NICT NEWS
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NiCT


# Virtual Node Project

## Virtualization Technology for Building New-Generation Networks

**Akihiro Nakao**

**Guest Expert Researcher**
**Associate Professor, Interfaculty Initiative in Information Studies, University of Tokyo**

After receiving master's degree in information technology from the School of Engineering, the University of Tokyo, Akihiro Nakao joined IBM Texas Austin Research Laboratory, and then IBM Research - Tokyo. He received master's and Ph.D. degree in Computer Science from Princeton University in the United States. He was appointed as an associate professor at Interfaculty Initiative in Information Studies, the University of Tokyo, in 2005. He also has been a guest expert researcher at NICT since 2007.

NICT and the University of Tokyo have been jointly leading the "Virtual Node Project." This project aims at building the communication infrastructure that creates virtual networks using "virtual nodes" that may resolve the issues of the current Internet and satisfy various needs of users. We interviewed Akihiro Nakao, an associate professor at the University of Tokyo and a guest expert researcher of NICT who has played a central role in the project and put forth the research on network virtualization.

### The key concepts of network virtualization include "continuous evolvability" and "accommodation of diversity"

**—— Before talking about the network virtualization, tell me about the background behind the research. What are the issues of the present Internet, and why was this concept advocated?**

**Nakao:** First, I will talk about the issues of the current Internet. The present Internet is so-called "a network of networks," connecting multiple small networks into a large one in order to ensure scalability. Although it seems to be working fine, there exist several issues: new protocols developed by researchers can neither immediately be implemented nor used; bandwidth (the data volume that can be transmitted in a given period of time) and latency (the time between the transmission of data and its reception at the destination, including retransmissions and error corrections) are not guaranteed for data transmissions; and the security is not fully enforced. To resolve these issues, the whole network should be created from scratch, which requires huge cost.

The reason behind this situation is that the Internet has not been configured to be continuously evolvable. We study how to create a communication infrastructure that may evolve continuously using network virtualization. The continuously evolvable network represents an environment where the current Internet and a new Internet may operate side by side simultaneously in the same region; users use these networks unaware of their parallel existence and seamlessly switch to the new Internet.

Second, although the current Internet has many issues, we will not be able to figure out how to change the current Internet without actually attempting to operate new ones. Therefore, we now believe that the best way to proceed here is to accommodate many newly invented networks concurrently and let users select the best suited one among them.

There may be several ways to realize this picture where users are allowed to choose their favorite one from multiple Internets. One way is to construct multiple sets of different physical infrastructures to run a separate network on each of them, which demands high cost. Another way is to build a system where multiple, completely independent virtualized networks coexist on a shared infrastructure. We take the latter approach and call each virtualized network a "Slice."

**—— Tell us more about the Slice; what is that?**

**Nakao:** As I said before, the Internet is a network of networks. A slice is defined as a set of resources across the Internet, as if horizontally cutting the Internet resources into a "slice" of the Internet. If the Internet could be sliced just like a slice of cheese, an arbitrary protocol can be implemented and operated in the slice. For example, Slice 1 and Slice 2 may run the IPv4 and IPv6 protocols, respectively, while Slice 3 may run a protocol completely different from any other protocols defined in the current Internet.

In this picture, we envision that slices are completely isolated and independent from one another. We call this feature "resource isolation." If we created 1,000 slices, for example, we could build 1,000 totally different virtual networks.

**—— How do you plan to enable advanced network virtualization, using the current Internet protocols and infrastructure or completely new protocols from scratch?**

**Nakao:** In the real-world experiment currently underway, we still try to understand how to build the infrastructure using the existing Internet protocols and techniques. We believe that is the first step.

However, we expect that the future network virtualization research will use the optical path technology to easily build isolated networks through wavelength. Ultimately, we may end up using totally different new technologies as well.

### What is the future router/switch to realize network virtualization?

**—— You said you will first build the network virtualized infrastructure on the existing Internet. What technologies will be used?**

**Nakao:** In the virtualized network we are now creating, slices will be built on the existing Internet protocol using tunnels, VLAN, MPLS, and other relevant technologies. At present, we are configuring virtual links using tunnels called GRE-Tap (GRE-Ethernet) between a pair of network nodes that are future versions of routers and switches. We will probably be able to configure slices using optical paths in the future. However, a slice is not just a logical network, but programs can be executed within a network node.

For instance, we can implement robust and efficient accesses to cloud computing platform through new protocols and functionalities such as advanced routing and redundant traffic elimination.

**—— Traditionally, virtual networks such as VPN already exist. What is the difference between the conventional network virtualization and advanced network virtualization you are conducting research on?**

**Nakao:** There are two major differences. One is that although the VPN is a technology for virtualizing connectivity only to multiplex the current IP networks, advanced network virtualization aims to allocate resources for creating networks that can run new protocols, even non-IP network protocols. The other is that a slice is a completely isolated environment, allowing packet processing in networks (In-Network Processing), which has been considered inappropriate traditionally. One of the innovative features in the infrastructure we are enabling is to facilitate programmability for implementing both new protocols and new functionalities. We are now pursuing several demonstrations to show what benefit we can bring through advanced network virtualization in a completely resource-isolated environment.

