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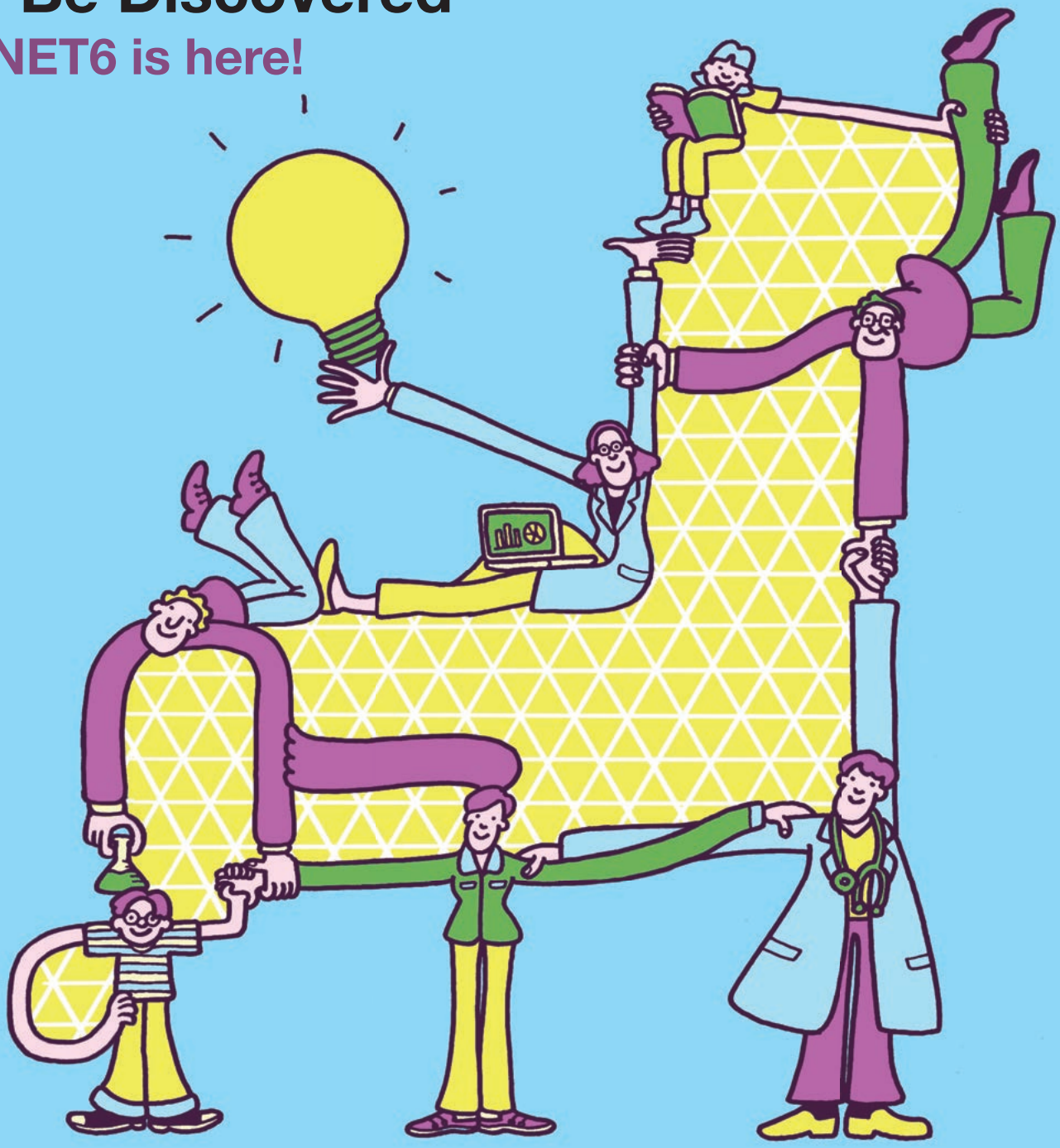
Feature

Knowledge Yet to Be Discovered

SINET6 is here!



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SINET, the academic information network constructed and operated by the National Institute of Informatics, has undergone an upgrade. SINET6 was launched on April 1, 2022 to replace SINET5. The main features of this upgrade include the expansion of ultra-high speed 400 Gbps across Japan with additional nodes, the integration of 5G mobile and 400 Gbps, edge functions and enhanced security, and increased international connectivity.

In this special feature, we look at various aspects of the new features of SINET6 – their usefulness, effectiveness, potential, future issues, and outlook – as well as explore SINET6's role in university education and research, and its effect on society.

Knowledge Yet to Be Discovered

SINET6 is here!

Special conversation

President of RIKEN
Professor, Graduate School of Science, University of Tokyo
GONOKAMI, Makoto

Director,
National Institute of Informatics
KITSUREGAWA, Masaru

Interviewer
YAMAMOTO, Kayoko
Editorial Writer
Nikkan Kogyo Shimbun

SINET6 will be a catalyst for growth in Japan, bringing innovation in data research

SINET6, the academic information network created and operated by the National Institute of Informatics (NII), was launched in April. With improvements in network speed, connectivity, security, and other aspects, there are high hopes for synergy with the newly linked research data cloud.
Will it lead to innovative research and results? RIKEN President GONOKAMI, Makoto (former President of the University of Tokyo), who saw the importance of SINET early on, and NII Director KITSUREGAWA, Masaru, discuss how SINET6 will contribute to data-driven research and Society 5.0.

— Firstly, could you explain how the two of you are involved with SINET?

KITSUREGAWA: I was involved in the digitalization of the University of Tokyo as a Special Advisor to the President while Professor Gonokami was university president. In the course of that project, Professor Gonokami saw the significance of SINET early on, and he has supported the project ever since.

GONOKAMI: From around 2015 when I became president of the University of Tokyo, the pace of change in both society and research has accelerated. In particular, due to the rapid growth of deep learning technology, artificial intelligence (AI) technologies utilizing data have developed quickly, so we are heading towards a data-driven society, as well as the fusion of cyber and physical systems. I was part of the government's Future Investment Meeting where we discussed this vision of "Society 5.0". One day, Professor Kitsuregawa came to my office to discuss moving the SINET hub from Nishi-Chiba to the University of Tokyo's Kashiwa Campus. This made me understand the superiority and significance of SINET, and I realized

that an advanced communication network like SINET, covering the entire country in full, could provide the social infrastructure for the Society 5.0 era, equivalent to expressways in Japan's postwar period of rapid economic growth.

Nationwide expansion of 400 Gbps speed makes SINET6 the fastest in the world

—— Could you explain the new developments with SINET6?

KITSUREGAWA: The biggest change is integration with the NII Research Data Cloud (NIII-RDC) which manages, publishes, and searches through data from research. The network is like a "road" that carries information, and in the future, the importance of data will increase dramatically.

Recently, increasing attention is being paid to a shift towards data-driven science and society, where new knowledge is created by collecting big data and analyzing it using artificial intelligence (AI). The importance of data is repeatedly highlighted in the Japanese government's 6th Science, Technology and Innovation Basic Plan from 2022.

In the research sphere, data science has become a fourth scientific research method after theory, experiment, and calculation. Collecting and analyzing data is becoming an essential part of research in all fields, including the humanities and social sciences as well as natural sciences. That is why we need a platform to collect and manage large amounts of data (big data). This is where NII will help by creating a "search engine for data", because this is something that does not exist yet.

It will work as an academic research platform, with SINET as the body and NII RDC as the head.

GONOKAMI: SINET is made up of dedicated optical lines and was specially constructed for the advanced needs of academia, which gives it immeasurable value. For example, security is extremely important when handling information over a network. SINET enables advanced management that is not possible with commercial services made up of different optical fiber networks joined together. Even the network connecting Japan's local governments is far inferior to SINET. When we consider the rapid shift towards Society 5.0, SINET holds incredible potential. It should be utilized as a social infrastructure for all kinds of areas, not just academia.

—— How has the network changed with the upgrade from SINET5 to SINET6?

KITSUREGAWA: SINET5 connected the whole of Japan at 100 Gbps. SINET6 is four times faster, providing a network speed of 400 Gbps. This makes it the fastest nationwide network in the world. We have also expanded the network by adding more nodes (systems combining routers and transmission equipment). Plus, we have upgraded technologies including 5th generation (5G) ultra-high-speed mobile access and virtual private networks (VPNs) tailored to the requirements of research.

SINET is an information network connecting around 1000 universities and research institutions all over Japan and has over 3 million users. Unlike commercial networks, it connects to large-scale experimental facilities and supercomputers, securely handling huge amounts of information, which is why it is upgraded regularly.

GONOKAMI: These days all kinds of online services are available via the Internet, but you always seem to run into connection problems due to high traffic when you need it most. SINET provides a robust network with sufficient capacity to ensure this never happens. It is reassuring to know that such an intricate, high-performance network connects all 47 prefectures of Japan and links to the whole world.

During the 20th century, researchers in Japan set up optical fiber networks throughout the country, leading the world in optical communication. SINET is the result of these efforts; "SINET was not built in a day." SINET6 is not simply a

KITSUREGAWA, Masaru

Creating a "search engine for data", because this is something that does not exist yet.

