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FEATURED TOPIC | **The Academic Cloud**

Academic Cloud Changing the Front

As the connection exists above the clouds themselves, cloud computing makes a high level of data processing possible. An environment has been set up in which leading-edge clouds can be used in the areas of education and academic research. What is this academic cloud being used on the front lines of education and research? And what will it bring to education and research in Japan in the future?

Nobukazu Yoshioka
Associate Professor, Information Systems Architecture Science Research Division, Center for Global Research in Advanced Software Science and Engineering (GRACE Center), NII

A Cloud for Learning the Cloud

Sugimori: Lately, we have been hearing the word "academic cloud." What is that?

Yoshioka: There is no standard definition. In cloud computing, data is saved and processed on a network. Cloud computing done within universities and research labs is what we refer to as the "academic cloud."

Sugimori: What are the characteristics of the academic cloud and how does it differ from the standard cloud?

Yoshioka: Well, in the standard cloud, efficiency is sought after by means of hiding its content. A major characteristic of the academic cloud at the National Institute of Informatics (NII) is that the content, or in other words mechanisms of the cloud, are visible. The academic cloud is not just for when one makes use of a computer. It is used in learning how the cloud works and in research.

Sugimori: So the purpose of the academic cloud can be said to be for studying and researching the cloud itself.

Yoshioka: That's right. As that is the case, only open source (in which specifications have been made public) technology is used. This allows those who use it to change and manipulate it.

Sugimori: But if it were to be changed on a whim, would other people using the same cloud not face problems?

Yoshioka: Well, with a standard cloud there would be a large unspecified number of people who share one machine. The NII "academic cloud" separates machines in terms of groups according to which research team or class unit they belong. It is then used exclusively within that group. As the designated space belongs to a specific group, content changes can be made freely and thus shared within the group itself.

Contributions of the Cloud in Education and Research

Sugimori: What is more convenient when using the cloud?

Yoshioka: Well, up until now, computer set-ups were necessary when performing computer language and web exercises. With the cloud, however, saved exercise environments can be read immediately; making it possible to accom-

Lines of Education and Research

Jun Sugimori

Yomiuri Shimbun Tokyo Head Office - Sciences Department Journalist

Jun Sugimori has an MSc from the University of Tokyo. He joined the Yomiuri Shimbun in 1989, the Sciences Department in 1999. He is mainly in charge of Education, Fundamental Sciences and Medicine. He has been in charge of IT and Technology since April. He has an interest in the cultivation of IT-related human resources, and has covered the NII training program "TopSE" in the past.

plish in a few minutes what used to take a day.

Sugimori: So what you are saying is that if there is an exercise that is easy to understand and has good educational merit, it can be copied and used with ease in another course.

Yoshioka: Exactly. By saving at certain points of the exercise, one can omit specific portions and concentrate their lesson on the important parts, much like in the television show "3-Minute Cooking."

Sugimori: What are the merits for students and researchers whose areas of expertise are not computers?

Yoshioka: Well, economics simulations and bibliographical source searches can be performed, as can advance preparation of menus that use computers. There is no need for people to set anything up by themselves; it makes computers more approachable.

Sugimori: To what extent has the academic cloud been popularized?

Yoshioka: Its usage has pretty much just begun. In 2009, NII constructed an academic cloud called the "edubase Cloud,*" and it has been in operation since 2010. Last year, one of the largest academic clouds in the country was constructed at Hokkaido University. Overseas, NASA has brought into one cloud various data that were previously managed in a non-centralized manner, resulting in more efficiency in terms of handling information. For educational purposes, they also offer a service in which the surface of Saturn can be viewed.

Sugimori: When you say "one of the largest in the country," just how large are we talking about?

Yoshioka: While the NII Cloud consists of 1,500 computers, the one at Hokkaido University consists of 2,000. Efforts are being made to offer services to individuals who are not very knowledgeable about computers, so that the cloud may have an even wider user base. By submitting an application to Hokkaido University, any researcher or student from any university across the country can use the cloud for a fee. The NII cloud, however, is free.

Sugimori: How will the academic cloud progress from here on?

Yoshioka: I think that these clouds will be the norm in about five years. There is little doubt that in the future, clouds will be tied together and linked. There are limits to computing power, but by linking to one another, power can be lent and borrowed when needed. In times of accidents or trouble, functions can also be taken over. At the present time, there is no system in place that can automatically control such lending and borrowing. As such, research about this area is moving forward. NII is currently trying to start a linkage with an academic cloud in Australia. I expect that computers all over the world will one day be linked and that a system will come about in which they can all work as one.

Sugimori: What is the merit of linkage only found in universities or research institutes?

Yoshioka: When undertaking joint research, sharing data via the cloud allows you to carry out data analysis and simulations easily, without having to even think about physical locations. If computing power can be fully facilitated, millions of computers can be called upon for computing during crises; for example, such as when there is a large earthquake and the height of a tsunami must be predicted. What NII wants to do is contribute to the development of this field by cultivating human resources capable of making full use of the cloud and creating new cloud systems. This is how I would like to contribute to the progress of this field.

