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Emerging Vortex Structure via Biomolecules

—Millimeter-sized ordered structure produced by dynamic interaction of nanometer protein—

Kazuhiro Oiwa

Director General, Advanced ICT Research Institute

After completing a doctoral course and serving as a lecturer at Teikyo University, Faculty of Medicine, Oiwa joined Communications Research Laboratory, Ministry of Posts and Telecommunications (currently, NICT) in 1993. Oiwa has been engaged in motor protein single-molecule measurement/structural analysis and research and development on molecular communication. Professor at University of Hyogo, Graduate School, Joint-Appointment. Ph.D. in Biology. Won the 23rd Osaka Science Prize. Recipient of 2009 JSPS Award for Excellent reviewers of Grants-in-Aid for Scientific Research.

Background

In the evening sky above a Kyoto Station platform, an enormous, black mass suddenly appears, changing shape as it flies about. It is a flock of grey starling. The sight of the entire flock instantaneously shifting direction in perfect formation makes it appear as if it was the flock's intention (Figure 1). We can observe this kind of behavior where many individuals create a group in our immediate surroundings. A school of sardines swimming and swarm of locusts are both examples of this. What is the mechanism where each individual acts as a group without colliding into each other? This phenomenon is not limited to the natural world. Crowds that naturally form in crowded underground malls and spontaneous highway traffic jams also fall under this category. Because colonies formed by bacteria and ameba and striped patterns that arise due to the process of insect egg development also are results of behavior of a group of individuals (self-propelled particles) capable of working alone, the key to producing this behavior is not in the intellect of an individual. There must be a universal principle in self-propelled participle group behavior that occurs between the participle and individual levels, beyond the biotic structure hierarchy.

Figure 1●A flock of grey starling flying about over Kyoto Station

Theoretical model

A simulation created by Reynolds in 1986 called "Boids" is famous as a model that mimics flocking behavior. In this model, three simple rules are imposed on each individual that forms the flock. 1. Do not collide with individuals near you. 2. Move at the same speed of motion as individuals near you. 3. Stay in the same proximity of individuals near you. According to these rules, individuals interact within a short distance and, as a result, the entire flock manifests uniformity for long distances. Approximately ten years later, Vicsek proposed a two-dimensional non-equilibrium model where self-propelled particles moving at a constant velocity within a plane locally interact with other particles nearby and attempt to move in the same direction as the average direction of adjacent particles. These models can imitate collective behavior based as numerical calculations and seem to succeed in capturing the essence of collective behavior. However, the appropriateness of rules imposed on individual particles cannot be substantiated from observing flocks of birds and other animals because it cannot be known from the outside what animals are thinking. The assessment of these models was that we had to wait for the emergence of an experimental system where one could rigorously demonstrate the rules of interparticle interaction.

Life science research tool

In order to understand a biological phenomenon, reductionistic research that separates/purifies nucleic acid and protein components bearing the phenomenon and biochemically and physicochemically reveals each characteristic under ideal conditions (simple picture of interaction based on a dilute solution conditions and assumption of a reactive environment uniformity) is an effective measure. In addition, recently, while the complexity of the environment when components are within cells is maintained, experimental systems have been developed with simplicity that are able to produce physical proof. As if putting into practice Richard Phillips Feynman's words, "What I cannot create, I do not understand," this is the development of a system that by combining purified finite types of components in a test tube reconstructs complex intracellular structure and cell functions. Because this experimental system recreates cellular functions closer than ever to a real cell based on loosening of ideal conditions hypothesized in past life-science research and uniformity assump-

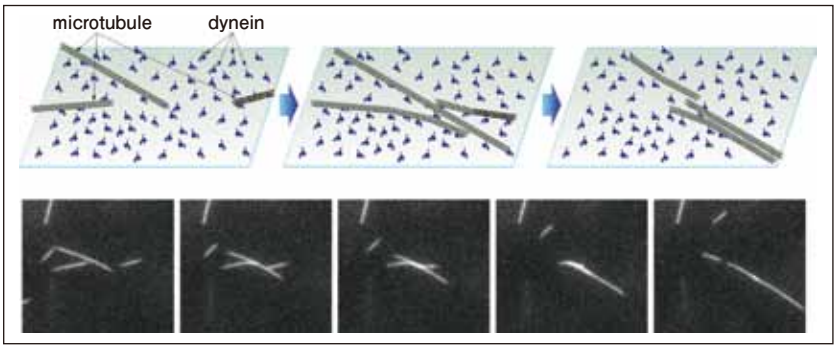


Figure 2●Microtubule collisions in a motion reconstruction experiment inside a test tube

The bottom image is the time course (recorded every 0.3 sec) of microtubule motion observed under a fluorescence microscope. 50nm dynein cannot be observed with an optical microscope, so only microtubule is visible in the image.

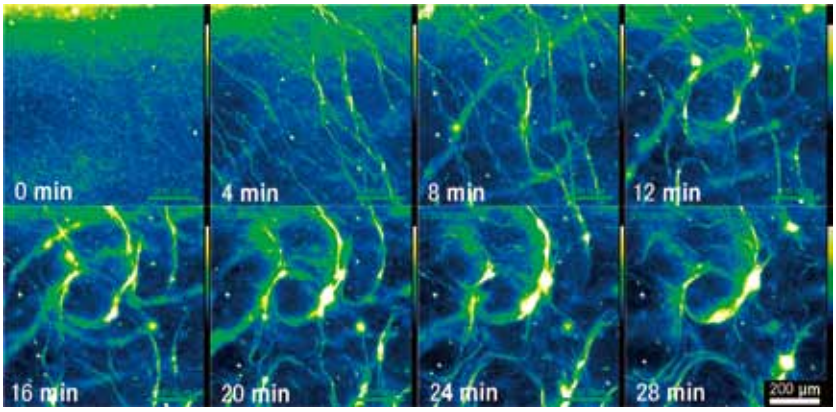


Figure 3●Time course of vortex structure on experimental tank surface created by microtubule trajectory of motion

Shows time course from start of motion. Microtubule batches appear within 3～6 minutes and many flows are visible. The direction of the flows rotate from horizontal to vertical (9～12 min), and suddenly form vortex patterns (12～15 min).

