独立行政法人
情報通信研究機構
NICT NEWS
National Institute of Information and Communications Technology

2012 OCT
No. 421
10



Advanced Sensor Information Aggregation and Analysis Platform

—Element Technologies for Realizing New Generation ICT Services—

Koji Zettsu
Director, Information Services Platform Laboratory
Graduated from university in 1992 and completed a doctoral course in 2005. After working at IBM Japan from 1992, he joined Communications Research Laboratory, Ministry of Posts and Telecommunications (currently, NICT) in 2003. Visiting Associate Professor, Kyoto University. Visiting Researcher at Institute of Computer Science, Christian-Albrechts University Kiel (2009). SWG Chair, New Generation Network Promotion Forum WG "Value Creating Networks" (2009-2010). Ph.D. (Informatics).

Yuuichi Teranishi
Research Manager, New Generation Network Laboratory, Network Research Headquarters
Visiting Associate Professor, Cybermedia Center, Osaka University. Graduated from university in 1993. Completed a doctoral course and joined Nippon Telegraph and Telephone Corporation in 1995. Lecturer at Cybermedia Center, Osaka University in 2005. Associate Professor of Graduate School of Information Science and Technology, Osaka University in 2007. Joined NICT in 2011. Engaged in research and development of distributed systems and network service infrastructure technology. Ph.D. (Engineering).

Kiyohide Nakauchi
Senior Researcher, New Generation Network Laboratory, Network Research Headquarters
Joined Communications Research Laboratory, Ministry of Posts and Telecommunications (currently, NICT) in 2003. Currently engaged in research and development of new generation network architecture, network virtualization technology, and mobile service infrastructure technology. Ph.D. (Engineering).

Introduction

At NICT, we are promoting a new generation network strategy project that will create a completely new network designed from scratch to handle vast amounts of traffic, a wide variety of terminals, and large-scale expansion—all difficult to resolve by solely improving the Internet. With the new generation network, we aim for the realization of a new generation ICT service that can capture real-world events happening in real time using vast amounts of data emerging in daily living environments including information handled by the traditional Internet. The advanced sensor information aggregation and analysis platform we will introduce here consists of 3 key technologies: dynamic network control middleware, wide area sensor networking technology, and mobile network virtualization technology (Figure 1).

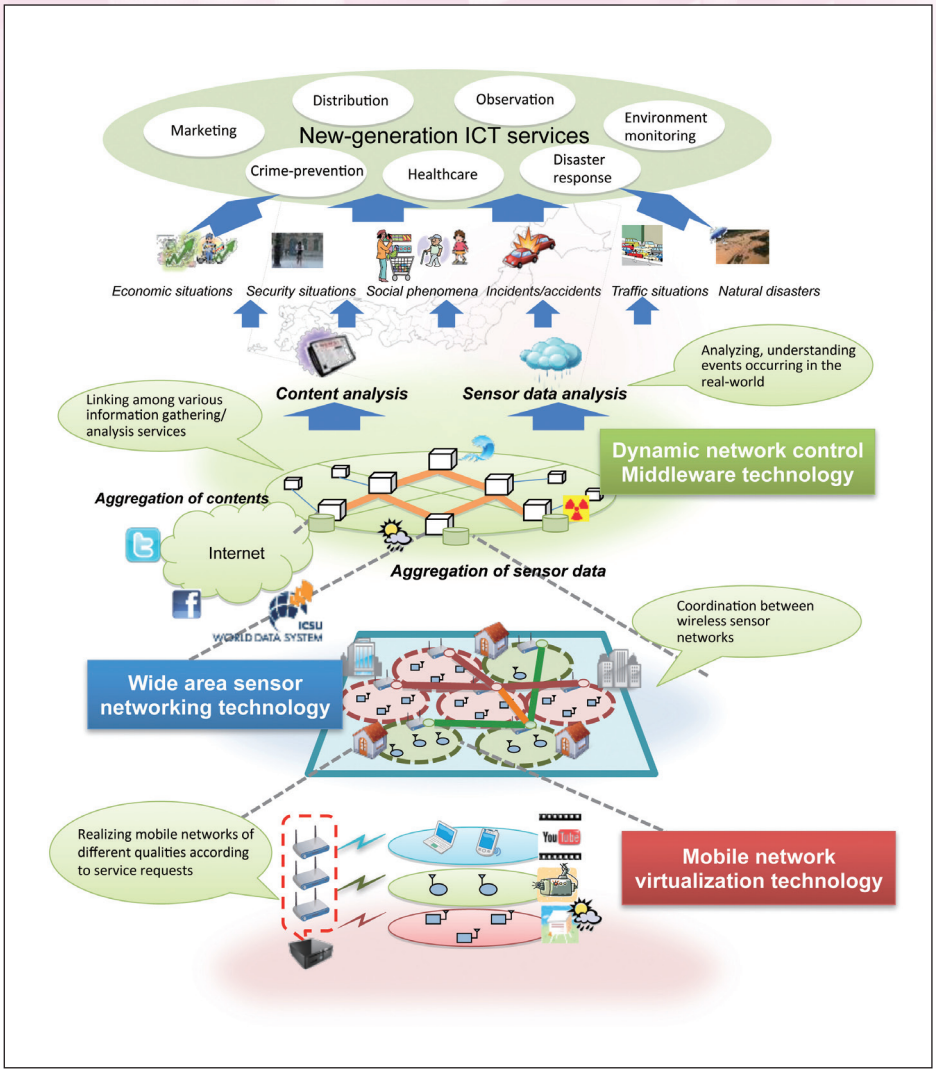


Figure 1●Overview of advanced sensor information aggregation and analysis platform