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A Word from the Interviewer

How is an academic cloud different from any other cloud? I went into this interview without any concrete image of what that difference was, but I was convinced by the explanation that an academic cloud is for "learning and researching about the cloud." Linux, an operating system used in computers around the world, came to be where it is now because of young people who learned on it and tried to make it into something satisfying. On that note, I cannot wait to see what the future has in store for the academic cloud.

* http://edubase.jp/cloud

Academic Cloud Gains Momentum with SINET

SINET is a science information network created and operated by NII which connects universities and research institutions around Japan. Full-scale operation of SINET4 began in April 2011, increasing the importance of its role as a foundation for science information. This report provides information on the latest trends and future prospects related to SINET, which supports the private cloud structure of many universities, and continues to evolve as an essential piece of network infrastructure for the academic community.

Offering Cutting-edge Research Environments to more than 700 Universities and Research Institutions

SINET has one ultimate task according to Professor Shigeo Urushidani (Information Systems Architecture Science Research Division), who is involved in the operation of SINET at NII. That task is the advancement of academic research and creation of new value through an ultra-high-speed information network." SINET provides infrastructure for ultra-high-speed communication to universities and research institutions throughout Japan. Its role extends much farther than simply the providing of information network.

"SINET connects cutting-edge research facilities, such as earthquake observers, high-energy experimental facilities, supercomputers, and private clouds; providing services to more than 700 universities and research institutions throughout the country. It is now being used by more than 2 million researchers, and even supports research institutions overseas through international lines." (Professor Urushidani) Connecting to SINET enables researchers throughout Japan to share a cutting-edge research environment. It is truly the ideal information infrastructure for those at the forefront of Japan's academic research.

Shigeo Urushidani
Professor, Information Systems Architecture Science Research Division, Head of Research and Development Center for Academic Networks, NII

SINET4: Offerings More Security and Higher Efficiency

During the time between February to March 2011, SINET3 was upgraded to SINET4; providing an additional boost in performance. All nodes acting as network connection points were moved from major universities to commercial data centers. A consolidation of network connection points enabled line-acceleration, making it possible to attain an ultra-high-speed communication rate of 40Gbps spanning from Hokkaido to Kyushu.

SINET4 has also evolved in its ability to prepare for disasters. "The data centers where the nodes were moved to are remarkably earthquake resistant, able to operate for 10+ hours after a blackout occurs. Communication lines are redundant, so for example, with a line for everyday use running along the Pacific coast, and a spare line running along the Sea of Japan's coast, we have an alternate line secured for use when a large-scale disaster strikes." (Professor Urushidani)

On March 11, 2011, the Great East Japan Earthquake hit, putting this high level of availability to the test right away. SINET4 was already operating in the Tohoku region at that time and the network was maintained without any interruption, proving its robust functionality and reliability.

The Full Potential of SINET: Realizing Full Operation of HPCI

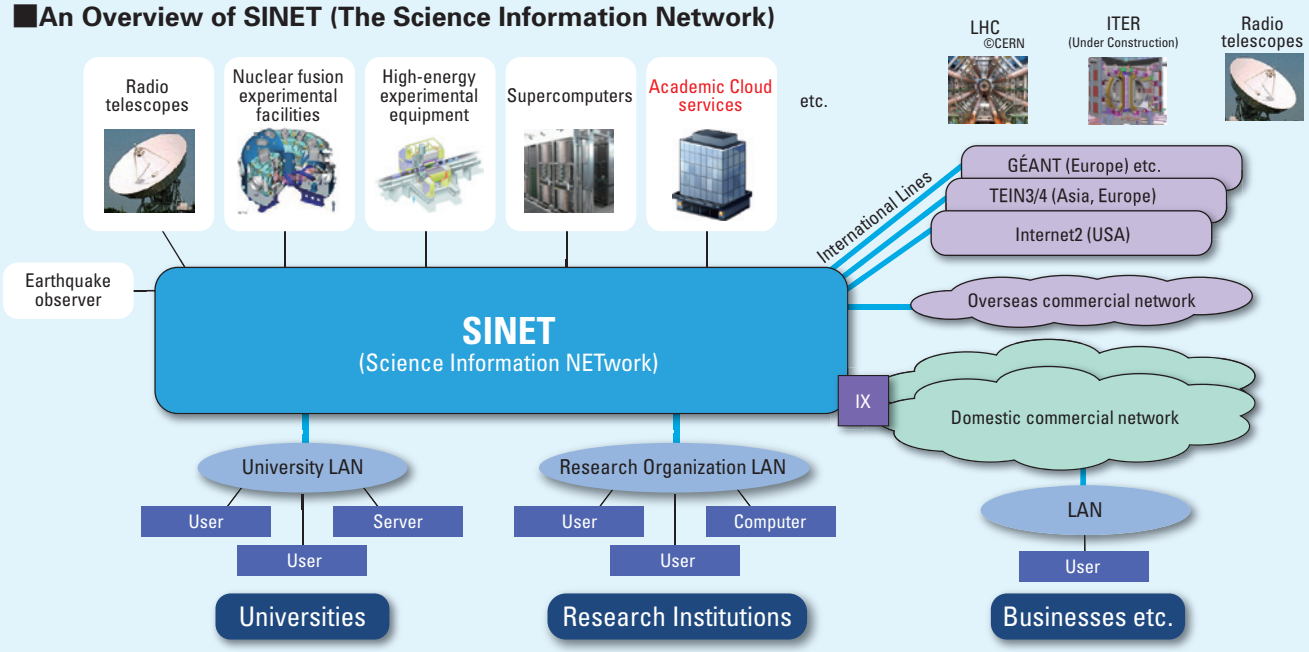
SINET4 offers cutting-edge functionality that accelerates joint research projects, such as a multicast function, enabling the simultaneous transmission of massive amounts of data to multiple partners, and the high-performance L2VPN (*1).

