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FEATURE

Toward Resilient ICT

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Cover Photo
Wireless mesh network equipment (NerveNet) for the testbed on the rooftop of the Resilient ICT Research Center. The box named as information and communication station, equipped with communications and information processing function, connects with other stations to form a mesh network.

INTERVIEW

Building Information and Communications Infrastructure Resilient to Major Disasters

Yoshiaki NEMOTO
Director General of Resilient ICT Research Center

Yoshiaki NEMOTO was a professor and a director at the Computer Center of Tohoku University and a professor with the Graduate School of Information Sciences until 2008. He served as the Executive Vice President of Tohoku University from 2008 to 2012 and is currently a Professor Emeritus of Tohoku University. From 2012, he has been the Director General of the Resilient ICT Research Center of NICT, Sendai, Japan. He also served as the Chairman of the Tohoku Regional Information and Communications Association, to promote computerization and ICT in the region. Ph.D. (Engineering).

NICT Resilient ICT Research Center officially began its activities with the opening ceremony for a new research building constructed on Katahira Campus of Tohoku University in Aoba, Sendai City, in March, 2014 (Figure 1). It comprises three laboratories aligned with its major research themes, including Robust Network Platform Laboratory, Wireless Mesh Network Laboratory, and Information Distribution Platform Laboratory. Its objective is to establish *disaster resilient technologies* while maintaining close relationships with Tohoku University. We spoke with Dr. Yoshiaki NEMOTO, Director General of the Center, regarding circumstances and initiatives leading to establishment of the Center.

Information and communications have become infrastructure

—— The opening of a research center focusing particularly on the theme of disaster resilience in information and communications technology seems like a very significant occurrence. Could you tell us about the circumstances leading to opening the Center?

NEMOTO The Great East Japan Earthquake on March 11, 2011 was not just a major earthquake, it was a triple-disaster, also including a giant tsunami and nuclear power plant accident. In addition to bringing major damage to people's lives and industry, it also caused devastating damage to information and communications. This damage affected more than just the three prefectures in the region, and extended to the whole country.

What we learned from this was that in today's society, "information and communications networks have become social infrastructure". In the past, with the 1978 Miyagi Earthquake for example, communications networks were damaged, but at the time, it was perceived as just an inconvenience that "the phones were down". However, with this earthquake, it was clear that information and communications networks have permeated deeply into our lifestyles and become indispensible. It was not until they stopped that we realized how important they have become (Figure 2).

Research on information and communications infrastructure that will not be interrupted by disaster is urgent—and in particular, the third supplementary budget for FY2011 mandated new "R&D for Resilient Information and Communications Networks". Of course, this is not a transient issue but requires concerted, on-going effort. NICT Resilient ICT Research Center was initiated to provide leadership as a national institute and to form a base for cooperation among industry, academia, and government.

Contributing to recovery and development in disaster-hit areas

—— In terms of utilizing the experiences of the Great East Japan Earthquake, the decision to locate the research center in this Tohoku area is a significant factor, isn't it?

NEMOTO Another important role of the research center is to contribute to recovery and development of the economy in the affected regions through advanced R&D in information and communications. Of course this cannot be accomplished by the research center on its own, and we also need the cooperation, understanding and support of various other organizations.

Figure 1 Resilient ICT Research Center

INTERVIEW

Building Information and Communications Infrastructure Resilient to Major Disasters

Locating within the site of Tohoku University is also closely related to the fact that the university itself was a *victim* of the earthquake, has an awareness of the magnitude of the disaster and has great enthusiasm for research and countermeasures to be taken in the future. Of course, we also intend to promote and strengthen cooperation with organizations beyond Tohoku University, including other universities, private enterprises, and local governments.

On the other hand, it is also important to become a base for contributing internationally, since Japan is a technologically advanced country, particularly in the field of disaster resilience.

Three key issues when disaster occurs

—— Could you tell us specifically, what sorts of R&D themes are being pursued at Resilient ICT Research Center?

NEMOTO A particularly serious issue during the Great East Japan Earthquake was that "the necessary information did not reach who needed it, where it was needed". Information and communications technology has developed, and we normally have very advanced functionality, but this functionality stopped working. This was because some small possibility was overlooked, and not accounted for.

So, in that light, what issues are important? The first is to make networks more robust. For example, due to network congestion, communications was disrupted. When power was lost, everything stopped. For such critical times, disaster resilience needs to be improved.

The second is to have backups. During the Great East Japan Earthquake, coastal areas were hit by a large tsunami and everything was swept away. This applied to information and communications networks too, and the entire network had to be rebuilt from nothing. For such cases, we need to establish wireless technologies that can be used to build networks quickly and adaptively.

The third important initiative is for technology that can deliver the information really needed during a disaster. For example, Twitter and other SNS play a large role in information and communications. These services can real-

