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Cover image: Microwave atomic clock based on trapped ions

Consciousness in Social Behaviors

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Senior Researcher, Center for Information and Neural Networks

After completing graduate school, worked at NTT Communication Science Laboratories, ATR, UCL Institute of Neurology, University of Cambridge (Department of Engineering) and Tamagawa University Brain Science Institute. Entered NICT in 2011. Engaged in computational neuroscience, social neuroscience. Invited professor at Osaka University BFS. Doctor of Engineering.

Introduction

A major social media operator conducted an experiment on 690,000 users, which was in the news recently. They manipulated the posts displayed in a section of their site called the "News Feed," and reported that users' posts also tended to be more negative when the number of posts with affirmative content was decreased, and conversely, positive content increased in users' posts if fewer negative posts were displayed. It is surely quite surprising to many people, seeing from this experiment, how strongly our decision making can be influenced by others, without our awareness.

For any particular behavior, we are aware of our decision making processes at some times and not aware at others. Conscious decision making can strongly influence the external world by concentrating mental resources on the subject, but the amount of information we can be conscious of at a given time is limited. Conversely, unconscious (or intuitive) decision making handles large amounts of information, but does not reach a conscious level, so it is susceptible to being influenced by the external world or other people.

In this article, we discuss awareness of social behaviors and its significance based on the neural mechanisms producing differences in social nature, which is the topic of our research.

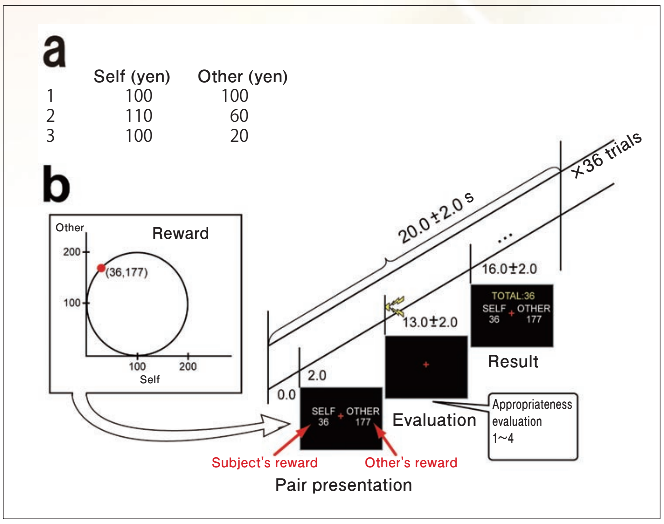


Figure 1 Experiments to identify the neural basis for social value orientation

a) Selection assignment to group subjects 1: prosocial, 2: individualistic, 3: competitive. b) Assignment for fMRI experiments measuring neural activity: Evaluating appropriateness of reward combinations into four levels

Individual differences in social behavior and the amygdala

As we experience daily on the Internet and social media, how we behave toward others and our awareness of others is pivotal to our social behavior. How we make decisions, based on this, regarding distribution of goods or information between the self and others is our distribution behavior.

What are the neural mechanisms that give rise to individual differences in distribution behavior—whether to behave fairly or to allocate more to the self? Differences in distribution behavior are known to relate to many other important issues as well, such as voting and volunteering behaviors, and also psychiatric disorders.

Conventionally, it was thought that fair behavior results when the emotion/reward system, which behaves in self-interest, is suppressed by the cognitive system in the frontal cortex. However, it is also possible that the emotion/reward system can behave fairly and avoid inequity in its unconscious decision making.

We performed experiments to study whether fair distribution behavior is based on conscious deliberation in the frontal cortex, or on unconscious (intuitive) decision making in the emotion/reward system. We first determined individual differences in distribution behavior of our subjects, which is called their social value orientation. Specifically, we gave them 10 s to select one of three ways of dividing an amount of money between themselves and an anonymous other person (Figure 1a). Choice 1 maximizes the equity and minimizes the difference in reward between self and other and is designated prosocial. Choice 2 maximizes the reward for self and is designated individualistic. Choice 3 maximizes the difference in reward and is designated competitive. A total of 64 subjects performed the task eight times, and of the 39 subjects that selected consistently six or more times, 25 were prosocial and 14 were individualistic. These 39 participated in functional Magnetic Resonance Imaging (fMRI) experiments to study their neural activity.