"Lessons were learned after the Great East Japan Earthquake, and as a result, universities throughout the nation backed up their computing resources. We also saw a rise in the utilization of SINET4 to decentralize risk. HPCI (*2), which uses supercomputers and ultra-high capacity storage through SINET4, is slated to become fully operational in late September 2012. HPCI will make it possible to use Tokyo University's next-generation supercomputers, as well as the "K computer," the fastest supercomputer in the world, from virtually anywhere." (Professor Urushidani). SINET4 will be upgraded as well so as to keep up with the constant advancement of such research activities.

SINET4 Built Academic Cloud University Alliances

ICT resources constructed at universities can also be used externally through this network.

■An Overview of SINET (The Science Information Network)



This ultra-high-speed information communication network connects more than 700 universities and research institutions nationwide. With the ability to transmit enormous amounts of data by connecting to a diverse group of resources, from supercomputers to Academic Cloud, SINET provides a cutting-edge research environment to more than 2 million researchers throughout Japan.

SINET4 has played a significant role in the creation of Academic Clouds; from the creation of Japan's most advanced Academic Cloud system at Hokkaido University, to the construction of Private Clouds at universities throughout the nation. By forming these sorts of Cloud Alliances in the academic community, ICT resources can be utilized more flexibly and strong cloud infrastructures can be built to deal with catastrophes.

"In order for cooperation to take place between university clouds, a function is needed for transmitting massive amounts of data within a combined environment along with the decentralization of risks during a disaster. This is why SINET4 will offer massive data transmission and high-quality communication to users the instant they need it, through features such as L2 On-Demand" (Professor Urushidani). Plans for a next-generation SINET are already in the works so as to offer an improved virtualization (*3) technology for clouds and networks and to enable deeper cloud cooperation.

In addition, in order to support the economical construction of private clouds at universities, a framework has been prepared which allows direct connection to SINET4 from commercial cloud service providers as well. From the construction of Private Clouds to the establishment of inter-cloud cooperation between universities, SINET4 will serve as a pivot point in the advancement of Academic Cloud alliances.

Next Generation Research Environments Born out of Academic Cloud Cooperation

Professor Urushidani provided us with insights on what sort of cutting-edge research will be made possible by forming these types of Academic Cloud alliances.

"Through SINET4, research institutions throughout Japan can take advantage of cutting-edge resources, making it possible to take on research topics that still remain unexplored. For example, the massive amount of data obtained from the Belle detector at Tsukuba's High Energy Accelerator Research Organization (KEK), can be transmitted at a high speed to universities cooperating through SINET; which proved useful in the verification of the Nobel Prize winning Kobayashi-Maskawa Theory (*4). Through Academic Cloud alliances, cutting-edge experimental data and the highly-efficient computational power needed to analyze that data can both be acquired. This should further advance next-generation research activities."

In April 2012, NII opened a Cloud Promotion Office with Professor Urushidani appointed as head. The forming of cloud alliances by means of inter-university cooperation and the creation of new value resulting from the advancement of research environments are now set to accelerate.

(Reported and organized by Yoshikazu Takahashi)

*** 1: L2VPN**
This service creates a virtual, exclusive network tailored to specific communication partners through a large-scale network shared by many users. "L2" stands for "Layer 2", which basically enables use of a network within the same building by operating at the Ethernet level.

***2: HPCI**
An innovative, ultra-high-speed computing infrastructure that connects supercomputers through cooperation between the Institute of Physical and Chemical Research (RIKEN), home of the K computer, and 9 universities throughout the country (see Page 6).

***3: Virtualization**
The act of (without physical configuration) separating/combining resources that make up a computer system. Virtualization enables one to divide a single computer to work as many, treat multiple disks as a single disk, and save massive amounts of data collectively.

***4: Kobayashi-Maskawa Theory**
A theory proposed by Makoto Kobayashi and Toshihide Masukawa in 1973, suggesting that at least 3 families and 6 types of quarks exist in nature. It has become a foundational theory of particle physics.

HPCI and GakuNin join forces to forge a

Project HPCI (High Performance Computing Infrastructure) is slated for kick-off in September 2012. This project will establish a computer environment to meet the diverse needs of users by linking the K computer, the world's fastest supercomputer, with supercomputers installed at universities and research institutions throughout Japan. Single sign-on technology will be the key to successful operation of this network, and NII's "GakuNin" initiative will soon make it possible to use supercomputers throughout the nation with a single ID/password combination.