**—— In the conventional network design and implementation, there exists common understanding that the simpler the functionality of a router, is the better it is. However, with network virtualization, the router itself will become significantly intelligent, won't it?**

**Nakao:** To avoid making a complex design of our network node, we decided to decouple the part in change of forwarding and redirection of data and that for pro-

Detail Explanation ①

## What is the network virtualization?(1)

### Network created by virtual nodes

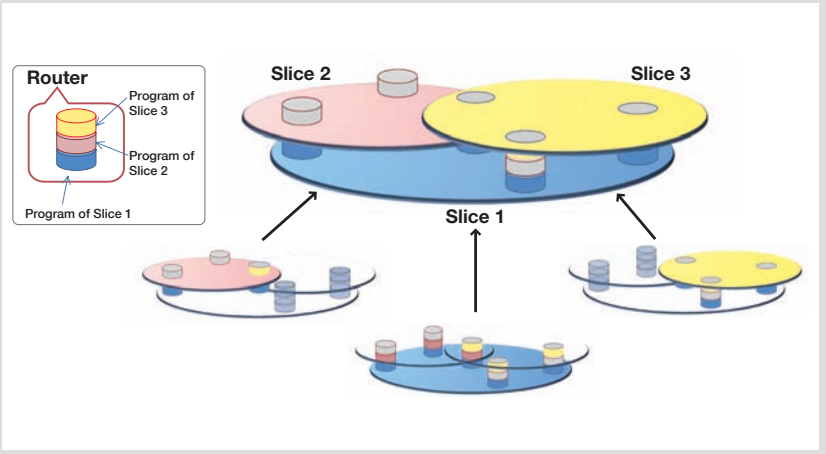



Figure 1 ●Basic concept of network virtualization

The concept of "virtualization" has a long history in various forms in the computing world. The virtualization technology is adding new capabilities effectively leveraging the existing machines, materials, and resources, such as the technology running an operating system (OS) on top of another one.

The "Virtual Node Project," a research project led by NICT and the University of Tokyo, is building virtualized networks on the existing networks using the advanced technologies.

We define "Slice" as a set of reserved resources where we can run an independent network. In our "Virtual Node Project", we build a network node called "virtual node" and instantiate a slice over multiple virtual nodes.

To understand the concept of network virtualization, one can imagine a lump of network resources in the communication infrastructure horizontally cut into slices. The current Internet may exist in one of the slices but the other kinds of networks may run within the other slices. These networks may have different capabilities and may run different protocols.

### Allowing us to build highly secure networks

The Virtual Private Network (VPN) technology is often used to generate a closed, highly secured private network on top of the current Internet. It gives the illusion that we were using a dedicated private network even if it is constructed on top of the public Internet. However, it cannot absolutely eliminate the risk of interception by third parties who use the same physical network. Constructing a private network using a dedicated line ensures high security but incurs high costs.

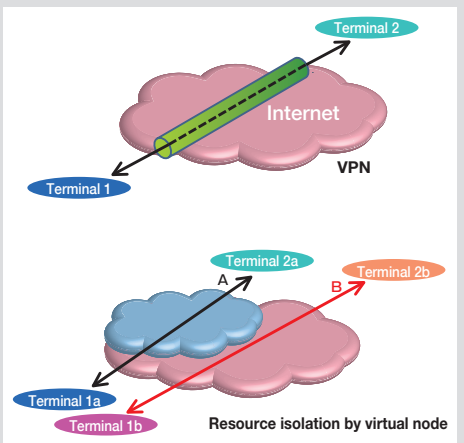



Figure 2 ●Comparison with VPN

Unlike VPN that enables running multiple private IP networks concurrently, our virtual node system offers programmability for implementing completely different protocols, e.g., with slice-specific security. In this way, one may use secure protocols no one outside the slice may find hard to parse.

Detail Explanation ②

# What is the network virtualization?(2)

## Hardware for realizing the network virtualization

The router used for the virtual node project is separated into two parts: the redirector part in charge of routing capability, and the programmer part where programs run to implement new capabilities and functionality.

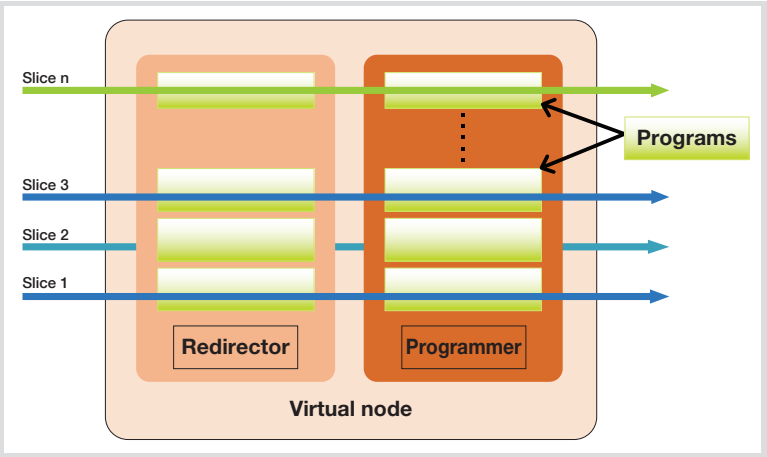



Figure 3 ●The configuration of virtual node (Router)

## Architecture of the network virtualization

Although the virtual node can add programs, it cannot do it randomly. All virtual nodes are controlled by the domain controller. The domain controller configures virtual nodes with programs for processing protocols and data. Each slice connects to networks such as the Internet through the access gateway.