In the fMRI experiments (Figure 1b), combinations of rewards for themselves (self) and a partner (other) were displayed (in the example in the figure, self received 36 yen and other received 177 yen), and the subjects were asked to evaluate the appropriateness of the rewards on a scale of 1 to 4 as quickly as possible and then to push a button. Rewards for both self and other averaged 100 yen, did not exceed 200 yen, and were selected from

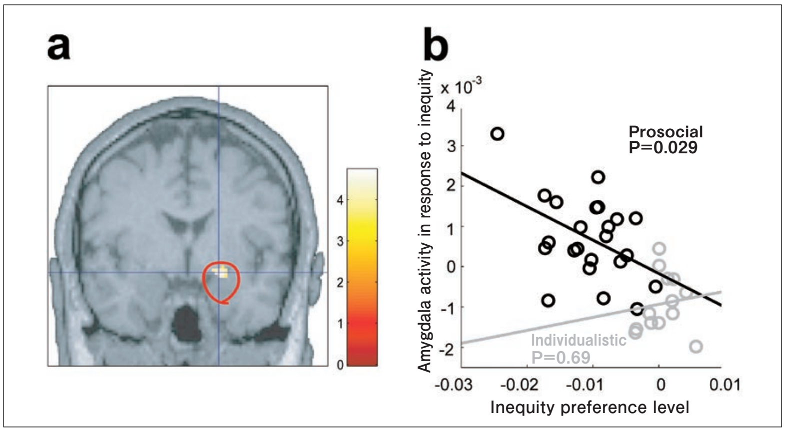


Figure 2 Experimental results
Prosocials, individualists, and individual differences among prosocials and neural activity in the amygdala (red).
a) shows activity in the amygdala in prosocials that correlates with the magnitude of the difference in rewards between self and other.
b) When evaluating reward combinations (in pairs), for each subject in the prosocials, there was a negative correlation between preference for inequity and activity in the amygdala in response to inequity.

36 points on the circumference of a circle to ensure that the minimum value would be 0 yen. This task can determine quantitatively, the influence of three variables, "self reward", "other reward", and "inequity" on the evaluations from each subject. When we looked for correlations between these variables and neural activity, and studied whether there were differences in neural activity among the subjects, we found a correlation between neural activity in the amygdala of the prosocial subjects and the "absolute difference in reward" (Figure 2a). On the other hand, this relationship was not apparent with the individualistic subjects. Furthermore, from the activity in the amygdala, we were able to predict the level of aversion to "absolute differences" (inequity) when each of the prosocial subjects evaluated reward pairs (Figure 2b). The amygdala is an almond-shaped structure deep in the brain, known to participate in rapid (intuitive) crisis management such as preparing to flee quickly after seeing a snake, or reading another person's facial expression. Our research results contradict the dominant view that the high-level social concept of fairness is based in the frontal cortex, and suggest that the amygdala—a structure that is also well developed in fish and mice—plays an important role.

Consciousness and social behavior

To study the relationships among fairness, intuition and consciousness further, we had 39 prosocial subjects and 20 individualistic subjects remember a random number sequence to load to their cognitive function, while they responded to ultimatum game task In the ultimatum game, a proposer first proposes how an amount of money should be distributed (e.g. 400 yen for himself/herself, and 100 yen for the respondent). The respondent then decides whether to accept or reject the proposal. If the respondent accepts the proposal, the money is awarded as proposed, if he/she rejects it, both participants receive nothing. To maximize the amount received for self, a subject should accept all proposals, but it is known that most people reject unfair conditions, when their portion is 20% or less. It has also been confirmed that subjects whose social value orientation is prosocial, emphasizing fairness more, tend to reject such conditions more often than those who are individualistic.

If social value orientation is intuitive, we would expect that in loaded conditions, under a cognitive load applied that makes deliberation using our cognitive function more difficult, prosocial subjects will emphasize fairness more and their rate of rejection should increase, while for individualistic subjects, who emphasize their own reward, the rejection rate should decrease. In our experimental results, the rejection rates for prosocial subjects did increase under loaded conditions relative to with no load, and rejection rates for individualistic subjects decreased (Figure 3a). This suggests that social value orientation is influenced more by intuition (unconscious) than deliberation (conscious). As for the research above, the behavior of subjects in such cases corresponds well with the idea that it is intuitive when explained using activity in the subcortical regions of the brain; the amygdala and the nucleus accumbens, which is involved in reward processing and value decisions (Figure 3b).

Consciousness in social behavior and ICT

We have seen that intuitive and unconscious processing involving subcortical activity and the emotion/reward system play an important role in social behavior. What is the significance of this?

We are not aware of unconscious processes and it is difficult to obtain useful responses from subjects through surveys. Social stress is a major factor in psychological conditions such as depression, so it is difficult to notice and quantify them at an early stage. In fact, it is known that sub-cortical areas including the amygdala and nucleus accumbens are deeply involved in such psychological conditions. It is also well known that purchasing behavior does not correspond with results of large-scale survey studies. Further, as discussed at the beginning, behavior on social media can be affected by others in ways of which the user is not conscious. These subconscious decision making systems of the brain that underlie social behavior are a frontier of neuro-science, and if it becomes possible to predict behavior based on brain state as our understanding of them advances, it will have a major effect on design of systems in real society and on information and communications systems.

