latency" has been achieved by not only increasing communication speed but also shortening communication delays, and this has greatly improved the network's communication performance.

Sekiguchi: Conditions were unfavorable for supercomputers during the period of governance by the Democratic Party of Japan. Was it necessary to secure the budget for constructing SINET5?

Urushidani: SINET was in a similar situation to supercomputers. However, as well as the fact that it was already being used as an artery for science and academia, there was increasing talk of the importance of new computer applications such as big data analysis and artificial intelligence (AI). The academic community, including the Science Council of Japan (SCJ) and university organizations, lobbied the Ministry of Education, Culture, Sports, Science and Technology, and as a result, the budget for migration to SINET5 was assigned in the last fiscal year. The budget for stable operation of SINET5 was also assigned in the current fiscal year.

Sekiguchi: Is the switch to SINET5 expected to attract new users?

Urushidani: Yes. Twenty-seven new organizations joined immediately. With the migration to SINET5, organizations that are already members have the speed of their access lines increased. Sixteen organizations have speeds of 100 Gbps or greater, and 10 organizations have speeds of 40 to 80 Gbps. The number of organizations with speeds of 10 Gbps or more greatly exceeds 100. Network nodes (connection points) used to be located at major cooperating universities and research institutions, but since SINET4, they have been located at data centers to facilitate the supply of electricity and provide line redundancy in case of failures.

Sekiguchi: Are there any new functions?

Urushidani: As well as supporting cloud computing, SINET5 also provides a "virtual university LAN service" that allows the local area network (LAN) within a university to be freely expanded via SINET. High-speed data transfer technology has also been developed, and it has been confirmed that an effective speed of approximately 100 Gbps is available from Kitami in Hokkaido to Okinawa.

Sekiguchi: What are the future challenges?

Urushidani: Japan led the world by implementing 40 Gbps with SINET3 in 2007, but the US, Europe, and China later took the initiative. SINET5 finally puts Japan back on an equal footing with the rest of the world. However, there are already moves to increase speeds up to 400 Gbps overseas, and so we must think about the next step. First, we plan to expand the use of SINET5, and then we will take on the next challenge. (Photography by Mariko Tosa)

*Gbps [gigabits per second]
A unit of data transfer rate. 1 Gbps means that one billion bits of data can be transferred per second.

A Word from the Interviewer

"Is second place not good enough?" These words spoken by member of the cabinet of Japan Renho Murata during a review of the supercomputer program under the Democratic Party of Japan highlighted the difficulty in striking a balance between budget and strategy with regard to Japan's science and technology policy. This also applies to SINET, and although Japan implemented the world's first 40 Gbps network, it was overtaken in quick succession by the US, Europe, and China.

The same goes for research on artificial intelligence. In the 1980s, Japan led the world with the "5th generation computer", but the failure of this project was traumatic and Japan conceded the lead to US venture companies and others.

However, as we enter the age of big data, there is no doubt that computers and networks will become increasingly important. I hope that SINET5 will help to enhance Japan's competitiveness.

Waichi Sekiguchi

Graduated from the Faculty of Law, Hitotsu bashi University in 1982 and joined Nikkei Inc. in the same year. Fulbright Fellow at Harvard University in 1988. Chief writer for the English-language edition of the Nikkei in 1989. Washington correspondent from 1990 to 1994. After working as chief writer covering electronics in the Industry Division, became a senior staff writer in 1996. Editorial writer for 15 years from 2000, primarily covering telecommunications. Visiting professor at three universities: Hosei University Graduate School since 2006, the Center for Global Communications (GLOCOM) at the International University of Japan since 2008, and the University of Tokyo Graduate School of Interdisciplinary Information Studies since 2015. Served as a news commentator for NHK World from 2009 to 2012. Also works as a part-time instructor at Waseda University and Meiji University, and as a member of the Expert Panel on Evaluation of the Cabinet Office's Council for Science, Technology and Innovation. He has written books titled *Pioneers of the Personal Computer Industry and Savvy Search Techniques,* and co-authored *Information and Communications Policy of the Future.*

Two Pillars of the New Service Provided by SINET5

SINET5 has evolved greatly in many ways, such as the increase in communication speed to 100 Gbps nationwide. It has also evolved to provide substantial functional enhancements and improvements in user-friendliness with respect to cloud services. Additionally, it now provides security measures that allow users to have more confidence in the network. We asked Professor Kento Aida, Director of NII's Center for Cloud Research and Development, and Professor Hiroki Takakura, Director of the Center for Cybersecurity Research and Development, about the cloud computing services and security measures provided by SINET5.

Cloud

Newly provides an environment that allows proactive use of the cloud

Kento Aida (Professor, Information Systems Architecture Science Research Division/ Director, Center for Cloud Research and Development/ Director, Cloud Promotion Office at National Institute of Informatics/ Professor, School of Multidisciplinary Sciences, The Graduate University for Advanced Studies)

Advantages of using the cloud

The form of computing known as "cloud computing", or simply "the cloud", has steadily taken root in society over the past few years. The new approach to resources for computations, data storage, and so on, which involves using only the necessary resources when they are needed via a network, has changed the state of IT assets from possession to utilization. Use of the cloud is spreading, not only among business but also among individuals. What are the advantages to universities and research institutions of using the cloud? Professor Kento Aida coordinated the development of the architecture for SINET5's cloud services and also serves as Director of the Cloud Promotion Office. He explains the advantages as follows.

"Some of the advantages of the cloud are speed, flexibility, and reduction in operational load. It can take several months to prepare the necessary equipment and build a large-scale information system by oneself, whereas if all goes smoothly, it takes just a few minutes to start using the cloud. Also, the system configuration can be changed flexibly to suit the research situation, and you only pay for what you use. The fact that the manpower, expenses, and other resources that until now would have gone into managing and maintaining the system can instead be allocated to your research, where you actually want to put your efforts into, is also a big advantage."

With SINET5, the intention is to take advantage of a high-speed network that is dramatically faster than ever before to expand the connection services to a general commercial cloud, known as a "public cloud".

Efforts to support the introduction of cloud computing

As described above, the cloud has many advantages, but in some ways, its use is not growing at universities and research institutions. According to Professor Aida, even though organizations may be using the cloud for their administrative systems, many are cautious about introducing cloud computing in their educational and research systems. Their reasons include vague uneasiness about reliability and security, and incomplete understanding of the selection criteria, method of introduction, method of use, and so on. NII is therefore making efforts to address concerns about the introduction of cloud computing. It started running practical seminars to support cloud installation in January of this year, and is also providing individual consultations.

In addition, GakuNin Cloud, which supports the introduction and use of the cloud by universities and research institutions, was launched last year, and it also supports cloud selection. "There are different types of public cloud, and selecting one that meets your needs is not easy. To solve this problem, NII has created a checklist for

Kento Aida

clarifying the key points of cloud selection, and this is available on the GakuNin Cloud website. Also, cloud providers supply self-assessments and information based on this checklist, and NII has started an initiative to verify and sort this information so that it can be used in cloud selection."

The role of GakuNin Cloud does not stop at matching the needs of universities and research institutions with cloud services. The aim is to create a gateway linking universities and research institutions with the cloud. "Eventually, we want to implement single sign-on to multiple cloud services using GakuNin's* authentication infrastructure."

Towards a more user-friendly environment

SINET4 also offered connection to the cloud, but SINET5 offers a new on-demand cloud building service known as an "intercloud". This is a service that uses the SINET5 network to provide high-speed, secure connectivity between university/research institution computers and multiple external clouds, allowing them to be used in an integrated manner. Professor Aida describes the service as follows.

"SINET has always offered a service that allows the information system within an organization to be used in combination with the cloud using a VPN. However, setting up the system by using this service was difficult and required time, labor, and technology. The plan is that, if the service is operated according to a simple scenario, the software settings on the cloud side are configured automatically. We are aiming to provide an environment in which users feel just as comfortable using the cloud as they do using the information system within their organization or their own computer."