Supercomputers are now essential for modern living

It may seem as if the average person is not familiar with supercomputers, but in fact, they are very closely related to our everyday lives. For example, automobile manufacturers use supercomputers to perform crash tests to help reduce the number of accidents. These computers run simulations designed to increase safety, lower air resistance, improve fuel efficiency, and such like. Pharmaceutical companies use supercomputers to find the molecular shape of a virus, and a combination of molecular shapes to act upon it, which is quite useful for developing effective drugs. Meteorological agencies all over the world use supercomputers to forecast the weather. Although supercomputers are not used by many people, the benefits they provide are immeasurable. Our dependence on supercomputers continues to increase as each year passes, making it difficult to function in modern society without them.

Single Sign-on Enables Use of Supercomputers throughout Japan with a Single ID

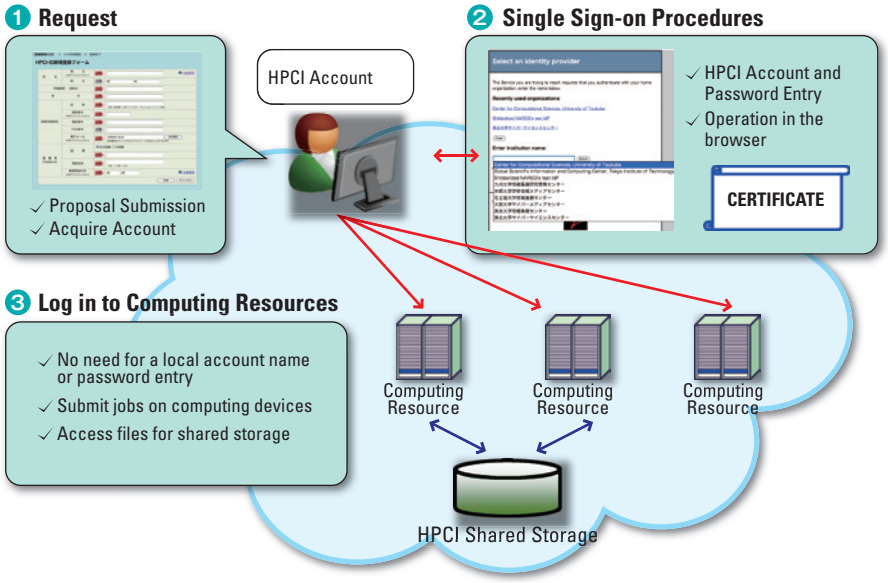
Professor Kento Aida of the NII Information System Architecture Science Research Division had this to share regarding simulations: "Even with today's supercomputers, simulations for tsunamis and other disasters can take more than a month to prepare. Cutting that computation time down to several days or several hours will require computing resources that operate at faster speeds."

To deal with these sorts of issues, Professor Aida has been involved with the HPCI Project; a project to make university and research institution supercomputers throughout Japan available to researchers through a network. Those involved are aiming to get it up and running by September 2012.

Kento Aida
Professor, Information Systems Architecture Science Research Division, NII

An important feature of this project is the single sign-on system, allowing users access to all systems with a single ID and password. Currently, a user requires multiple IDs and passwords to access individual supercomputers because they are held at different universities and research institutions, which is not very efficient. The NII-led Academic Access Management Federation (GakuNin) is focusing on this system, which is currently being used by national universities and academic institutions. The federation is made up of organizations and publishers who provide academic e-resources, along with the universities involved. To make this authentication collaboration possible, mutually trust in the policies put forth by the federation is required of each institution taking part. The result is seamless access with a single ID, not only within a university, but to other universities and commercial services as well. (GakuNin will be featured in the December issue of NII Today (No. 58).)

■ With the Single Sign-on System, a single account is all it takes to access all the computing resources HPCI has to offer.



path to the future, with Academic Cloud

Kazutsuna Yamaji
Associate Professor, Digital Content and Media Sciences Research Division, NII

Associate Professor Kazutsuna Yamaji at the NII Digital Content and Media Sciences Research Division, who is working on the GakuNin Project, had this to say: "This setup can also be used with HPCI. For example, through the University of Tokyo account, people can use supercomputers at other universities in addition to those at their home organization. He also mentioned that GakuNin service will extend outside of Japan to overseas federations as well; offering the major benefit of interoperability between worldwide academic institutions.

Supercomputers and Private Clouds can soon be accessed via Common Authentication

GakuNin offers additional benefits with the single sign-on feature. Professor Yamaji explains: "Various academic services such as electronic journal sites and research collaboration tools are now available through GakuNin." Our goal is that, once HPCI service begins, users will gain access not only to the supercomputers offered by multiple institutions but also to these valuable academic services, with a single account. This feature can advance their research activities.

Professor Aida clarified the tremendous potential of this idea. "Eventually we want to go beyond supercomputers, and enable HPCI connection to the private clouds that many universities have started constructing as well. If this can be done, data acquired through experimentation for example, can be processed by cloud, HPCI can be used for supercomputer calculations, and the results can be sent back to the user in a seamless chain of events."

NII has offered various network and web services through the years, but by connecting various individual services through common authentication, the company hopes to provide a foundation that serves as a core for the workflow of research.