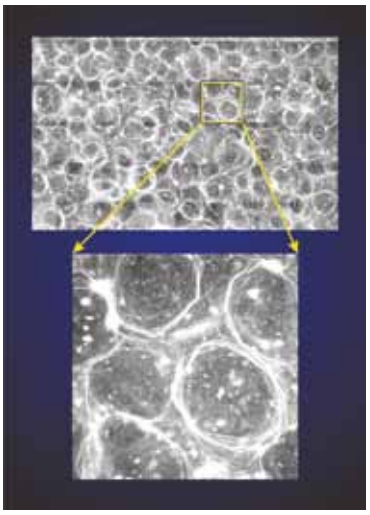


Figure 4●Arrangement of microtubule vortexes formed on the bottom and front surfaces of experimental tank

Vortexes with diameter as much as 400μm (micrometers) form on bottom and top surfaces of experimental tank. Because the bottom surface is put into focus, the top surface vortexes are out of focus. Vortexes adjoining on the same surface are in contact with one another without thrusting.

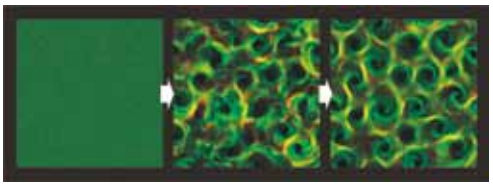


Figure 5●Simulation result of vortex formation via mathematical model

Microtubules moving clockwise and counterclockwise in vortexes are identified by color.

tions, it is a high-order reconstruction that introduces constraints by component congestion and intracellular structure, and mechanical influences from an external field. In addition to analyzing functions of motor proteins with biological motion driving force, our research group has developed in vitro a moving reconstruction system as a useful tool. It was discovered that this experimental system is a suitable experimental system for research on self-propelled particle collective behavior. This is a bridge in that links physics of self-propelled particle collective behavior and research on protein functions that produce intracellular structure.

Vortexes Emerging from Microtubule Motion Driven by Dynein

With adenosine triphosphate-powered motor protein “dynein” absorbed into the glass surface of a flow cell, we discovered a phenomenon where by using an experimental system in which microtubules, one kind of cytoskeletal filament, move on the dynein surface, a structure covering a long-distance emerges from local interaction between moving microtubules (Figure 2). As microtubules collide with one another, they eventually begin to align in the direction of motion and create many thick flows (Figure 3, panels 4–8 minutes). Moreover, approximately 10 minutes after the initiation of motion, large vortexes suddenly appeared. Once we observed the entire experimental flow cell, we confirmed that vortex structures were created sequences on the entire ceiling and bottom flow cell surfaces (Figure 4).

Using this experimental system, the motion of each particle (microtubule) and behavior at points of collision can be analyzed in detail and physical components within the background of this emergent phenomenon turned into a concise mathematical model based on experimental data. In this mathematical model that expands and builds on the Vicsek model, a section called “Short-time memory of self-propelled particles (deviation in direction of motion)”. When we applied an experimental data on microtubule interaction and its motion characteristic directly to a mathematical model and performed a numerical calculation, the short-time memory of direction of motion was enhanced and we successfully achieve to reconstruct an ordered structure and vortex lattice structure with a space size difference of 1,000 times under the condition of an ample number of particles were assembled (Figure 5).

When looking at the motion of each particle, with the characteristic of moving particles retaining memory (deviation in direction of motion), the direction of motion aligns and particles nestle close together or align in opposite directions, exchanging interaction by passing by one another. Compared to particles moving close together, interaction with particles passing one another is an instantaneous occurrence for particles, so there is no large effect in interactions with a small number of particles. However, in conditions with a large number of particles, interaction with particles passing one another is essential for an exchange point of memory information. With a large number of particles colliding and continuing to pass by one another, memory is shared throughout the entire group and an ordered structure far more massive compared to the size of the particles is created.

Thus, this discovery, a simple and easily repeatable experimental system that displays the accumulation of various short-time memories via clustering, is thought to be an important step to understand the general collective motion of self-propelled particles and attract a great deal of interest, being introduced not only in complex systems physics journals but also ones related to cellular biology.

Note: This research achievement, is the result of collaborative research include Assistant Professor YUTAKA Sumino (Aichi University of Education Department of Physics), Ken H. Nagai (Univ. of Tokyo, JSPS research fellow), Prof. Kenichi Yoshikawa (Department of Physics, Graduate School of Sciences, Kyoto University), and Dr. Hugues Chaté (CEA-Saclay)was printed in Nature 483, 448-452 (2012).

Non-Coding RNA Plays an Important Role in Homologous Chromosome Pairing during Meiotic Prophase

—Discovering the strategy of chromosome pairing—

DAQIAO DING

Senior Researcher, Bio ICT Laboratory, Advanced ICT Research Institute

After completing a doctoral course, DING joined Communications Research Laboratory, Ministry of Posts and Telecommunications (currently, NICT) in 1992. She is engaged in visualization technology development of bio information and research on homologous chromosome recognition and pairing mechanisms. Ph.D. (Science).

Background

The Bio ICT Laboratory is conducting fundamental research and development to uncover the sophisticated information transduction mechanisms of life and to apply them to information and communications technologies in the future. All life activity must respond to changes in the environment up to the DNA level. It is said that living organisms were compelled to choose sexual reproduction as a strategy to survive in battles with environmental changes and foreign enemies (pathogens, etc.). The fundamental of sexual reproduction (in humans, the process that makes ovum and sperm) is the process of meiosis. The exchange of chromosomal DNA between individuals of different sex in meiosis has been providing living organisms' gene diversity and protecting species' prosperity and succession

All of our cells contain two (a pair of) homologous chromosomes from each parent, and in meiosis, genetic exchange is undergone between these homologous chromosomes (homologous recombination). While conducting research to visualize the chromosomal behavior of living cells, the Cell Biology Group in the Bio ICT Laboratory has been demonstrating that the formation of a special structure called telomere bouquet[*1]—adjacent to the end of a chromosome (telomere)—being followed by the nuclear movement, is essential to the spatial alignment of homologous chromosomes.