SINET5's intercloud is a forward-looking initiative, even when compared with Internet2 in the US and other research and education networks in Europe and US. "Hereafter, we will make improvements that incorporate the views of users to provide the service on a full-scale basis," says Professor Aida. As well as lowering the hurdle for using the cloud, it is hoped that this feature will be useful for data sharing between universities and research institutions and will help to encourage collaborative research and education.

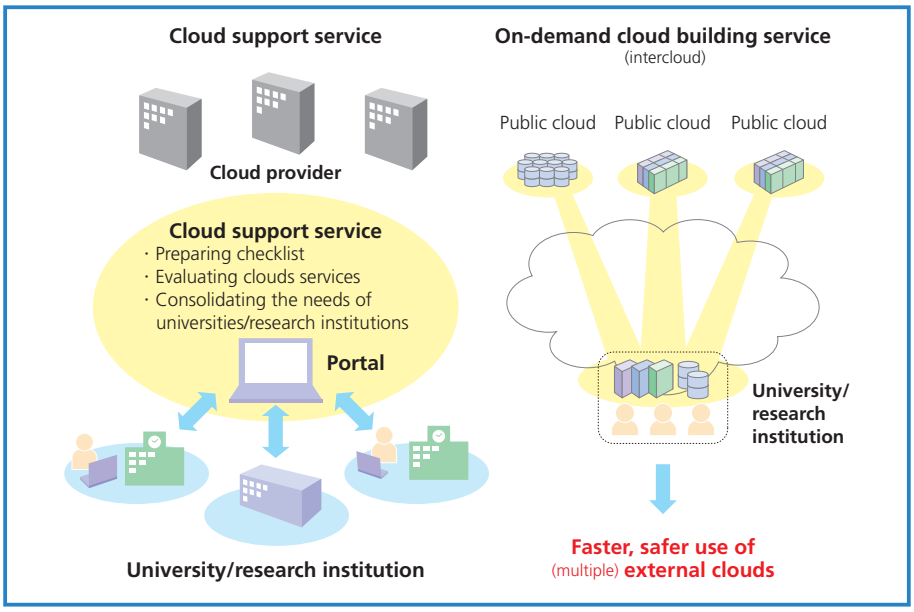


Figure Promotion of cloud use with SINET5

"Infrastructure such as SINET is a tool. Unless it is used, it is meaningless. Tools incorporating cutting-edge technology are necessary for implementing cutting-edge academic research and education. It is NII's mission to provide SINET as a tool that combines both the necessary user-friendliness and efficiency. I also want to contribute to that," emphasizes Professor Aida. SINET continues to evolve in the direction of further advancement of Japan's academic research and education.

(Interview/Report by Akiko Seki. Photography by Yusuke Sato)

*GakuNin
The Academic Access Management Federation, established collaboratively by NII and universities nationwide. Authentication infrastructure allowing single sign-on (the ability to access all systems using one ID/password) within a university and seamless access to electronic academic resources.

Security

Developing technology, personnel, and careers in cybersecurity

Hiroki Takakura (Professor, Information Systems Architecture Science Research Division/ Director, Center for Cybersecurity Research and Development at National Institute of Informatics/ Professor, School of Multidisciplinary Sciences, The Graduate University for Advanced Studies)

Current state of university security

A computer network for research purposes that connected Japanese universities and research institutions was established in 1984. Commercial Internet services began eight years later in 1992. Universities and research institutions were using networks before the general public, and so they had little awareness of the Internet as social infrastructure and tended to lag behind with regard to security measures. Professor Hiroki Takakura oversaw the security of SINET5, and he said the following regarding the current state of network security at universities and research institutions: "Security experts are needed in order to keep an entire network, whose configuration changes from one minute to the next, constantly secure and to detect and deal with risks. Network technicians at universities and research institutions, who up until now have implemented security measures to protect the network while also carrying out network administration, can no longer handle security adequately. There has been a succession of major incidents concerning cybersecurity over the past year or so."

Now that university and research institution networks are connected to the public Internet, the fact that they are a part of so-

cial infrastructure cannot be avoided. As well as preventing circumstances that cause trouble externally, whether due to maliciousness or carelessness, universities and research institutions are required to respond in a responsible manner when problems occur. Of course, networks within universities and organizations must be protected from external attacks. Also, secure research environments must be built to prevent research details and other intellectual property from being stolen via the networks. However, a certain degree of freedom and flexibility is required in education and research environments. It is important to bear in mind that large numbers of students and faculty will connect their own computers and smartphones to the network, and some of their external activities may involve taking laboratory equipment outside of the university and then returning it to the laboratory.

There are solutions, of course, such as employing cybersecurity experts or outsourcing services to specialists. However, there are currently few such experts and the needs of all universities and research institutions cannot be met. NII therefore established the Cybersecurity Research and Development Center on April 1 of this year, in conjunction with launching SINET5 services.

"The primary mission of the new center is to protect the security of SINET5. There are two key elements to this. The first is to provide technical support concerning cybersecurity to network technicians at universities and research institutions. The second is to provide the information required for universities and research institutions to decide who should do what and when if there is a problem. SINET5 provides the capability to select particularly important problems and contact the university or research institution."

Incident or accident?

Problems with the potential to threaten security occur constantly, and they originate from both inside and outside an organization. Professor Takakura gives "incident" and "accident" as essential keywords for determining the importance and urgency of problems.

"An incident is a problem that a technician can deal with. If the problem is simply that a computer is infected with a virus, it's an incident."

Then, under what circumstances would that develop into an accident?

"Let's assume that the virus-infected computer infects the server via the network and personal information stored on the server is leaked. This is not a problem that a technician can deal with, but rather one that requires decisions to be made by the management. An accident is the kind of problem that forces management to decide matters such as who will incur losses and to what extent, what measures should be taken to prevent the damage from spreading, who should make public announcements or give press conferences or apologize, and when."

Therefore, problems that are very likely to develop into accidents and accidents themselves are selected and reported to universities and institutions.

"Accidents cannot be dealt with by management alone. The decisions are difficult to make if you do not understand the technology." There is currently a lack of technical experts, but there is also a lack of mediators working to enhance cooperation between managers and technicians.

A widespread challenge

Professor Takakura is involved in the Crisis Management Contest every year as a judge. Six teams made up of four students from universities, technical colleges, or senior high schools who have made it through a preliminary round compete to respond to an accident under the theme of protecting client servers from a cyber-attack. The tenth Crisis Management Contest will be held in May of this year. Based on a pre-prepared scenario, the teams are evaluated on how appropriately they respond to a cyber-attack that forces them to make a series of difficult decisions.

"Having excellent hackers in a team does not mean that the team will be able to win. There must also be people who can manage the team and carry out external negotiations, and there must be good teamwork. Only after that, the team will be able to win. I would like the Cybersecurity Research and Development Center to offer this kind of opportunity for realistic practice too, so I am developing the idea of offering a training program based on the real data and experience obtained through operating SINET. I would like to help build an infrastructure for cultivating people who have both knowledge of specialized security technologies and communication skills," says Professor Takakura.

The lack of cybersecurity experts is a concern throughout the world. However, in countries outside of Japan, cybersecurity is tackled as part of national defense, and the military has been the place for training mediators. Consequently, overseas cybersecurity companies employ as managers many people who have had careers in the military.

"There are few people who follow this kind of career path in Japan. Therefore, Japan must create its own model for developing cybersecurity personnel. This is also one of the aims of the Center."