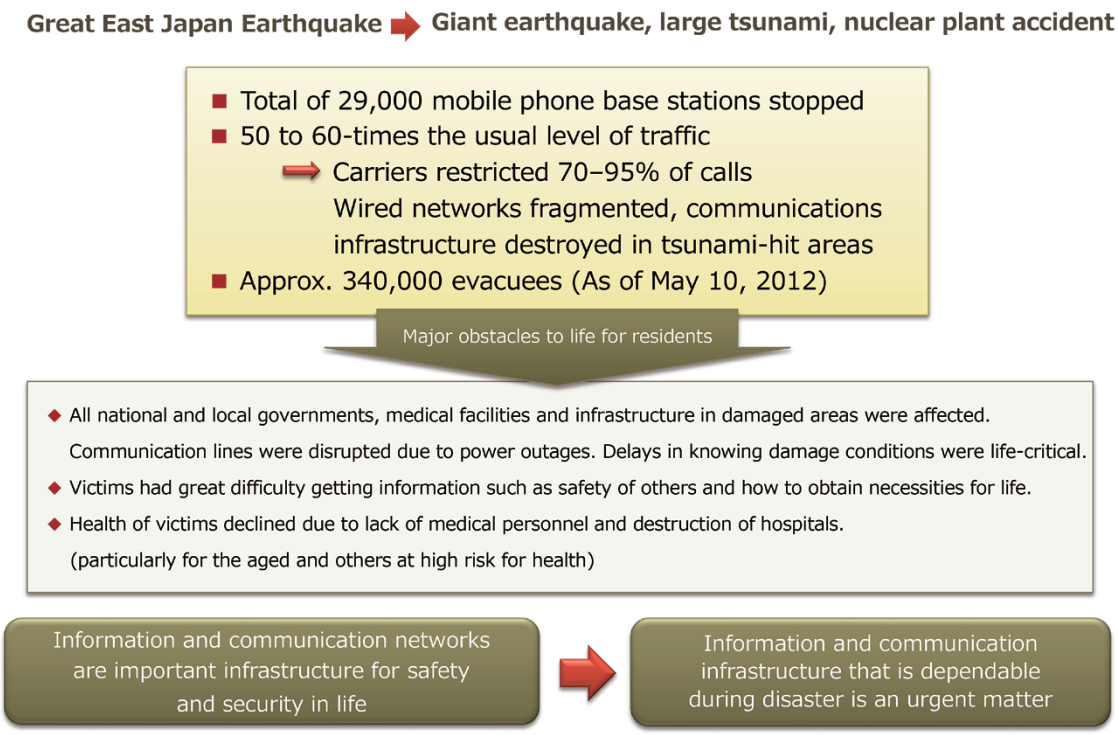


Figure 2 Damage to communications networks from the Great East Japan Earthquake and its effects

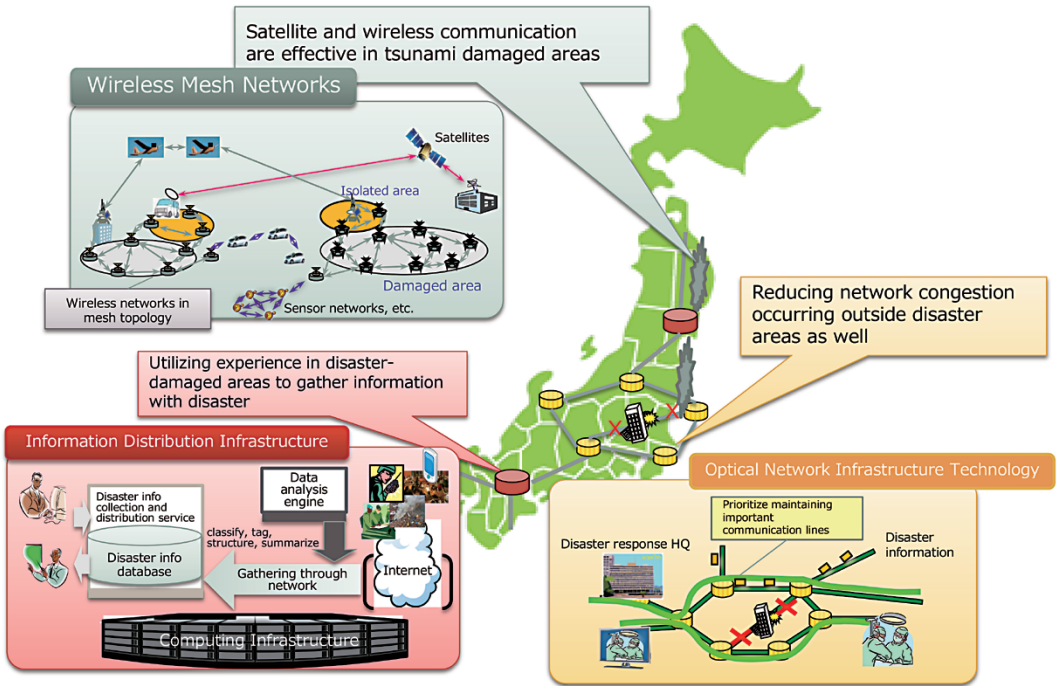


Figure 3 Three key research themes for Resilient ICT

ly show their strengths during an earthquake, but they are not fully utilized yet. Such hidden but useful information should be captured and actively used.

These three key issues have been taken as the research themes for the three laboratories in Resilient ICT Research Center (Figure 3).

This research center house works on construction of an optical network infrastructure able to handle communication loads during a disaster, establishing wireless network technologies that are resilient against disaster, and implementing information distribution infrastructure able to provide appropriate support during disaster. It also has equipment providing testbeds for testing, demonstrating and evaluating these systems and technologies.

■ Usability and efficiency

—— How will these technologies be deployed in society in the future?

NEMOTO Implementing these technologies in society is an urgent task. Large Tonankai Earthquakes are supposed to occur in the near future. Considering the geography, these will certainly strike the core of Japan as well. If networks are interrupted by this, the effects will surely be much greater than the Great East Japan Earthquake.

It will be impossible to avoid all damage, but by taking appropriate measures, damage can be kept to a minimum. Various circumstances beyond our expectations are sure to occur in a large disaster, but at minimum, it is important to prevent the things that we can anticipate from happening again.

In May, 2012, the Resilient ICT Forum was also inaugurated (Figure 4), with participation from 28 organizations including the Ministry of Internal Affairs and Communications, NICT, Tohoku University, private enterprises, and local governments. This is also a place to gather opinions, use them as feedback, and further improve technologies.

The important concept is *easy operation and easy maintenance*. Even if effort is made to develop new technologies, if they are difficult to use or are normally left idle, sitting in storage, they have no value. Technologies must be closely linked to everyday use, and also be easy to use during disaster. To achieve this, cooperation and discussion with local governments, who will be the main users, are important.

■ Inheriting and utilizing memory

—— What we do must be implemented quickly. On the other hand, on-going effort is also important, isn't it?

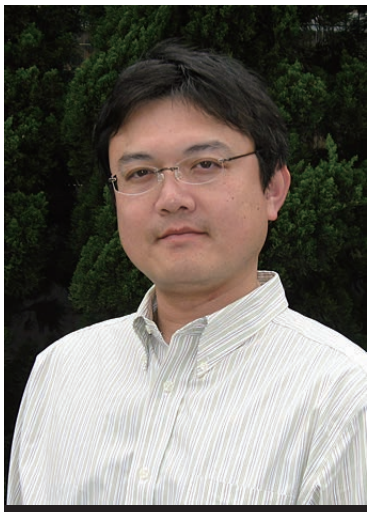
NEMOTO Perhaps it cannot be helped, but no matter how large the disaster, as time passes, memories of the event are lost. Even with the Great East Japan Earthquake, although the area itself has not changed, for those away from the region the earthquake is gradually becoming more and more *distant*. However, it should not be allowed to be forgotten, and we must take the measures that we are able to on an on-going basis.