The advanced information network and the data it handles will provide a foundation for creating new economic value

high-speed communication network, but should provide the infrastructure to transform the whole of Japan into a digital island.

Remote surgery at hospitals in Hokkaido and Kyushu

—— Can you give some examples of research made possible by sharing big data on SINET?

KITSUREGAWA: In terms of leveraging SINET6's outstanding communication capability, one area of note is the development of remote surgery support robots. If the surgeon is in Sapporo and the patient is in Fukuoka, data like surgical images and information needed to operate the robot can be exchanged over a distance of around 2,000 km (4,000 km there and back) with excellent stability and low latency, allowing surgery to be performed as if there were no distance between them. Thanks to SINET6, Japan is currently the only country that can demonstrate the communication conditions required for remote surgery.

Another promising benefit is instantly sending large amounts of computed tomography (CT) data – images showing thin slices of an affected area – from a university hospital to another hospital or research institution.

GONOKAMI: Looking back at the COVID-19 pandemic gives an example of the importance of leveraging real-time data. When the infection began to spread, a key area of research was real-time monitoring of crowds of people from mobile phone mast signals. Before long, local governments and the media were able to use this data to send out messages about avoiding crowds. This led to behavioral changes; people would avoid going to Shibuya if they received information that it was currently very crowded.

If we think about disaster prevention, in the event of localized torrential rain, huge amounts of observation data can be fed into SINET in real time, which could then be used to run a simulation on a supercomputer connected to SINET. In just five minutes, it will be able to predict "flooding will occur in these areas in 30 minutes from now". If this can be achieved, it could help to establish disaster preparedness systems and mitigate damage in the event of a disaster. The important point is that data and the analysis results of this data will create new economic value.

What treasures could be uncovered by analyzing data from a corporate perspective?

—— In the past, use of SINET by private companies has been limited to joint research with universities and public research institutes. Apparently SINET6 will be available for trial use for companies?

KITSUREGAWA: The aim is to make SINET a new tool to support cutting-edge research and development in industry. For example, at the large synchrotron radiation facility SPring-8, a number of the beam lines are for commercial use. Big data from measurements using synchrotron radiation can be stored on the server of RIKEN, the owner of SPring-8. What kind of treasures could be uncovered if this data could be sent to RIKEN's "Fugaku" supercomputer via SINET, analyzed, and handed over to companies? As one example, it could handle huge amounts of data from observing the deterioration of a storage battery in real time. What will companies focus on, and what new worlds will unfold? I'm looking forward to seeing how companies will make use of SINET.

GONOKAMI: Securely carrying huge volumes of data with no delay requires expertise and systems. SINET is leading the world in the

GONOKAMI, Makoto

Graduated from the Department of Physics, Faculty of Science, University of Tokyo. Worked as an assistant at the Faculty of Science, lecturer at the Faculty of Engineering, and assistant professor at the Faculty of Engineering, before becoming professor at the Graduate School of Engineering and the Graduate School of Science, University of Tokyo. Served as Vice President of the University of Tokyo and Dean of the Graduate School of Science. Appointed as the 30th President of the University of Tokyo in 2015. President of RIKEN since April 2022. Specializes in photon quantum physics.

Another great thing about SINET is that academia is leading the way in leveraging data and showing the value of a reliable infrastructure (GONOKAMI)

capability to provide this, so it could be used to develop business models for the future. Thanks to SINET, Japan could become a testbed for creating new businesses around the world.

Students who do not go to school can still enjoy learning

—SINET's communication network was extensively used and really came into its own when universities all started offering online lectures during the COVID-19 pandemic. It is also expected to contribute to primary and secondary education, which is of high interest to the public.

KITSUREGAWA: The government's GIGA School Program will provide one device to every elementary, junior high, and high school student, making all kinds of things possible. In the past, it has always been up to the class teacher to keep track of children's learning. But analyzing children's facial expression data using these "digital eyes" could immediately show which child is bored, or identify particularly gifted children.

The online classes that started during the pandemic have already shown that children who do not attend school can enjoy learning through digital methods.

GONOKAMI: Most tests, like the national academic ability survey and learning status survey, are administered on paper, but making these tests digital would make it much easier to analyze the results. It would also allow regional differences in academic ability to be identified and changes to be monitored in real time. As an extension of the GIGA School Program, if 36,000 schools across the country could be interconnected as data collection points, it would form an amazing digital neural network.

If SINET can be used in this way, it will make Japan a digital island like nowhere else in the world. It could be used to develop new business ahead of the rest of the world. It could add a lot of value, becoming a catalyst for new types of growth.

SINET could fundamentally change medicine and agriculture

— So utilizing data using SINET will impact society as a whole, not just matters related to the Ministry of Education, Culture, Sports, Science and Technology.

KITSUREGAWA: That is right. It has possibilities in every area of government. For the Ministry of Health, Labour and Welfare, it could support remote healthcare to make up for the shortage of doctors in rural areas. The Ministry of Agriculture, Forestry and Fisheries is promoting smart agriculture, so sensor data and images showing the state of crops could be sent over the network to be analyzed.

Using SINET could fundamentally change both medicine and agriculture.

GONOKAMI: Because SINET has been built for academic research, it can quickly respond to advanced challenges.

As our society becomes more diverse, to solve ever more complex social issues, people and society need to modify their behavior, backed up by scientifically reliable data. The COVID-19 pandemic measures and efforts to become carbon neutral are perfect exam-

> It is important for a country to have a strong foundation that can respond if something happens, like the COVID-19 pandemic (KITSUREGAWA)

ples of this. Academia should show examples of leveraging data and the value of a reliable infrastructure. Another great thing about SINET is that it can serve as a platform for this.

An inclusive society where nobody is left behind

—— How should we view SINET's mission from a medium- to long-term perspective?

KITSUREGAWA: The world of research lets us deepen our ideas by making full use of incredible resources that are far ahead of the real world. So, science is a source of national power. SINET will inspire Japanese researchers to think "What can we do?" "Let's try this!"

We may not be aware of its power in normal times, but it is important for a country to have a strong foundation that can respond if something happens, like the COVID-19 pandemic.

GONOKAMI: Another important point is that the information infrastructure provided by NII is available in any part of the country. During the post-war reform of our education system, national universities were established in all 47 prefectures of Japan, which means there are people all around the country who can manage and maintain an advanced network. This is extremely important in creating an inclusive society where nobody is left behind. For humans to achieve a sustainable society without destroying the Earth, we need to understand in real time how our individual actions affect society as a whole, so that we can make choices about how we act based on seeing other people's problems as our own. This requires an advanced network that can smoothly handle data in real time. I believe that SINET has great significance.

KITSUREGAWA: To distribute information and data, the communication power of SINET6 will be a catalyst for Japan's new society. SINET will provide an essential part of the infrastructure to build Japan's future.

A Word from the Interviewer

Researchers in the natural sciences have long relied on SINET, especially for large-scale research projects. But some aspects were not clear from the perspective of humanities and social sciences. I sense that the situation is changing now that data management is required in all fields and the need for big data analysis is spreading to industry. With the key combination of data and communication, I think the benefits of SINET will become more widely known.

YAMAMOTO, Kayoko

Editorial Writer,
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Master's degree, Tokyo Institute of Technology Graduate School.
Joined Nikkan Kogyo Shimbun as a reporter specializing in science, technology, and university/industry collaboration. PhD from Tokyo University of Agriculture and Technology. Part-time lecturer at Tokyo Institute of Technology, special assistant to the president of the University of Electro-Communications, visiting professor at Tokyo City University. Author of books including "理系女性の人生設計ガイド."

[Interview]

Supporting advanced technologies like 5G mobile, VPN, and cyber security

SINET6 has evolved

The National Institute of Informatics (NII)'s academic information network SINET (Science Information NETwork) has been upgraded for the first time in six years, with SINET6 launched in April.
What is new in this latest iteration and what will researchers be able to do with this new platform? We asked URUSHIDANI, Shigeo, director of NII's Research and Development Center for Academic Networks.

National Institute of Informatics
Information Systems Architecture Science Research Division
Professor and Vice Director-General

URUSHIDANI, Shigeo

Interviewer

YOSHIKAWA, Kazuki

Senior Staff Writer,
Nihon Keizai Shimbun

—What are the major changes with the upgrade from SINET5 to SINET6?

Firstly, the communication speed has increased significantly. Previously we only had a 400 Gbps connection between Tokyo and Osaka and the rest of the network was 100 Gbps, but SINET6 offers 400 Gbps over the whole of Japan, except for Okinawa. A speed of 400 Gbps means the information from one Blu-ray disc can be transferred in one second, and full-spec 8K video can be transmitted without being compressed.

We have also added 20 new data centers (DCs), the connection points of SINET, making a total of 70 DCs. They are all interconnected by ultra-high speed logical lines to form a full mesh network, allowing flexible use of the 400 Gbps network bandwidth. This enables researchers in far-apart locations like Hokkaido and Kyushu to conduct research involving huge amounts of data, just as if they were working right beside each other.