However, the biggest remaining mystery of this process, "how a homologous chromosome can identify other ones with the same arrangement as itself out of the many other chromosomes (a total of 46 in humans) and align with one another?", has been remaining to be an open question. In this research study, we succeeded in uncovering the clue to this question using fission yeast that can easily induce meiosis.

Chromosome Site that Performs Pairing at a High Frequency

In fission yeast, a protein called Mei2[*2] exists that controls meiosis. This protein is clustered at a determined site in the chromosome (*sme2*[*2] gene locus) during meiosis prophase. Despite there being two homologous *sme2* gene loci in cells, there was only one Mei2 cluster. It suggests the possibility that each *sme2* gene locus is easy to make into a pair. After examining *sme2* gene locus pairing, we found that it showed a higher rate of pairing than that of any other chromosomal regions examined before (Figure 1). Moreover, when we moved a *sme2* gene to another chromosome, pairing frequency in the original site decreased and the frequency increased in the position the gene inserted. It shows that the *sme2* gene locus plays a role in pairing of homologous chromosomes. We also discovered that the pairing of *sme2* gene locus is dependent on telomere bouquet formation and nuclear movement. These findings mean that at first, homologous chromosomes are arranged in the adjacent position led by telomere bouquet formation and nuclear movement, and then homologous chromosome pairing is promoted by *sme2* gene locus.

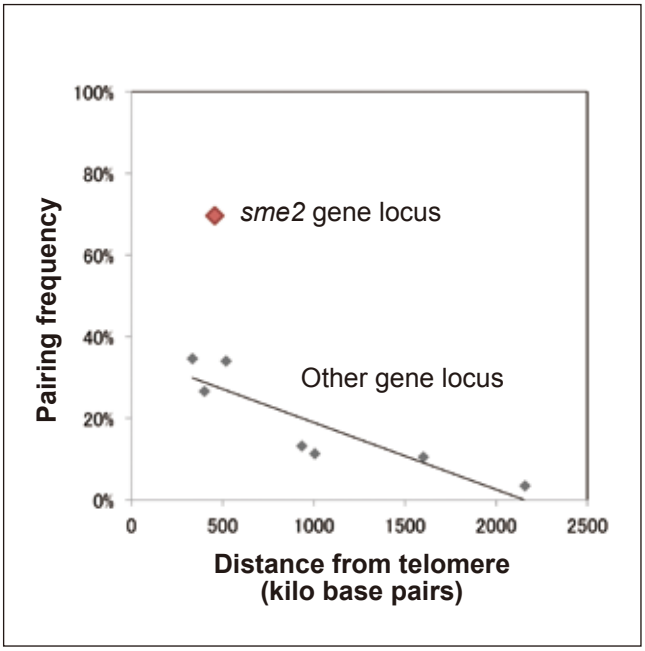


Figure 1●*sme2* gene locus that shows a high-pairing rate
The pairing frequency of a *sme2* gene locus during meiosis prophase is far higher than other gene locus.

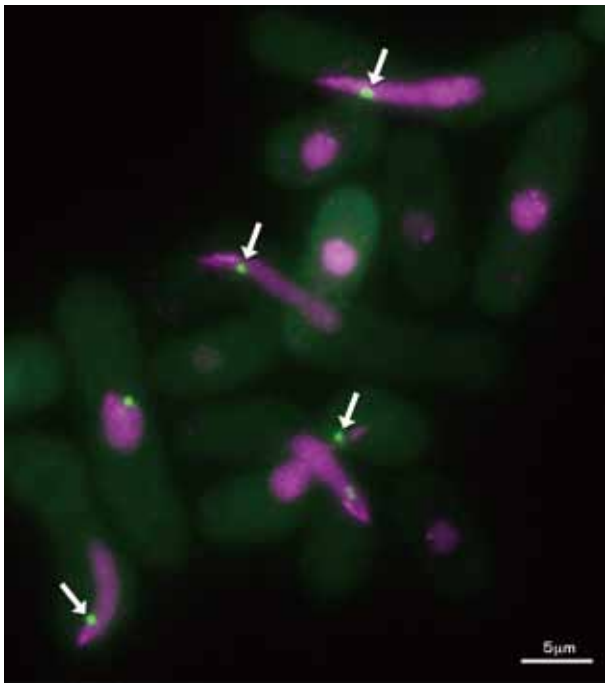


Figure 2●Non-coding RNA accumulated at in a *sme2* gene locus

Live cell image of non-coding RNA cluster (green) (arrow) at sme2 gene locus in a meiosis prophase nucleus (DNA: Magenta) of fission yeast.