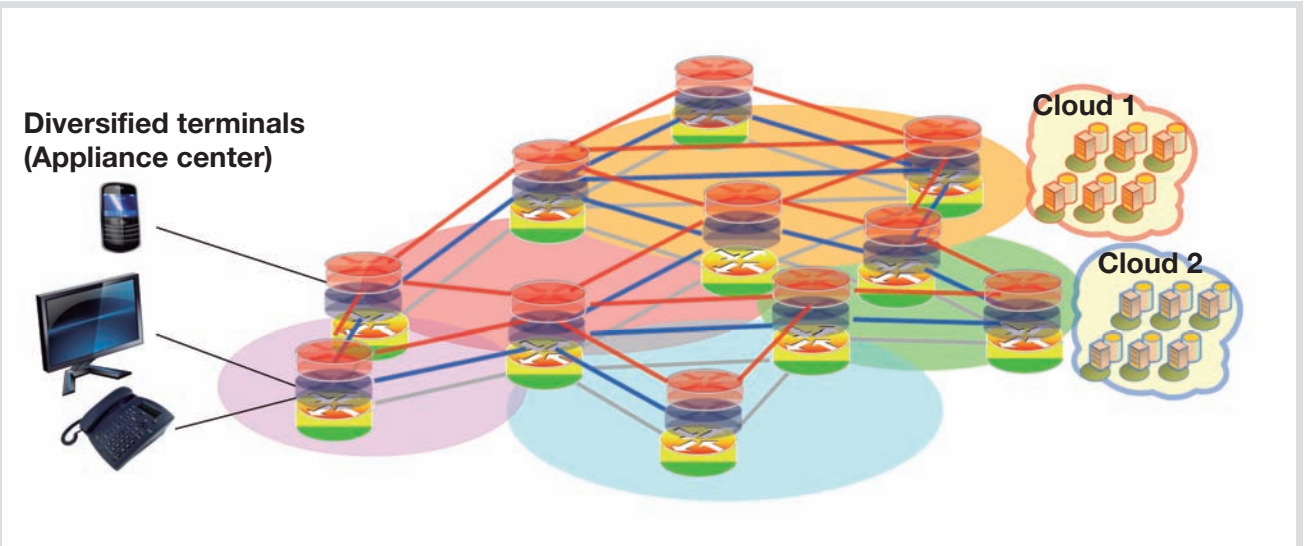



Figure 4 ●Virtual node architecture

## Virtual node router

The photo shows the virtual node router released in the Interop Tokyo 2010 held at the Makuhari Messe from June 7 to 11, 2010. The upper half of the rack is the programmer part, and the lower half is the redirector part. The router is now expensive because it is a prototype currently under development. However, when the achievements of the Virtual Node Project are widely implemented and the cost and the size of the virtual node router are further reduced, the routers having such capabilities may be installed in general households.

In addition, the network infrastructures should introduce optical networks that may use multiple frequencies simultaneously, instead of the infrastructures including the present protocol. However, the thorough shift from Ethernet to optical network may not occur promptly. We expect that the present protocol and optical network will coexist while the former is steadily being replaced with the latter. Users of the network virtualization will not be aware of such transition.

Figure 5 ●Virtual node router displayed at the NICT booth in the Interop Tokyo 2010

grammability for processing data. The former part is called *redirector* that creates the fundamental structure of a virtual network. The latter part is called *programmer* that installs Intel processors, network processors, and cutting-edge computing resources including multi-core network processors and general-purpose computing on graphics processing units (GPGPUs). Using a set of these two parts combined will realize a network node called VNode that enables advanced network virtualization.

Although one might imagine a router as the one deployed in households, VNode can be viewed as a future version of router placed at the core of the network. Our first prototype of VNode is a rack of machines relatively expensive due to the developmental cost. It is also not small in size, but we expect the near future versions of our prototypes should rapidly become more and more compact. Downsizing VNode may lead to its deployment at edges of the network, for example, in general households, where we may be able to integrate firewall capability inside the network. In this way, the firewall capability may be automatically updated within the network all the time so that users may use the latest firewall functionality without any intervention on their part.

However, firewall is just one way of utilizing advanced network virtualization. We can also address an even larger problem, "if we don't use an IP network at all, the security may be hard to be breached." Using a protocol totally different from the protocol for IP networks currently used for a network handling national secrets, for example, we can build a network using proprietary protocols and data transmission schemes.

—— **Is it possible to guarantee no interference between individual slices, isn't it?**

**Nakao:** Right. In addition, bandwidth and latency, which we discussed at the beginning of this interview, may be guaranteed by creating completely independent environment using VNode's capabilities. In short, we may be able to define a "reserved network" where the communication quality is fully guaranteed.

—— **Virtualization is a method for creating such a new network, isn't it?**

**Nakao:** Our purpose is not virtualization. Our true purposes are incorporating programmability in the network and isolating computational and network resources within slices. This concept becomes a foundation for a new-generation network. Virtualization is just a tool after all, but the virtualization technology itself is highly focused in this area of study.