Reflecting back, the 20th century has been *an age of quantity*. A great variety and number of conveniences have been created and have permeated society. The 21st century will be an age of quality. It will be important to maintain the quality of those technologies, so they function well in any situation.

If disaster resilience is handled properly, we can certainly move in the direction of reducing damage. This region holds ingrained experience and wisdom that can contribute, and it is our duty to capture it and put it to good use.

Figure 4 Director General of Resilient ICT Research Center NEMOTO presenting at the symposium jointly held with the Resilient ICT Forum

Enhancing Resiliency in Optical Fiber Communications



Yoshinari AWAJI
Director of Robust Network Platform Laboratory, Resilient ICT Research Center

After completing a doctoral course, he joined Communications Research Laboratory, Ministry of Posts and Telecommunications (currently NICT) in 1996. He has been mainly researching optical signal processing, optical amplifiers, and optical packet switching. He was engaged in information security strategies at the Cabinet Secretariat from 2004 to 2006. Ph.D. (Engineering).

Optical fiber networks are composed of communication buildings and buried or overhead fiber cables, so if facilities are damaged by large disasters such as earthquake, tsunami, or land slide, functionality can be degraded or lost. However, accommodating the communication needs of users requiring much information for recovery after a disaster has occurred is also an important role of optical networks. Accordingly, although some damage may be unavoidable, keeping the effects of any damage to a minimum is directly related to enhancing disaster resiliency.

Two themes in enhancing resiliency in optical fiber networks

Examining the 2004 Chuetsu Earthquake and the Great East Japan Earthquake as examples, not only were certain areas damaged directly, but communication throughout Japan became obstructed. Communication operators restricted calling, but basically, there was a sudden increase in traffic and even fewer communication resources than usual, which caused congestion, increased communication failure and other secondary damage.

The first research theme in the Robust Network Platform Laboratory is *damage control for optical fiber networks* and aims to avoid such nation-wide congestion (Figure 1).

Restoring functionality to optical fiber networks that have been damaged physically can also take considerable time and the time required to recover services can be measured in weeks. But areas hit by disaster require information for support, relief, and recovery. If entrance to the high-capacity optical fiber network can be recovered quickly, these various requirements can be accommodated. This is called *emergency rehabilitation of optical fiber networks* and is the second main research theme (Figure 1).

Damage control technologies

For some time NICT has been leading initiatives in optical packet switching. The core damage control technology is OPCI, which integrates conventional technologies with optical packet switching (Figure 2). Optical paths are for services that guarantee bandwidth, while optical packets provide lower-cost, best-effort-based services. Normally, the communication path is chosen based on individual service requirements, but when traffic increases suddenly during a disaster, it is more important to maximize utilization of the network, and being able to connect is better than not being able to connect at all, even if the quality is poor. In other words, the role of optical packets increases during disaster. As is also true with the Internet, the quality of best-effort services decreases with an increase in the number of users. On the other hand, if some decline in communication quality is permitted with optical packet switching, communication requests from more users can be accommodated, effectively providing damage control. Specifically, during ordinary times, optical packet and optical path channels are each allocated to separate wavelengths, but when a disaster occurs, this allocation is quickly switched, dramatically increasing the ability of the optical network to accommodate users and preventing congestion from spreading to the whole country.

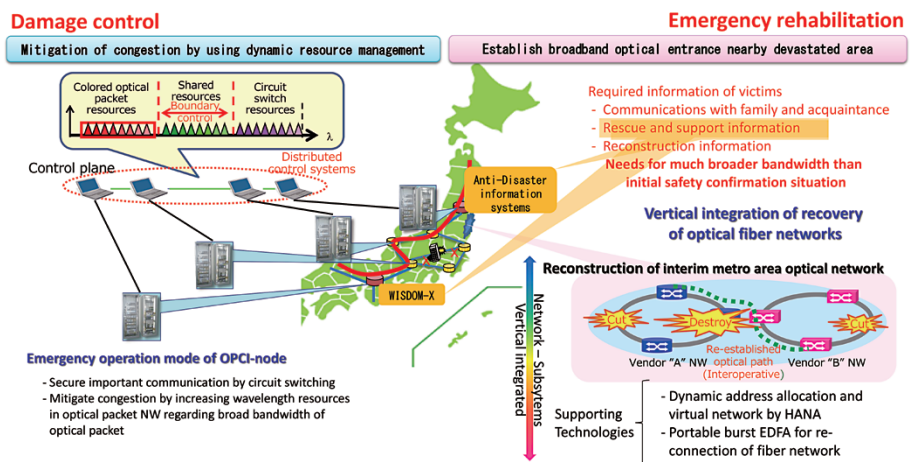


Figure 1 Two approaches for resilient optical network

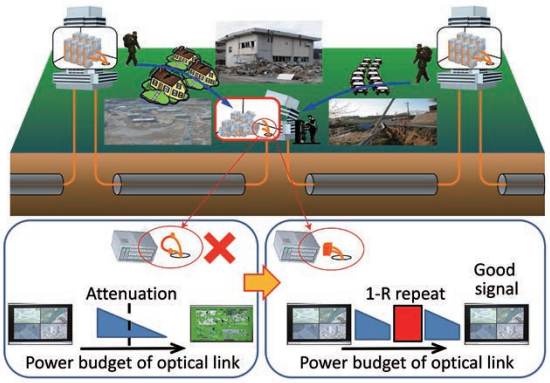


Figure 5 Re-connection of fiber link by portable EDFA

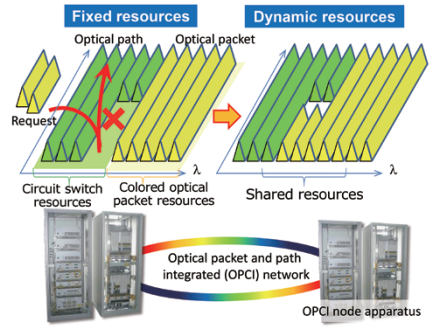


Figure 2 Dynamic resource management in OPCI-NW

Emergency rehabilitation technologies for optical fiber regional networks

Emergency rehabilitation involves three technology layers: technologies for temporary recovery of regional optical fiber networks, automatic reallocation of network addresses, and technologies to reconnect torn optical fiber links.