A Super Network Providing access to K Computer in Full Operation

HPCI gives special attention to K computer, the fastest supercomputer on the planet. With its mind-boggling operation speed of 10 petaflops (10 quadrillion computations per second), it will begin full operation together with HPCI. Efforts are being made through HPCI to bring the supercomputers of 9 universities throughout Japan, with the K computer at the forefront, into cooperation via SINET (see Pages 4 and 5). This is to provide users with a computing environment that meets various needs. This will make possible ultra-high-speed operation that could not be done with the K computer alone, enable data sharing between all supercomputers on HPCI, and so on.

"For example, when using certain data to run a natural disaster simulation, past weather data and topography data is very important. But this type of data is in the possession of researchers, and isn't stored at supercomputer centers. Because of this, a hard disk containing necessary data has to be manually taken into a computing center, and the results have to be taken home. This process takes a lot of time and effort to accomplish. HPCI would eliminate it altogether, so that data could be sent automatically, calculated, and then results could be automatically sent back. Another option we'd like to make possible is to preprocess data via supercomputers, then send to K computer for computing, and finally have the results sent to another supercomputer to be visualized for observation" (Professor Aida).

All you'll need is a single university ID to access a supercomputer like K computer, the fastest in its class, as if it was sitting right in front of you. The ability to connect to the private clouds of many universities will be possible as well. GakuNin itself serves as a gateway to various systems, tying together the academic world, commercial services, and business users to build a bright path to the future.

(Reported and organized by Kazuo Aoki)

Expectations Gathering Around the Linker of University Clouds; the "Inter-cloud"

Private clouds are being constructed for universities nationwide. These clouds are connected by the NII-run SINET and efforts are being made toward inter-clouds that are mutually utilized between universities. Expectations are high for inter-clouds that can be utilized at a low cost, as the cloud environment in this case is large scale and cannot be realized within the confines of just one university. The present situation and foresight with regard to this project were discussed by Hokkaido University, Hiroshima University, Kyushu University, and NII during a video conference. (Please refer to page 4 for details on SINET.)

The Ongoing Construction and Utilization of Private Clouds at Universities around the Nation

How is the utilization of clouds moving forward at universities?

Munetomo: The largest academic cloud in the country has been in operation since November of 2011 at the Information Initiative Center at Hokkaido University. We provide our service not only on-campus, but also to university researchers across the nation. Efforts concerning remote collaboration technologies that tie together private clouds built at universities are also being made.

Nishimura: Although there is not yet a cloud at Hiroshima University, research is underway with data being distributed and handled across multiple clouds at other universities and in the private sector. Such data is linked together and accessed as necessary. Although we did think about how important it would be to back up the university data about one year before the Great East Japan Earthquake, we were a bit passive about storing our data in an off-campus cloud. Since the earthquake, however, we have been proactive in our efforts concerning backup systems that use clouds and have been investigating distribution arrangements for university-held data mutually with other universities.

Kusakabe: Three years ago, a cloud was launched as a pilot project at one of the departments at the Graduate School of Kyushu University, and the use of cloud technologies has been expanding ever since. Last year, for example, we began the operation of a private cloud that virtualizes a desktop based on the VCL (Virtual Computing Lab.), an open source for academic clouds (*1). This year, departments whose areas of expertise are related to information are cooperating with Research Institute for Information Technologies in the Information Infrastructure Initiative (which offers IT services campus-wide) in a plan to further expand the sphere in which the cloud is applied.

Expanding New Academic Networks by Linking University Clouds

What exactly are these "inter-clouds" which link private clouds together?

Munetomo: Inter-cloud technologies create one large cloud by tying together private clouds, much in the same way that the internet brings the world together by linking networks. The cost effectiveness of the cloud can be increased by enlarging its scale. Also, by tying in many resources on a large scale, it becomes possible to deal with load fluctuations flexibly, making administration easier. If this develops into one global cloud that can be freely used by everyone, it will become an indispensable piece of social infrastructure much like the Internet.

What kind of efforts are the universities putting forward with respect to inter-clouds?

Kusakabe: Well, at my organization, we are making efforts towards a system where clouds at other organizations can be utilized when a certain cloud is unable to perform a job adequately. We are also considering solutions in which we can make use of academic clouds at other universities, like in the system found at Hokkaido University.

Munetomo: As a cloud has been constructed at the Research Institute for Information Technology at Kyushu University, we are now performing remote linkage experiments with the Initiative Center at Hokkaido University.

Nishimura: A system that can correctly administer the operation of an inter-cloud is important. A key issue for rural universities, where it is difficult to have a large scale cloud, will be how to use off-campus systems.

Masaharu Munetomo
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Kouji Nishimura
Professor, Information Media Center, Hiroshima University

Munetomo: Member universities are moving forward with a cloud linkage project as a joint research field of the JHPCN (*2). Up until now, the member universities have been Hokkaido University, the University of Tokyo, Tokyo Institute of Technology, and Kyushu University, and others. Beginning this year, Ryukyu University and the Kitami Institute of Technology, among others, will go forward with research development geared towards practical realization, creating a test bed for a nationwide inter-cloud.

Nishimura: To kick off the creation of a sectional committee for inter-cloud research at the ITRC (*3), we held an academic cloud workshop in February of this year. This kind of meeting serves as a get-together for related parties in industry and academia. I think that it is also important as an opportunity to exchange information and further deepen cooperation between parties.