(Interview/Report by Yoshiko Miwa.
Photography by Yusuke Sato)

Hiroki Takakura

Commentary

SINET5

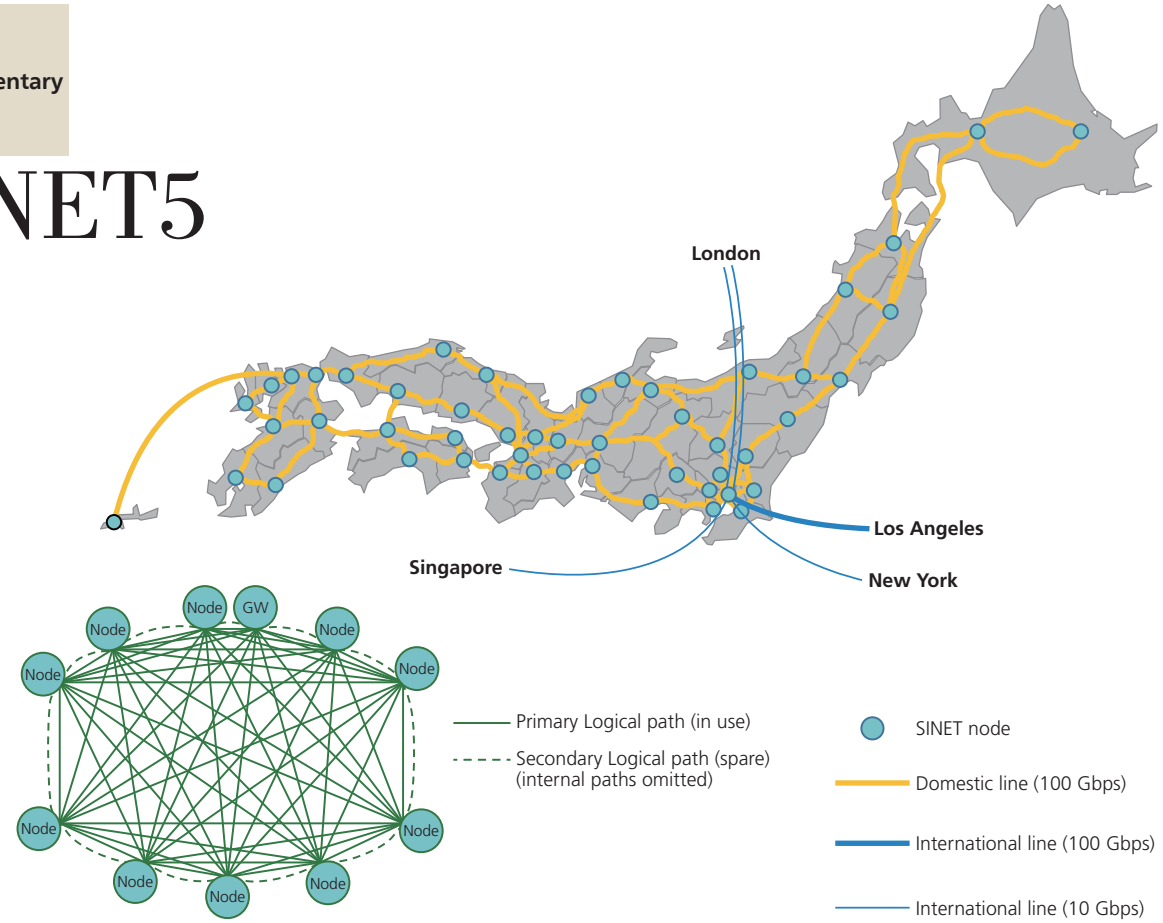


Figure1 Network configuration of SINET5

Construction

Organically connects network service functions

Hiroshi Yamada (Specially Appointed Professor, Research and Development Center for Academic Networks, National Institute of Informatics)

The network architecture of SINET5 enables us to use various network service functions connected originally to each other.

The transmission layer of SINET5, where data frames are transmitted at tremendously high speed, consists of MPLS-TP[1] equipment and logical MPLS-TP paths. MPLS-TP equipment is introduced in each data center (DC) as the transmission node on the ladder-like nation-wide physical 100Gbps optical fiber network. All MPLS-TP equipment nodes in SINET5 are logically connected to each other in the full-mesh fashion by using the following two types of logical MPLS-TP path. One is the primary logical MPLS-TP path, which is configured to minimize the propagation delay between any two nodes on SINET5. The other is the secondary logical MPLS-TP path, which is configured to be disjoint with the primary logical MPLS-TP path. Therefore, when the primary logical MPLS-TP path fails, the secondary logical MPLSTP path can be immediately used as a detour path. This design scheme enables SINET5 be more robust in the transmission network layer.

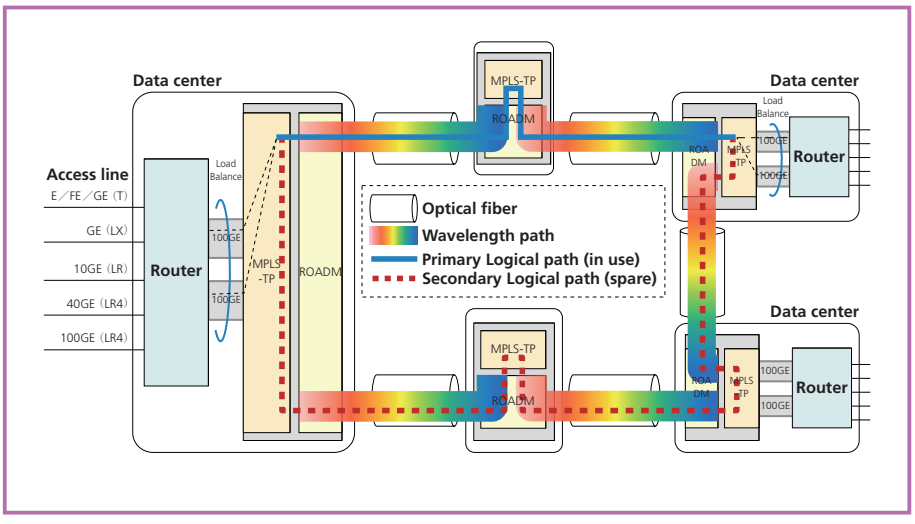


Figure2 Node configuration and connections using transmission equipment

Routers that forward packets according to the IP protocol scheme are connected to the MPLS-TP equipment node at each DC and multiple diverse logical networks are configured using various routing protocols and routers' functions. The network that consists of routers overlays on the above transmission network layer. At several milestones of the SINET5 construction project, many tests were carried on in order to verify the interoperability and interconnectivity between the data frame transmission and packet routing network layers. To take a redundant configuration in the routing network layer, a MPLS-TP equipment node and a router device in DC are physically connected by two physical 100-Gbps links, and disjoint logical MPLS-paths between

any different routers are configured in order to provide load balancing using ECMP[2] and VPN[3] services. The redundant configuration policy in the transmission and routing network layers is capable of responding to failures by coordinating with the both network layers.

The "L2VPN", which is the network service that provides a layer 2 VLAN traffic forwarding among customers, and the "L3VPN," which is the network service to provide the IP packet forwarding among customers, and, the "L2OD," which is the L2VPN on demand service, are provided in SINET5. In the above services, the virtual private LAN services (VPLS) and the virtual routing and forwarding (VRF) instances are properly configured in routers. In addition the "virtual university VPN" service is newly started in SINET5. This new network service enables to forward multiple VLAN traffic among physically separated campuses. In this new service, the virtual switch instances are properly configured in routers. Therefore, SINET5 network platform performs as an L2 switch to transmit multiple VLAN traffic.

To operate SINET5 in a stable and safe manner, several equipment, which can monitor, measure and analyze the status of network, are introduced in the network monitoring segments. A lot of data indicating the status of each network device, traffic volume and utilization in interfaces are sent to these monitoring segments using the SNMP[4] protocol and processed. Traffic flows from customers to SINET5 network are also measured in all routers. Using these traffic flow data, the traffic flow matrices among DCs are calculated. In order to analyze the traffic characteristics in detail, network tap devices and monitoring switches which perform the traffic steering function to forward traffic flow to appropriate analysis devices are also implemented. The performance and log data sent from all devices are analyzed and analytical results are used to operate SINET5 in a safe and stable manner.