Dynamic Network Control Middleware

In the advanced sensor information aggregation and analysis platform, we can create a virtual sensor that collects and analyzes various sensor data related to natural and social phenomena. The virtual sensor consists of various information services that supply, process, collect and store sensor data. To efficiently implement such applications in which information services work in conjunction with one another, we are researching and developing Service-Controlled Networking (SCN) middleware that dynamically controls network resources in response to demand of service collaborations. SCN[*1]

*1 Tetsuo Toyomura, Takashi Kimata, Kyoung-Sook Kim, and Koji Zettsu: Towards Information Service-Controlled Networking, Proceedings of the 5th International Universal Communication Symposium (IUCS2011), pp.155—163, Oct. 2011

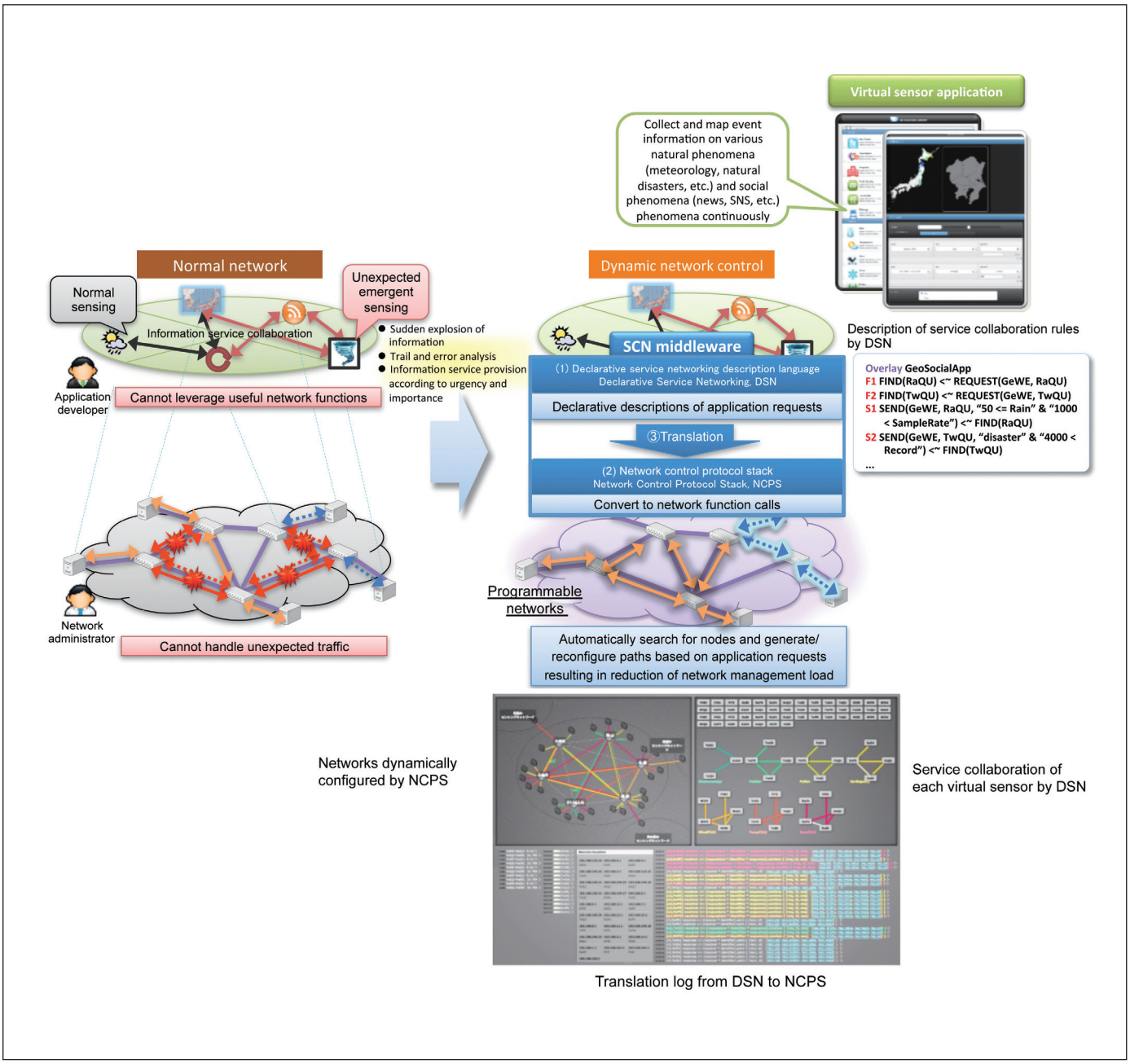


Figure 2●Dynamic network control based on SCN middleware

is implemented as middleware located between programmable network infrastructures (e.g., OpenFlow, virtualized node infrastructure) and information service platform (e.g., service computing and clouds) (Figure 2). Programmable networks provide commands and API's to operate networks from software. SCN middleware leverages this functionality to automatically adjust network configurations to satisfy application-specific service collaboration requests.

SCN middleware consists of the following components.

1) Declarative Service Networking (DSN) for describing declarative rules specifying service collaboration requests.

2) Network Control Protocol Stack (NCPS) for executing commands that controls programmable networks.

3) Mechanism that interprets DSN descriptions and converts them into a sequence of NCPS commands.

When an application declares a simple DSN request telling, "exchange this kind of data between these two services," SCN generates NCPS commands that configure an appropriate network by, for instance, searching for the nodes running the applicable services and creating an optimal path for transferring the data between them. In SCN, an application only declares rules on when, between which services, and what types of data to exchange, leaving the actual procedures to execute data exchange up to the middleware. The advantage is that it can transparently control underlying networks regardless of the differences in protocols and allow applications to change their behaviors even in the midst of being executed just by modifying the declarative rules. The applications specify the rules regarding service discovery, data exchange between services, and service situation monitoring. SCN interprets the rules described in DSN and translates to adequate commands in different network protocols using NCPS. It also conducts coordination and optimization of NCPS commands generated from multiple DSN for resolving conflicts and/or improving performance.