Leading the Inter-clouds of Tomorrow, Today

What are the issues being faced currently in constructing inter-clouds?

Munetomo: There are two sides to constructing inter-clouds; the technology side and the operational side. A current issue is that there is still no software that makes cloud services easier to use, and in terms of technology, there are no frameworks that can flexibly deal with cloud linkage between universities. However, we are optimistic that these issues are solvable if we vigorously move forward with research and development. It is actually the operational side that is the worrisome part, as the service levels and operation policy of each respective cloud will be different. The lack of know-how related to operation, including on how billing/charging is set up, is also an issue at this time.

Kusakabe: There are also problems related to the accounting systems at universities. For example, there are instances where the competitive funds awarded to professors can only be used for the originally intended purpose. This sort of regulation may be detrimental to movement into the cloud. There are also problems related to university infrastructure. Even if there is a very capable network between the Information Initiative Centers of partner universities, there may not be one between the Center and on-campus users although network performance is critical for cloud services.

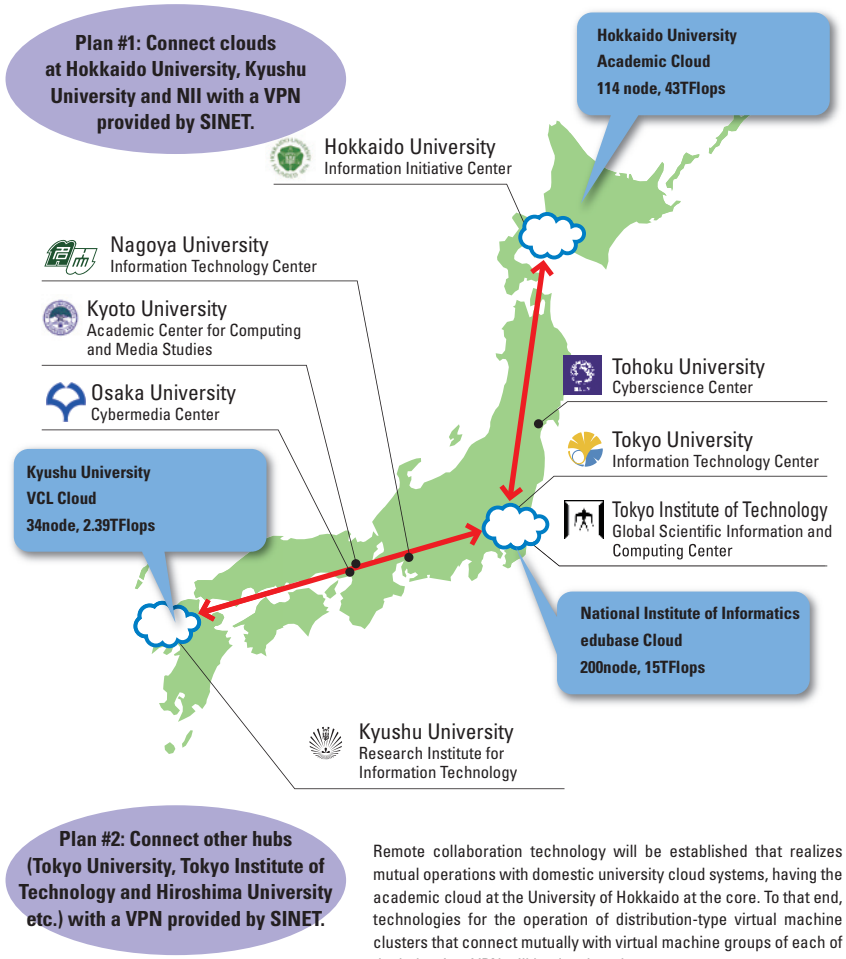
What does the future hold for inter-clouds?

Munetomo: At present, cloud infrastructures are connected through SINET. This makes SINET indispensable in building inter-clouds on a nationwide scale. Linking clouds together throughout the nation with a dedicated line is a difficult job for the private sector. As such, it would be realistic if those of us at the universities began the initiative amongst ourselves and went forward with joint research with the private sector. Inter-clouds will no doubt be the norm in five to ten years. We will move forward with verifiable research together with the SINET operator NII as a pre-emptive project.

Nishimura: We are also going to be building private clouds in the future. They will, however, be much easier to use if we can establish usage facilities that can connect seamlessly when capacity is insufficient. We are now working on creating the guidelines for such situations. As such, we would like to think about how we can best utilize off-campus clouds.

(Coverage and Format: Kazuo Aoki)

■ Establishment of Remote Linkage on Inter-cloud Systems



Remote collaboration technology will be established that realizes mutual operations with domestic university cloud systems, having the academic cloud at the University of Hokkaido at the core. To that end, technologies for the operation of distribution-type virtual machine clusters that connect mutually with virtual machine groups of each of the hubs via a VPN will be developed.

*** 1: VCL**
A system that realizes an on-campus cloud in which applications and operating systems can be utilized with high efficiency after using the network to access a virtual desktop environment built on on-campus servers.

***2: JHPCN**
The Joint Usage/Research Center for Interdisciplinary Large-scale Information Infrastructures; the framework hub for super-computer facilities at Hokkaido University, Tohoku University, Tokyo University, the Tokyo Institute of Technology, Nagoya University, Kyoto University, Osaka University, and Kyushu University.