Hereafter, we will do traffic engineering activities, that is, dimensioning the network capacity to deal with increasing demands for access line's bandwidth and traffic, upgrading the transmission devices with 400Gbps interfaces, and implementing intelligent operating and monitoring systems. We will also continue to develop the new network services using VXLAN[5] and SDN[6] technologies.

Migration

From SINET4 to SINET5

Takashi Kurimoto (Associate Professor, Information Systems Architecture Science Research Division, National Institute of Informatics)

To achieve the lower latency and larger capacity of SINET5, a new network was built and the architecture was renewed. Therefore, in order to use SINET5, member organizations using SINET4 had to change (migrate) the access lines connected to SINET4 over to SINET5.

SINET is a lifeline for the organizations that use it, so any period of interrupted communication during migration had to be as short as possible. Also, during the period when SINET4 and SINET5 were both in existence, member organizations still on SINET4 and member organizations who had completed the migration to SINET5 had to be able to communicate with each other. Further, the migration work had to be carried out over a wide geographic range because the points of connection to SINET (nodes) exist in each prefecture of Japan and amount to 50 nodes nationwide. The network system and migration procedure were investigated and prepared taking these requirements into account, and migration of all member organizations (approximately 850 organizations) was carried out during a two-month period from late January to the end of March 2016.

During migration, the physical and logical aspects of the network were changed in tandem. The physical changes involved work at the connection points throughout Japan. Wiring had to be installed correctly between a great number of devices. Work to make logical changes could be concentrated by performing it remotely but numerous parameters had to be correctly set for each member organization. Migration was only complete when there was consistency between both aspects. By improving this physical/logical switchover process while carrying out the migration work, the out-of-service period was ultimately reduced to several minutes. Migrating each member organization individually, including adjusting schedules, would have imposed a heavy burden, and so the work was carried out by the SINET side on behalf of the member organizations, and multiple member organizations were migrated simultaneously in a short time using switchover techniques on the SINET side.

Also, there were requests to increase the capacity of access lines (100 Gbps) and to economically add new access lines to different points at this time. A joint procurement scheme by multiple member organizations was adopted in order to respond to these requests. Joint procurement of access lines with fully guaranteed bandwidths (1 Gbps to 100 Gbps) was implemented using dark fibers, and 73 organizations/88 lines were procured to start in 2016.

There were situations during the migration in which member organizations were inconvenienced, such as a few hours being required for network service to resume or migration work being split over multiple occasions; however, with the cooperation of member organizations, the work was successfully completed.

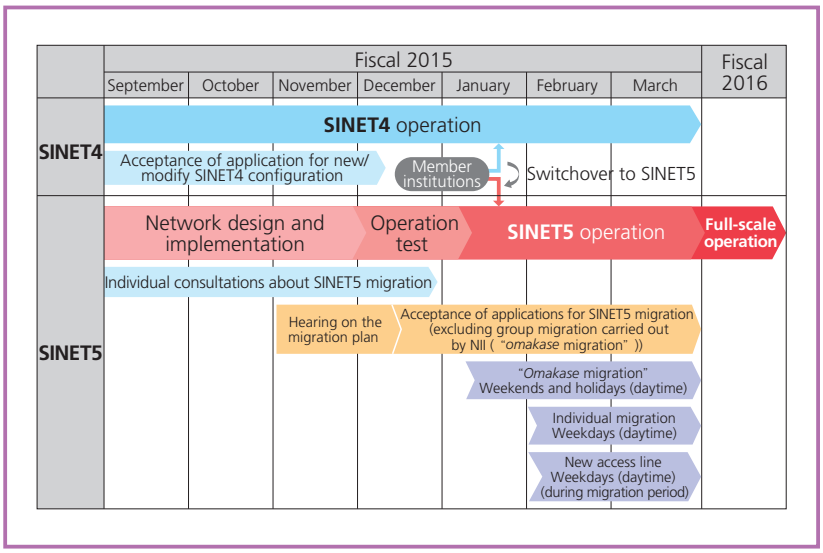


Figure3 Schedule of events up to start of full-scale operation of SINET5

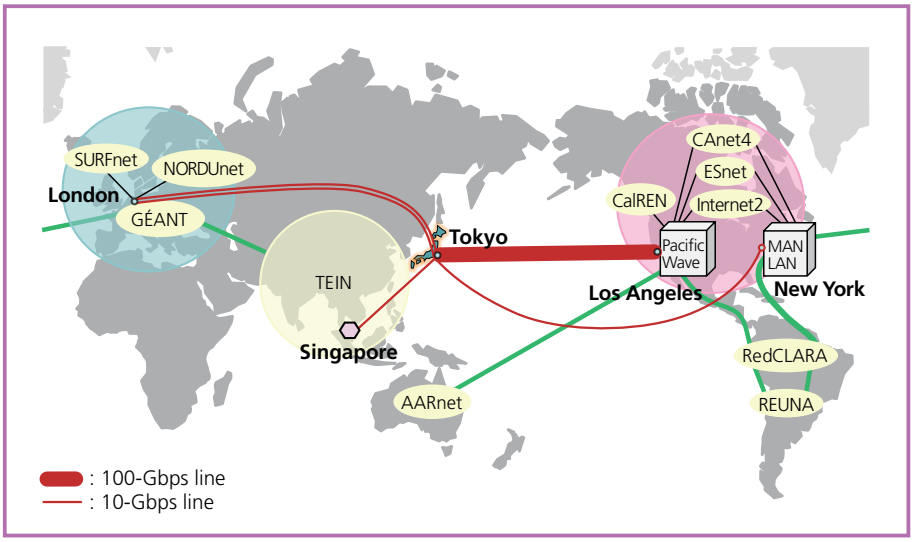


Figure4 **Increase in speeds and reduction of delays on international lines**

International

Cutting-edge large-scale researches pioneered by International networks

Motonori Nakamura (Specially Appointed Professor, Cyber Science Infrastructure Development Department, National Institute of Informatics)

Collaboration with other organizations over networks has become essential in research and education, and not only domestic but also international collaborations are extremely important. International collaboration for cutting-edge, large-scale research projects in fields such as high-energy physics and astronomy has progressed in recent years. For example, it is becoming commonplace for various countries to concentrate their budgets to create large research facilities that are then connected via large-capacity networks so that the facilities can be used remotely from relevant research institutions. It is also becoming commonplace for large volumes of data obtained from large research facilities such as monitoring equipment to be analyzed at high speed by linking computers all over the world. Education is also shifting online and spreading internationally with activities such as OCW[7] and MOOC[8], and to support this kind of international academic cooperation is another important role of SINET.

To communicate with academic institutions overseas, SINET4 was connected to the US with a total bandwidth of 30 Gbps (Los Angeles, Washington DC, and New York, each 10 Gbps) and Singapore with a bandwidth of 10 Gbps. Many research institutions also exist in Europe, such as the European Organization for Nuclear Research (CERN), and data transmission between Europe and Japan was possible, but this transmission went via the US in the past and so had to travel more than halfway around the earth. In the generally widely used transmission protocl called TCP, the quantity of data transmission per unit time depends to a large extent on the RTT (round trip time), that is, the distance, as well as the line bandwidth. It is therefore advantageous to make the communication line route as short as possible.

SINET5 newly provides a line that connects directly to Europe with the cooperation of GÉANT[9] rather than going via the US. It is given a redundant configuration by means of multiple routes like the lines to the US. The total bandwidth of 20 Gbps comes from two 10-Gbps lines with routes that are as different as possible to avoid an accident causing them both to be cut at the same time. With this new European line, the RTT has been shortened by more than 30% from approximately 250 ms to 170 ms, and users have already reported that the time required to transmit experimental data has been reduced dramatically.