SCN middleware is effective in responding to unexpected situations such as disaster cases by combining existing information services, aggregating/analyzing enormous amounts of information, and by discovering alternative information services, through leveraging high scalability and performance of networks. By using SCN middleware technology, one can dynamically and continuously rebuild a network even with sudden requests from applications. Through this, it is expected that application developers will be able to leverage network performance more efficiently and network administrative costs will be alleviated by avoiding manual reconfiguration of networks for every request from application developers.

Wide Area Sensor Networking Technology

Due to advances in wired/wireless network technology and device technology, small sensors, home electronics, and other things that until now required special equipment are starting to be able to connect to networks at all times. In order to be able to ascertain real-world events occurring in real time and detail, it is necessary to enable the use of sensor data generated from a vast number of wireless sensors setup in these daily living environments. We are currently researching and developing technology for wide area sensor networks that efficiently connect sensors mutually out of a vast number of wireless sensors deployed over a wide range.We have been developing the Virtual Federated Sensor Network (VFSN) Platform for prototyping the technology of flexible configuration of wide area sensor networks under a distributed architecture with no centralized server (Figure 3). This system is designed to operate on a network virtualization infrastructure. Each wireless sensor network is connected under virtual base stations that compose the network virtualization infrastructure. Modules are built into the virtual base stations to construct an overlay network that interconnects between each wireless sensor network in the distributed architecture. This module, implemented using an overlay agent platform software, PIAX[*2], has functions to efficiently search and aggregate necessary sensor data from a vast number of wireless sensor networks existing and dispersed geographically. Furthermore, in order to realize mutual sensor resource exchanges, VFSN has a function to integrate different wide-area sensor networks. This function realizes a cross-sectional wide area network in the time of a disaster with low cost observation area expansion. This prototype system runs on the 'PIAX test bed[*3]' which enables easy operations and verifications of the systems using PIAX on the new generation network test bed called 'JGN-X', provided by NICT.