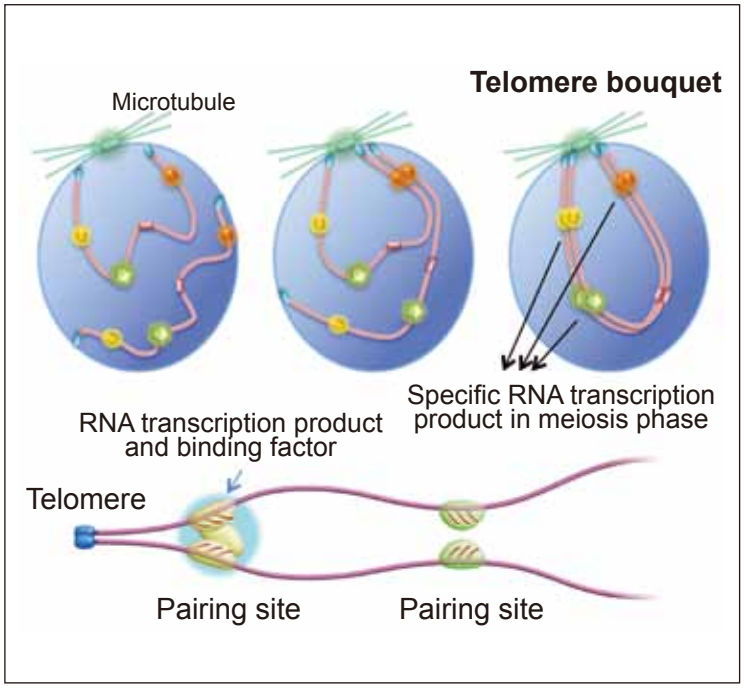


Figure 3●Homologous chromosome pairing model illustration

Along with the telomere bouquet formation, pairing sites that include RNA are formed from various chromosome sites, a special recognition characteristic, like a barcode, is provided to the chromosome, and pairing and homologous chromosome reciprocal recognition is enhanced.

Chromosome RNA Transcription from both chromosome— the Key to Pairing

How *sme2* gene locus can facilitate chromosome pairing? *sme2* genes produce non-coding RNA that lacks protein coding information. When the transcription of RNA is inhibited, pairing frequency decreases, so, we concluded that RNA transcripts made from *sme2* gene are indispensable for promoting pairing. Moreover, the fact that pairing promotion does not occur when transcription on only one side of homologous chromosomes shows that RNA production from both homologous chromosomes is essential to pairing. When we visualized this RNA, we found that it localized at *sme2* gene locus as an RNA cluster (Figure 2). We also found that when the end of a *sme2* gene is missing, RNA cannot retain onto a *sme2* gene locus, thus inhibiting pairing. Our results revealed that clustering of RNA at *sme2* gene locus is the mechanism that identify homologous chromosomes and invoke pairing preferentially.

Future Prospects

Our new finding—that non-coding RNA clustered on chromosome contributes to the identify chromosome—revealed the mechanism of homologous chromosomes identification for the first time in the world. In order to identify the homologous chromosome to become a pair, it seems very rational not to use DNA of which any damage leads to a fatal error, but to use RNA, which can make copies used in DNA as a temperate.

Furthermore, if these kinds of non-coding RNA clusters exist in numerous places within a chromosome, the clusters can give easily-identifiable characteristics to the chromosome (Figure 3). We consider it as a strategy of chromosome "pairing" to recognize the homologous chromosome identification efficiently. In the future, we will elucidate the molecular mechanism on non-coding RNA of facilitating homologous chromosomes pairing and apply it to practical uses in information communications technologies such as biosensors utilizing biomolecules like RNA.

This achievement was published in the international science journal Science May 11, 2012 edition.

Glossary

∗1 Telomere bouquet

A phenomenon in which all telomeres at the end of chromosomes gather in a small area on nuclear membrane and chromosomes are bundled together like a bouquet during the meiosis prophase. This phenomenon is common in yeast, mammals, and plants. Due to the formation of telomere bouquet and nuclear movement led by telomere, homologous chromosomes align in the same direction and spatially come closer together, allowing for more efficient pairing.

∗2 Mei2,*sme2*

Mei2 is the name of the gene that controls meiosis. *sme2* is the abbreviation for the suppressor of mei2. Our research has revealed that non-coding RNA called *meiRNA-L* transcribed from *sme2* gene are clustered at the *sme2* gene locus and strongly facilitates the pairing of homologous chromosomes.

Design and Prototype Implementation of Risk Visualization System

—Toward reinforced security awareness—

Takeshi Takahashi

Researcher, Security Architecture Laboratory, Network Security Research Institute

He worked for the Institute of Communications Engineering of Tampere University of Technology in Finland as a researcher from 2002, for the Department of Global Information and Telecommunications Studies of Waseda University Japan as a researcher from 2004, and for Roland Berger Ltd as a strategic consultant from 2006. Since 2009, he has been working for National Institute of Information and Communications Technology as a researcher. His research interests include communication protocols, cybersecurity information, and multimedia encoding. Ph.D. (Global Information and Telecommunication Studies).

1.Introduction

The number of security incident cases has been increasing alongside the development of cyber society. One cause of this is the low user awareness towards security risks, and in order to maintain security in cyber society, the improvement of average IT user security awareness levels is necessary.

In order to tackle this issue, here I propose a security risk visualization system concerned with user communications. Based on this system, users will be able to instantly recognize risks. This system differs from anti-virus software in that it can create a visualization of risks that takes into account all communications and also creates a visualization of vulnerabilities of routers in communication pathways. Incident visualization systems for network administrators have already been proposed, however, we propose a system that creates a visualization of risks that directly concern the end user.

Furthermore, we will also introduce a prototype of this system that we implemented on iOS and Android. This implementation takes into consideration the differences in each user's security risk information needs by coming equipped with a number of visualization modes.

2.System Overview

This system monitors computers and networks, gathers pertinent information, analyzes security risks lurking in user communications, and creates a visualization of these risks in real time.

2.1 Four roles that comprise the system

As shown in Figure 1, this system is comprised of 4 types of roles: user terminal, network sensor, analyzer, and knowledge base. Knowledge base accumulates a wide variety of security-related knowledge. Network sensor monitors the network and collects information on security in user communication pathways. Analyzer analyzes risks based on information received from the knowledge base, network sensor, and user terminal. And the user terminal collects and shares security-related information with the analyzer received from the terminal, and at the same time, creates a visualization of the risk analysis result for the user in an easy-to-understand format.

Risk visualization is implemented based on coordination among these 4 types of roles. During implementation, one entity can also hold multiple roles simultaneously.