With regard to the connection to the US, the limitations of the previous 30-Gbps bandwidth were becoming apparent and international lines owned by other countries were starting to be upgraded to 100 Gbps. We therefore upgraded the line to Los Angeles to 100 Gbps and terminated the line to Washington DC. The New York line has been kept at 10 Gbps, and so the connection to the US has a total bandwidth of 110 Gbps. The number of large-scale, collaborative international research projects are expected to continue to grow after the start of operation of SINET5, and so we will investigate necessity and possibility aimed at increasing line speeds by keeping an eye on SINET5 usage.

References

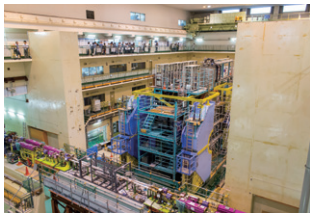
[1]MPLS-TP: Multi Protocol Label Switching - Transport Profile
[2]ECMP: Equal Cost Multi Path
[3]VPN: Virtual Private Network
[4]SNMP: Simple Network Management Protocol
[5]VXLAN: Virtual eXtensible Local Area Network
[6]SDN: Software Defined Network
[7]OCW: Open CourseWare
[8]MOOC: Massive Open Online Course
[9] GÉANT: Organization operating the European academic network that connects EU countries.

NII's SINET team, responsible for building and operating the Science Information Network (SINET). The three people at the front in the center are Specially Appointed Professor Hiroshi Yamada, Associate Professor Takashi Kurimoto, and Specially Appointed Professor Motonori Nakamura (from left).

SINET Users Talk about the Significance of Migrating to SINET5

The key to success of a project is network capacity

Computing Research Center, High Energy Accelerator Research Organization, Inter-University Research Institute Corporation
Center Head/Professor Toshiaki Kaneko, Associate Professor Tomoaki Nakamura, Associate Professor Soh Suzuki



Belle II detector
©KEK

Big science creates huge amounts of data

As Japan's base for accelerator science, the High Energy Accelerator Research Organization (KEK) provides research opportunities for domestic and international researchers. International collaboration on large-scale, cutting-edge research, known as "big science", is becoming commonplace in the field of high-energy experiments. Large volumes of experimental data are obtained, and vast computing resources are essential in analyzing these data. KEK's Computing Research Center is responsible for recording, storing, processing, and distributing the diverse experimental data handled by KEK.

KEK is a core facility for research on elementary particles and nuclei—which uses accelerators to unravel the mysteries of the creation of the universe—as well as research on materials science and life science. Particularly noteworthy is the Belle experiment[1] carried out at KEK, which contributed greatly to verifying the Kobayashi–Maskawa theory for which the Nobel Prize in Physics was awarded in 2008. The phenomenon of neutrino oscillation, for which Takaaki Kajita was awarded the Nobel Prize in Physics last year, was discovered by the Super-Kamiokande experiment. The more detailed T2K experiment[2] is being carried out using high-intensity neutrino beams produced at the Japan Proton Accelerator Research Complex (J-PARC) which is managed jointly by the Japan Atomic Energy Agency (JAEA) and KEK.

The Head of the Center, Professor Toshiaki Kaneko, explains the recent trend in research: "The Large Hadron Collider (LHC) at the European Organization for Nuclear Research (CERN) near Geneva, known for the discovery of the Higgs particle, accumulates several tens of PB (petabyte: peta- is 2^{50}) of data annually. It is impossible for just one research institution to analyze this amount of data. Therefore, the data are shared out and analyzed throughout the world by research institutions that exchange huge amounts of data. This method is called 'grid computing', and the international exchange of data is increasing at KEK too."

To determine, for example, whether data are consistent with a theory requires many simulations, and so the exchange of data increases many times above and beyond the raw data. Associate Professor Tomoaki Nakamura, who is the person in charge of grid computing at the Computing Research Center, says, "Analysis does not end when the experiment ends. Many years may be spent analyzing the data after the end of an experiment in order to publish the results. But immediacy is also important. The success or failure of a project depends on having enormous computing resources for processing and a stable, large-capacity network connecting those resources."

Attempting to make new discoveries with Belle II

The SuperKEKB project is currently underway at KEK. This project aims to upgrade the KEKB accelerator, which helped to verify the Kobayashi-Maskawa theory, and to improve its performance by a factor of 40. In conjunction with this, the Belle detector is being upgraded to Belle II. Preparations are underway for full-scale operation next fall. Associate Professor Soh Suzuki, who is the person in charge of the Computing Research Center's networks, stresses the importance of SINET5 in the Belle II experiment: "The raw data obtained over a period of seven years will amount to approximately 100 PB, and the analysis will be carried out by sharing the data with a total of 40 research institutions in 17 different countries. The aim is to make new discoveries that go beyond the Standard Model of elementary particles. To this end, the high-capacity, stable network provided by SINET5, which connects KEK bi-directionally with each research institution, will be essential."

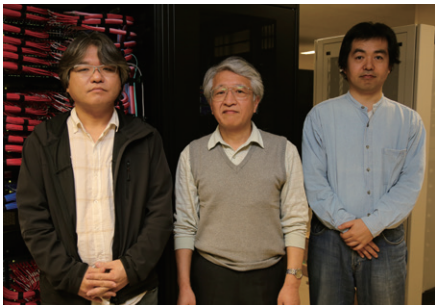
The switch to SINET5 connects Japan directly with Europe, where many collaborating research institutions are located, and has the great advantage of substantially reducing delays in data transmission. Professor Kaneko says, "Network development is changing the way research is done. The ideal is for users to be able to devote themselves to doing research without even being aware of where the data are located. I have high expectations that further development of network technologies, including cloud technologies, will make this ideal a reality."

(Interview/Report by Madoka Tainaka)

References

[**1**] The Belle experiment
An international collaborative experiment to observe CP-violation in B-mesons. The Belle detector examines secondary particles derived from collisions of electron and position beams produced by the KEKB accelerator, which achieved the world highest luminosity in 2009.
[**2**] The T2K experiment
An experiment that aims to understand and precisely measure parameters of the neutrino oscillation using the neutrino beam produced by the accelerator on the J-PARC, at Tokai-mura in Ibaraki Prefecture, and the neutrino detector Super-Kamiokande, in Kamioka-cho, Hida City, Gifu Prefecture.

From left, Associate Professor Nakamura, Professor Kaneko, and Associate Professor Suzuki



Contributing to data transfer from the "ultimate radio telescope"

National Astronomical Observatory of Japan, National Institutes of Natural Sciences, Inter-University Research Institute Corporation
Ken'ichi Tatematsu, Professor and Manager of East Asian ALMA Regional Center, Division of Radio Astronomy, NAOJ Chile Observatory,

ALMA telescope ©ALMA (ESO/NAOJ/NRAO)

International joint project by Japan, Europe, and the US

People have looked up at the skies and observed the celestial bodies since ancient times. Evidence of this remains in the ruins of many ancient civilizations, including ancient Egypt, Greece, and the Indus Valley. Astronomy is the oldest natural science. Professor Ken'ichi Tatematsu, Manager of the East Asian ALMA Regional Center of the ALMA[1] telescope project, gazed at the stars through a telescope as a young boy. However, today's astronomy examines wavelengths other than the visible light detectable by the human eye. These wavelengths include radio waves, for which radio telescopes are used to observe them. Consisting of an array of sixty-six parabolic antennas located in the Chilean desert, ALMA is the "ultimate radio telescope, the most powerful in human history" (Professor Tatematsu). The international project is engaged in explaining such mysteries as the formation of galaxies like the Milky Way after the Big Bang and the formation of planetary systems like our Solar System, as well as the evolution of matter in the universe, and "it was based on network utilization from the start," says Professor Tatematsu.

The ALMA telescope construction project began in 2002, and its inauguration took place in March 2013. The final antenna was installed two years ago in June. A total of twenty-one countries and regions in East Asia, North America, and Europe now participate in the project. The international joint research project came about because Japan, Europe, and the US, who had originally planned to construct large radio telescopes individually, all decided on the same plateau in Chile as a result of searching for the best location. The Atacama Desert in the north of Chile is arid with little water vapor to absorb submillimeter waves[2], and it has a stable climate. It is also extensive enough to install numerous parabolic antennas. Thus, ALMA was built on a plateau in the Andes Mountains at approximately 5,000 meters above sea level.