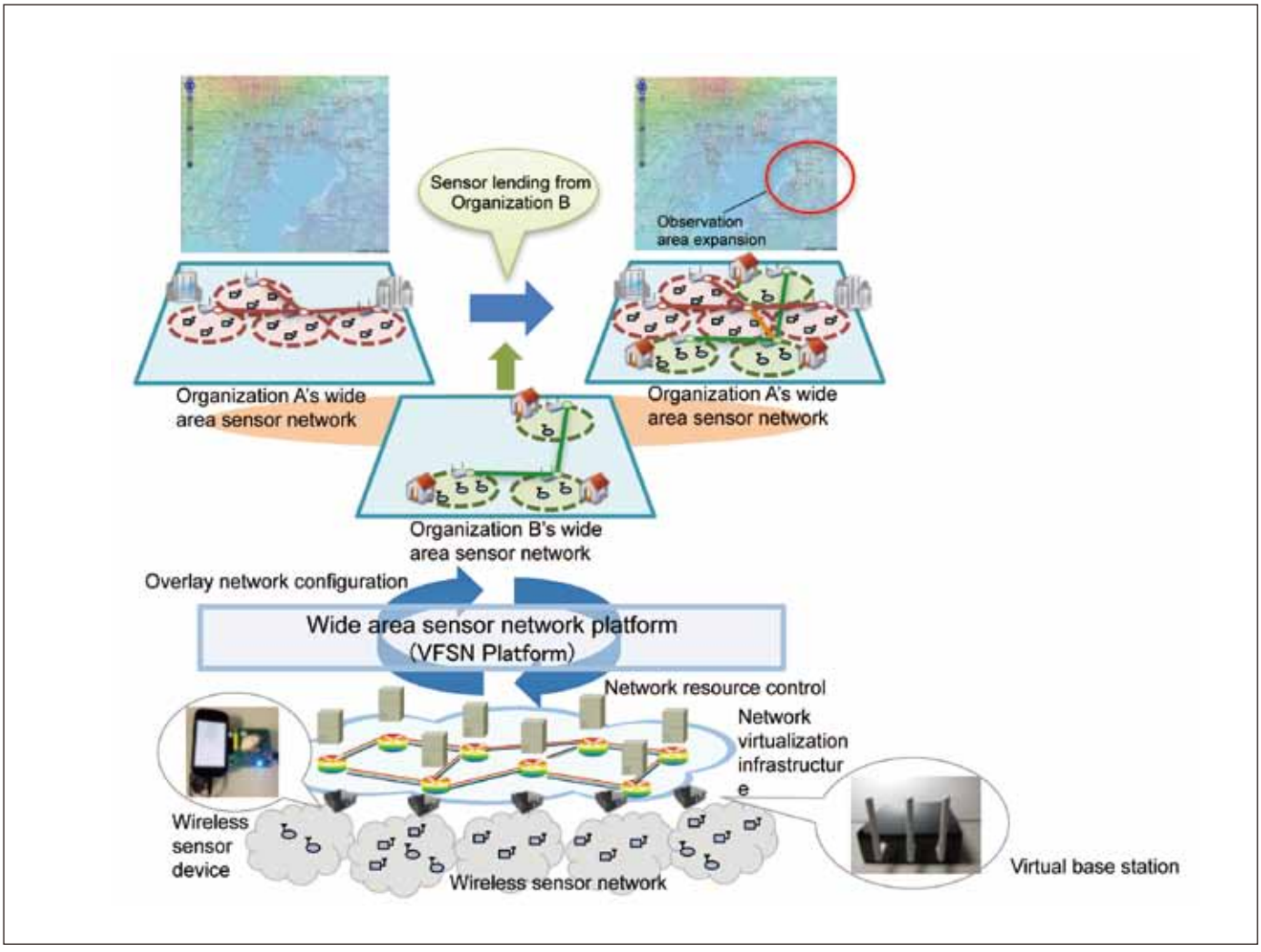


Figure 3●Virtual integrated sensor network platform

*2 Reter to http://piax.org/

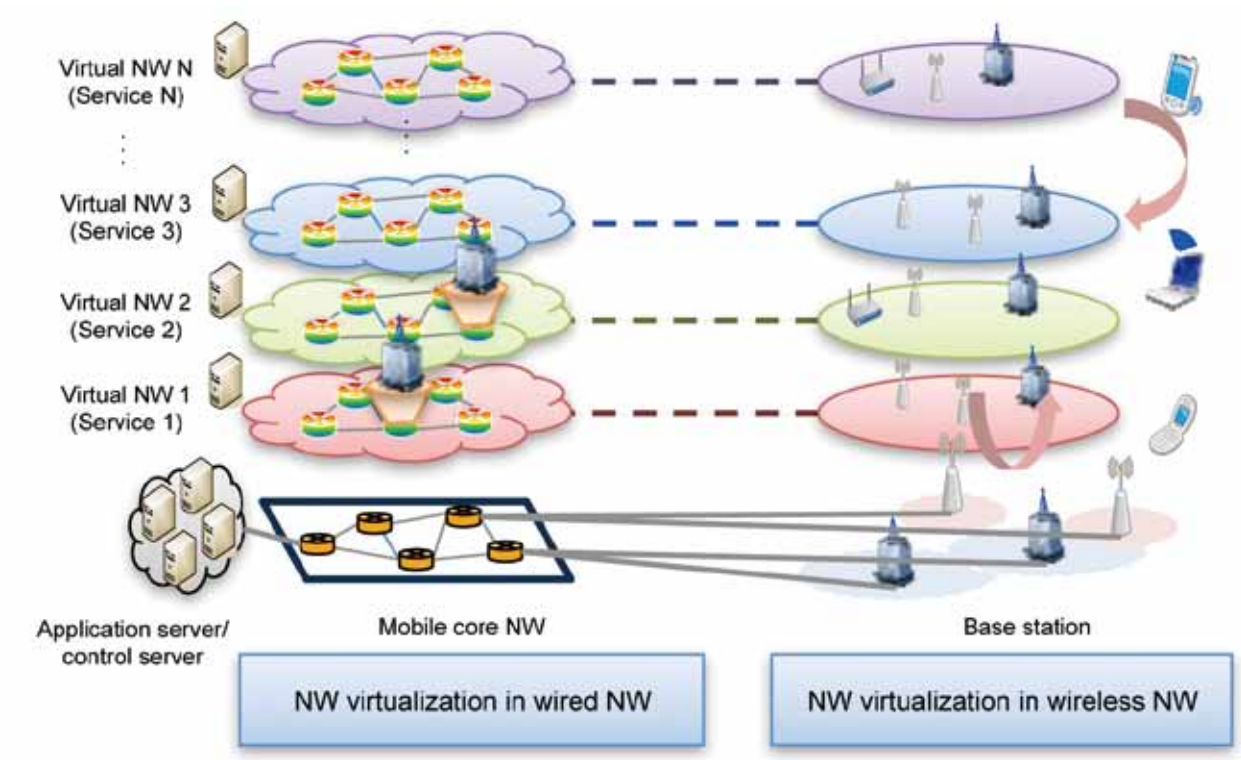


Figure 4●Outline of Mobile network virtualization

Mobile Network Virtualization Technology

Within the advanced sensor information aggregation and analysis platform, there are two types of services, one that collects large quantities of small-sized data in real time and another that exchanges large-sized data in a best-effort, each carrying its different urgency, importance, and connectivity. We are aiming for the realization of a mobile network that can continuously provide and allocate the most appropriate, optimized mobile network resources to the highest priority, important services requesting different qualities.

Network virtualization technology is the key to this and is attracting worldwide attention as a technology that can efficiently accommodate networks with differing requests for various services and transmission methods in a shared infrastructure[*4]. The basic concept behind network virtualization is programmability (adaptable implementation of packet processing capabilities and independent transmission protocols) and resource isolation (elimination of reciprocal interference among virtual networks that coexist). By realizing these, we can construct virtual networks of differing qualities. We took this concept one step further and are working on researching and developing mobile network virtualization technology that makes network virtualization possible even in mobile networks connected to various wireless networks and wired networks (Figure 4). The integrated resource control method over wireless and wired networks that we proposed has a feature where in wireless networks it dynamically adjusts media access control (MAC) parameters in increments of virtual base stations, taking into consideration uplink and downlink traffic in both directions which allows it to allocate network resources (airtime: wireless media access time) at an arbitrary rate for each virtual network.

Conclusion

With the advanced sensor information aggregation and analysis platform we introduced here, new generation ICT services previously unavailable in the Internet will be realized by constructing a platform that can recognize events occurring in the real-world using a vast amount of sensor information from around the world. In the future, we plan to conduct further studies on collaborations of these element technologies and their related technologies. We will also continue research and development of new generation network infrastructures to be established based on our technologies.

*3 Reter to http://piax.jgn-x.jp/

*4 A. Nakao, "Network Virtualization as Foundation for Enabling New Network Architectures and Applications," IEICE Trans. Communications, Vol. E93-B, No. 3, pp. 454−457, 2010.

*5 K. Nakauchi, Y. Shoji, N. Nishinaga, "Airtime-based Resource Control in Wireless LANs for Wireless Network Virtualization," Proc. ICUFN 2012, July 2012.

Privacy Protection Technology

Miyako Ohkubo
Senior Researcher, Security Architecture Laboratory, Network Security Research Institute
After completing a doctoral course and having worked at Nippon Telegraph and Telephone Corporation, Ohkubo joined NICT in 2010. She is engaged in research on cryptographic algorithms and protocols. Ph.D. (Engineering).