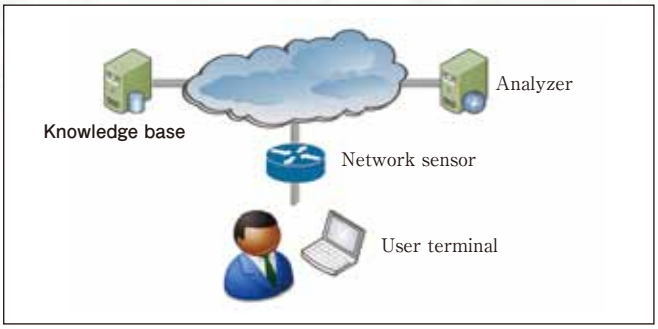


Figure 1●Roles that Comprise the Proposed System

2.2 Functional requirements

The system implements at a minimum the following four functions.

●Acquire information on communications/current status of network:

This function acquires pertinent information necessary to determine risks from places where these risks could exist in communications and communication pathways. For example, the function acquires from each place information such as the software (including OS) version ID of the user environment such as the terminal, encryption application situation in wireless LAN access points, network routers, security settings of service-providing clouds and hosts, communication methods being used in server-client, and types of information used by services the user utilizes.

●Collect/accumulate knowledge of existing risks:

This function collects and accumulates existing risk information as knowledge in order to determine future risks. For example, it collects and accumulates routers on the user side and within pathways, vulnerability information corresponding to each version ID of software, etc. used in servers, code-strength information, functions that can be used by each device and system, security measure techniques, and current threat trend information. Also note that it does not collect information on its own but relies on outside databases such as the NIST's NVD[*1].

●Analyze risks from acquired information:

This function analyzes risks based on aforementioned current status information and risk-related knowledge. The prototype described below determines risks by threat/risk databases based on CVSS[*2] scores and expert knowledge, but various algorithms are flexibly implementable.

●Display analysis results:

This function conducts expressions in accordance with risk analysis results, aligning a display of risks from each place where risks exist with user awareness levels. The prototype below provides three display modes, each of which provides differing level risk information.

3.Prototype Implementation

This prototype, focusing on mobile communication, creates visualizations for iOS and Android terminal users. For example, it creates a visualization of risk for users performing internet banking procedures on an unreliable wireless LAN and issues warnings. Here, I shall introduce the risk analysis and risk visualization within this prototype.

3.1 Risk analysis

The risk analysis process begins from when the user terminal sends an analysis request. Within this request are user terminal OS/application ID and version numbers and information such as codes being used in the transmission. When the request is sent, the analyzer requests the OS version information from the router. Based on this information, the analyzer refers to the knowledge base and confirms whether or not risks exist in the current user transmission. Currently, the knowledge base is built around NVD information that holds vulnerability information of over 50,000 cases.

If the knowledge base is referred to and related risk information found, that risk severity is evaluated. Specifically, the CVSS base score is referred to where vulnerability information within the knowledge base is listed, and based on that value being large, medium, or small, a risk level of high, middle, or low is determined. Furthermore, a table attached with combinations of cryptographic technologies being used, service types, and risk levels exists within the knowledge base, and the analyzer, in addition to vulnerability information above, determines risk levels by referencing this table.

3.2 Risk visualization

Figure 2 shows the 3 types of visualization modes of the prototype.

Figure 2(a), the simple mode, uses only the browser's top-right signal and creates risk visualization by illuminating the signal either in red, yellow, or green in accordance with the risk level. Based on the risk analysis result described above, the color changes to red, to denote a high situation, and green, a low one.

Figure 2(b), the topology mode, creates a simple display of entities related to current communications executed by the user. When a signal is tapped from simple mode, this mode is displayed. Also, each entity is colored either in red, yellow, or green, based on the risk level. Based on this mode, it is possible to easily understand whether or not risks exist in certain parts of the transmission.

Figure 2(c), verbose mode, is displayed when the user clicks on any entity icon as described above. In this mode, previous data that gave grounds for each entity's risk level evaluation result is displayed. For example, CVE (Common Vulnerabilities and Exposures) information and CVSS Base Score information is displayed as is. When this mode actually takes measures against security risks, although it displays helpful information, at this point in time, it does not assume things used by the average terminal user. Moreover, when the signal in the top-right of the screen is tapped from this mode, it is possible to return to simple mode.

(a) Simple Mode (b) Topology Mode (c) Verbose Mode

Figure 2●User Terminal Screen Prototype (via iPad terminal)

4.Conclusion & Future Issues

This article introduced a system that creates a visualization of security risks during user transmissions and its prototype implementation. At this point in time, although implementation aims at a proof of concept, in the future, we hope to incorporate our laboratory's research achievements into this system and develop it further. The future holds many challenges, but we hope to expand security knowledge base necessary for high-precision analysis and realizing confidential risk analysis functions for information provided by each intelligence source. For details, please refer to the reference below.

[Reference] T. Takahashi, S. Matsuo, et. al, "Visualization of user's end-to-end security risks," In SOUPS, 2012.

Glossary

*1 NVD
National Vulnerability Database: a vulnerability database administered by NIST, it is an accumulation of information from over 50,000 cases.

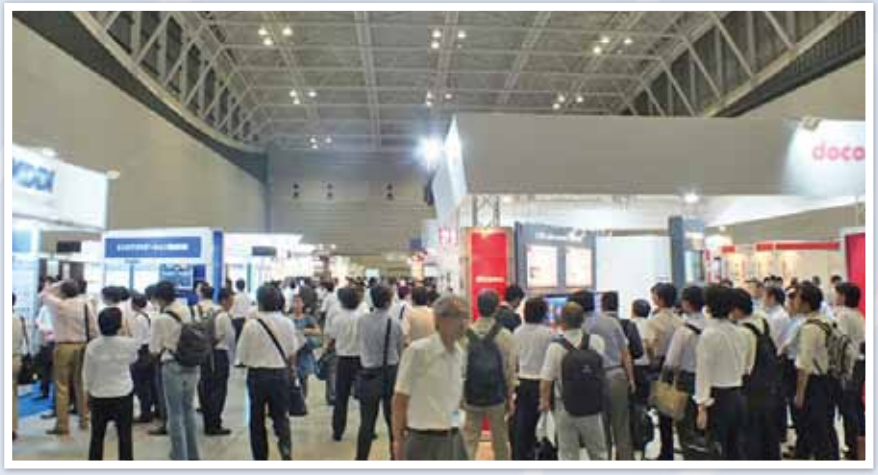
*2 CVSS
Common Vulnerability Scoring System: a scoring method of vulnerabilities constructed mainly by FIRST. It displays handling information in order of priority based on the score.