## Currently, Japan may be one-step-forward in the international competition in the field so as to start making this technology generally available in 3 years from now

—— **How will you pursue your research plan in the future?**

**Nakao:** Just developing high-performance network nodes makes little sense. We need to define an architecture encompassing all from gateway devices for users to access to administration systems to control the whole infrastructure. We plan to integrate all these prototype systems and incorporate them by August into JGN-2plus, a network testbed that is operated by NICT. The network testbed will be used by beta users while gradually becoming available to the public. We hope we can develop the environment that people can use without any stress for creating new network services and network architectures.

—— **Several companies have already participated in the project. Will any other companies join in the future?**

**Nakao:** Yes, they will. We hope to integrate into the project distinguished engineering and R&D capabilities that each company is primarily specialized in. The overall architecture is based on my idea, and I think my responsibilities are to collect and integrate the recommendations and proposals from researchers of private companies to improve the architecture.

—— **Are there any projects like this outside Japan?**

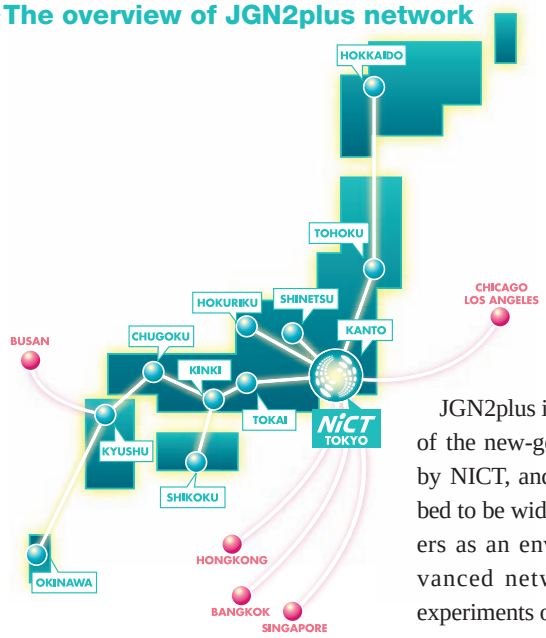
**Nakao:** Yes, there are. In the GENI project running in the United States, all universities across the United States have worked together to promote the project. The FIRE project in Europe is an initiative similar to our project. Although our project is smaller than that in Europe, our major advantage lies in already having involved private companies. Both the United States and Europe are watching our movement in Japan. We have already started collaborating with them this year and begun to explore a framework to federate different systems in Asia, the United States, and Europe. These three parties are promoting international collaborations.

## Business Models and Socio-Economics Impacts

—— **There seem to be many things to be examined in the future, aren't there?**

**Nakao:** My recent concern is about business models or other things related to so-

### ◆The overview of JGN2plus network




JGN2plus is a network testbed for R&D of the new-generation network promoted by NICT, and also an open network testbed to be widely used by general researchers as an environment for R&D of advanced networks and for real-world experiments of various applications.

Detail Explanation ③

# What is network virtualization?(3)

## Advanced researches by the cooperation among industry, academia, and government

Researches on network virtualization technology similar to the Virtualization Node Project are also promoted in the United States and Europe. While the projects in the United States and Europe are led mainly by universities and research institutes, Japan's Virtual Node Project features the cooperation among industry, academia, and government. The benefit of this cooperation is that the speed of the R&D will be increased because each party contributes to the area of their specialty. Moreover, not only theories but also ideas assuming possible actual usage can be incorporated as specifications at earlier stages.

Look at the assignments of each company participating in this project. The NTT is in charge of the domain controller part to control the whole network, Fujitsu is in charge of the access gateway part acting as the gateway to other networks such as cloud, Hitachi, Ltd. is in charge of the router part, and NEC is in charge of the CPU chips for control. Each party is pursuing network experiments using different slices.

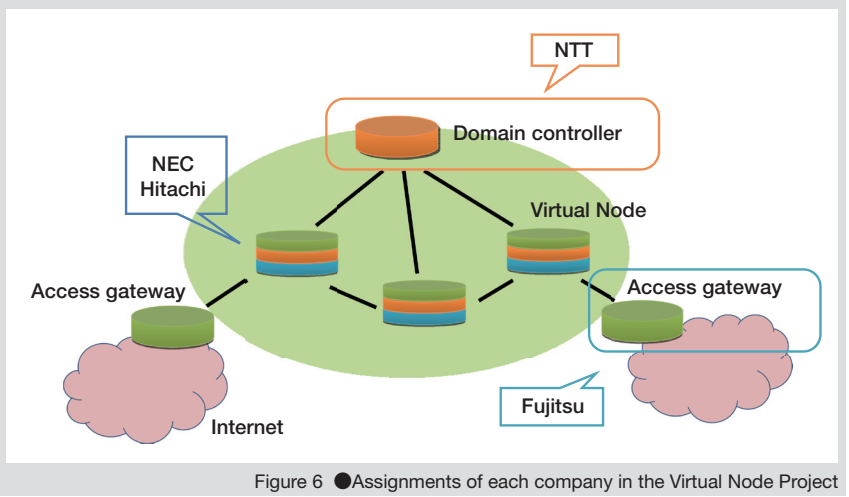



Figure 6 ●Assignments of each company in the Virtual Node Project

## Progressing network experiments

I will introduce the packet cache research jointly promoted by NICT and the University of Tokyo as one of the network experiments. For example, accessing a video site to play back movie content in the conventional system requires downloading the video data from the server of the video site for each access. The data is divided into smaller parts called "packets" transmitted on the network.