No other country has such an ultra-high-speed, high-density academic network. The US and Europe are bringing in 400 Gbps for backbone networks, but performance is limited by the speed of the regional and national lines connecting to the backbone. SINET6 provides a 400 Gbps connection practically anywhere, which will make a huge difference in communication performance from the user's perspective.

Plan to support local 5G

— Apart from the communication speed, are there any particular services available with SINET6?

Mobile SINET was available in SINET5 since late 2018, and has been upgraded for SINET6. This is a unique service, not available anywhere else, allowing data to be collected from field research or wireless IoT sensors. It previously used 3G or 4G mobile networks, and SINET6 now uses 5G.

Mobile SINET works using dedicated virtual networks, separate from the Internet, within a commercial mobile network, connected to university servers and commercial clouds via virtual private networks (VPNs) on the SINET side.

We also plan to support local 5G – where universities, research institutes, and research groups create their own 5G networks – with trials starting soon.

— It seems to be a very secure research environment via VPNs, including Mobile SINET.

Due to concerns about cyber security, there is an increasing desire among researchers to configure research networks using VPNs, which are closed networks isolated from other networks.

VPNs are now commonly used to allow people to work from home since the COVID-19 pandemic. Most VPNs are configured with software, so they cannot provide sufficient speed if used by many users at once. With SINET's VPN, a closed network is formed with network equipment, guaranteeing the same 400 Gbps communication speed as when using 400 Gbps lines.

As well as Japanese universities and research institutions, SINET's VPN connects to a global network including Europe and the US. One example use of this is the high energy physics research at Japan's High Energy Accelerator Research

History of SINET

1987
Japan' s academic information network started operation
The predecessor of SINET. Started as a packet-switching network to connect large-scale computer centers of the seven former Imperial Universities and provide catalog location information services.

1992
SINET started operation
Internet backbone using TCP/IP. SINET nodes were established at core universities to serve institutions in each region. Based on IPv4 and interconnected with commercial networks. Final network speeds up to 1 Gbps.

2002
Super SINET parallel operation
Advanced academic research network using optical transmission technology. L3VPN (Layer-3 Virtual Private Network) later used to connect research institutes. Network speeds up to 10 Gbps.

2007
SINET3 started operation
Combined features of SINET and Super SINET. The world's first 40 Gbps connection between Tokyo and Osaka. Many new services including IPv4/IPv6 dual stack, IP multicast, L2VPN (Layer-2 VPN), and QoS (Quality of Service) control.

2011
SINET4 started operation
SINET nodes expanded to cover all 47 prefectures of Japan. Major cities from Sapporo to Fukuoka connected at 40 Gbps. High reliability achieved by installing SINET nodes at data centers (instead of universities) and ensuring redundancy. Uninterrupted service even after the March 2011 Great East Japan Earthquake.

2016
SINET5 started operation
All 47 prefectures of Japan connected with short delay at 100 Gbps, the highest speed in the world at that time. Advanced services including virtual university LAN, L2 on demand, direct cloud, and high-speed file transfer. Mobile functions were introduced in December 2018, the world's first global 100 Gbps international line in March 2019, and the world's first long-distance 400 Gbps line (Tokyo-Osaka) in December 2019. Uninterrupted service even after disasters such as the Kumamoto Earthquake (April 2016), flooding in western Japan (July 2018), and the Hokkaido Eastern Iburi Earthquake (September 2018).

2022
SINET6 started operation

Organization (KEK) located in Tsukuba, which is connected to the European Organization for Nuclear Research (CERN) located in Geneva, Switzerland. Their experiments produce massive amounts of observation data, which is shared not just within Japan, but with overseas research groups.

Experimental trials of remote surgery

—— Do you have any other examples of how VPNs are utilized?

A system called "broadcast VPN" is used in earthquake research. Universities and research institutes all over Japan are part of a large-scale VPLS (Virtual Private LAN Service) to transmit observation data simultaneously when an earthquake strikes in a certain location, allowing researchers in each region to rapidly share data and get on with research.

In the experiments with remote surgery that started last year between the university hospitals at Hokkaido University and Kyushu University, the communication bandwidth can be adjusted on demand. Using surgical support robots made in Japan, the team experimented with different communication bandwidths to verify how much bandwidth is required to successfully perform remote surgery. These trials will now continue with SINET6.

—— For such a uniquely high-speed and high-density network, you have to devise ways to precisely control the whole network.

NFV (network functions virtualization)*1 technology is used in various ways to control the network and provide new services. NFV is a software technology that virtually creates network equipment functions on a server. In SINET6, the system is configured with high-performance servers located at 11 "edge" facilities around Japan.

To safeguard against cyber-attacks, the system rapidly responds to DDoS (distributed denial-of-service) attacks that try to paralyze systems by flooding them with large amounts of data (packets). In the past, SINET operators would receive reports of DDoS attacks from a university then take action to suppress the attack packets.

For universities and institutions requiring this service, DDoS attacks can now be detected by traffic monitoring and dealt with automatically. Whereas it would previously take several hours to suppress the attack packets, it should now take around 10 seconds.

We plan to introduce "mirror on demand" functionality to quickly detect suspicious communications

Working with NII Security Operation Collaboration Services (NII-SOCS), we also plan to introduce a function called "mirror on demand" which copies communication traffic between designated universities and transfers it to the NII-SOCS analysis platform.

Linking to supercomputers for research and development

—I hear that SINET6 will be integrated with NII's Research Data Cloud (NII-RDC)*2.

On one hand, some data obtained through research should be openly available from an "open science" perspective, but on the other hand, some data needs to be used within a closed environment. Integrated operation with SINET will mean that data that should be open will be available via the Internet, while data that should be closed will be transferred and managed in a closed environment using VPNs. We want to create a system allowing researchers to use data with confidence, without worrying about the network.

—— Are any symbolic research projects being launched at the same time as SINET6?

Research projects involving transfer and analysis of large amounts of data are maximizing the use of SINET by increasing access lines. For example, there are plans to back up data between RIKEN's supercomputer Fugaku and the University of Tokyo using the full 400 Gbps

data transfer capability.
With SINET6, we have installed new DCs near large-scale research facilities that did not have existing DCs nearby. I think we will see an acceleration in research at these locations, including the Super-Kamiokande observatory in Gifu, the large synchrotron radiation facility SPring-8 in Hyogo, and the International Fusion Energy Research Center (IFERC) in Aomori.
We also expect a surge in research at medical universities. A high-speed network will have

massive benefits for recent areas of medical research, such as remote healthcare using ultra high-definition images, AI analysis of scan images, and experiments in remote surgery using robots.
SINET could also be opened to Ministry of Education, Culture, Sports, Science and Technology's GIGA School Program, which equips elementary and junior high school students with electronic devices. This is currently under consideration, with a target launch date of 2024.

Impact of the war in Ukraine

— What were the difficulties in building SINET6?

The war in Ukraine is a concern. SINET's international network covers the US, Europe, and Asia. The connection to Europe uses Russian lines, which could become unavailable due to economic sanctions against Russia. We would still be able to exchange data with Europe via the US lines, but the transfer time would be considerably longer. We are concerned about the impact this could have on global research activities like the high energy physics experiments, where the data analysis work is shared between Japan and Europe.

— I believe there are plans to open up SINET to private companies.

From April 1, we have set up a system for private trial use of SINET. This is in response to SINET being identified as part of Japan's social infrastructure in the government's Science, Technology, and Innovation Basic Plan. Private companies will be able to use SINET independently.
We expect it to be used for research and development projects involving large amounts of data, such as companies taking part in medical research and development, or industry sectors related to AI and big data. But there are some aspects of a high-speed network like SINET that you just cannot appreciate until you have tried it. We would like to work with interested companies to find effective ways of utilizing SINET.

***1**
NFV:
Network Functions Virtualization
Technology to virtualize functions normally requiring dedicated equipment such as routers, switches, and firewalls, to provide network functions on a general-purpose server. Reduces equipment and operating costs because it replaces hardware.

***2**
NII RDC (Research Data Cloud)
Launched by NII in 2021 as a platform to support the life cycle of research data. Made up of a research data management platform (GakuNin RDM), a publication platform, and a discovery platform (CiNii Research).

A Word from the Interviewer

I knew that Japan had the world's leading academic network, but I did not quite appreciate how incredible it really is. Perhaps that is because I have never experienced for myself the direct benefits of supercomputers and large-scale experimental facilities. But this interview convinced me that the network infrastructure is the engine of data-driven science.
Not only can SINET effortlessly handle massive amounts of data, but its high-density network reduces the distance between researchers, leading to new scientific discoveries and ideas. I am sure other countries are also aware of its potential. I will be keeping an eye on how SINET expands further.

YOSHIKAWA, Kazuki
Senior Staff Writer,
Nihon Keizai Shimbun

Joined Nihon Keizai Shimbun after graduating from Kyushu University. Previously worked in the industry division, Seoul office, director of science and technology division, and head of Nikkei Science. Senior staff writer for science and technology since 2015. Science Journalism Fellow at the Massachusetts Institute of Technology (1997-98).