Introduction

As the use of networks expand and keeps varying every day, more transactions that had previously been unavailable and achieved either face to face or by paper, such as contracts, trading, buying and selling, are now available on the Internet. Along with this improvement in convenience, the number of things we must be aware of and protect in order to conduct these procedures over the Internet without impropriety are increasing. Furthermore, in recent years, a variety of information has become available by using the Internet, and it has become possible to easily research and gather information one is looking for. On the other hand, the chances of private information you are unaware of becoming vulnerable are also increasing. Given this situation, at our research laboratory, we are advancing research that aims to realize a large-scale authentication infrastructure that can flexibly provide security and privacy protection functions to networks without sacrificing current efficiency and convenience.

Shifts in Network Usage and Desired Functions

In order to stop illicit activities on a network, various requirements must be met. For example, in the case of a contract, there must be a mechanism that can check whether the person you are communicating with over the network is really your contract counterparty, the contract content being sent in electronic data is not being falsified during the transmission, and whether or not the counterparty's intention is being verified (Can you confirm his/her signature?). At the same time, in the case of contracts, transactions, and trading that includes private information, individuals do not wish to let go of their information unless it is necessary. For example, in electronic auctions, there are demands for bidding procedures to proceed anonymously. Also, in electronic voting, there are demands such as that voter identities should never be specified or whom the voter submitted a ballot to cannot be identified.

At a glance, the requirements to prevent impropriety and to assure security and the requirement to protect privacy seem to contradict each other. However, these requirements can be balanced using cryptography.

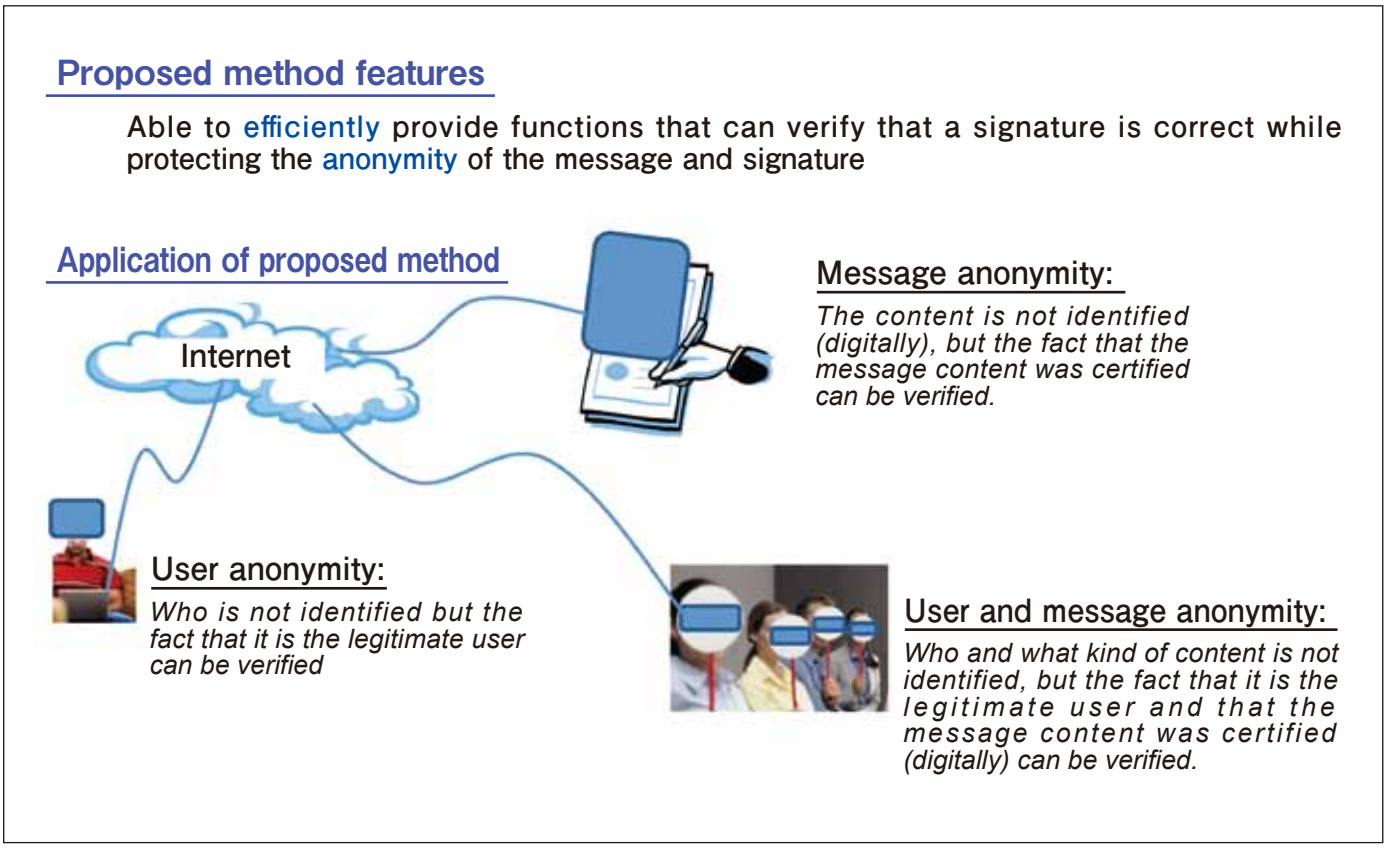
Privacy information one wishes to protect is different for every user and usage scene. All the more, considerable situations in future network with numerous terminals connected to much larger-scale networks that should be considered will become more complicated and diverse. Even if it is the same user, there are cases where terminals or devices used are different or where user information is exchanged among different services, considering all the multiple events that could occur, it is desirable that individual privacy is protected and security levels are maintained. For example, cases such as when it is necessary to identify that it is the same user across multiple services or when identifying that it is the same user leads to an invasion of privacy. Also, an invasion of privacy could occur from identifying that it is the same user even when using several different devices. If you customize to certain uses and goals and it is a system design that confirms privacy information that should be protected, it can be constructed to a certain extent by combining several existing cryptographies. However, recently, where goals are diversifying and privacy information that should be protected is becoming unstandardized, realizing these requirements with differing directions in one system is difficult, and even if it was able to be constructed, this would invite system bloating.