For temporary recovery of regional optical fiber networks (Figure 3), the physical topology is a ring, so when neighboring regional networks are damaged, recovery is not possible until the damaged location is repaired. However, it may be possible to recover some of the regional network by interconnecting with surviving equipment in neighboring networks. The issue is to ensure interconnectivity between regional networks, but unfortunately, optical communication device specifications differ by vendor and they usually cannot interconnect. As such, the research tasks include developing a control layer middleware that enables interconnectivity without changing specifications of optical communication devices, verifying communication of optical signals, and building the temporary network. We are currently conducting tests with two vendors.

The Optical Networking Laboratory has been conducting research on a hierarchical IP address allocation technology (called HANA) that can also be used at the network level as a recovery technology (Figure 4). One feature of HANA is that high-order prefixes and low-order suffixes of IP addresses are maintained in independent address spaces, so that if, for example, the network entrance (high-order prefix) stops functioning, allocation of low-order suffixes can be maintained. In this situation, if a connection to a different entrance (different ISP, etc.) can be obtained as an alternative route, the suffixes maintained by HANA can be re-used as-is and IP address allocation can be recovered quickly. With conventional technology, IP addresses of all hosts being accommodated must be recomputed and allocated from nothing. On the other hand, the reallocation process is done automatically with HANA, so any human error that could occur with current operations on commercial networks (manually allocating addresses) is avoided.

Practical testing of HANA is already being done on various types of network, including testbed experiments with wireless mesh networks and OPCI networks, and we are accelerating initiatives toward practical implementations.

Lastly, we introduce some reconnection technologies for optical fiber links (Figure 5). Another lesson we have learned from past major earthquakes is that the survival rate of buried optical fibers is quite high, depending on how they are buried. Compared to overhead optical fiber cables, cables that have been installed, buried at a suitable depth, can possibly be reused. However, if the buildings to which these optical fibers are connected are destroyed, the relay function is lost, so even if the optical fibers are simply reconnected, optical signals will not reach the same distance due to cumulative losses. If some sort of 1-R Repeating (light amplification) is provided at the relay point, the optical fiber link can be restored, but in most cases in areas where stations are destroyed, the power also is out and roads are buried in debris so that vehicles cannot access them. As such, we have devised a portable optical amplifier that can operate for long periods of time without requiring power. The device weighs approximately 5 kg, so a person can carry it, it is capable of wavelength dispersion compensation according to the characteristics of the optical fiber before and after the relay point, and it can operate for a long time on batteries or by remote pumping, so this amplifier is ideal for emergency reconnection of optical fiber links. It is also designed with dust and rain-proofing so it can operate in harsh environments.

The Robust Network Platform Laboratory will continue to develop these platform technologies further and work to attain robustness in optical fiber networks.

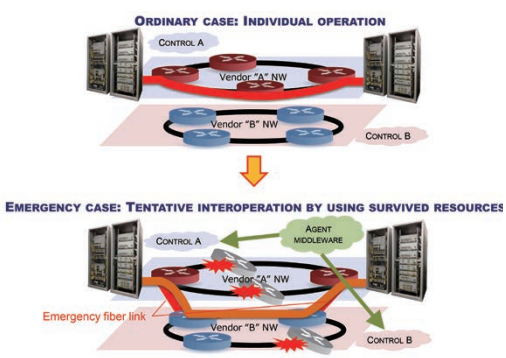


Figure 3 Emergent optical network integration for Multi-Vendor

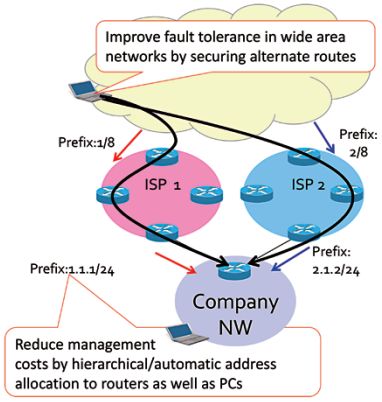


Figure 4 Hierarchical automatic number allocation system

R&D on Wireless Network Systems Resilient against Massive Disaster

Application and use of developed system in disaster drills

Kiyoshi HAMAGUCHI
Director of Wireless Mesh Network Laboratory, Resilient ICT Research Center

After completing a Master's degree in 1993, joined the Communications Research Laboratory of the Ministry of Posts and Telecommunications (currently NICT). He has been engaged in R&D in areas including mobile radio communication schemes, radio propagation measurement, and short-range wireless communication systems. He has held his current position since April, 2012.

In the Wireless Mesh Network Laboratory, we are conducting research and development to implement wireless network systems that are resilient against communication disruption during disasters. To deploy our research results in society as quickly as possible, we are actively promoting use of systems we have developed in activities such as disaster prevention drills, in collaboration with local governments and disaster-aid agencies. In this article, we introduce two such activities conducted recently.

Introduction

At the Wireless Mesh Network Laboratory, we are conducting research and development based on practical tests for realizing resilient wireless networking systems that are resistant to communication disruption during disaster. These include wireless communications systems, and their applications, which combine autonomously operating wireless mesh networking technology with wireless stations spread over wide areas and satellite communications that guarantee communication over even wider areas, and use mobile wireless components such as vehicles and aircraft.

It is important to check what problems exist in developed systems when applying them practically, what users require during a disaster, and what technical development will be required in the future, so we actively promote activities in cooperation with first-aid, fire-prevention and other rescue agencies through disaster prevention drills. Recently, we have collaborated with fire and disaster agencies in various areas, including local governments in Western Japan, where there is concern over large scale disaster due to earthquakes in the Nankai Trough, and in South-East Asia, where there is concern over flooding and other natural disasters. In this article, we leave these for another occasion, and focus on the two initiatives described below.

National emergency communications drill anticipating large-scale disaster

Starting in April, 2014, NICT built an independently developed disaster-resilient wireless mesh network (Figure 1), which maintains robust communication even during disaster, in the town of Onagawa in the Oshika District of Miyagi Prefecture, and is conducting long-term testing there. Recovery of areas affected by the Great East Japan Earthquake is progressing little by little in the stricken area, in-

Figure 1 Connecting four locations: the Onagawa Provisional Town Office, the Community Medical Center, the Onagawa Tsunagaru Library, and the refrigeration plant; with an unlicensed wireless network and enabling local governments to use it as an independent network

Figure 2 Municipal disaster prevention staff at the Onagawa Provisional Town Offices (Disaster Countermeasures Department) check conditions and deliver information using NICT live camera video, and VoIP telephones.