The idea of packet cache is to capture packets of large content data such as video in the router. The first access is the same as conventional accesses, but the second and later accesses just download cached data. It is estimated that effective packet caching will reduce the data traffic from the conventional one third to one eighth.

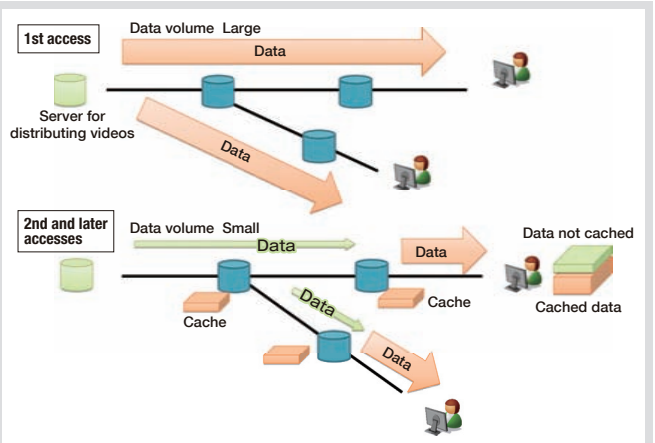



Figure 7 ●Flow of packet cache

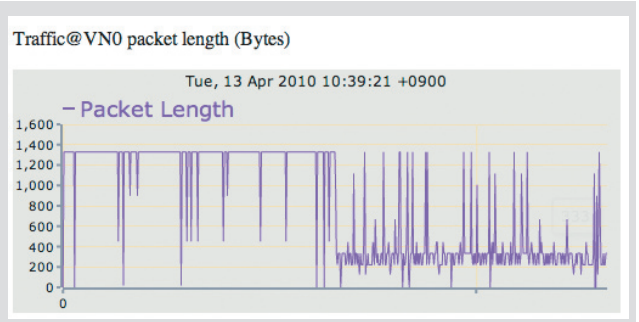



Figure 8 ●Demonstration image of packet cash effects

## Future realized by network virtualization

The network virtualization aims at flexible new-generation networks that *can build a network with required capabilities based on the needs without any inhabitation*, for example, a network related to the national administration or the national defense that requires robust security, a set of sensor networks operated without human intervention, or *one-time network* for a limited time only; we will be able to use any network if we build in relevant programs in the network.

In the future when the cost of routers with the virtual node technology built in is reduced and these routers are also used in general households, part of capabilities currently provided by PCs will be mounted on the routers. The firewall capability, virus check, and monitoring of phishing sites will be implemented as network capabilities, and the latest monitoring status will be maintained automatically without any human intervention and any configuration or update by the users.

cio-economic impacts as well as technical aspects. The Assessment Working Group for assessing technologies from the social perspective in the New Generation Network Promotion Forum of the Ministry of Internal Affairs and Communications has started evaluating the social impacts of network virtualization and cloud networking from this year. New networks released in the world are expected to create new markets and significant impacts. We would like to forecast these impacts together with economists and other relevant experts. The initiative aims at developing a report each year.

**—— For wide use of this virtualization technology users need to have killer applications or other equivalent offerings, isn't it?**

**Nakao:** First, we are focusing on the collaboration with the field of cloud computing and networking. The current study of cloud computing primarily focuses on the virtualization of servers only within data centers in order to trade virtualized resources for data processing. Our idea may extend the application of virtualization to the access to the data centers, for example, inventing new protocols for the access and trade virtualized resources including those of access networks. The combination of cloud computing and advanced network virtualization may become a killer application and more exciting research areas may follow from here.

**—— From the users' perspective, conventionally, they are offered only with the service "You can connect to the network," but in the future will they be offered with the options "Safe and guaranteed access to cloud computing platforms with tailored security" or "High bandwidth service for watching high-definition videos"?**

**Nakao:** There may be other services featuring "Exceptionally low-price network" or "Network providing significantly robust accesses" or "Also offering voice over IP with four-nine" The purposes, features, and capabilities of network are visible to users and the prices are determined based on these factors.

**—— The conventional wisdom is that a network is just a "pipe" for passing information. However, the new network will also have additional features and values in itself, won't it?**

**Nakao:** The network virtualization is a tool to make various people happy. Users will use low-price networks. Network researchers will release their ideas to the world to provide pilot services. Carriers will create networks with additional values instead of just pipes. I believe that the network virtualization is a project that makes every party happy.

**—— Thank you very much for your sparing time for the interview today.**

# Report of Fiscal 2010 “NICT Science and Technology Experience Day”

Group leader, Iwao Hosako, on his demonstration using various types of camera

Hand made Camera workshop by Akifumi Kumai from a nonprofit organization (NPO), CANVAS

A science event entitled as “NICT Science and Technology Experience Day” was held on April 24 (Sat.), 2010. This event, for the kids between 4th and 6th grades of elementary school, was held as a part of events of Science & Technology Week designated by the Ministry of Education, Culture, Sports, Science & Technology.
This year, Group Leader of Advanced Device Research Group in the New Generation Network Research Center, Iwao Hosako, gave a lecture on “Terahertz camera that can catch invisible light,” and a related workshop “Make a camera using materials in your surrounding!” was held.