The Atacama Desert is ideal for carrying out observations, but in addition to being a 35-hour one-way trip from Japan, it is higher than Mount Fuji and the mountains of the Alps, such as Mont Blanc and the Matterhorn, so altitude sickness is a problem. Therefore, rather than visiting the ALMA telescope, researchers do everything from preparation to observations remotely, and they acquire the observed data, which are sent to bases in Japan, Europe, and North America. In this regard, the migration to SINET5 with its enhanced international lines between Japan, the US, and other countries is important. "When we were using the ASTE telescope[3], installed in 2002, only commands were sent remotely because the 'last mile' was connected by slow satellite communication," reflects Professor Tatematsu. Observed data were stored on hard disks and researchers brought them back once every month or two.

"Treasure" buried in noise

Two years ago in November, a major finding of the ALMA telescope was published—a higher quality image than ever before of a disk of dust where planets are being formed. "Scores of papers have already been written in connection with these data, and new theories are also emerging. The world of research is competitive. High-speed networks are required so that researchers around the world can obtain the latest data as quickly as possible," says Professor Tatematsu.

The ALMA telescope has the same capability as a giant telescope with a diameter of sixteen kilometers, and its maximum resolution is equivalent to a human visual acuity of 6,000. It is hoped that the telescope will obtain important observational clues about the universe, galaxies, planetary systems, and even the origin of life, but "the 'treasure' that leads to such discoveries is buried in noise." Therefore, when the data are transmitted, they cannot simply be thinned out. The approximately 200 GB of data currently transmitted per day are expected to increase to approximately 500 GB per day by Cycle 5 of the project starting in October next year.

"As a child, I was thrilled when I first saw Saturn, the Orion Nebula, and so on, through a refracting optical telescope," says Professor Tatematsu. Observations using visible light only allow us to see "adult stars", but radio telescopes "make it possible to explore the life of a star from the time it is young." The means by which we view the stars may change, but the excitement of exploration and discovery remains the same, and SINET supports this sense of excitement.

(Interview/Report by Shoichi Midoro)

References

[**1**] ALMA
Abbreviation of the Atacama Large Millimeter/submillimeter Array. An arrangement that combines multiple antennas is called an array. This array consists of a group of fifty parabolic antennas of twelve meters in diameter and a group of sixteen Atacama Compact Array antennas, which Japan was responsible for developing and manufacturing.

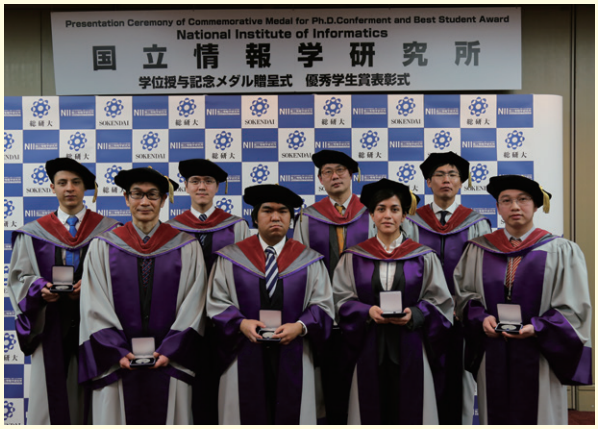
[**2**] Submillimeter waves
Electromagnetic waves with wavelength less than one millimeter. Submillimeter waves are observed by the ALMA telescope together with millimeter waves, and they correspond to the portion of radio with the shortest wavelength. By observing millimeter and submillimeter waves, it is possible to comprehend the structure of parts that cannot be captured with optical telescopes. In the ALMA telescope, the National Astronomical Observatory of Japan (NAOJ) was responsible for producing the world's cutting-edge receivers for three frequency bands, including the shortest wavelength, Band 10. The shorter the wavelength is, the greater the level of technical difficulty in developing the receiver.

[**3**] ASTE telescope
A submillimeter wavelength radio telescope installed by NAOJ in the Atacama Desert for experimental purposes, and which also served as a prototype for the ALMA Project.

Professor Tatematsu

News 1 Department of Informatics, Graduate University for Advanced Studies/ A season of departures and encounters

—Degree medal ceremony and guidance for new students



The National Institute of Informatics joined with the Graduate University for Advanced Studies (Sokendai), the first graduate university in Japan, to establish the Department of Informatics within the School of Multidisciplinary Sciences. The department currently offers research and teaching through 5-year and 3-year doctoral programs.

On March 25, a ceremony was held to present commemorative medals to eight students (seven Department of Informatics students and one student of an affiliated graduate school) who had earned degrees by studying at the Institute (top photograph). After each student's achievements had been announced by their supervisor, Director General Masaru Kitsuregawa presented them with their medal. In Director General Kitsuregawa's congratulatory speech in English, he asked, "How can technology contribute to the benefit of society? How can we make society peaceful?" He stressed the importance of researchers in the global community considering any small way that they could make use of their research under chaotic social conditions, and he called on researchers to act ethically. In the Outstanding Student award ceremony held at the same time, a commemorative shield was presented to Shimon Machida, who was chosen as outstanding student for his research on technology to prevent privacy leaks in SNS.

Meanwhile, five students were admitted to the department in the year ending April 2016, and a guidance session for the new students was held on April 1 (bottom photograph). Following an introduction to the department by Professor Zhenjiang Hu, who became Chair of the department this year, the Institute staff showed the students around and explained how to use the facilities. Mature student Kimitoshi Takahashi said, "At the National Institute of Informatics, I want to study infrastructure technologies that allow anyone to easily access services in the age of cloud computing." Currently working for a systems company and engaged in building infrastructure with redundancy, Mr. Takahashi said, "I hope to make use of this experience of studying and coming into contact with our world-leading research in my future work."

News 2 Malaysia's Minister of Higher Education visits NII

Malaysia's Minister of Higher Education Idris Jusoh visited NII on April 6 (center of photo). The purpose of his visit was to gather information and exchange ideas about the "Science Information NETwork (SINET)", built and operated by NII as academic information infrastructure for Japan's universities and research institutions, in preparation for future development of the academic information infrastructure in Malaysia.

Including Minister Jusoh, the visiting party comprised ten people. NII's Director General Masaru Kitsuregawa, Deputy Director General Jun Adachi, and Director of the Cyber Science Infrastructure Development Department Shigeo Urushidani explained NII's role as an Inter-University Research Institute Corporation, the state of development of SINET, and collaborative activities with university libraries involving the distribution of academic information. NII's team answered enthusiastic questions about the development of academic information infrastructure from the Malaysian side, and there was a lively exchange of opinions.

News 3 Latest edition of Jouhouken Series *Camera? Camera! Camera?!*

The 20th edition of the Jouhouken Series (Maruzen Library), edited by NII, *Camera? Camera! Camera?!*—Future Cameras That Calculate, was published at the end of March. The authors are Associate Professor Kazuya Kodama of the Digital Content and Media Sciences Research Division and writer Keiko Takarabe. This edition introduces technology positioned between the camera and the image display, focusing on image processing that manipulates light information and recreates it according to the user's wishes. Compiled in an easy-to-understand format with color photos, illustrations, and articles. Published by Maruzen Publishing Co., Ltd., regular price 760 yen (excluding tax).