Figure 3 WINDS satellite earth station in front of the Japanese Red Cross Ishinomaki Hospital

cluding Onagawa. This wireless mesh network forms mesh-like wireless connections between bases, so that even if some communication routes are interrupted by a large-scale disaster, communication functions can be maintained.

The 77th emergency communications drill, planned by the Central Emergency Communications Council, was held in November, 2014, to plan for the smooth operation of emergency communications in the Tohoku region. As part of this drill, we participated in the emergency communication transmission drill in the town of Onagawa, together with 14 cities, 8 towns and 2 villages in the 6 Prefectures of the Tohoku region (Figure 2).

In the drill, damage over broad areas due to a disaster such as a large-scale earthquake was assumed, and damage conditions were conveyed to the Cabinet Office using emergency communications routes through prefectural disaster response departments and with cooperation among cities, towns and villages in the affected areas. NICT's provided overall cooperation in the drill, and used a disaster-resilient wireless mesh network in the town of Onagawa, with the ability to convey necessary information from shelters to local government offices, even when normal means of communication were damaged and unable to make connections. This was the first such demonstration in Japan in a national emergency communications drill. NICT demonstration equipment, including wireless network, live cameras for checking damage conditions, and VoIP telephones allowing remote locations to communicate their damage conditions with each other, was used successfully simulating real operation in the drill, and fulfilled its roles as expected.

In evaluations after the drill, the Onagawa Disaster Response Headquarters praised the NICT's network, with comments such as, "We were able to connect reliably, without confusion, even when normal means of communication were down", "It was extremely useful for the disaster response headquarters to obtain such clear image data", and "It helped ensure safety of our workers by enabling us to avoid sending them to dangerous areas as much as possible".

Note that this drill was conducted in cooperation with the town of Onagawa, the Tohoku Bureau of Telecommunications, Ministry of Internal Affairs and Communications, and the Tohoku region Emergency Communications Council.

Demonstration of the Miyagi Mobile Assessment System at Michinoku ALERT 2014

In November, 2014, an earthquake drill called Michinoku ALERT 2014 was held with the cooperation of local governments and Ground, Maritime, and Air Self-Defense Forces (including 13,000 personnel, 1,200 vehicles, and approximately 40 aircrafts including Osplays) mainly from the North Eastern Army of the Japan Ground Self-Defense Force. As part of this, a DMAT* assembly drill was held at the Japanese Red Cross Ishinomaki Hospital, which is the core medical relief facility in the region, including a data gathering experiment using the Miyagi mobile assessment system, supervised by Dr. Tadashi ISHII, Tohoku University School of Medicine. Satellite channels capable of communication over wider areas, even when existing communications infrastructure is interrupted were also used. These channels were provided using a Wideband InterNetworking engineering test and Demonstration Satellite "KIZUNA" (WINDS) fully automatic mobile ground station provided by NICT (Figure 3).

The Miyagi mobile assessment system developed by Dr. ISHII, is able to gather information electronically regarding the various environments at shelters scattered throughout the region. DMAT and staff of Ishinomaki Red Cross Hospital participated in the drill cooperatively, and were able to check that assessment data from simulated shelters in the region could be entered into a dedicated application, on tablet terminals at the shelters, and transmitted quickly and reliably through the WINDS earth stations (Figure 4). The system received high praise in being useful and effective even when existing communications infrastructure was interrupted during a large-scale disaster.

However, just before this satellite communication demonstration, there was some trouble with the WINDS control station equipment (in Tsukuba City, Ibaraki Prefecture), and regenerative relay through satellite communication was not possible. We were able to handle the unexpected situation with a non-regenerative relay communication mode, quickly preparing a non-regenerative relay modem and reconfiguring the earth station. While this contributed to accumulating technical know-how for a large-scale disaster, we also strongly felt the importance of building systems able to respond to all circumstances, the importance of minimizing the possibilities "beyond expectations", and the need for redundant communication routes.

Summary

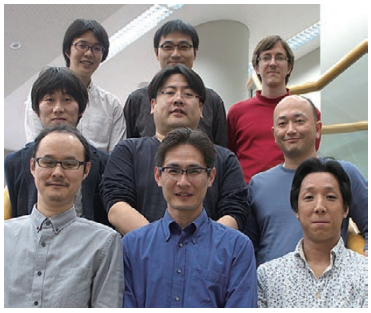
The chance to use disaster-resilient systems resulting from research and development in exercises such as disaster prevention drills is a vital opportunity to operate them under conditions close to their real intended environments, and to find out what is required of such systems. Through such activity, we will improve the systems, gain the understanding of our users, and deploy our results in society.

Figure 4 Doctor ISHII (right), checking the tabulated assessment data

* **DMAT**: Disaster Medical Assistance Team. A trained medical team with mobility to take action during the critical period after a disaster.

DISAster-information ANAlyzer (DISAANA) for SNSs

Real-time analysis and question answering for disaster-related information on SNSs



From upper left: Takuya KAWADA, Jong-Hoon OH, Julien KLOETZER, Masahiro TANAKA, Kentaro TORISAWA, Chikara HASHIMOTO, Jun GOTO, Kiyonori OHTAKE, Junta MIZUNO

Kiyonori OHTAKE
Director of Information Distribution Platform Laboratory, Resilient ICT Research Center

He received Dr. (Engineering) in 2001, and he joined the ATR Spoken Language Communication Research Laboratories in the same year. He joined NICT in 2008, where he engaged in research on spoken language and natural language processing.

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On a trial basis, NICT has released a question answering system called DISAster-information ANAlyzer (DISAANA) that processes tweets (http://disaana.jp (Japanese only)). DISAANA analyzes tweets that are posted in real time, and when simple questions are input, it instantly extracts and presents answer candidates. The system can be used from such terminals as smartphones and PCs. During future disasters, DISAANA will increase the efficiency of getting disaster-related information and make relief and rescue activities more effective.