Dr. Hosako gave, in his lecture, an easy explanation of light wavelength and camera mechanism to tell that general cameras catch visible light for imaging, but some cameras can catch invisible light to contribute to the society. He also demonstrated different imaging results from a thermal camera when using it for the objects at different temperatures. Subsequently to the lecture, each participant of the workshop assembled a hand made camera using some materials found in their surrounding, including drinks package, black drawing paper, a magnifier, and others. After the completion, everyone used hand made camera to study the mechanism and adjustment of focus. Here are some of the comments from the questionnaires filled in by the participants, “I understood well the camera mechanism, how to make a camera, and human eyes and light. I appreciated that.”, “I enjoyed it.”

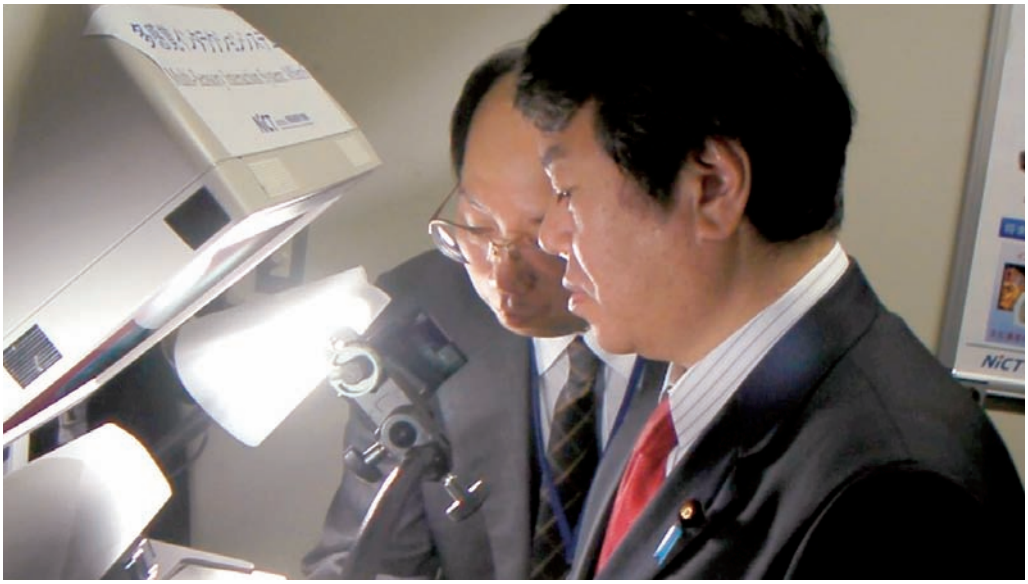
We believe that the kids who participated were happy to know something that they did not know and had enjoyable experience of making something, and also that this event became a valuable day for them. After the event, we could take commemorative photos full of smiles with great satisfaction. We hope to promote the pleasure of science through similar events in the future.


A commemorative photo full of smiles

# Kazuhiro Haraguchi, Minister for Internal Affairs and Communications Visited the Keihanna Research Laboratories

## - Experienced the State-of-the-Art Technologies -

Satoshi Nakamura, Director General of the Keihanna Research Laboratories



Kazuhiro Haraguchi, Minister for Internal Affairs and Communications, on performing Multi-Sensory Interaction System

Kazuhiro Haraguchi, Minister for Internal Affairs and Communications, visited the NICT Keihanna Research Laboratories and Advanced Telecommunications Research Institute International (ATR) on May 8 (Sat), 2010. At NICT, the minister eagerly listened to the explanations of four research projects and watched the demonstrations:

**(1) Glasses-free 70-inch Screen 3D display system**
**(2) Multi-sensory interaction technology based on four senses including vision, audition, touch, and smell**
**(3) Multilingual speech-to-speech translation technology**
**(4) Spoken dialog interface**

The minister commented on the glasses-free 3D display system and the multi-sensory interaction system in which real objects seemed to exist in front of him. He especially seemed to realize that multilingual speech-to-speech translation and other such high-quality technology were very close to commercial viability. The minister also seemed to have strong feelings about the importance of the research being done by NICT, saying, “Highly-motivated research is being conducted under a limited budget. The "Interdisciplinary Research on Info-communication and Brain" being conducted by NICT and ATR is key to the growth strategy. The technologies, including multilingual speech-to-speech translation technology and robots, can be applied to medical care, remote operation, and tourism. Proactive promotion of R&D of these technologies at the national level is necessary, and we will work on the implementation of “Nationwide Broadband Networks (Hikari-no-michi)” for these applications.” He also commented on the upgrading of researches, saying that unconfined research environment is necessary. On the way to return, he tweeted “I visited NICT Keihanna Research Laboratories and ATR. The research is state-of-the-art for even Japan, which leads the world. The corpus-based approach will advance automatic translation technologies. Hikari-no-michi’s cloud computing, high capacity and speed will build an infrastructure for social innovation.”

During the minister’s visit, seven news media companies also visited the place. His visit was reported by NHK news programs, the Yomiuri Shimbun, the Kyoto Shimbun, the Osaka Nichinichi Shimbun, the Kobe Shimbun, the Nikkan Kogyo Shimbun, and the Denpa Times.