***3: ITRC**
Work is underway on the Japan Society for the Promotion of Sciences' 163rd Committee of Internet Technology; where the development and growth of networks and remote lectures between universities, among other things.

Cultivation of Technical Experts Who Forge the Future

At a time when cloud usage is spreading at a rapid pace, there is an urgent need to cultivate technical experts in software with specialized knowledge and experience. Last year at the NII GRACE Center, a course on clouds began within the IT human resources training program "TopSE" This course is designed to train cloud engineers and is aimed at working people. Also, a training course utilizing cloud computing for people in software will begin at the Graduate School of Osaka University in 2013. We asked about the content of these programs and what characterizes them.

The Start of TopSE; a Cloud Course at the GRACE Center

In 2005, the NII GRACE Center began an educational program to train engineers called "TopSE" (http://www.topse.jp/english/) which is targeted at working people. In 2011, cloud courses that enhance cloud-related education also began. TopSE is held on weeknights and Saturdays in order to make it easier for working people to attend. Cloud courses in 2012 will mostly take place on Saturdays, and will consist of five lectures. Classes can be carried out in 7 sessions, 8 sessions, or 15 sessions.

Courses will cover topics such as "Implementation of Distributed Applications (such as Hadoop)," "Infrastructure Implementation in Cloud Computing," "Foundations of Distributed Systems," and other vital areas of the world of cloud computing. The lectures will of course begin with an outline of what cloud computing is, with "Introduction to Cloud Computing" and "Practical Exercises in Cloud Computing." All the development and design for the cloud course has been undertaken by Professor Shigetoshi Yokoyama of the GRACE Center. Professor Yokoyama is also part of the operation and development of the edubase Cloud, the GRACE Center-operated cloud used for education. The edubase Cloud offers a cloud environment that can be accessed by students either from home or the office, allowing free access to lectures and experiments in IT education.

Putting the Content of Lectures into Practice with Cumulative Production Assignments

For the past seven years, TopSE has had twenty to forty students complete the program every year. The GRACE Center gathers students who have been recommended from around 40 participating corporations. The center also takes in people who go through a general application process and pass the entrance exam. The ratio of enterprise-type engineers that make corporate systems to embedded-systems engineers is about 2:1. In addition, user corporations, in other words people who use IT, also attend these classes.

Research Professor Yoshinori Tanabe of the GRACE Center says that he wants to increase the number of students who are operational-users since it is important that they learn cloud computing skills. Cloud engineers are not only required to have the ability to pick up new skills; they also have to keep in mind the operational phases of the software they are developing.

The first half of the year-long cloud course program consists of lectures. The three to six months following that period is used for a cumulative production assignment in which the students work alongside their supervisors to put the content they learned in lectures into practice. Students will also be able to realistically apply this production to their own work. Professor Yokoyama says that students meet with lecturers every week during their cumulative production assignment and bring it back to their place of work. They discuss it with their colleagues, resulting in repeated feedback. There are many cases where students working on the front lines at their respective companies are dealing with issues that are, realistically speaking, quite difficult. It is therefore not uncommon for students to make use of their cumulative production assignment in creating operational flows and in improving work at their companies.

The cumulative production assignment, which was born out of the process of students holding frequent discussions together, is bringing about new cloud solutions. During this time, lecturers

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■ TopSE Cloud Course Curriculum Outline (Held every Saturday)

Course Length	Lecture Title	Credits	# of Sessions	Lecture Content
Semester #1 Apr.–June	Introduction to Cloud Computing	1	7	This lecture will deal with distribution application development methods in cloud computing environments. Students will also learn about the cloud environments themselves and deepen their understanding about the special characteristics of these environments. They will gain the skills needed to apply distribution application development technologies to real issues and problems.
	Practical Exercises in Cloud Computing	1	8	In groups, students will carry out development in an actual cloud environment using the knowledge they gained from Introduction to Cloud Computing. This can be also be utilized as a pre-cumulative production assignment.
Semester #2 June–Aug.	Infrastructure Implementation in Cloud Computing	2	15	Using open source software, explanation starting with fundamentals will be given on the knowledge required in building the cloud environment called "IaaS." While performing exercises using the edubase Cloud, students will learn the necessary technological elements for designing and building clouds.
Semester #3 Sept.–Nov.	Foundations of Distributed Systems	1	7	Students will learn the rules and fundamentals about technologies used in distribution systems to secure mutual operability and performance along with fault tolerance etc. In line with actual cloud services, they will learn protocols for the administration and mutual operation bases of CORBA and Web services along with others.
Semester #4 Nov.–Jan.	Implementation of Distributed Applications	2	15	Students will learn distribution processing application building with Hadoop while utilizing the edubase Cloud environment.

themselves also apply what they have learned to the next curriculum.

Hiroshi Igaki
Specially Appointed Associate Professor,
Information Science Research,
Graduate School of Osaka University

Preparation for Cloud Classes for Graduate Students at Osaka University

At the Osaka Graduate School of Information Science and Technology, in an effort to turn graduate students into human resources who can take the lead in innovation, METI is in the process of developing research and education programs for taking the lead in software innovation. One of the themes is software development using cloud computing and the cultivation of management abilities for carrying out projects.