This article has mainly looked at social behavior and the unconscious, which till now has not received much attention, but it goes without saying that, from the perspective of information and communications, neural systems of conscious decision making are also very important in reading or realizing users' intensions.

Our research group is using the state-of-the-art computing facilities of the Center for Information and Neural Networks to advance R&D on high-dimensional big-data analysis methods for social behavior and decision making.

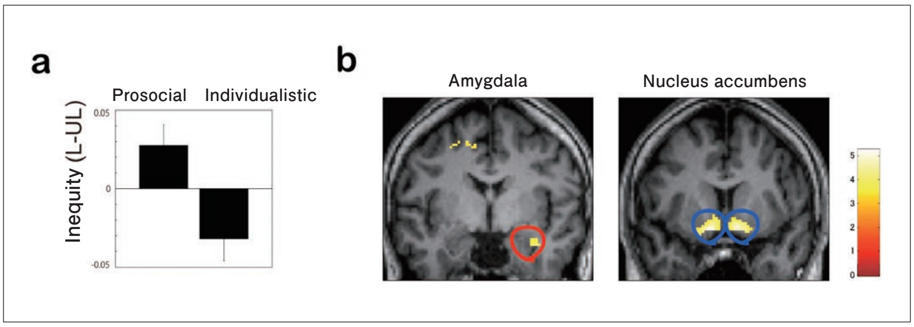
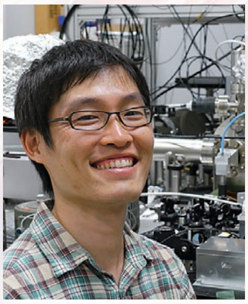


Figure 3 Suggestion game with cognitive load and experimental results
Task organization with prosocials and individualistics looking at fairness with a cognitive load applied. a) Comparing cases with cognitive load applied (L condition) and not applied (UL condition), prosocial subjects are more equitable, while individualistic subjects emphasized their own reward.
b) Neural activity reflecting behavior of prosocial subjects and individualistic subjects was seen in the amygdala (red) and nucleus accumbens (blue).

Development of a Trapped-ion Microwave Atomic Clock

—Five times better precision than Rubidium atomic clocks—



Nobuyasu SHIGA

Researcher, Space-Time Standards Laboratory, Applied Electromagnetic Research Institute

After completing graduate school and working at the ionospheric observatory in Alaska and NIST in Boulder, Colorado, joined NICT in 2008. Engaged in development of atomic clocks. Researcher of "PREST," JST, since 2009. Ph.D. (Physics).

Introduction

This article introduces development being done at NICT on a microwave atomic clock. Development of atomic clocks can be divided into two fields that differ similarly to how developing ordinary passenger cars and F-1 race cars differs. Microwave atomic clocks are resilient and seldom break down, but are less accurate, while optical atomic clocks cannot operate continuously for long periods of time, but provide unprecedented accuracy over short periods of time (Figure 1). Here, "microwave" and "optical" indicate what is used as the clock oscillator. The clock counts oscillations of the oscillator, and displays the time in units of hours or minutes. The accuracy of a clock is simply how much the frequency of the oscillator varies, and there is a great difference in quality of the clock whether a microwave oscillator or laser light is used as the oscillator.

For a pendulum clock such as "Grandfather's Clock," the pendulum swings one way each second, so it only cycles 0.5 times per second, but a microwave atomic clock uses an electromagnetic field oscillating at approximately 10 GHz as the oscillator so it oscillates 10 billion times per second. One second is measured by counting 10 billion oscillations of the microwave oscillator. Instead of explaining in terms of measuring lengths of time, the frequency of the oscillator corresponds to the graduations on the scale on a ruler. To measure a length more accurately, a ruler with a finer scale is needed, so one second must be divided extremely finely in order to measure time accurately. A microwave clock already divides a second extremely finely, but light is an electromagnetic wave with frequency five orders of magnitude higher than microwaves. Counting the oscillations of an optical atomic clock was not an easy task and many difficulties had to be overcome. In this article we focus on the design of a microwave atomic clock, represented by the passenger car, and leave the wonders of the optical atomic clock to another time.