Experiencing a multilingual speech-to-speech translation technology

# Prize Winners

Prize Winner ● **Naoto Iwahashi** Expert Researcher, Spoken Language Communication Group, Knowledge Creating Communication Research Center
**Komei Sugiura** Expert Researcher, Spoken Language Communication Group, Knowledge Creating Communication Research Center

Joint Prize Winners :
Tamagawa University, The University of Electro-Communications
◎DATE : July, 5, 2009
◎NAME OF THE PRIZE :
**Second Place in RoboCup@Home**
◎DETAILS OF THE PRIZE :
Autonomous robot to support humans in daily life. As members of eR@sers, a joint team with University of Electro-Communications and Tamagawa University, they won the second place at world-famous robotic competition.
◎NAME OF THE AWARDING ORGANIZATION :
RoboCup Federation
◎Comments by the Winner :
We participated in RoboCup Japan and international competitions. In the preliminary session under noisy environment, our high-accuracy speech recognition technology contributed to our high scores. In the finals, we could win Second Place, thanks to the high evaluation of our demonstration of reference-based motion learning capability that was not possible for conventional robots.

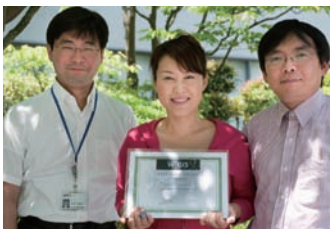
Prize Winner ● **Naoto Iwahashi** Expert Researcher, Spoken Language Communication Group, Knowledge Creating Communication Research Center

Joint Prize Winner : Tadahiro Taniguchi / former Expert Researcher (currently at Ritsumeikan Asia Pacific University)
◎DATE : July, 14, 2009
◎NAME OF THE PRIZE :
**Best Paper Award, Commemoration for the 20th Anniversary of Japan Society for Fuzzy Theory and Intelligent Informatics**
◎DETAILS OF THE PRIZE :
Imitation learning from unsegmented human motion based on N-gram statistics of linear prediction models
◎NAME OF THE AWARDING ORGANIZATION :
Japan Society for Fuzzy Theory and Intelligent Informatics
◎Comments by the Winner :
Imitation learning is one of the important capacities defining human intelligence among human learning abilities. However, one of the difficulties that robots face in learning is "which part of behavior of a demonstrator is to be imitated by an imitator," when the imitator learns the behavior of the demonstrator as a teacher, although humans can conduct this imitation without any difficulties. To solve this problem, we have developed an effective solution based on the low-dimensional and predictable nature of characteristic behaviors. We are very pleased with the recognition of our achievement.


Tadahiro Taniguchi (left) and Naoto Iwahashi

Prize Winner ● **Kyoung-Sook Kim** Expert Researcher, Knowledge Clustered Group, Knowledge Creating Communication Research Center
**Koji Zettsu** Senior Researcher, Knowledge Clustered Group, Knowledge Creating Communication Research Center
**Yutaka Kidawara** Group Leader, Knowledge Clustered Group, Knowledge Creating Communication Research Center
**Yasushi Kiyoki** Guest Expert Researcher, Knowledge Clustered Group, Knowledge Creating Communication Research Center

◎DATE : December 8, 2009
◎NAME OF THE PRIZE :
**Best Paper Award**
◎DETAILS OF THE PRIZE :
Moving phenomenon: Aggregation and Analysis of Geotime-Tagged Contents on the Web
◎NAME OF THE AWARDING ORGANIZATION :
The 9th International Symposium on Web and Wireless Geographical Information Systems
◎Comments by the Winner :
We have been conducting R&D for a new method to integrate various types of spatio-temporal information on the Web for 2 years. We are very happy to be awarded the best paper award from this academic society as an evidence of recognition of our research work by other specialist researchers. We would like to work toward producing a lot of research results based on this study. In the end, we want to express deep gratitude for the support from Knowledge Clustered Group.


Koji Zettsu (left), Kyoung-Sook Kim, Yutaka Kidawara

Prize Winner ● **Zhen Wang** Group Leader, Nano ICT Group, Kobe Advanced ICT Research Center

Joint Prize Winners :
Yoshinori Uzawa, Kroug Matthias
(National Astronomical Observatory of Japan)
Masanori Takeda, former NICT Expert Researcher
(currently at Shizuoka University)
Takafumi Kojima (Osaka Prefecture University)
Yasunori Fujii, Takashi Noguchi
(National Astronomical Observatory of Japan)
◎DATE : April 13, 2010
◎NAME OF THE PRIZE :
**Superconductivity Science and Technology Award**
◎DETAILS OF THE PRIZE :
Development of superconducting SIS receivers for ALMA band 10
◎NAME OF THE AWARDING ORGANIZATION :
Forum of Superconductivity Science and Technology, The Society of Non-Traditional Technology
◎Comments by the Winner :
We are honored to be awarded the Superconductivity Science and Technology Award for our successful development of terahertz-band superconductivity SIS heterodyne receiver with world's highest performance and its application to ALMA, using superconductivity materials including Nb and NbTiN, and device technology. The way to the practical application of and the production of usable materials from superconductivity materials is not easy, but to the best of one's poor ability, we would like to work for the researches on superconductivity materials with low energy consumption and device applications in this 21st century when the harmony of "human" and "nature" is sought.