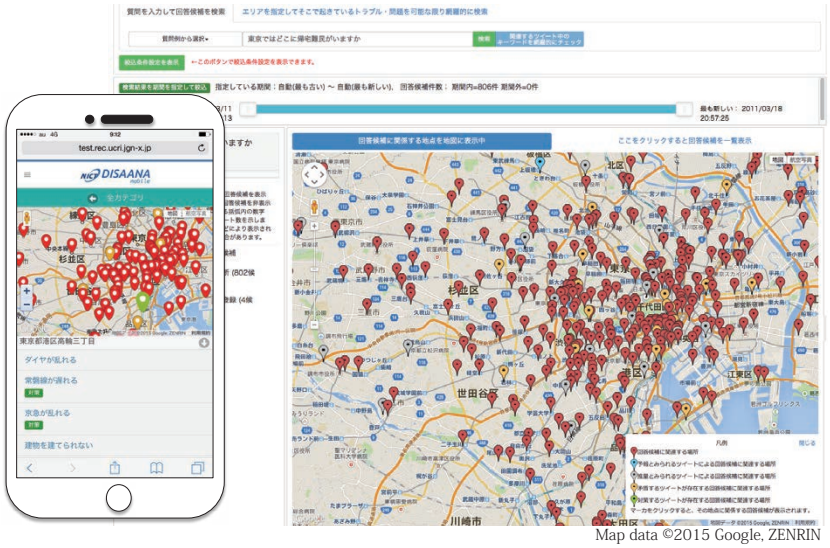
Background

During the 2011 Great East Japan Earthquake, even though useful information related to the disaster was posted on SNS sites such as Twitter, ways to analyze and search this information were inadequate, so it was difficult to obtain the required information. Accordingly, NICT has researched and developed a system that can quickly analyze disaster-related information on SNSs, and provide useful information to disaster victims and to people engaged in rescue and recovery activities. One result of this work is DISAANA, which we are currently releasing on a trial basis.

From keyword search to question answering

During the Great East Japan Earthquake, attention focused on the effectiveness of SNSs and other types of Internet services. Twitter is one such SNS that many deemed extremely useful. However, scrutinizing posts on Twitter ("tweets") shows that most of them to which "RT if you agree" was attached, rescue requests, or those with useful relief information received no responses. One reason might be that no efficient way exists to search for tweets. For example, during the Great East Japan Earthquake, if victims wanted to find locations in Miyagi Prefecture where emergency food was being distributed and searched by the key words, "Miyagi Prefecture emergency food distribution," they had to read through a huge amount of search results to find the information they needed.

We solved this issue using a question answering technology that we have been developing in the WISDOM X system (http://wisdom-nict.jp (Japanese only)), which answers questions using information from the web. DISAANA lists a wide range of answers to disaster-related questions from a vast amount of SNS texts. For example, with respect to tweets during the Great East Japan Earthquake, for the question



Map data ©2015 Google, ZENRIN

Figure 1 Display on a map of DISAANA the Great East Japan Earthquake trial edition

Figure 2 Automatic selection and display of problems and other issues with DISAANA mobile

"What is in shortage in Miyagi Prefecture?", several hundred or maybe several thousand response candidates can be displayed instantly, ranging from such expected answers as "milk, food, water, and clothing" to others more difficult to imagine like "food for allergic children". The response candidates are categorized in semantic clusters to help users quickly survey all the answers for fruitful and surprising answers.

There are several issues about searches in such a question answering format. One is that since people can express very similar meanings in different ways, the search might fail. A second issue is that location restrictions can be expressed in various ways, complicating desired searches. For example, a tweet saying "There is a shortage of blankets at Tenshin Elementary school" (Tenshin Elementary School is in Tagajo City, Miyagi Prefecture), cannot be a response for request "What shortages are there in Miyagi Prefecture?" to get "Blankets", because the tweet does not contain the words "Miyagi Prefecture" or "Miyagi".

DISAANA solves the first issue using a database of rewordings, created by automatically extracting them from hundreds of millions of web pages. Using approximately 300 million pieces of knowledge such as "there is a shortage of X, which can be reworded as there is not enough X", the search is extended when producing answer candidates. For the second issue, we created a database of 3.4 million place names with place name and address information. For example, since the entries specify that Tenshin Elementary School is in Tagajo City, Miyagi Prefecture, an answer for the earlier example can be produced, even if the tweet does not contain "Miyagi Prefecture". The location name database also includes latitude and longitude data for each entry to quickly show locations related to answer candidates on a map (Figure 1). GPS information can be attached that shows the location of the person who posted a tweet, but such tweets are quite rare due to privacy concerns. DISAANA does not use such coordinates; it analyzes the text of the tweet, identifies locations, and shows them on a map.

Automatic detection of problem and other issues by specifying only a location

DISAANA can also output a list of problems and other issues in an area by simply specifying the location without entering a question. On DISAANA mobile for smartphones, GPS data from the device can be used to automatically select and display problems/issues occurring at the current location at the touch of a button (Figure 2).

Simultaneously finding and displaying contradictory information to reduce confusion caused by false rumors

During the Great East Japan Earthquake, a flood of false rumors on SNSs was an issue. DISAANA handles this issue by searching for answer candidates in tweets that contain contradictory information in addition to just searching for answer candidates. Contradictory tweets are shown separately, simplifying the determination whether the selected answer candidate tweets are false rumors.

For example, a well known false rumor during the Great East Japan Earthquake was that a fire at a petroleum industrial complex in Chiba was polluting the air and producing toxic and acid rains. Figure 3 shows the results when the question "What is happening at a petroleum industrial complex in Chiba?" is entered in the current Great East Japan Earthquake trial edition of DISAANA. The acid-rain response candidate shows tweets with both "there is acid rain" and the contradictory, "the rumor about acid rain is false". In such cases, caution is urged with a warning mark, and for DISAANA mobile, a note also mentions contradictory information.

Future prospects

In the future, we plan to collaborate with external organizations to demonstrate DISAANA in disaster drills. Through such demonstrations, we will identify operational issues during disasters and improve our system's functionality and usability.

Figure 3 Operation of DISAANA the Great East Japan Earthquake trial edition when contradictory information is found

Minister for Internal Affairs and Communications Visits to the Resilient ICT Research Center

The Third World Conference on Disaster Risk Reduction was held on March 14 to 18, 2015, in Sendai City. Ms. Sanae TAKAICHI, the Minister for Internal Affairs and Communications (MIC), attended the conference on March 14, and the next day, after visiting the Arahama Elementary School and the Takasago Branch of the Miyagino Fire Station, she visited Resilient ICT Research Center. At the beginning, Dr. Masao SAKAUCHI, President of NICT, gave an overview of NICT activities, after which Dr. Yoshiaki NEMOTO, Director General of the Research Center, gave a history of the Center and explained how the mission is to bring the results of resilient ICT research into society as quickly as possible.