Photography by IMAMURA, Takuya (pages 8-11)

6 features of SINET 6

A high-speed mesh network

Nationwide 400 Gbps coverage with more nodes to allow constant communication

SINET6 provides a 400 Gbps network covering the whole of Japan. Four times faster than before, it is one of the most advanced networks in the world. What are the aims of this high-speed network, how was it constructed, and what can it do?

National Institute of Informatics
Information Systems Architecture Science Research Division
Associate Professor
KURIMOTO, Takashi

— How did the nationwide 400 Gbps network come about?

SINET6 connects the whole of Japan using a total length of 16,000 km of optical fibers, enabling data to be transferred at speeds up to 400 Gbps between 70 nodes covering every prefecture. (100 Gbps in Okinawa).

Data traffic is increasing exponentially every year. These days, research often involves machine learning, prediction, and control of huge amounts of data, namely big data and AI, so networks are now essential for academic research, and faster speeds are required.

Now that SINET6 operates at 400 Gbps, if a university has two or more sites located at a distance from each other, they can now connect at 400 Gbps by connecting each site to the nearest SINET6 data center (DC). The US academic network Internet2 has also started operating at 400 Gbps, but this is the network backbone, and a constant 400 Gbps connection between universities will not be possible for some time yet. This makes SINET6 the most advanced network in the world.

SINET5 did provide a 400 Gbps connection between Tokyo and Osaka in 2019, but this was something of a one-off, involving a special layout of new optical fibers and the latest equipment. It would be too expensive to use the same method for the whole country, so we have found ways of achieving 400 Gbps with the optical fibers already laid, by carefully selecting those with the best characteristics.

With 400 Gbps communication, if the optical fibers are subjected to vibration, this can cause signal fluctuations which will affect communication. Since the line between Tokyo and Osaka was constructed, improvements have been made to improve stability, so SINET6 ensures more stable communication. The optical fibers have been laid inside steel-plated pipes, as deep underground as possible, to avoid being cut during road construction work.

More data centers for improved connectivity

— What is the purpose of the increased number of data centers?

Experimental facilities for elementary particle research, quantum energy research, and so on are often located in non-urban areas, to avoid the effects of electromagnetic waves and because they require huge sites. And due to advances in experimental equipment, the

“SINET 6 is a world-leading, top class network”

amount of highly detailed experimental data is constantly increasing. So universities were asking for SINET nodes nearby, which is why we have added 20 new nodes. If a data center is located closer, faster communication is possible for the same price.

We hope this will make it easier to acquire data, improving the research environment.

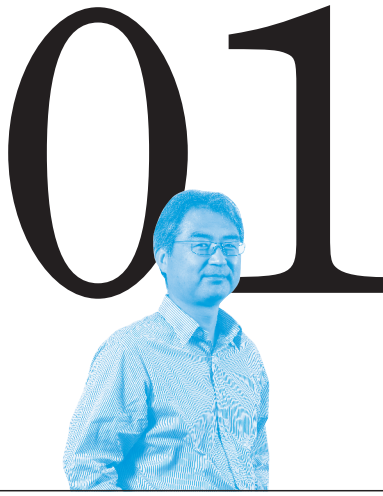
—— Apparently there are fewer communication delays, too.

Fewer delays will allow communication in real time, facilitating all kinds of services. But even with communication using optical fibers, the further the distance, the greater the delay.

For example, if you had one network in the Tohoku region and another network in the Kanto-Koshinetsu region, connected between cities in each region (for example Sendai and Tokyo), even communication between nearby prefectures like Niigata and Akita would have to go through Sendai and Tokyo, making the physical distance longer.

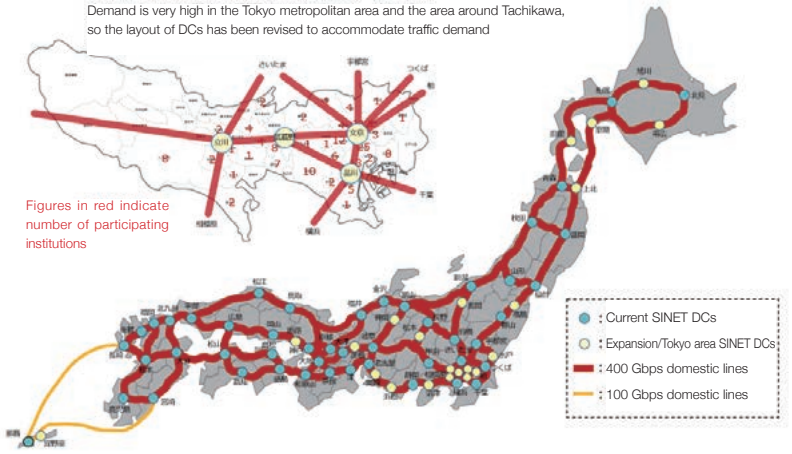
SINET6 is a mesh network with all nodes interconnected to allow communication over the shortest possible distance. It is designed to minimize delays by connecting the whole country at 400 Gbps and with the minimum distance.

Making it a mesh network also increases redundancy*1. For example, the Great East Japan Earthquake caused disconnection of many optical fibers in the Tohoku region. Providing a high level of redundancy allows communication to be maintained in the event of disconnection. As well as natural disasters, communication may be interrupted by equipment failure, which can take several hours to repair or replace. But the current network is required to be connected 24 hours a day, 365 days a year, and communication must be available all the time. The mesh network means communication can always be re-routed in case of failure.



*1
Redundancy: A way of improving reliability by ensuring a system/equipment can still be used if a failure occurs. Spare equipment is provided to avoid the network becoming unavailable. In this case, it means the network can still be used even if an optical fiber becomes disconnected or equipment fails at a data center.

Nationwide expansion of 400 Gbps network and increased number of nodes



(Interview/Written by IGARI, Tomonori)

Photography by IMAMURA, Takuma

Fusion of 5G mobile and 400 Gbps

World-leading mobile usage will unlock new possibilities

National Institute of Informatics
Research and Development
Center for Academic Networks
Project Professor

SASAYAMA, Koji

—— What is the significance of the fusion of 5G and SINET?

SINET was the first academic network to offer mobile functionality, starting at the end of 2018, and is still the only one in the world to do so.

A feature of mobile SINET is that it is directly connected to SINET by constructing virtual private networks (VPNs)*1 as well as borrowing networks from existing private carriers. Crucially, this means the system is configured securely for terminals, SINET, and the computer environment of universities and institutions.

And now we have brought together the 400 Gbps SINET6 network with 5G mobile.

One of the advantages of 5G is that it offers large capacity at high speed. Theoretically, 10 Gbps (5G) is one order of magnitude higher than 1 Gbps (4G), which allows large amounts of data to be rapidly collected and transferred. In addition, its ultra-low latency expands the possibilities of remote real-time control, and since multiple simultaneous connections are possible, the number of sensors can be significantly increased. In the ever-expanding world of IoT (the Internet of Things), this will make it possible to gather information from more sensors or control more devices.

In academia, research is not just carried out on campus and in laboratories. Many researchers are conducting field experiments in agricultural areas, in the mountains, and at sea. Remote healthcare is also a burgeoning area of research, with trials currently underway between Hokkaido University and Kyushu University. If remote surgery is to become a reality in future, there must be absolutely no delay between the operator and the surgical machine. The ultra-low latency of 5G could bring it a lot closer to practical use.

Mobile SINET with 5G will allow the power of SINET to be demonstrated in applications like this.

Local 5G connection is effective even in uninhabited places

—— What are the challenges in using 5G mobile on SINET?

Looking to the future, I think it will be essential for local 5G *2 networks to be constructed and developed at the level of individual universities.

The mobile network in Japan already covers almost 99% of the population. But as IoT applications expand, sensors and devices located in uninhabited are-

as will become more important, making it vital to improve the area-based coverage rate, which is currently only 50% to 70%. Public services provided by private carriers can only cover areas that are profitable as a business, so the development of local 5G is also important to fill that gap.

Currently, 5G mobile SINET runs on a dedicated virtual network within a private carrier network, which relies on the private carrier network combined with the SINET VPN. I foresee that cooperation with local 5G at universities and research institutes will play a major role in future. When it comes to establishing local networks, Japan is leading the world in terms of legislation, which I think is a massive advantage for the academic field.

Another major feature of SINET's local 5G configuration is that rather than placing all functions in individual universities, functions that can be aggregated, such as user management and switching, are placed on SINET and shared by multiple users as a kind of cloud model. Access between SINET and local 5G uses the existing high-capacity lines connecting the LANs of each university and SINET, which will reduce the cost of building local 5G.

—— What are the future prospects?

The biggest challenge for Mobile SINET is how widespread local 5G will become.

Compared to 4G, there is not such a competitive environment for 5G yet, so universities will have to bear some of the cost. This means we will have to start small.

Last year (2021) we embarked on trials of local 5G construction as a joint research project with four universities. In the future, we will invite proposals for good research themes related to 5G mobile, expanding the scope to include local universities. For some of the best themes selected, we are also considering developing local 5G base stations to be installed at universities through joint research with SINET. This is part of our initiative to quickly expand local 5G nationwide.

We hope examples of good practices like this will stimulate the spread of local 5G.