The assembly of leading-edge wireless communication technologies toward the new market

Report on Wireless Technology Park (WTP) 2012

Kaori Sawada, Planning Office, Wireless Network Research Institute

NICT, YRP R&D Promotion Committee and YRP Academia Collaboration Network jointly held the WIRELESS TECHNOLOGY PARK 2012 (WTP, below) in Pacifico Yokohama on July 5-6, 2012.



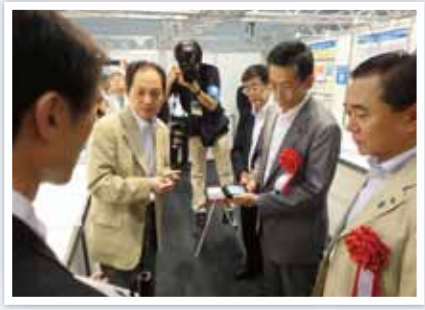
●Exhibition hall with scores of visitors extending to the roads

WTP consists of four components: an "exhibition" that presents leading-edge wireless technologies, a "seminar" focusing on radio communication trends, an "academia session" where university laboratories present their research achievements, and "exhibitor presentations" where commentaries are made on the development issue and the technology information that is useful for product development. It is a highly specialized event in the research and development (R&D) of radio technology, and is held as a business-matching venue between universities, institutes, and industries involved in the field. This year's event, marking the 7th time it has been held, was opened under the special theme, "Radio technology that supports disaster recovery." In accordance with it, disaster-resistant radio technologies and systems were introduced through the seminar and the exhibition as well as technologies, products, and efforts that can contribute to the rehabilitation and the recovery from the disaster by collaborating with radio technology. Also, exhibitions in the "Wireless Power Transfer" zone garnered much interest from visitors along with high expectations in the wireless market and growing opportunities of its extended application. Whereas all the excitement in each company/organization's exhibition booth, NICT exhibited 9 recent R&D achievements from the Wireless Network Research Institute, Universal Communication Research Institute, and Resilient ICT Research Center. Many visitors including Takashi Morita, the Vice-Minister for Internal Affairs and Communications, and Yuji Kuroiwa, the Governor of Kanagawa Prefecture, took a look and put forth questions/comments from many different angles.

In the seminar program composed of 10 courses with separate themes, professionals of industry-academic-government gave 48 talks. From NICT, presentations were given by Dependable Wireless Laboratory's Dr. Huan-Bang Li, Senior Researcher, on "IEEE Std 802.15.6 for BAN and Related Standardization Trends," and Smart Wireless Laboratory's Dr. Fumihide Kojima, Senior Researcher, on "Smart Meter Radio Standardization and Foresight." The session for the special theme had a great turnout with the seats filled up soon after the advanced registration began. Besides, 4 companies participated in the exhibitor presentations, and 15 research laboratories from 13 universities joined in the academia and poster session.

There were a total of 7,732 visitors (last year: 6,668) in two days, making the event the second most successful one yet. We sincerely appreciate all who visited WTP2012 and will double our efforts on making an even better event next year encouraged by the result and comments received this year.

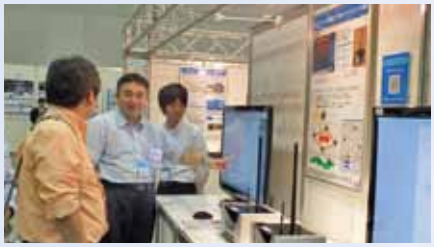
●Dr. Hiroshi Kumagai, the Vice President of NICT, conducting greetings as the host at the opening ceremony



●Dr. Naoto Kadowaki (second from left), the Director-General of Wireless Network Research Institute, introducing Mobility Assistance System for Visually Impaired People using UWB Positioning to Takashi Morita (second from right), the Vice-Minister for Internal Affairs and Communications and Yuji Kuroiwa (right), the Governor of Kanagawa Prefecture

●Dr. Fumihide Kojima, Senior Researcher, speaking in the lecture course titled, "ICT Technology Supporting Future Smart Cities"

Exhibition by NICT

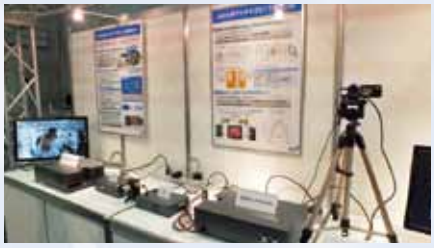


Wireless Communication in TV White Space
(Wireless Network Research Institute)

Introduced the "White Space Database" that provides a channel list usable for the secondary systems in the TV broadcasting band (470MHz-710MHz) and "White Space Base Stations" that reconfigure itself for operation in the white space in cooperation with the white space data base.

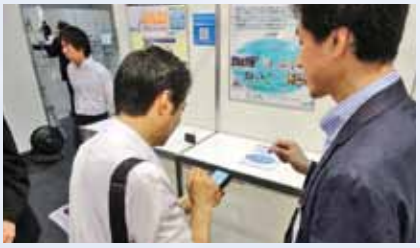
Wireless Grid Technology for Smart Meters
(Wireless Network Research Institute)

Provided a demonstration where the world's first IEEE 802.15.4g/4e small-sized and low-power radio device is connected to a gas meter and radiation dosimeter and gathers meter data via multi-hop transmission in 920MHz band.



60GHz Multi-Gigabit Wireless LAN System
(Wireless Network Research Institute)

Achieved the Non-Line-Of-Sight (NLOS) communication in 60GHz band with the new IEEE802.11ad wireless LAN system that is able to transmit large amount of data such as the uncompressed Full-HD movies and music files in a few seconds.