Associate Professor Igaki Hiroshi thinks about carrying out and planning cloud computing education like this: to compare these classes to a television, our goal would not be to teach students how to use the television, but to have them think about how it is used after learning how it is made. Having students experience what kind of technologies are behind the cloud through lectures and exercises would be a base upon which to build both experience and knowledge.

This class will begin next year with a series of lectures and exercises spanning a year-long period. The Center aims to have compelling lectures given by part-time lecturers from companies in a wide range of fields, including hardware and data centers, applications, and disaster recovery. Exercises will be practical and take over project management processes by using private clouds that were constructed at Osaka University at the end of last year.

Accelerating the Cultivation of Cloud Engineers through Mutual Cooperation

The cloud is still a developing technology. It is always evolving, and therefore Professor Yokoyama keeps in mind that the technologies used this year may be obsolete years later. It does after all seem to be the case that not everyone has the same idea of what a cloud is to begin with.

Professor Igaki says that the cloud classes about to begin at Osaka University will likely be reviewed and changed every year. He wants to build lectures where the concepts that are universally sought after at that point in time can be harnessed and continuously made a part of classes.

In this sense, the cooperation between Osaka University and NII, the supporter of cloud education going forward, shows great promise. It is anticipated, for example, that there will be all kinds of collaborations, such as the mutual utilization of teaching materials and content, the sharing of web applications used in exercises, and in the future, the linking of the edubase Cloud to the private cloud at Osaka University.

There is little doubt that the proactive efforts on the parts of both parties in the still unknown technological area of cloud computing are likely to accelerate the new cultivation of IT human resources.

(Coverage and Format: Kazuo Aoki)

Can Social Networking Websites Once Again be Effective during an Ongoing Emergency?

Shinichi Honiden
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NII

On March 13th 2011, I saw the following tweet on my Twitter feed: "My home in Sendai, Miyagi; everything's all over the place. The power's out too…" At that moment, there was a loud roar in the research lab. One of the research lab students was still at home, and even after sending off numerous e-mails, we received no reply. Phone calls to the student's cell phone wouldn't go through either. Just when we feared the worst, there was this tweet.

Social Networking sites like Twitter and Facebook were very effective during the Earthquake last year, as people used them as tools to confirm the whereabouts of others and to get information out.

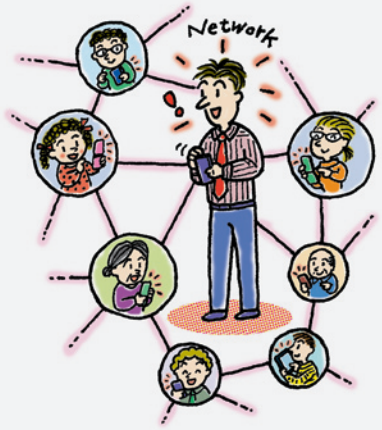
For the young people of today, networking sites such as these, which can be accessed with both smart phones and regular mobile phones, have become indispensable in order to regularly keep in touch with friends and peers. Whereas e-mail has mainly been a means of communication between two people, with these mediums, people gain a sense of unity with their friends even through the posting of a single comment. Particularly since the earthquake occurred, they have become a much-valued means of strengthening the bonds between people. Personally, I think that the reason for the recent explosion of popularity of Facebook lies in the "Like Button." There is great significance in the fact that, with just one click, the bonds between people can be affirmed on a regular basis.

Some of the conditions for this kind of exchange of information are that mobile and smart phones must be charged and that an internet connection must always be available. Recently, however, there have been reports that traffic can become too great even under normal circumstances, and that even the internet has entered a state of saturation. During a particularly large disaster, it can be difficult to access the internet. As being able to connect regularly with friends and family is the norm, there would likely be an immeasurable sense of emotional insecurity in the event that the regular connection is severed. People who panic emotionally will no doubt continue trying to access the internet until they are connected. This will result in the frequency of access to the internet greatly surpassing the assumed amount, making internet access more impossible.

After the Great Hanshin Earthquake, it was mobile phones that took the place of landlines to shine during the crisis. During the Great East Japan Earthquake 16 years later, the internet then replaced the mobile phone. Will it be the internet that that succeeds again during the next crisis? Considering what I have said above, I think that we cannot say for certain. There is therefore a need for specialists in various areas to show their originality and ingenuity by identifying concrete issues with the assumption that the internet may not be available during such times.

For example, in my area of expertise (software), we are making efforts to build systems in which temporary networking sites for the purpose of sharing information with nearby people are built by means of constructing a local network in which nearby mobile terminals can contact each other in the event that the internet cannot be accessed. There may also be the need to create a new generation of social networking websites that are based on completely different ideas than current ones.

In any case, we do not know when the next crisis will occur, and therefore we need to prepare ourselves more quickly. We must face these difficult issues head on and gather the wisdom of researchers from all kinds of fields.



Weaving Information into Knowledge

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Cover Illustration
The building of academic clouds accelerates the use of IT resources at universities and educational/research institutions, making what was impossible yesterday, possible today. In the same way that a cotton-candy machine excites children, academic cloud components are surrounded by the dreams and anticipation of researchers like us.