Security Goals and Convenient Security Technology

In response, at our research laboratory, we are researching cryptography that enables the provision of authentication methods equipped with privacy protection functions that can flexibly respond to various requirements from service providers and users on the platforms.

For example, one platform aims for a comprehensive information infrastructure that can provide functions in accordance with requirements of each aim and objects desired to be protected such as electronic voting, application systems, and questionnaires on one platform.

In terms of cost, implementing these will allow you to provide numerous systems that together cost several to several hundred million yen at the cost of one system. Also, on a



●Application diagram of proposed method for privacy protection

functional front, with maintaining the mutual security of user and service provisions on one platform, it allows different requirements of each individual user and service provider and also the provision of authentication equipped with privacy functions that can flexibly implement different required functions for each providing service and user's usage goals.

Future Prospects

Network usage has the potential to expand without end. At our research laboratory, in order to maximize this potential, we wish not to use it only as a means for defending security technology but to take advantage of it as a means to foster its potential.

Column　Variety of Applications of Cryptography

People tend to think that cryptography is used only to protect confidential information. However, the application of cryptography is not only on confidentiality. It is applied to timestamps that prove that text existed at a certain time and authentication that confirms a transmission correspondent.

In many cases, authentication is realized by using static identifier and password. However when using cryptography, authentication is realized a condition that an user keep an encryption key secret. Specifically, an authentication server sends temporary random numbers and has those random numbers encrypted and sent back by the transmission correspondent. If the data returned can be correctly decrypted, the correspondent will know that it is the correct owner of the key, or rather, the correct transmission correspondent.

To realize Timestamp, we use digital signature, a cryptography that realizes the same function of signing paper documents for digital documents. In TSA (Time Stamping Authority) that holds the exact time, like NICT, time data is appended to a digital document and TSA's digital signature is attached to that data. Then, by verifying the digital signature, we can confirm at the very least at what point the digital document existed. This service is also called digital notary.

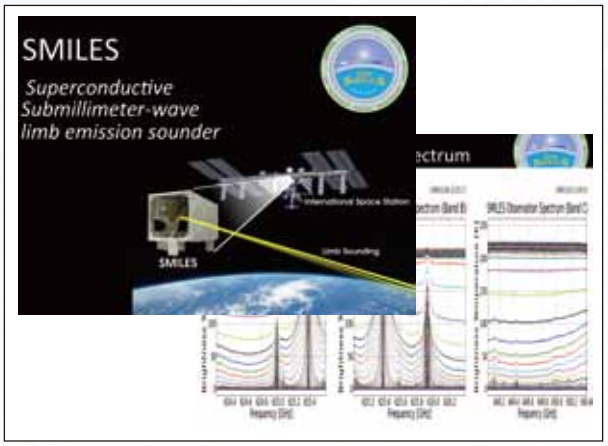
In recently years, security functions that protect the privacy of network users' actions and ensure the validity of digital data are becoming important. Digital signature and other technologies with privacy protection functions written here are the technologies that will realize these functions.

Report of the Special Lecture at Tokyo Metropolitan Tama High School of Science and Technology

Yasuko Kasai, Senior Researcher, Remote Sensing Fundamentals Laboratory, Applied Electromagnetic Research Institute

On June 6, a bright and clear day, I headed out to the "Special Science and Technology Advisor Lectures" held at Tokyo Metropolitan Tama High School of Science and Technology. The one-and-a-half hour lectures were aimed at second year high school students. With the five lectures listed below available, each student chose one lecture they were most interested in. If you were a high school student, which lecture would you like to take?

1. "Earth Observed from Space" NICT
2. "Environment and Bio" Tokyo University of Technology
3. "Useful Mathematics" Tokyo University of Agriculture and Technology
4. "The Semiconductor Devices that Support Our Daily Lives" Central Research Laboratory, Hitachi, Ltd.
5. "Humanoid Robot Research and Its Application" Waseda University



●Some of the materials used in the lecture

Generally, lectures for students become more difficult the lower the age and grade (graduate student→university student→high school student→middle school student→elementary school student→kindergarten student). Therefore, the more extensive and deeply essential topics must be explained in simpler language. I had quite a difficult time with the lecture on "Earth Observed from Space" for high school students. I can't use the lecture materials for graduate and university students I have accrued. For lecture preparation, I started first by thinking, "What would high school students want to learn from us?" and "What is our mission as NICT researchers?" With the average life expectancy in Japan at 80 years and second year high school students being 17, they have on average about 63 more years in their lives. After they spent some years as students, they will go play important roles as members of society. What should NICT researchers convey to this kind of people? This time, in the first half of the "Earth Observed from Space" lecture, we studied "What is an Earthling?" with the intent of having students learn from the perspective as humans living on Earth. It was material taken out on the existence of Earth from general, broad-ranging knowledge I acquired through my research life (physical chemistry, radio astronomy, Earth planetary remote sensing). In the latter half, I introduced NICT's submillimeter wave Earth atmosphere observation from space research as an example of the world cutting-edge Earth observational research.

In "What is an Earthling?", we confirmed where the Earth is located in space both spatially and temporally. Spatially, after confirming Tokyo Metropolitan Tama High School of Science and Technology's address within Japan□the location of Japan within the Earth, we watched a beautiful video provided by NASA, visiting the location of the Earth's solar system□the location of our solar system within its galaxy□the location of our galaxy. In addition, temporally, we confirmed the Earth's age and its journey to the present. Our Earth's lifespan is approximately 90 billions years (if we think of it as the same as the sun's), and presently, the Earth has just turned 46 billion years old.—for humans, the Earth in its prime. We studied how the Earth became what it is and how it will become in the future.