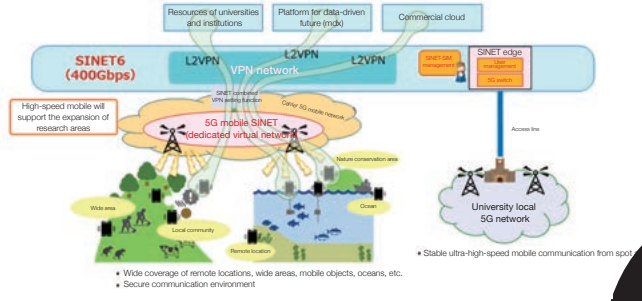
***1**

VPN: Virtual Private Network. A technology used to create dedicated networks that can only be used by certain organizations within a communication network.

***2**

Local 5G: A 5G network that can be independently constructed and used within a limited range to fulfill the needs of companies, local governments, universities, etc.

Convergence of 5G mobile and 400 Gbps network



SINET6 has evolved to support the 5th generation (5G) mobile communication system. What will this 5G mobile connectivity make possible, and what kind of future will emerge?

SINET6 is the world's first and only academic network with mobile functionality

02

(Interview/Written by KAWABATA, Hideki)

Photography by IMAMURA, Takuma

Blocking DDoS attacks in a matter of seconds

Edge functions for improved usability and reinforced security

SINET6 includes more methods of redundancy with multiple lines. It can also now respond to DDoS*1 attacks in just 10 seconds. We find out more about the new system.

National Institute of Informatics
Information Systems Architecture Science Research Division
Associate Professor
KURIMOTO, Takashi

—— More connection methods have been added to connect to SINET via multiple routes. What is the aim of this?

These days, a network must be able to provide stable and uninterrupted service. Universities and institutions are connected to SINET6 by multiple lines to provide redundancy. Lines from universities and institutions to SINET's data centers (DCs) are connected to line cards in a chassis. If there is only a single connection, communication will be lost in the case of a failure.

Previous versions up to SINET5 avoided this by providing two connection methods. One method was to have two lines to one DC, connected to two different line cards, so that if one line card fails, communication is still possible using the other one. The other method is by connecting to two DCs. With this method, if there is a failure at one DC, connection is maintained via the other DC. But this requires separate lines for different DCs. (Individual institutions provide the lines to connect to SINET.) This can become very expensive, especially when connecting to a DC in another prefecture, due to the longer distance.

With SINET6, it is now possible to connect one line to the line card and another to a line multiplexer so that it can connect to a different DC via VPN*2. The line card and line multiplexer are separate devices, which means communication can be maintained even if one of them fails. This keeps costs down as well as provides a higher degree of redundancy.

—— Do a lot of universities have multiple connection lines?

It is on the increase recently, particularly among larger universities. But it does add to the cost, so many universities have one high-speed line and then a low-speed line as back-up.

Edge functions quickly block DDoS attacks

—— Tell us about the newly added edge/NFV functions in SINET6.

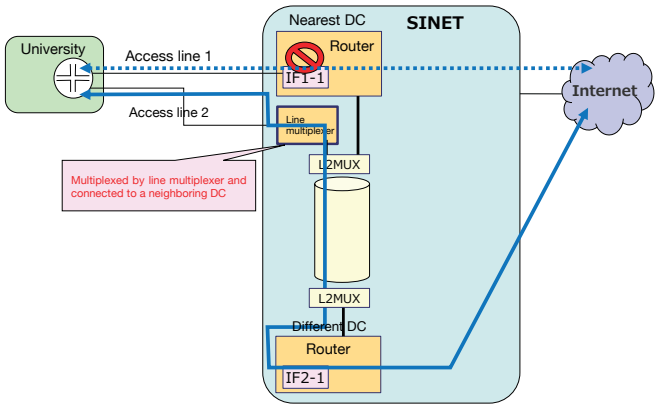
We have installed edge/NFV (to run network/security equipment on a virtual machine on a general-purpose server) at 11 locations.

In SINET, "edge" serves two purposes. The first is edge computing in a literal sense, to provide services making use of the extremely small delay of less than 2 ms (milliseconds = 1/1,000 of a second) each way.

The other is as a service provision platform. SINET's routers*3 require stable

“These days, a network must provide a stable and uninterrupted service”

The new redundancy configuration of SINET6



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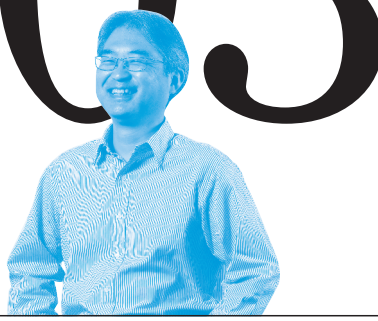


operation, so we need to be careful when adding functions to our routers. Using edge to install new functions allows more flexibility to add functions like local 5G functions and VPNs that are not possible with routers.

We also plan to implement a high-speed file transfer function. Files can be transferred faster by installing dedicated software for both the sender and receiver, but by providing that function using edge/NFV, users will be able to transfer files at high speed simply using a web browser.

— The safeguarding function against DDoS attacks also operates using edge, doesn’t it?

DDoS attacks disrupt communication by flooding the system with large amounts of data.

Previously, an operator would have to perform settings to destroy the attack packets in response to a request from a university, so it took time to respond to DDoS attacks.

It can be difficult to distinguish attack traffic from legitimate traffic, and increasingly, such attacks quickly destroy the system and then get away. It is vital to quickly detect and stop DDoS attacks. Our new edge-based DDoS detection and control system samples (1/1,000) and monitors communications to pre-determined addresses at the internet connection point. If an attack is detected, the attack packets are destroyed in around 10 seconds. We have actually been working on this since SINET5, but it has now been fully introduced with SINET6.

Some universities already implement thorough safeguarding measures against DDoS attacks and analyze the attacks. The measures provided by SINET6 are not sufficient on their own, and are intended to be used in combination with each university’s system.

*1
DDoS attack: Distributed Denial of Service attack.
A DoS attack overloads a server by deliberately flooding it with excessive amounts of traffic or exploiting vulnerabilities in a system. A DDoS attack is a DoS attack from multiple computers.

*2
Using a VPN, you can connect to a different DC from the one you are actually connected to via a line multiplexer, as if using a dedicated line.

*3
Router: The device that relays communications in a network. It determines which route to use to transfer data from source to destination. SINET routers are installed in each DC, and must support 400 Gbps.

(Interview/Written by IGARI, Tomonori)

Photography by IMAMURA, Takuma

Enhanced international network

Boosting academic research and education in Japan and around the world

SINET is connected to large-scale international experimental facilities in Japan and other countries.
The enhanced international network of SINET6 will boost academic research and education in Japan and around the world.

National Institute of Informatics
Research and Development Center for Academic Networks
Project Professor
AKASHI, Osamu

— Which international lines have been enhanced in SINET6?

In 2019, SINET formed an academic network with a 100 Gbps line all around the world. With SINET6, we have added two new 100 Gbps lines from Japan to Los Angeles and New York. In Asia, a new 100 Gbps line has been installed to Guam, in addition to the existing 100 Gbps link with Singapore. There is also already a 100 Gbps line connecting Japan to Europe, and there are plans for a second line (200 Gbps) by 2024. SINET is the world's only academic network with such an advanced configuration of international lines, and it has now been enhanced even further by increasing the bandwidth and adding the new Guam line.

— Tell us about the background of this enhanced international network.

SINET is connected to large-scale international experimental facilities including the Large Helical Device (LHD) at the National Institute for Fusion Science in Japan, as well as the Large Hadron Collider (LHC) and International Thermonuclear Experimental Reactor (ITER) in Europe. Obtaining detailed, high-quality data from these large-scale experimental facilities requires a lot of bandwidth. Researchers, especially those handling data from international facilities, have asked us to increase the bandwidth by using the shortest routes possible to minimize round trip time (RTT *1).

Another factor was the recent increase in large-scale international collaboration projects in the US, Europe, and Asia. The ability to handle stable and large-capacity traffic will fuel academic research and education in Japan and around the world.

Guam is becoming a hub

The main difference from best-effort*2 commercial internet services is that SINET is a specialized network for research and education traffic, so it is designed for efficient exchange of this type of traffic based on forecast demand. Bandwidth is guaranteed from any user institution in Japan, and the available bandwidth can be used effectively.

SINET also allows data to be transferred securely. Confidential data should not be sent over the Internet, but SINET provides virtual dedicated networks allowing data to be exchanged securely

with academic networks in other countries.

— Why was Guam chosen to enhance the Asian line?

One problem with the existing line to Singapore is that the sea is relatively shallow, meaning there is a higher risk of damage to under-sea cables. The sea is much deeper around Guam. Another reason for selecting Guam was its superior location between the US and Australia. Guam is becoming a hub for connection to networks like Australia and Hawaii. The Guam line means that traffic can be rerouted in case of problems with the Singapore line.

— What effects will the enhanced international network have?