At a press conference after the visit

Regarding research activities, Dr. Kiyonori OTAKE, Director of Information Distribution Platform Laboratory, explained and gave a demonstration of DISAster-information ANAlyzer (DISAANA). Then, Dr. Fumie ONO, Senior Researcher of Dependable Wireless Laboratory, Wireless Network Research Institute, described exhibits including a Very Small Aperture Terminal (VSAT), a Wireless Mesh Base Station, and Onboard Wireless Repeater for Unmanned Aerospace System, and as an example of a result from MIC contract research, an ICT unit housed in an attaché case. This visit was introduced on the NHK evening news as part of a report on Minister TAKAICHI's visit to Sendai, stating that this was her first visit to the area affected by the Great East Japan Earthquake since assuming her position, and that she visited Resilient ICT Research Center in the Aoba ward of Sendai City which was established in March last year as a world-class research base in the area of disaster-resilient information and communications.

Top row from the left: President SAKAUCHI giving an overview of NICT, Director General NEMOTO giving an overview of Resilient ICT Research Center
Bottom row from the left: Director OTAKE describing DISAANA, Senior Researcher ONO describing wireless networks, Director HAMAGUCHI describing operation of the ICT Unit

Report on Disaster Resilient ICT Symposium

Held as a public forum of the Third UN World Conference on Disaster Risk Reduction

Disaster Resilient ICT Symposium, on the theme of "Establishing Disaster Resilient ICT—Disaster Resilient ICT Research Results and Societal Implementation—", organized by NICT and supported by the Ministry of Internal Affairs and Communications (MIC), Resilient ICT Forum, was held at the TKP Garden City Sendai, as a public forum during the Third UN World Conference on Disaster Risk Reduction. The symposium was held to reflect on activities implementing disaster resilient ICT research in society today, four years since the Great East Japan Earthquake, and to revisit approaches to implementation in society. It was attended by 162 participants from ICT enterprises, universities, research facilities, the MIC, and local governments.

The keynote speech was given by Dr. Tadashi ISHII, Professor of Tohoku University Hospital, who was the disaster medical coordinator in the Ishinomaki region after the earthquake. Dr. ISHII described his experiences during the disaster, initiatives to prepare for the future, and his hopes with respect to ICT. In the general lectures, Sendai City gave a lecture on their initiatives to improve information and distribution in their city, universities and private enterprises gave lectures on potential new technologies, and there were lectures on standardization activities in international development, and initiatives applying disaster prevention ICT in the Philippines.

After that, a panel discussion was held to revisit needs and seeds today, now that four years have passed since the earthquake, and how implementation in society should be promoted in the future. Comments from attendees pointed out the importance of using installed systems during normal times, of maintaining on-going development of these systems, and of eco-systems. The importance and strong desire to expand Japan's disaster-resilient ICT technologies to developing countries, and the need for specific policies in that area, were emphasized. Due to the enthusiastic discussion, no one left their seats until the very end, and the discussion ended in great success.

During the UN World Conference on Disaster Risk Reduction, NICT participated in many events such as the "Disaster prevention and recovery exhibition", symposia on "resilient disaster prevention" and "tough robotics", and promoted our research activities.

Photo, upper: Disaster Resilient ICT Symposium panel discussion
Photo, lower: Keynote lecture: Tadashi ISHII, Professor of Department of Education and Support for Community Medicine, Tohoku University Hospital

Awards

Shingo YASUDA/ Researcher, Cyber Range Laboratory, Cybersecurity Research Center
Yuuki TAKANO/ Researcher, Cyber Range Laboratory, Cybersecurity Research Center
Razvan Beuran/ Senior Researcher, Network Testbed Research and Development Laboratory, Network Testbed Research and Development Promotion Center
Toshiyuki MIYACHI/ Associate Director of Network Testbed Research and Development Laboratory, Network Testbed Research and Development Promotion Center
Co-recipients: Yoichi SHINODA, Tomoya INOUE (Japan Advanced Institute of Science and Technology)

ShowNet Demonstration Category Special Jury Award

◎Awarding Organization:
Interop Tokyo 2014

◎Award Date: June 12, 2014

◎Details:
The "NERVF Electrical Net Verification" demonstration presented at Interop Tokyo 2014 under the topic "Interactive Network Verification" was nominated by the jury in the Interop 2014 Demonstration category as being particularly excellent.

◎Comment from the Recipients:
NERVF was highly evaluated for making it possible to interactively add elements such as towers and UAVs to the wireless networks emulated in real time on StarBED, and to visually check their effects on the environment. We plan to continue our research on generalizing this technology for use as a provisioning tool for quickly and efficiently installing new network equipment for disaster recovery. We would like to thank the many people who collaborated with us on this research. We hope to continue to cooperate with people in various organizations, and to further contribute to expanding this technology.


From the left: Razvan Beuran, Tomoya INOUE, Yuuki TAKANO, Shingo YASUDA, Yoichi SHINODA, and Toshiyuki MIYACHI

Kiyoshi HAMAGUCHI/ Director of Wireless Mesh Network Laboratory, Resilient ICT Research Center
Co-recipients: Wei Zhao, Zubair Fadlullah, Hiroki NISHIYAMA, Nei KATO (Tohoku University)

Globecom 2014 Best Paper Award

◎Awarding Organization:
IEEE Communications Society

◎Award Date: December 8, 2014

◎Details:
Awarded as a best paper for "On Joint Optimal Placement of Access Points and Partially Overlapping Channel Assignment for Wireless Networks"

◎Comment from the Recipient:
IEEE Globecom is one of the top conferences in the ICT field, and it is a very great honor as a researcher to be selected as one of 14 papers among 2,171 papers submitted. The award recognizes our original method for maximizing communications capacity of wireless networks such as Wi-Fi, which can be applied to deal with excessive communication traffic occurring suddenly when a disaster occurs. It is the result of research done in cooperation with Tohoku University, and I am very pleased that it has been recognized in this way.

I would like to express deep gratitude to all that have been involved in this research to this point. I intend to continue working to contribute to the resilient ICT research field in the future, encouraged by this award.