Human Resources

Research and teaching staff newly appointed in Academic Year 2016

Ryoichi Ando

Assistant Professor, Digital Content and Media Sciences Research Division

Degree: Ph.D. (Design)
Research Fields: Pattern media
Research Subjects: Computer graphics, physics simulations, computational fluid dynamics

Yoichi Iwata

Assistant Professor, Principles of Informatics Research Division

Degree: Ph.D. (Information Science and Technology)
Research Fields: Mathematical Informatics
Research Subjects: Exact algorithms, parameterized complexity, algorithms using real-world input structures

Teruhito Kanazawa

Associate Professor, Digital Content and Media Sciences Research Division

Degree: Ph.D. (Engineering)
Research Fields: Text and language media
Research Subjects: Construction of infrastructure for Open Science Repository, bibliography and person identification, machine learning, big data processing, integrated metadata for Linked Open Data

Megumi Kaneko

Associate Professor, Information Systems Architecture Science Research Division

Degree: Ph.D. (Engineering)
Research Fields: Information network
Research Subjects: Wireless communication engineering, wireless resource allocation, protocol design for mobile communication systems

Masako Kishida

Associate Professor, Principles of Informatics Research Division

Degree: Ph.D.
Research Fields: Mathematical informatics
Research Subjects: Control theory and optimization for uncertain systems and network systems

Yusuke Komiyama

Assistant Professor, Digital Content and Media Sciences Research Division

Degree: Ph.D. (Agriculture)
Research Fields: Foundations of Content Management
Research Subjects: Open science, Semantic Web, Linked Open Data, bioinformatics

Atsuko Takefusa

Associate Professor, Information Systems Architecture Science Research Division

Degree: Ph.D. (Science)
Research Fields: Computer architecture
Research Subjects: Parallel and distributed processing, cloud infrastructure technologies, intercloud technologies

Miho Funamori

Associate Professor, Information and Society Research Division

Degree: Master's (Science)
Research Fields: Science information
Research Subjects: Multifaceted university institutional research (IR) systems, open access in the digital age and interaction with physical world problems

(Officially announced on April 1, 2016. Listed in order of the Japanese syllabary.)

Research and teaching staff who left NII in Academic Year 2015

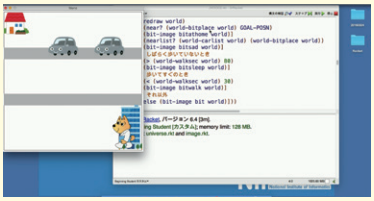
Hiroko Satoh Associate Professor, Principles of Informatics Research Division (June 30, 2015)
Tetsuro Kobayashi Associate Professor, Information and Society Research Division (December 27, 2015)
Asao Fujiyama Professor, Principles of Informatics Research Division (March 31, 2016)
Soichiro Hidaka Assistant Professor, Information Systems Architecture Science Research Division (March 31, 2016)

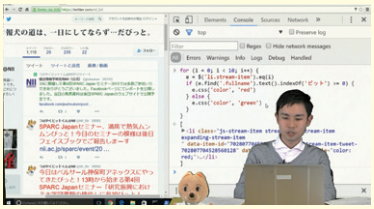
News 4

First programming course via Japan's MOOC

From August, the National Institute of Informatics will offer a programming course titled "Hajimete no P" (My first P) via a free online education service certified by the Japan Open Online Education Promotion Council (JMOOC). The course is aimed at people of senior high school age or above who are studying programming for the first time.

The instructors are all young researchers at the Institute—Assistant Professor Takuya Akiba of the Principles of Informatics Research Division, and Assistant Professor Kazunori Sakamoto and Assistant Professor Kanae Tsushima of the Information Systems Architecture Science Research Division. The moderator is Ayaka Ikezawa, who is known as a celebrity who can program. The course will include a lecture by Assistant Professor Tsushima titled "Introduction to Programming—Completing a Bit-kun game!" in which students will experience changing a game program using Racket (top photo), and a lecture by Assistant Professor Sakamoto titled "Fundamentals of Programming—Completing a Bit-kun game!" in which users will run simple JavaScript programs (bottom photo). In Assistant Professor Akiba's lecture, students will learn the essence of the mathematics behind computing using familiar materials. They will experience the fundamentals of algorithms using games such as nim or scrabble and mazes. For details and course registration, visit the JMOOC website (http://www.jmooc.jp/).





Human Resources

Administrative staff (Officially announced on April 1, 2016)

(Assistant section managers and above. *Officially announced on March 25, 2016)

	Name	New position	Old position
Transfers in	Akio Saito	Deputy Manager, Planning Division, General Affairs Department	Assistant Director, General Affairs Division, Kanto Bureau of Telecommunications, Ministry of Internal Affairs and Communications*
	Koji Kamei	Head, Academic Infrastructure Division, Cyber Science Infrastructure Development Department	Head of Information Planning, Office of Information and Documentation, National Museum of Ethnology, National Institutes for the Humanities
	Soichiro Tsubakiyama	Deputy Manager, Academic Infrastructure Division/Assistant Section Manager (NII-SOC Team)	Specialized Staff, Infrastructure Section, Information Systems Department, University of Tokyo
	Tatsumi Abe	Assistant Section Manager(LAN/CSIRT Team), Academic Infrastructure Division	Senior Staff, Infrastructure Section, Information Systems Department, University of Tokyo
	Tadasuke Taguchi	Assistant Section Manager (Research Products Team), Scholarly and Academic Information Division, Cyber Science Infrastructure Development Department	Senior Staff, General Affairs Division, Graduate School of Agriculture, University of Tokyo
	Yukio Yanagihashi	Head, General Affairs Division, General Affairs Department	Head, General Affairs and Planning Department, Akita University
	Wataru Hashimoto	Deputy Manager, Planning Division/ Head, Office for Social Collaboration/ Deputy Manager, General Affairs Division	Assistant Section Manager, General Affairs Section, Institute of Industrial Science, University of Tokyo
Internal transfers	Yasuo Saito	Assistant Section Manager(Cloud Promotion Team), Academic Infrastructure Division	Assistant Section Manager(Academic Content Team), Scholarly and Academic Information Division
	Yukinae Yoshida	Deputy Manager, Scholarly and Academic Information Division	Assistant Section Manager (Support Team), Scholarly and Academic Information Division
	Koji Sakaguchi	Assistant Section Manager (Academic Content Team), Scholarly and Academic Information Division	Assistant Section Manager (Coordination, Infrastructure and Liaison Team), Academic Infrastructure Division
Transfers out	Asaji Sakamoto	Head of Department of Information Systems, Kyushu University	Head, Academic Infrastructure Division
	Nanako Takahashi	Head, Academic Content Division, Chiba University Library	Deputy Manager, Scholarly and Academic Information Division
	Akira Maeda	Assistant Section Manager, Infrastructure Section, Information Systems Department, University of Tokyo	Assistant Section Manager (Research Products Team), Scholarly and Academic Information Division
	Yuki Hama	Director, Planning Division, Guidance and Counseling Research Center, National Institute for Educational Policy Research	Head, General Affairs Division
	Masahiro Akasaki	Senior Coordinator for Planning, Information and Communications Collaboration Promotion Division, Information and Communication Department, Chugoku Bureau of Telecommunications, Ministry of Internal Affairs and Communications	Deputy Manager, Planning Division
	Miki Yamazaki	Manager, Research Cooperation Section, Tokyo University of Foreign Studies	Deputy Manager, Planning Division/ Head, Office for Social Collaboration/ Deputy Manager, General Affairs Division
	Isao Sakuma	Chief (responsible for research collaboration), URA Station, Strategic Planning Headquarters, ROIS	Assistant Section Manager (Big Project and Intellectual Property Team), Office for Social Collaboration

SNS

"Hey, this is great!"

Hottest articles on Facebook and Twitter (March–April 2016)

National Institute of Informatics, NII (official) Facebook
www.facebook.com/jouhouken/

National Institute of Informatics Degree medal ceremony and Outstanding Student award ceremony

The National Institute of Informatics established the Department of Informatics at the School of Multidisciplinary Sciences, Graduate University for Advanced Studies, and offers research and teaching through 5-year and 3-year doctoral programs taught in the National Center of Sciences Building. On March 25, a ceremony to present commemorative medals to students granted degrees and an Outstanding Student award ceremony were held. During the ceremony, the achievements of each of the seven students who studied at the Department of Informatics (SOKENDAI) and one student of an affiliated graduate school were announced by their supervisor, and they were then presented with medals by Director General Masaru Kitsuregawa.