Firstly, it will improve experimental efficiency by enabling huge amounts of data to be obtained from large-scale international experimental facilities in other countries with a short RTT. Acquiring highly detailed data should benefit research. Having a network with high bandwidth will also increase the influence of Japanese researchers within international collaboration projects and increase the competitiveness of Japanese academic research.

Secondly, it will enable stable operation of the network. SINET is interconnected with other academic networks at high bandwidth, so it functions as a network backbone, providing mutual back-up and interoperation.

In the unlikely event of SINET getting cut off, other academic networks can be used as back-up to ensure even more stable operation.

— What are the future prospects?

The European line will be strengthened in two years' time. We are currently discussing possible routes. There is demand for higher traffic, but there is a trade-off between the bandwidth of under-sea cables and cost. We need to proceed carefully, listening to the views of each institution. International lines are also affected by political factors, so we will need to prepare alternative routes and back-up plans.

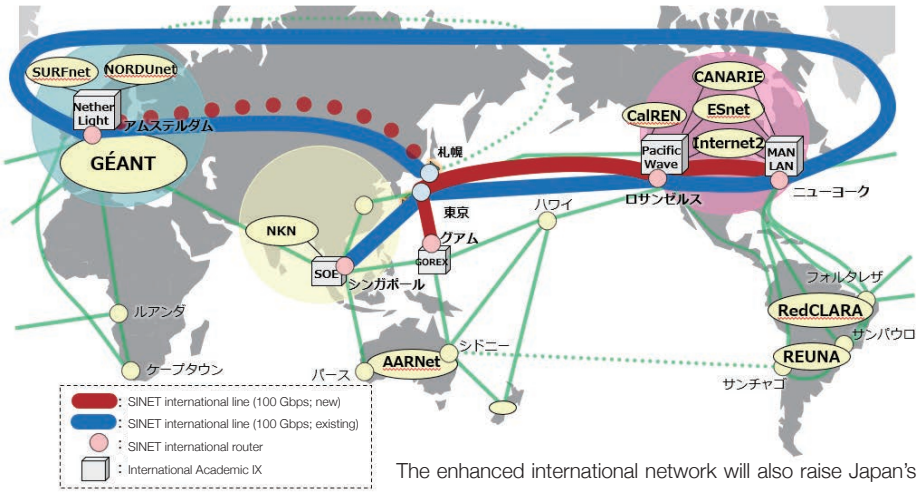
A new under-sea communication cable via the Arctic Ocean is under consideration, although it would take a long time from planning to implementation. But if the Arctic Ocean line becomes a reality, it might be possible to achieve 400 Gbps for international lines.

*1
RTT: Round-Trip Time. The time taken from sending data or a signal to receiving a response. Depends on the physical distance between sender and receiver, relays on the route, the number of devices, etc.

*2
Best-effort: Internet service providing the best effort speed up to the maximum communication speed advertised by the provider (actual communication speed is not guaranteed).

More efficient experiments and international-level research

International network bandwidth has doubled



The enhanced international network will also raise Japan's influence and international competitiveness in different fields of research.

(Interview/Written by NAKAMURA, Hitomi)

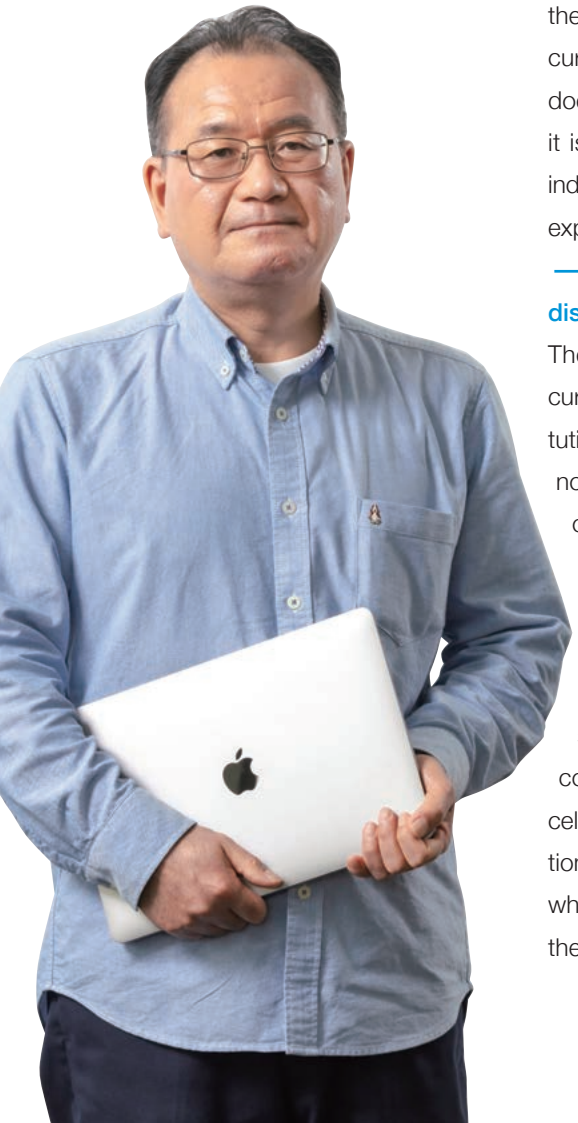
Photography by IMAMURA, Takuma

Joint purchase brings big budget savings!

The significance and benefits of jointly procuring access lines

User institutions bear the costs for access lines connecting them with SINET's routers at data centers (DCs). The National Institute of Informatics (NII) encourages institutions to share the cost through joint procurement*1. We asked about the advantages, disadvantages, and challenges.

National Institute of Informatics
Associate Professor, Information System Architecture Science Research Division
Head of SINET Promotion Office
ABE, Shunji



—— What is the purpose of joint procurement of access lines?

We started offering joint procurement from SINET4, to reduce the cost of access lines for user institutions.

—— So it is about the financial benefits of joint procurement?

That's right. Of course, users can expect a direct reduction in costs due to the volume discount effect of joint procurement. But even if a user institution does not take part in joint procurement, it is possible to negotiate the price for individual procurement too, so they can expect some kind of discount.

—— Does joint procurement have any disadvantages?

The basic specifications for joint procurement are set by NII, so a user institution may not be able to join if they are not happy with these specifications. Of course, we do take institutions' views on board through questionnaires and so on when setting the specifications, but there are certain conditions they must agree to, like the start date of April 1 and the 6-year contract period which cannot be cancelled mid-contract. Sometimes institutions cannot accept these conditions, in which case they would have to procure the line individually.

Higher-than-expected savings and an increased uptake in joint procurement produce a synergistic effect

—— The uptake in joint procurement has increased significantly from SINET5. What are the factors behind this increase?

With SINET5, there were 117 jointly procured lines, but there are now 222, an increase of around 90%.

I think one of the main factors is the major cost saving of joint procurement.

Another factor is that when SINET5 was first launched, some institutions using jointly procured lines could not get the full performance, but we provided extensive user support to help them with fine tuning and so on. The stable operation of SINET, including this sense of trust, could be another factor in the increased uptake.

—— Did the COVID-19 pandemic cause any difficulties?

There were some delays in delivery of equipment like routers.

The pandemic caused shortages in the semiconductor industry, which severely affected the supply of routers.

We were aware before the start of joint procurement that it would be difficult to secure supplies of optical fibers and

“We want the specifications to incorporate the circumstances of as many user institutions as possible”

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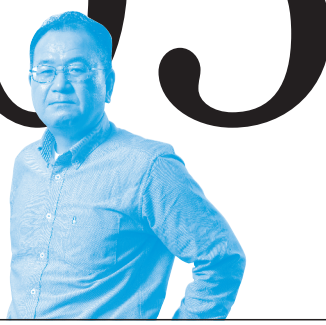


communication equipment, but unfortunately the delays were worse than expected.

Of course, this had a big impact on user institutions too, because they were all working to their own plans and delivery delays meant they could not start using the service as planned. I think it was particularly tough for the team working on our inquiry desk, because they had to handle lots of inquiries and complaints from user institutions asking “how much longer will it take?”

How to incorporate individual needs

—— Are there any other challenges?

Coordinating the specifications for joint procurement is a challenge. We need to properly incorporate the needs of each user institution when setting the specifications so that more institutions can take part.

We want the specifications to incorporate the circumstances of as many user institutions as possible, but it has been difficult due to a lack of human resources on the specification setting side, and concerns about the increased cost if individual requests are taken into account. Currently, we have had to go with a one-size-fits-all approach.

—What about future development?

We want to improve the specifications to get the balance right so that more user institutions will take advantage of joint procurement.

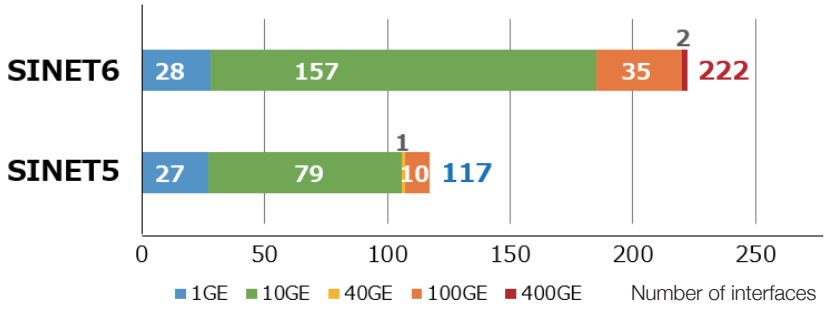
Providing stable service is very important, too. SINET6 will be evaluated based on how it operates, and whether it can recover quickly in the unlikely event of a failure.