Mobility Assistance System for Visually Impaired People using UWB Positioning
(Wireless Network Research Institute)

Held an interactive demonstration of the high-precision navigation system implemented by a link between Ultra Wide Band (UWB) with ranging and positioning function and highly sophisticated smart phone devices (collaborative research between NICT and Fujitsu Limited).

Satellite/Terrestrial Integrated Mobile Communication System (STICS)
(Wireless Network Research Institute)

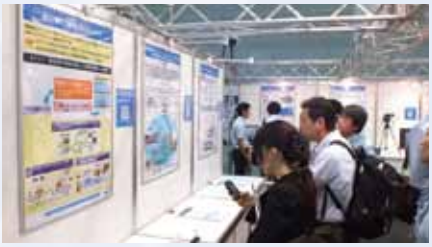
Displayed and introduced the onboard channelizer and DBF and the human head phantom for the R&D on integrated satellite/terrestrial mobile communication system that simultaneously realizes the communication in times of emergency/disasters and the efficient use of frequencies.

Satellite Sensor Network
(Wireless Network Research Institute)

Introduced the satellite sensor network useful for early detection of disasters that gathers important data via satellite even from places where communication and electrical supply is difficult to procure.

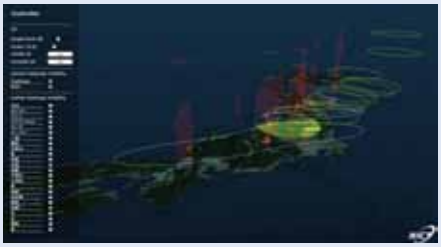
Intruder Detection System Using Radio Waves
-Introduction of the new interference reduction technique-
(Wireless Network Research Institute)

Introduced the latest version of the developed security system that can monitor an entire room just by installing a single system with high-detectability even in non-line-of-sight condition.



Resilient ICT Research Project
(Resilient ICT Research Center, Wireless Network Research Institute)

Introduced the industry-university-government cooperative Resilient ICT Research Project aimed for the disaster-resistant ICT through the R&D including satellite communications and wireless mesh networks.



Cyber-Physical Data Cloud: An Infrastructure for Accessing Heterogeneous Sensor Data for Supporting Daily Life and Disaster Management
(Universal Communication Research Institute)

Demonstrated a cross-domain infrastructure to collect, integrate, and analyze heterogeneous sensing data from networked-people and devices for understanding comprehensive situations during peacetime and disasters, using VSN (Virtual Sensor Network) as a kind of cloud service facilitating creation of user-defined virtual sensor networks, and Sticker (SpatioTemporal Information Clustering and Knowledge ExtRaction) as a visual data mining tool facilitating exploration of those sensing information in three-dimensional spatiotemporal space.

Memorandum of Understanding Concluded with MIMOS in Malaysia

In past relations with research institutes in Malaysia, NICT has concluded Memorandum of Understanding (MOU) with the University of Malaya. However, since 2011, research coalitions have been arranged between NICT and MIMOS* in the field of radio communication. After that, through a mutual agreement to expand coalition relations via the conclusion of an MOU, on Thursday, June 7, 2012, NICT members Hideo Miyahara, President of NICT, and Masahiko Tominaga, Vice President of NICT, visited MIMOS where the signing of the MOA was performed by Hideo Miyahara, President of NICT, and MIMOS's President and CEO, Datuk Abdul Wahab Abdullah.

＊ MIMOS

MIMOS was established in 1985 as a government research institute in information-communications under the supervision of Ministry of Science, Technology & Innovation (MOSTI) and engages in a wide range of information-communications technology research and development centered around microelectronics.

●Signing of MOU

Datuk Abdul Wahab Abdullah, President and CEO of MIMOS (left), Hideo Miyahara, President of NICT (right), and watchers of the signing, Ambassador of Japan in Malaysia Shigeru Nakamura (rear left side) and Rodziah Puteh, Deputy Under Secretary, DICT, MOSTI, Malaysia (rear right side)

Dr. Hamadoun Touré, ITU Secretary-General, Visits

International Telecommunication Union (ITU) Secretary-General, Dr. Hamadoun Touré, visited NICT headquarters on Tue, June 12, 2012 where he exchanged opinions with Hideo Miyahara, President of NICT. After a greeting from President Miyahara, Masahiko Tominaga, Vice President of NICT, gave an outline on NICT and explained the situation of NICT's standardization activities at ITU. He also explained that NICT will try to its best to support ongoing and future initiatives of ITU such as, standardization activities in the field of Resilient ICT to cope with natural disasters and "Kaleidoscope" to encourage collaboration in standardization among academia, research institute, industries and governments.

Dr. Touré also made an on-site visit to laboratories in NICT regarding Network Incident analysis Center for Tactical Emergency Response (nicter) at Network Security Research Institute and Optical packet and circuit integrated network system at Photonic Network Research Institute.

●Dr. Hamadoun Touré, Secretary-General of ITU (left), and Hideo Miyahara, President of NICT (right)

Prize Winners

Prize Winner ● Masahiko Haruno / Senior Researcher, Brain ICT Laboratory, Advanced ICT Research Institute

◎Date: 2011/12/16

◎Name of Prize:
Japanese Neural Network Society Best Paper Award

◎Details of Prize:
In recognition for discovering the key role of the amygdala in intuitive fairness in humans

◎Name of Awarding Organization:
Japanese Neural Network Society

◎Comments by the Winner:
What is the brain structure behind prosocial behavior towards others? This is a critical issue for human decision-making in our modern network society. In the past, the dominant theory was that the reflective frontal lobe controlled the selfish and emotional brain. However, I thought that the intuitive decision making by old brain might be rather important to avoid unfairness. In this appraised research, I demonstrated that the amygdala, which is a part of old brain, responds proportionally to unfairness and is involved in intuitive fairness. I am encouraged by this award to seek the essence of human societal behavior and will conduct further research on brain information processing that contribute to realize better communication.