Congratulations to everyone who was honored in the ceremony today! We wish you continued success. (03/25/2016)

National Institute of Informatics, NII (official) Twitter
@jouhouken

[NII NEWS] Assistant Professor Takuya Akiba (Principles of Informatics Research Division) has won the Database Society of Japan's Kambayashi Incentive Award (03/01/2016)

Bit on Twitter! Twitter
@NII_Bit

Programming course by Dr. Akiba, Dr. Sakamoto, and Dr. Tsushima now being filmed. JMOOC will start accepting applications for the course after the Golden Week holidays in May! (04/17/2016)

*Some text omitted.

NII People Vol.1

"Adrenaline-producing algorithm research"

Takuya Akiba

(Assistant Professor, Principles of Informatics Research Division)

Born in 1988. Ph.D. in Information Science and Technology (University of Tokyo). Engaged in developing efficient algorithms for real-world large-scale networks. Successful in Japanese and international programming contests, winning the Japanese Olympiad in Informatics and the ACMICFP Programming Contest.

—— We are together doing the "Hajimete no P" programming course offered through Japan's version of MOOC. (Ikezawa)

Akiba "In this course, I want to show people how interesting algorithms are by playing with puzzles and mazes."

—— Algorithms are your main area of expertise, right? To me, that seems a tough field. I studied programming at university, and recently I've been writing simple programs for fun, but actually, I'm not very good at algorithms.

"In my case, I started creating various programs when I was a junior high school student, and at some point, my interest gradually shifted to algorithms. An algorithm is like the 'idea behind a calculation'. Algorithms are responsible for programs behaving cleverly. And the ability of a program to solve a problem efficiently depends on algorithms."

—— Among my acquaintances, the people interested in algorithms seem to be the kind of people who take part in programming contests and are exceptional in some way.

"I was obsessed with programming contests when I was a student too. I was even rated fourth in the world. Now, I think that algorithm research is the field that allows me to make the best use of the skills I developed as a result."

—— Fourth in the world! That's amazing. What is the subject of your research?

"My research involves devising new algorithms to speed up calculations. I'm looking particularly at big data. The bigger the data, the more powerful the algorithms."

—— It would be irritating to finally enter the age of the IoT with appliances connected to the Internet, only to find that they are slow to respond.

"Oh yes. Things like response speeds and memory constraints can be solved effectively using algorithms. But I'm working with slightly special data, namely graphs."

—— Like bar charts and line graphs?

"That's what generally comes to people's minds (laughs). But these graphs are a mathematical theory in which points are connected by lines. Massive social networking sites like Facebook, which connects over a billion people, are also graphs. Such mathematical graph data are very useful in examining relationships between people and figuring out the shortest distribution channels, but they aren't being used much yet. This is because the elements are interconnected in complex ways, making it difficult to extract information, so the processing takes a long time."

The traditional Japanese house in Nezu, Tokyo, where "Hajimete no P" was recorded. The pair are holding "Bit-kun cards" specially made by Assistant Professor Akiba for learning about algorithms.

—— And that's what you're working on?

"I want to develop an algorithm capable of quickly processing graph data, however large. That's my dream."

(Written by Akiko Ikeda. Photography by Yuka Shiga)

*Ayaka Ikezawa, who is known as a celebrity who can program and has been called "The Ruby Goddess", presents a variety of people working at NII in a wide range of fields, from research to business.

Face-to-face with "NII People"

When I said that the word I live by is probably "relaxed", Dr. Akiba said, "Well then, my word is 'fast'." His brain seems to produce adrenaline when he is programming or thinking about algorithms. One of his recent hobbies is going kart racing once a month. He seems to absolutely love speed. I'm looking forward to seeing how Dr. Akiba's high-speed algorithms change the world.

Ayaka Ikezawa

Celebrity/Engineer. Active in the field of IT, including NHK's high school lecture program "Society and Information". The author of *Idea Wo Jitsugen Saseru Saiko No Tool Programming Wo Hajime Yo* (Let's Start Programming: The Best Way to Realize Your Ideas) (Daiwashobo). Won the Special Jury Award at the 6th Toho Cinderella Audition.

Essay

Information Technology is a Bastion of University Reform

Hiroto Yasuura
Executive Vice President, Kyushu University, National University Corporation

Institutions of higher education in Japan, and national universities in particular, are being forced to reform in the face of challenging conditions. Ongoing cuts to management expenses grants following the incorporation of national universities have cumulatively reached more than 130 billion yen annually, or more than 10% a year compared to fiscal year 2004. Meanwhile, society's expectations of universities, which include international competitiveness and collaboration with government, industry, and community, are expanding. As well as producing world-leading research results, universities are expected to improve their education and research environments by providing new research facilities capable of accommodating open science and big data analysis, and diversifying their education with Massive Open Online Courses (MOOC) and e-Learning. In addition, the university management and operation systems that support education and research have not been optimized like those in private enterprises, and they remain almost unchanged since the last century.

To change this status quo, it is necessary to make use of the latest information and communications technology, as is being done in society and industry, to swiftly 1) establish world-leading research infrastructure, 2) develop active learning environments through informatization of education, and 3) drastically improve the efficiency of university operations. NII has provided a variety of information infrastructure and operational services such as SINET to Japan's higher education organizations. However, the majority have focused on upgrading research infrastructure. Now that the national universities, which are the main target of these services, are on extremely shaky ground, NII's mission must be greatly expanded to include improvement of education environments and enhancement of support services.

Cloud services will help greatly to enhance support for education, research, and operation, and reduce costs for national universities overall. With regard to computing and storage resources, as well as operating expenses such as maintenance, it is no longer possible for individual universities to possess their own machines and customize and maintain them themselves. There is absolutely no need for national universities that are operated under the same national university corporation to individually customize their financial accounting or payroll systems. There have been numerous cases in which the use of individual systems has become a breeding ground for misconduct and made it difficult to maintain compliance. If flexibility capable of accommodating the individual character of each university can be assured, the information systems for academic affairs used in education can be shared using the Cloud. To put the concepts of open data and open science into practice, it is also advisable for research support environments to be shared. Also, each university's expertise can be shared to prevent research misconduct and research grant fraud. Furthermore, when it comes to ensuring the safety of each institution's system in the current state of cyberspace war, measures by individual universities are not practical.

I believe that by sharing education, research, and operational support services between universities using Cloud services built on SINET, with its guaranteed security, Japan's universities will change dramatically and once again become an example for the world.

Future Schedule

June 22 | 1st public lecture "Big Data Analysis of Relationships: The Science and Application of Social Networks" in the 2016 series titled "The Forefront of Informatics" (Lecturer: Assistant Professor Takuya Akiba, Principles of Informatics Research Division). A series of six free public lectures over one year in which the Institute's researchers explain their research to the general public. Details on this year's lectures, including subjects and schedule, are available on the Institute's website via the link below.
http://www.nii.ac.jp/event/shimin/

July 11 | 6th Industry-Government-Academia Collaboration Lecture (Associate Professor Junichi Yamagishi, Digital Content and Media Sciences Research Division). Details are available on NII's website via the link below.
http://www.nii.ac.jp/research/iga/juku/

August 25 | 2nd public lecture "How Do Computers Work? From Smartphones to Supercomputers" (Lecturer: Professor Masahiro Goshima, Information Systems Architecture Science Research Division)

October 20 | 3rd public lecture "How Can You Easily Write Correct Programs? Program Schemata and Debugging Techniques" (Lecturer: Assistant Professor Kanae Tsushima, Information Systems Architecture Science Research Division)

Notes on cover illustration A "SINET5" sign is being put up over a road stretching straight ahead. The brand new road that allows traffic to travel back and forth at high speed symbolizes the infrastructure for smooth communication pioneered by SINET5.

Weaving Information into Knowledge
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