I want to work with the whole team to provide a service that will make user institutions feel that joint procurement was the right decision.

*1

Joint procurement: Joint procurement covers access lines, monitoring and maintenance, cost of installation space at data centers, installation, and removal. User institutions can select from 400 G, 100 G, 10 G, or 1G lines to suit their environment.

Uptake of joint procurement of SINET6 access lines



(Interview/Written by ENDO, Hiroyuki)

Photography by IMAMURA, Takuma

Improving the international research environment

National Institute of Informatics
Project Associate Professor,
Advanced ICT Center

YAMANAKA, Kenjiro

—What is the importance of long-distance high-speed data communication technology in SINET6?

Currently, protocols*1 like FTP and SCP are generally used to transfer files. These can achieve quite good speeds over short distances, but the speed drops greatly over long distances such as between Japan and the US or between Japan and Europe. SINET5 already provided 100 Gbps performance on major international lines, but normal software cannot deliver that performance, so speeds fell to a few Mbps at best.

However, the idea of "data-intensive science" is gaining a lot of attention these days. This means distributing data to different parts of the world to be analyzed, allowing much larger volumes of data to be processed than ever before.

In the field of high-energy physics, for example, the Large Hadron Collider itself is located in Switzerland, but the data obtained from it is distributed around the world to be analyzed.

To better achieve this, large amounts of data need to be sent at high speed. As mentioned earlier, SINET provides a 100 Gbps connection for international lines and 400 Gbps within Japan, so we need a transfer method that matches those speeds to take advantage of that infrastructure. That is why NII has developed the MMCFTP (Massively Multi-Connection File Transfer Protocol).

Long-distance transfer is now much faster

—What are the features of MMCFTP and what were the difficulties in developing it?

I was involved in developing the software, so speaking from my own experience, one feature is that clock synchronization, a so-called hardware concept, is applied to normal software development. This facilitates parallel processing by allowing multiple devices to be operated simultaneously.

Conventional communication methods rely on a single connection, so the speed is limited by the performance of one core (the CPU core responsible for processing). MMCFTP is a multi-connection communication method with many connections, so the greater the number of CPU cores, the faster communication can be achieved. It also provides "dynamic connection control" to automatically adjust the number of con-

nections according to the network conditions for a specified transfer speed. In other words, it can make the most of the available network environment.

It used to take around 20 minutes to transfer 1 Tb of data at 8 Gbps with the conventional method, but it takes just 2 minutes at 80 Gbps with the new method.

Although we were confident that this method should work, in reality "you never know until you try it". I can say that it was only possible to improve speed this much because development was done with SINET.

—Can you tell us about the future challenges?

So far, we have been focusing on speed, but I feel that practical usability has been somewhat left behind. Compared to similar technologies in other countries, we are proud of our superior speeds, but there is room for improvement in other aspects, such as tutorials to teach users about the functions and usage, the usability of the product itself, and bug fixes.

The software is currently available to SINET users. I think we need to involve these users as widely as possible in publicizing and refining it as a product.

But for higher speeds, you need a network that can handle it. SINET provides lines with speeds of 100 Gbps or more, but 100 Gbps is out of reach for normal people, so they will not benefit from high speeds with software alone. This limited reach is one difficulty.

In terms of increasing speed itself, we will never know what is possible unless we keep trying.

One difficulty in information technology is that the anticipated performance of one element cannot be demonstrated unless all elements are improved in a balanced way. File transfer requires data to be read from a disk, which causes a bottleneck, stopping overall transfer speeds from increasing. This is an issue we have struggled with since the development stage. But now this is improving rapidly, thanks to the increasing popularity of SSDs *2.

I hope we can carry on improving file transfer methods to keep pace with advances in related technologies like this.

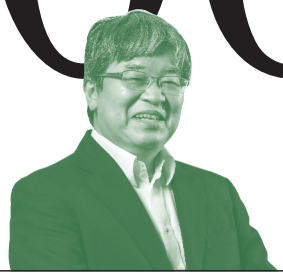
*Titles at the time of writing in April 2022.

*1
Protocol: A set of rules and specifications for communication on a network.

*2
SSD: Solid State Drive. A storage device that can be used in the same way as an HDD (Hard Disk Drive). Smaller than an HDD, with faster processing speed.

Higher speeds were achieved by development with SINET

06

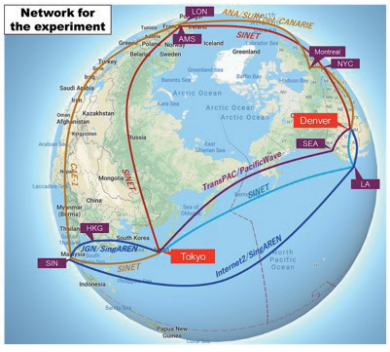


NII's own protocol to speed up long-distance high-speed data communication

Making use of big data requires unprecedented transfer speeds and volumes.

For SINET6, NII has independently developed a long-distance high-speed data transfer method that does not require OS modification or complicated tuning. We look at its features and future prospects.

Transfer test between Tokyo and Denver



Transfer test between Tokyo and Denver using the MMCFTP file transfer protocol developed by NII at the SC19 international conference. Peak transfer speed of 416.3 Gbps recorded using five 100 Gbps international lines.

(Interview/Written by KAWABATA, Hideki)

Photography by IMAMURA, Takuma

The journey from [Science Information NETwork]

During the migration from SINET5 to SINET6, the members of the SINET Team at the National Institute of Informatics (NII)'s Academic Infrastructure Division worked tirelessly as a point of contact for user institutions and to coordinate discussions with related parties. We talked to those who worked behind the scenes to make the migration happen.

Behind-the-scenes teamwork that supported the migration

National Institute of Informatics
Academic Infrastructure Division SINET Team

The SINET Team is made up of seven employees from the Academic Infrastructure Division. "We are jacks of all trades," the team members all agree. Their work covers everything from handling user inquiries to planning, operation, specification design, troubleshooting, and supporting user institutions when connecting to SINET. "We individually outsource some tasks, like the operation center dealing with failure queries and the point of contact for new applications, but we skim off any queries that do not fit in to the outsourcing workflow, or irregular cases requiring individual decisions." (SINET Team)

In 2021-22, at the same time as these normal tasks, the team worked on the migration to SINET6.

Put simply, "migration to SINET6" involves switching where user institution lines connect to. There are two ways of doing this: "delegated migration" where NII's outsourced workers go into the SINET data center (DC) at a weekend to perform the switching, or "individual migration" where the user institution arranges the work during the working day and performs the switching on site.

On this occasion, migration work was affected by delivery delays due to the COVID-19 pandemic, so the migration timeline ended up changing significantly from the original schedule.

NII started letting users know about the migration in 2020. Information on SINET6 was available to user institutions through the SINET Open Forum in June 2020 and the NII service briefing in December 2020.

At the service briefing held online in January 2021, user institutions were informed that SINET5 would be ending in March 2022 so they would need to migrate by then. Once the locations of DCs for SINET6 were decided in April 2021, user institutions affected by relocation (those who would be connected to a different DC) were informed in June. A migration briefing session was held in October, and scheduling of delegated migration should have started in November.

"We started procuring facilities for DCs in 2020, but the DCs were only finalized in April 2021, so that is when we started setting up access lines for user institutions and installing DC equipment on the SINET

Progress towards migrating to SINET6

January 2021	NII service briefing (online)
April 2021	Location of SINET6 DCs decided (e-mail notification) Start of inquiries for SINET6 DC addresses
June 2021	Notification to DC relocation institutions (individual e-mails)
July 2021	Open forum (online)
July–November 202	Physical construction of SINET6 DC sites
	August 20, 2021: 25,975 new cases (positive PCR tests) in Japan*
August 2021	SINET6 migration method survey (e-mail, online form)
October 2021	Migration briefing (online)
	to explain the delay due to the impact of semiconductor shortages
October 2021–February 2022	Equipment installed at SINET6 sites
November 2021	NII service briefing (online)
November–December 2021	Individual consultations (online meetings)
December 2021–February 2022	Delegated migration registration/scheduling
	February 1, 2022: 103,595 new cases (positive PCR tests) in Japan*
	University entrance exams and events
February–March 2022	Delegated migration/individual migration
April 1, 2022	SINET6 started operation (press conference)

*From Ministry of Health, Labour and Welfare data for number of newly confirmed cases (daily)

The steep road to migration from SINET5 to SINET6, and what comes next

side. We had to complete the migration in under a year, making the schedule very tight for each task."(SINET Team)

Coordinating related companies and responding to user institutions

Meetings that would normally have been held face-to-face, including sharing information within NII, communication with user institutions, and negotiations with related parties, all had to be done online during the pandemic.