Daisuke MAKITA/ Researcher, Cyber Tactics Laboratory, Cybersecurity Research Center

Symposium on Cryptography and Information Security, Best Paper Award

◎Awarding Organization:
Technical Committee on Information Security

◎Award Date: January 21, 2015

◎Details:
Paper: "Correlation Analysis between DNS Honeypot and Darknet for Proactive Countermeasures of DNS Amplification Attacks"

◎Comment from the Recipient:
The Symposium on Cryptography and Information Security (SCIS) is the largest symposium on cryptography and information security technology in Japan and I am very happy to receive a paper award at such a symposium. In this research we analyzed a type of cyber-attack called DNS amplification attack and showed that pre-emptive defenses and early responses for this type of attack can be implemented. I would like to express deep gratitude to all who supported me in receiving this award.

Masataka HIGASHIWAKI/ Managing Director, Advanced ICT Research Institute /Director of Green ICT Device Advanced Development Center

The 11th JSPS Prize

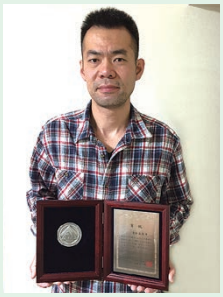
◎Awarding Organization:
Japan Society for the Promotion of Science

◎Award Date: February 24, 2015

◎Details:
Pioneering Research and Development on Wide Bandgap Semiconductor Transistors

◎Comment from the Recipient:
This award recognizes research and development on an earlier research theme, ultra-high-frequency gallium-nitride transistors, as well as a major current research theme, gallium oxide devices. It also recognizes pioneering results cultivating new semiconductor materials and device architectures, and work toward practical applications.

Taking this award as encouragement, I intend to increase my efforts, continuing my research and development and finding industrial applications.



Ye Kyaw Thu/ Researcher, Multilingual Translation Laboratory, Universal Communication Research Institute
Finch Andrew/ Senior Researcher, Multilingual Translation Laboratory, Universal Communication Research Institute
Eiichiro SUMITA/ Associate Director General of Universal Communication Research Institute
Chiori HORI/ Former Director of Spoken Language Communication Laboratory, Universal Communication Research Institute
Co-recipients: Win Pa Pa , Aye Mya Hlaing , Hay Mar Soe Naing (University of Computer Studies, Yangon)

ICCA 2015 Best Paper Award

◎Awarding Organization:
13th International Conference on Computer Applications (ICCA 2015)

◎Award Date: February 5, 2015

◎Details:
Syllable Pronunciation Features for Myanmar Grapheme to Phoneme Conversion

◎Comment from the Recipients:
Grapheme-to-Phoneme (G2P) conversion is a necessary step for speech synthesis and speech recognition. This paper addresses the problem of grapheme to phoneme conversion for the Myanmar language. In our method, we propose four simple Myanmar syllable pronunciation patterns as features that can be used to augment the models in a Conditional Random Field (CRF) approach to G2P conversion. Our results show that our additional features are able to improve a strong baseline model that does not include them. We found that combination of all four features gave rise to the highest performance for Myanmar language G2P conversion.

From the left: Eiichiro SUMITA, Finch Andrew, Win Pa Pa, Ye Kyaw Thu, Aye Mya Hlaing, Chiori HORI, and Hay Mar Soe Naing

Manabu ITO/ Research Expert, New Generation Network Laboratory, Network Research Headquarters

Young Researcher's Award

◎Awarding Organization:
The Institute of Electronics, Information and Communication Engineers (IEICE)

◎Award Date: March 11, 2015

◎Details:
"An Experimental Evaluation on the Effect of Signaling Load Reduction using EPC/IMS Virtualization" and "A Study on Reasonable Sharing of Flow Control Information for Mobile Network Virtualization"

◎Comment from the Recipient:
It is a great honor to receive this Young Researcher's Award from the IEICE. I would like to express deep gratitude to my co-authors as well as everyone who provided guidance and support. Encouraged by receiving this award, I intend to continue to work even harder in the future.

Zhang Bing/ Senior Researcher, Dependable Wireless Laboratory, Wireless Network Research Institute

"Wireless Power Supply Application Contest" Progress 1st Prize

◎Awarding Organization:
IEICE Technical Committee on Wireless Power Transfer

◎Award Date: March 12, 2015

◎Details:
Wireless Display Powered by Sheet Medium Communication

◎Comment from the Recipient:
I am very happy to have been selected for this prize, "Wireless Power Supply Application Contest", by experts and visitors from the public. In the system we developed, a display is placed on a sheet medium which is placed on the desk, power is supplied to the terminal by transmitting a 2.4-GHz-band electromagnetic wave in the sheet, and the video from a built-in camera is shown on the display. Development of this technology enables the display, mouse, keyboard, speakers, and smartphone to operate on the desktop without batteries or wires.

Fumihiko TOMITA/ Vice President

60th Maejima Hisoka Award

◎Awarding Organization:
Tsushinbunka Association

◎Award Date: March 20, 2015

◎Details:
R&D on Space Weather Forecasting

◎Comment from the Recipient:
The new wording of "Space Weather Forecast" was introduced to the world in 1987 from Radio Research Laboratory (RRL), the direct ancestor of the NICT. After that, our research and development has been making a remarkable progress based on the researchers' hard works in observations and simulations. I hope that our international Space Weather Forecast program will continuously progress and deeply contribute to the future more safety and reliable world human lives.

2015 Open House Schedule

NICT will be holding "NICT Open House 2015" events throughout Japan, presenting lectures, exhibits and demonstrations of the latest results from NICT research and development.

July 25 (Sat.)	NICT Open House 2015 in Kobe —Facility Open House 2015 of the Advanced ICT Research Institute—	588-2, Iwaoka, Iwaoka-cho, Nishi-ku, Kobe, Hyogo
October 22&23 (Thu.&Fri.)	NICT Open House 2015	4-2-1, Nukui-Kitamachi, Koganei, Tokyo
October 29–31 (Thu.–Sat.)	Keihanna Information and Communications Fair 2015 —NICT Open House 2015 in Keihanna—	1-7 Hikaridai, Seika-cho, Soraku-gun, Kyoto
November 21–23 (Sat.–Mon.)	Keihanna Information and Communications Fair 2015 @ The Knowledge Capital —NICT Open House 2015 in Umekita—	3-1 Ofuka-cho, Kita-ku, Osaka
November 21 (Sat.)	NICT Open House 2015 in Kashima —Kashima Space Technology Center Open House—	893-1, Hirai, Kashima, Ibaraki
November 21 (Sat.)	NICT Open House 2015 in Okinawa —Okinawa Electromagnetic Technology Center Open House—	4484, Onna, Onna-son, Kunigami-gun, Okinawa

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