Prize Winner ● Taro Yamashita / Researcher, Nano ICT Laboratory, Advanced ICT Research Institute

◎Date: 2012/3/15

◎Name of Prize:
Young Scientist Oral Presentation Award

◎Details of Prize:
In recognition for his lecture paper at The 72nd Japan Society of Applied Physics Academic Meeting, "Fluctuations and origin of dark counts in superconducting nanowire single-photon detectors," having been acclaimed as a lecture paper of extremely high value from the standpoint of The Japan Society of Applied Physics

◎Name of Awarding Organization:
The Japan Society of Applied Physics

◎Comments by the Winner:
Research and development on superconducting single-photon detectors (SSPD) as key devices in fields such as quantum communication and quantum optics is actively advancing. Although the reduction of error counts called dark count is essential to further SSPD performance improvement, the physical origins were a mystery until now. In my awarded lecture, the physical mechanism of dark count generation was revealed for the first time and knowledge towards the realization of a dark count-free, high-performance shared.

Prize Winner ● Zhen Wang / Distinguished Researcher, Advanced ICT Research Institute
Shigehito Miki / Senior Researcher, Nano ICT Laboratory, Advanced ICT Research Institute
Mikio Fujiwara / Senior Researcher, Quantum ICT Laboratory, Advanced ICT Research Institute

◎Date: 2012/3/15

◎Name of Prize:
Superconductors Division Research Paper Award

◎Details of Prize:
In recognition of the paper presented at IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS titled, "Superconducting Nanowire Single-Photon Detectors for Quantum Information and Communications," being appraised as a highly valuable academic paper related to superconductivity application.

◎Name of Awarding Organization:
Superconductors Division of the Japan Society of Applied Physics

◎Comments by the Winner:
This award, one given every three years for excellent original papers by young researchers published in academic journals and related to applied superconductivity research, was this time bestowed upon us for our development of a superconducting single-photon detection system and an early-phase paper on quantum information-communications application. We are currently continuing with this research and by applying a quantum key distribution system in development through sponsored research, we have demonstrated high performance through the most rigorous evaluation methods in the world. In the future, we hope to advance the efficiency improvement of superconducting single-photon detectors and the development of new fields of application. We wish to extend our heartfelt appreciation to all those involved for their cooperation and support in our past research and development.

From left: Miki, Wang, Fujiwara

Prize Winner ● Chikara Hashimoto / Senior Researcher, Information Analysis Laboratory, Universal Communication Research Institute
Kentaro Torisawa / Director, Information Analysis Laboratory, Universal Communication Research Institute
Stijn De Saeger / Senior Researcher, Information Analysis Laboratory, Universal Communication Research Institute
Jun'ichi Kazama / Senior Researcher, Information Analysis Laboratory, Universal Communication Research Institute

Joint Prize Winners:
Sadao Kurohashi (Kyoto University)

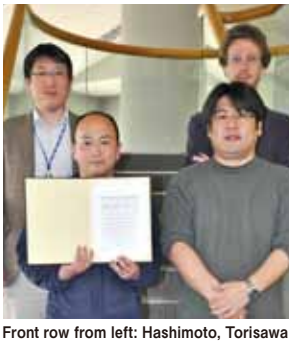
◎Date: 2012/3/15

◎Name of Prize:
Annual Meeting Excellent Paper

◎Details of Prize:
In recognition for the research presentation given at the 17th Annual Meeting titled, "Extracting Paraphrases from Definition Sentences on the Web," being recognized as an particularly excellent paper by as a result of screening based on the Annual Meeting Excellent Presentation Award Stipulations.

◎Name of Awarding Organization:
The Association for Natural Language Processing

◎Comments by the Winner:
It is a great honor to receive the Annual Meeting Excellent Paper award at the 17th Annual Meeting for our research presentation on the automated Japanese paraphrase knowledge acquisition technology we developed. In this research presentation, we proposed a technique where useful knowledge for automatic paraphrasing of Japanese is automatically acquired from a vast number of definition sentences on the Web. We believe this technology is an extremely significant achievement that holds the possibility to dramatically improve the performance of information analysis technology being developed at our laboratory. We wish to express our deepest gratitude to those involved in this research for their guidance and cooperation. In the future, we will pursue further useful research and development for society.



Front row from left: Hashimoto, Torisawa
Back row from left: Kazama, Stijn

Special Event in Summer Holiday in NICT Exhibition Room

From August 1(Wed) through 2(Thu), 2012, NICT held the "NICT Summer Holiday Special Event" in the exhibition room at NICT headquarters (Koganei), which 353 visitors attended.

This event was held to introduce our research mainly to elementary school children and make them feel familiar with science and technology. This year, besides the workshop under the theme of "light," we hold the study on communications, introduction of Japan Standard Time and Antarctic expedition, as well as the detailed explanation on our permanent exhibits.

In the workshop, after making a "spectroscope", children observed many kinds of light around them, and learned about the nature of light. At the corner of study on communications, a "Morse code activity" was held. The children looked up their own name, which were typed by themselves, through a printing machine. A fundamental talk on the history of communications/radio waves was also given. In "Talk with Japanese Antarctic Research Expedition member," participants were connected with the Antarctic Station over the Internet to talk with the expedition team. Through the lecture by the experienced worker of the Antarctic expedition team, children learned about the job and daily life in the Antarctic. They also received the precious experience of actually touching the ice from the Antarctic brought back by expedition team members. In the research introduction corner, an explanation about the "leap second insertion" held in July was given to them. In the permanent exhibit corner, the multi-sensory interaction, where students could virtually experience touching an important cultural property which they actually can never touch, was quite popular.

●Making a "spectroscope" in the workshop

●Experience of typing Morse code

●Children asking many questions to the expedition team members

●Explanation of "Leap second insertion"

●Multi-sensory interaction activity

●Antarctic postal service

Information for Readers

The next issue will feature topics including pairing cryptographic technology drawing attention as the next generation public key cryptography, the development of a walking support system technology for visually impaired, and the world's first successful technology for the automatic construction of wide area network.

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