In "The World's Forefront in Earth Atmosphere Observational Research," I introduced observation of Earth's atmosphere and covered Superconducting Submillimeter-Wave Limb Emission Sounder (SMILES) mounted on an international space station that NICT co-developed with JAXA. SMILES has been mentioned in NICT News many times already, so I won't report on the details, but later I heard that the high school students enjoyed the vigor of the "Off the Chart SMILES Achievement" that Japan takes pride in and far surpasses NASA technology.

Besides studying and research ability, aspiring to engage in Earth observation requires enduring grit and persistence for 10 years between a satellite proposal and its launch. I tried my best to convey how difficult and powerful it is to engage in Earth observation. I hope the high school students now care a little more about Earth by learning about Earth's "location" in this class and that they will continue living day to day with large-scaled, dense grit 60 years down the road and beyond. Also, I hope that the number—even one—of students who aspire to do great technological research such as SMILES will grow.

●Students listening to the lecture intently

Special Lecture at Fuchu City Lifelong Learning Festival

Tetsuharu Fuse, Senior Researcher, Space Communication Systems Laboratory, Wireless Network Research Institute

I was invited as a lecturer to the special lecture seminar of the 19th Lifelong Learning Festival held in Fuchu City, bordering Koganei City where NICT Headquarters is located. I first introduced activities at the Kashima Space Technology Center such as the results of VLBI (Very Long Baseline Interferometry) observations with a 34 meter antenna and communications experiments using geostationary satellites as the latest achievements at the center. I also reviewed this year's astronomical events, the discovery history of the solar system, the development of the astronomical telescopes, and the scenes of the universe looking through Japan's largest telescope, "Subaru." Since there were various age groups at the venue, I covered a lot of topics and all participants seemed satisfied with them.

●Some slides used in the lecture

The theme of this year's festival was "Let's Create a Circle of Expanding Opportunities to Meet and Learn!" Many events related to lifelong studies were held on Saturday, September 8 and Sunday, September 9 at the venue; for example, "Kids' Science Lab" at the entrance hall, exhibitions of paintings, ceramics, handcrafts, etc. made by Fuchu citizens, concerts, and personal computer classes. I got a chance to talk to the citizens this year at the festival because I was asked to give a lecture to Fuchu City Lifelong Learning volunteers last year.

After arriving to the venue, Mr. Hideaki Miyahara, a Lifelong Learning volunteer in charge of planning, and Mr. Nobuyuki Wada, who belongs to Lifelong Learning Center, said that they were worried about the number of the participants because this was the first time to have a special lecture related to science and technology; however, approximately 120 people, from elementary school students to seniors, came together and listened to my talk intently for two hours.

During a Q&A session at the end of the lecture, there were questions such as "What are dark matter and dark energy talked about in astrophysics?" and "I remember that the orbit of Pluto had swapped with that of Neptune, and I want to tell my grandchild the truth. So please explain the details."

As I mentioned, it was the first time for the Fuchu City Lifelong Learning events to have a scientific theme, so it might be rare for municipalities around the area of NICT research facilities to hold a lecture concerning science and technology. I feel that it is becoming more and more important to give talks about our research developments and results to the general public both as a global social action program and as an aim of increasing our presence.

Photograph 1●Venue entrance to Lifelong Learning Festival
(Photo by Mr. Wataru Sugawara, YUUGAKUNOKAI)

Photograph 2●The author during the Special Lecture
(Photo by Mr. Kozaburo Ozawa, YUUGAKUNOKAI)

Report on National Science and Technology Fair 2012 in Thailand

The National Science and Technology Fair 2012, hosted by Thailand's Ministry of Science and Technology: MOST was held from August 17~31 at BITEC - Bangkok International Trade and Exhibition Centre in the suburbs of Bangkok. NICT has been running an exhibition every year since 2007. This time, introducing parts of advanced technologies of NICT were introduced in an easy-to-understand way through a demonstration exhibit on Intruder Detection System that Uses Radio Waves* and using panels on Hybrid Satellite & Terrestrial Mobile Phone Systems and NICT's contributions during the Great East Japan Earthquake, etc.

During the exhibition, approximately 1,240,000 visitors (according to the host) attended from all over Thailand, including not only specialists but also primary school students. After the ceremony on August 22, Her Royal Highness Princess Maha Chakri Sirindhorn along with MOST senior officials visited NICT's booth and showed interest in Intruder Detection System that Uses Radio Waves.

●Her Royal Highness and MOST senior officials visit the NICT booth. (Photo provided by National Science Museum, Thailand)

●Scene of the National Science and Technology Fair 2012 venue

●NICT booth inside the Japan Pavilion

●Researcher of Thailand listens intently to an explanation.

*Refer to NICT News Aug 2011
URL: http://www.nict.go.jp/publication/NICT-News/1108/01.html

Report on 2012 Youngster's Science Festival in Koganei, Tokyo

"The 2012 Youngster's Science Festival in Koganei, Tokyo" was held on Sunday, September 9 at the Koganei Campus of Tokyo Gakugei University. This year again, NICT held an exhibition as part of a regional partnership.

This event is held to stop young people's moving away from sciences by allowing them to experience the fascination of natural science and thereby foster their sensibility and intellect.

Moreover, another aim is to create a new culture in the region and foster its vitality through collaboration between education, research institutes, and regional industry.

NICT's booth held a workshop titled "Let's make a receiving antenna and get real reception!" based on the theme of Japan Standard Time.