# Broadcasting NICT's latest activities on YouTube's official channel "NICT Channel"

NICT has set up "NICT Channel," on YouTube's official channel. Already, NICT has been delivering a lot of contents including "Weekly Space Weather News," "Network Revolution for the Future," "Space-Time Standards," and others. We will add many contents about NICT's R&D and its results, supporting advanced information communications society, as information useful for education and daily life. Don't forget to watch them.
http://www.youtube.com/user/NICTchannel


### ● Weekly Space Weather News

This video supplies the basic information and forecast of geomagnetic environment in space. The easy explanations from experts in the magnetosphere field are welcomed by users.


### ● New-Generation Network -Network Revolution for the Future-

This video is showing R&D based on new design concept, related to the New-Generation Network that addresses the issues and limitations that are difficult to solve using conventional technologies.


### ● Space-Time Standards - Achieving an ultimate clock -

This video shows the maintenance of accurate Japan Standard Time (JST), Emitting Standard Time and Frequency Signal, satellite positioning technology, R&D of optional clock, and others.

### ● The First Asian Network-Based Speech-to-Speech Translation System by the A-STAR Consortium

This video shows in English the achievements of A-STAR (Asian Speech Translation Advanced Research Consortium) that is conducting joint researches on Network-Based Speech-to-Speech Translation System.

### ● "Ultra" Multilingual Translation System

This video shows "Ultra" Multilingual Translation System that can run on smartphone to support 21 languages.

### ● Hokuriku Research Center's activities (StarBED)

This video shows R&D of ubiquitous network simulator (StarBED) and next-generation ubiquitous network simulation technology that is meant for ICT for security and safety.

### ● Web Information Analysis System: WISDOM

This video introduces WISDOM. The system is on trial-open at http://wisdom-nict.jp/

## How to access YouTube "NICT Channel"

* Enter "http://www.youtube.com/user/NICTchannel" in the address bar of your Web browser and press Enter key to access "NICT Channel."
  If you want to receive video update notifications from "NICT Channel," click on the Subscribe button above the video screen.
* You can also access our channel by going to NICT Web (http://www.nict.go.jp/) and clicking "Video Library" and "YouTube NICT Channel".

Infinite possibilities! New technologies!

Free

# Facilities Open House 2010

## July 23(Fri) and 24(Sat)

## 10:00 - 16:00 (Reception open until 15:00)

**Venue**

**National Institute of Information and Communications Technology (NICT)**

4-2-1 Nukui-Kitamachi, Koganei-shi, Tokyo, Japan

E-mail: publicity@nict.go.jp

URL: http://www.nict.go.jp/

Exhibition of research results and lectures by researchers to be scheduled.
For details, check NICT Website.

**[Access]**

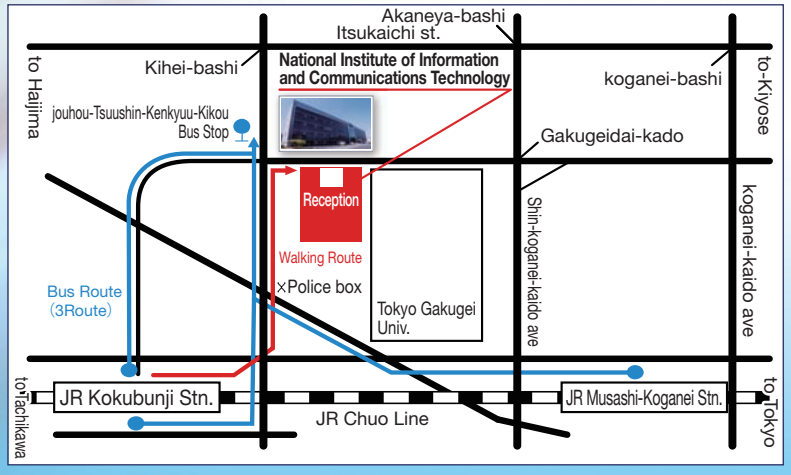
From JR Musashi-koganei Station:
KEIO-Bus from Track No.5 at North Exit bound for "Kodaira-Danchi"

From JR Kokubunji Station:
KEIO-Bus bound for "Kodaira-Danchi" at South Exit
TACHIKAWA-Bus bound for "Syowa-Byouin," "Kodaira-Danchi-Chuo," "Onuma-Danchi," or "Josui-Eigyosho" at North Exit

Get off from the bus at **"Jouhou-Tsushin-Kenkyuu-Kikou" Bus Stop** regardless of bus lines
Take any bus going to Kokubunji Station for return.

*Only 2-minute walk*

* Please use public transportation because the parking space is limited.




**Contact info for inquiries: Public Relations Office, NICT. Tel: 042-327-5322, Fax:042-327-7587**

* NICT staff may take photos during open house. These photos may be used in our website and publications. They shall not be used for any other purposes.

Other facilities open house days are scheduled at Kobe Research Laboratories on July 24 (Sat) and Kashima Space Research Center on July 31 (Sat). Keihanna Research Laboratories and Okinawa Subtropical Environment Remote-Sensing Center will have open house days in autumn.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