"Usually, a member of the team would sit in on meetings between professors and so on, but this time they were mostly held online, so in some cases we were not able to attend due to time clashes, which made it difficult to share progress and keep everyone up-to-date on the finer details. It takes about six months to procure equipment, so sometimes we might come across an unexpected issue in the meantime that could affect functionality or cause operational difficulties. There were some delays in updating this kind of information." (SINET Team)

The SINET team also had to deal with delays in the supply of equipment due to the shortage of semiconductors. One aspect of this was negotiating with related parties.

"There were various different companies involved, including network equipment vendors, DC and domestic/international line vendors, and domestic and overseas operation centers. We had to negotiate between them as necessary, including tasks falling in the gaps not covered by any of them."(SINET Team)

The team also had to explain delivery delays to user institutions and consider measures to be taken. User institutions were pressing forward with preparations based on the original migration plan, and any delays would impact them in various ways, so they were understandably nervous. Some harsh words were directed at the team members handling inquiries.

"We had to coordinate the timescale for migration for almost 1,000 institutions, but we did not know when the equipment would be delivered. It was very frustrating when institutions were asking "when will it be?" and we could not give them an answer."(SINET Team)

Migration work was originally scheduled to begin in January 2022, but it was actually put back to mid-February onwards, meaning that all institutions had to be migrated in just a month and a half.

"We ended up having to coordinate time periods to minimize disruption for each user institution, and doing 60 to 80 tasks per day for delegated migration on weekends. By the end of March, there were more than 20 migrations per day on weekdays too (individual migration), working right up to 31 March, the day before SINET6 was launched. It must have been hard for everyone involved."(SINET Team)

Thanks to the cooperation of user institutions and related companies and the tireless work of the SINET Team, SINET6 was successfully launched on schedule on April 1. The team members must surely have felt a sense of relief? "Oh, no. Our work really starts now that SINET6 has been launched. We are working to ensure stable operation." (SINET Team)

"We skim off irregular cases requiring individual ecisions"

NII NEWS TOPICS

Period From February 15 (Tue.) to May 6 (Fri.), 2022

More details about news items are available online.
www.nii.ac.jp/news/2022

NEWS RELEASE

2022

Apr. 18 Discovery of academic information linked to articles with CiNii Research:
CiNii Articles integrated into CiNii Research

Apr. 8 Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology (Promotion Category) for medical big data cloud platform's contribution to AI automatic diagnosis researchJointly awarded to SATOH, Shin'ichi and AIDA Kento (Professors, NII); MORI, Kensaku (Professor, Nagoya University); and HARADA, Tatsuya (Professor, University of Tokyo)

Apr. 1 Launch of our academic research platform to support Society5.0: SINET6, offering speeds of 400 Gbps nationwide, is integrated with NII-RDC to promote Japan's research data utilization, communication, and management

Mar. 15 Research using storyboards from the animation "Little Witch Academia": Production studio Trigger starts providing animation resources data to researchers

Feb. 28 Distributed data linkage platform technology developed as part of research and development of "Big-data and AI-enabled Cyberspace Technologies." for the government's Strategic Innovation Promotion Program (SIP) Phase 2, and demonstration for social implementation started

AWARDS

2022

Apr. 26 ROIS-DS Center for Open Data in the Humanities (CODH) awarded Code for Japan 2021 Award for Excellence

Apr. 8 2022 Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology (Science and Technology Promotion Category) awarded to ARAI, Noriko (Professor, Information and Society Research Division); MASUKAWA, Ryuji (Professor by Special Appointment, Research Center for Community Knowledge), and their team

Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology (Promotion Category) for medical big data cloud platform's contribution to AI automatic diagnosis research: Jointly awarded to SATOH, Shin'ichi and AIDA, Kento (Professors, NII); MORI, Kensaku (Professor, Nagoya University); and HARADA, Tatsuya (Professor, University of Tokyo)

Mar. 14 A paper by AOKI, Shunsuke (Assistant Professor, Information Systems Architecture Science Research Division) et al awarded the 37th Telecommunications Advancement Foundation's Telecom Systems Technology Award, Encouragement Award

Mar. 2 NEMOTO, Kae (Professor of Principles of Informatics Research Division, Director of Global Research Center for Quantum Information Science) awarded France's National Order of Merit

Feb. 21 AOKI, Shunsuke (Assistant Professor, Information Systems Architecture Science Research Division) awarded Funai Foundation Research Encouragement Award

IGARASHI, Ayumi (Associate Professor, Principles of Informatics Research Division) awarded Funai Foundation Research Encouragement Award

HIRAHARA, Shuichi (Associate Professor, Principles of Informatics Research Division) awarded Funai Foundation Research Encouragement Award

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www.nii.ac.jp/today/iken

Bit (NII Character)

NEWS

2022

Mar. 29 Corpus of Japanese Empathetic Dialogue Speech (STUDIES) is published

Mar. 17 PR magazine NII Today, No. 94 “Don’t Stop the Education!: Two years of the DX Symposium for Educational Institutions” is published

Mar. 10 “Rakuten Dataset” updated in the Informatics Research Data Repository (IDR)

Feb. 21 2021 NII Public lecture series No. 4 “Who owns academic information? Creating our future society through open science” (FUNAMORI, Miho, Associate professor)

EVENT

▶ www.nii.ac.jp/news/2022

NII OPEN HOUSE 2022

☐ **Jun. 6 to Jun. 10, 2022** Japan Open Science Summit 2022 (JOSS2022) held online
▶https://joss.rcos.nii.ac.jp/

☐ **Jun. 3 to Jun. 4, 2022** NII Open House 2022 (public presentation of research results) held as a hybrid event (online and in-person)
▶https://www.nii.ac.jp/event/openhouse/

☐ **May. 30 to Jun. 2, 2022** NII Open Forum on Informatics 2022 held online
▶https://www.nii.ac.jp/openforum/2022

☐ **May. 16, 2022** 2022 NII Research and education staff recruitment briefing

☐ **May. 13, 2022** 50th Cyber Symposium on Online Education and Digital Transformation in Universities and Other Institutions “DX Symposium for Educational Institutions” (held online)

☐ **Mar. 29, 2022** 2021 NII Commemorative Lecture on the retirement of Professor HASHIZUME, Hiromichi and Professor TAKANO, Akihiko

☐ **Mar. 25, 2022** Academic forum “Data Society and Open Science in the Time of COVID-19” (Sponsored by Science Council of Japan)
2nd anniversary. 48th Cyber Symposium on Online Education and Digital Transformation in Universities and Other Institutions “DX Symposium for Educational Institutions” (held online)

☐ **Mar. 4, 2022** 47th Cyber Symposium on Online Education and Digital Transformation in Universities and Other Institutions “DX Symposium for Educational Institutions” (held online)

☐ **Feb. 22, 2022** 2021 Public lecture series “Frontiers of Informatics” No. 4]
“Who owns academic information? Creating our future society through open science” FUNAMORI, Miho, Associate professor (online)
SPARC Japan Seminar 2021 “What Should Research Data Policies Achieve?”

[Essay]

The best research needs the best tools

—— The anxiety and joy of putting your work out there

When I was a student, I was building a prototype for a parallel computer in my laboratory for my graduation project.

These days, now that even smartphones contain multiple CPU cores, we may think nothing of a computer with multiple CPUs executing programs in parallel. But it was still a new type of computer in those days, with research being conducted at many universities and research institutes. I would write a program from a seminar assignment and try it out, but a program that worked one day might not work the next day. When I asked my senior colleagues for advice, they would joke that I was not giving it enough affection. “Please work,” I would pray as I pressed the return key. When making a prototype for your own research, this is acceptable (I think!) In fact, for a researcher, this makes it more interesting.

However, when it comes to actual equipment to be used by thousands of researchers, such an approach will not do. It has to work 24 hours a day, 365 days a year. In the unlikely event that it fails, you need to be able

to provide a strong, intelligent, and decisive response.

If stable, long-term operation is required, you could avoid any technical challenges, but that is not good enough for something that will be used for cutting-edge research. Thinking of it like a car, we must pursue the reliability of a passenger car and the high performance of a racing car at the same time. The best research needs the best tools.

To create such a tool, people with various specialties and skills must work together to put together the different pieces of the puzzle – performance, reliability, budget, and people. Just when you think it has all come together, you find a mistake or a missing piece. But you must not let it get to you. Sometimes you feel like giving up, but your colleagues encourage you to carry on.

When a tool has been created in this way, it is mostly an anxious feeling when it is first launched out into the world. But there is nothing like the feeling when researchers produce good results using that tool. Usually, the people who made the tool are not directly involved in research and are never named in research papers. But we still feel happy and proud that the tools we have made are being used to produce good research results. At such times, we feel glad to have worked on it with our colleagues without giving up, which motivates us to take on the next challenge.

SINET6 was launched in spring 2022. I want to express my respect for everyone involved in the development and maintenance (especially the on-site teams) and my gratitude to everyone who has supported us. I cannot wait to see what research results will be produced.

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National Institute of Informatics
General Manager, Cyber Science Infrastructure Development Department
Director, Center for Cloud Research and Development

AIDA, Kento

Weaving Information into Knowledge
NII

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