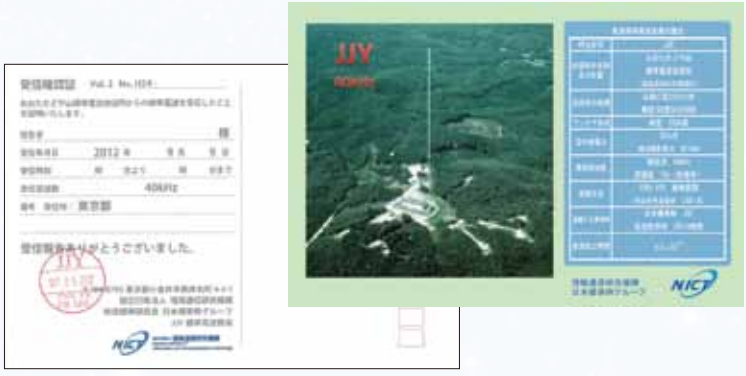
Children got to experience connecting a handmade antenna to a PC and confirming that it received real JJY. As proof of the reception, JJY[*1] QSL cards[*2] were issued.

We believe that this event allowed many more children to take an interest in sciences.

●Children keen on listening to an explanation

●Checking whether the radio waves can be received using the handmade antenna

●Antenna in process of making



●The JJY QSL card (left photo: front, right photo: back)

*1 JJY

Radio station identification signals (call sign) that broadcasts Japan Standard Time

*2 QSL Card

A card issued to a person at the other end of a transmission to prove that the radio amateur transmitted

NICT OPENHOUSE 2012

Technology Exhibition | Lectures | Free admission

—The Future of Information and Communications Technology—

Friday, November 30 - Saturday, December 1,
10:00AM - 5:00PM

NICT will hold "NICT OPENHOUSE 2012," introducing a large variety of latest research achievements through lectures and demonstration panel exhibits.

Program

■ Friday, November 30 ※Mainly for persons concerned with information and communications.

10:30 ～ 11:45	**Opening ceremony** ■ Greeting from the host Hideo Miyahara, President of NICT ■ Special lecture R&D Strategies of Our Global Age -Making Japan's Advanced Research & Development Power a Source of International Competitiveness- Mr. Hiromichi Shinohara, Director of Research and Development Planning Department, In charge of international standardization, NTT.
13:00 ～ 17:00	**Lectures** ・Towards Realization of the New-Generation Network ・Unbreakable Network Structure Technology that Quickly Recovers if Damaged ・Frontline of Cybersecurity Research ・Challenge towards the Outer Limits! Quantum Information Communications that Pioneer the Future ・Wireless Communication Network Technology in Flexible New-age ・Measurements of Clouds and Rain using Satellite-borne Radar ・NICT's Text Information Analysis Technology ・Efforts for Intellectual Property/Technology Transferring at NICT

■ Saturday, December 1 ※Mainly for the public

10:30 ～ 12:30	**Lectures** ・Aiming for Realization of a Network Connecting 10 Million Objects ・Leading-edge Technology for Space Radio Wave and Optical Communications ・Latest Trend in Cryptographic Technology that Ensures the Security of Network Society ・Advanced Technology of Super-Multiple-Perspective 3D Video
13:00 ～ 16:30	**Lectures** ・Brain Information and Inspiration ・NICT's First New Material Transistor that Aims for a Super Energy-Saving Society ・Technology that Captures Invisible Light (Terahertz Light) ・Making Japan Standard Time of the World's Highest Accuracy ・Observing the Surface from the Sky in 30cm Detail ・Earth's Environment Observed from Space ・The Wave of Big Data is Here! Science Cloud Challenge

—Exhibition - Friday, November 30, Saturday, December 1—

■ Network Fundamentals Technology

・NerveNet -Disaster-Resilient Regional Network Using Portable Base Stations that Can Immediately Expand Even in Emergencies When Cellular Networks are Unusable-

・Anti-Cyber Attack Technology (nicter/DAEDALUS/NIRVANA)

■ Universal Communications Fundamental Technology

・8K Electronic Holography Real-Time Recording/Playback System

・WISDOM2013: Next-Generation Large-Scale Web Archive Analysis Infrastructure

■ Advanced ICT Fundamental Technology

・Information Strategies of Organisms

・Introduction of Quantum Key Distribution-Related Technology

■ Electromagnetic Sensing Fundamental Technology

・What's Space Weather? Let's Experience Space Weather Forecasting!

・The Earth's Environment, Observation, Aiming to Reduce Damage from Disasters and Accidents -Advanced Radar Technology-

In addition, many other demonstrations and panel exhibitions will be held.

Venue:
National Institute of Information and Communications Technology
4-2-1 Nukui-Kitamachi, Koganei, Tokyo 184-8795, Japan

For access/details:
http://www.nict.go.jp/en/index.html
Inquiries:
NICT OPENHOUSE 2012 Division
【Phone】042-327-5322
【FAX】042-327-7587
【E-mail】open-house2012@ml.nict.go.jp

We are looking forward to seeing many visitors.

Information for Readers

The next issue will feature topics related to energy-saving home electronics EMC and an introduction to Advanced ICT Research Institute's Nano ICT Laboratory (Kobe).

■ Apology and Corrections

We apologize for an error in the NICT NEWS September issue and correct it as follows.

NICT NEWS September (No. 420)
Affiliation of Torisawa on the back cover
【Error】NICT Network Security Research Institute
【Correction】NICT Universal Communication Research Institute

NICT NEWS No.421, OCT 2012
ISSN 2187-4034 (Print)
ISSN 2187-4050 (Online)

Published by
Public Relations Department,
National Institute of Information and Communications Technology
<NICT NEWS URL> http://www.nict.go.jp/data/nict-news/

Editorial Cooperation: FULFILL co., ltd.

4-2-1 Nukui-Kitamachi, Koganei, Tokyo 184-8795, Japan
Tel: +81-42-327-5392 Fax: +81-42-327-7587
E-mail: publicity@nict.go.jp
<NICT URL> http://www.nict.go.jp/