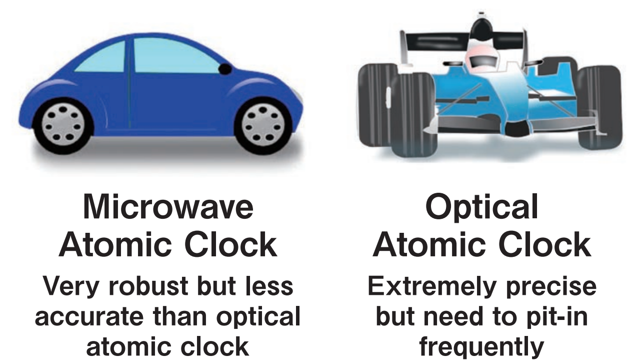


Figure 1 Comparison between Microwave and Optical atomic clock

Trapped-ion microwave atomic clock

In this article, we describe the trapped-ion microwave clock mechanism developed as part of the JST Basic Research Program (PRESTO) at NICT. Above, we described how a microwave oscillator is used. The accuracy of the clock is determined directly by how stable (not changing over time) the frequency of the oscillator is. Thus, the clock is designed to minimize the effects of environmental changes (temperature, magnetic and electric fields, etc.) on the microwave oscillator, but there are limits on this, and some shifting in frequency with time is unavoidable. An atomic clock frequency is used as the standard to detect any such shifting in the frequency.

Explaining in more detail, atoms have the property of absorbing certain specific frequencies of electromagnetic waves. In fact, each atom has many such frequencies, but if the atom and frequency are selected carefully, the frequency will not fluctuate, even if the environment surrounding the atom changes. This makes them ideal as a standard. A device that continuously matches a micro-

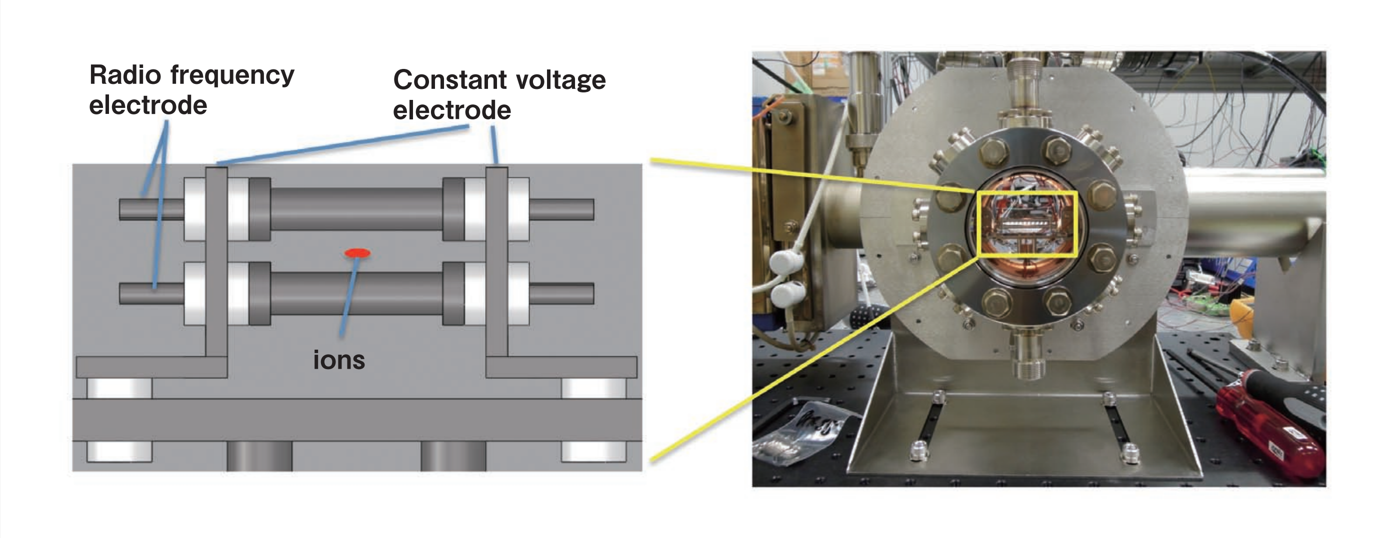


Figure 2 Ion trap

wave oscillator frequency with the stable frequency of an atom is called a microwave atomic clock. When an ion—an atom carrying an electrical charge—is captured in an ion trap and used as the atom for such a standard, it is called an ion trap atomic clock.

In this case, we have created a stable microwave atomic clock by capturing approximately 1,000 ytterbium ions, suspended in a vacuum chamber in the center of an ion trap as shown in Figure 2, and using the 12.6 GHz frequency of these ions as a reference. We then showed that this new atomic clock is five-times more accurate than the rubidium atomic clocks widely used in the broadcasting and communications industries (Figure 3). Conventionally, if accuracy higher than a rubidium atomic clock was needed, an atomic clock called a hydrogen maser, which is large (hundreds of kg) and very expensive (20 million yen), had to be used. The ion-trap atomic clock that we have developed will be both low-cost (millions of yen) and compact (several tens of kg), so it is promising to meet needs in the wide gap between rubidium and hydrogen maser atomic clocks.

There are many types of ions that could be used as an atomic clock standard, but with ytterbium ions, semiconductor lasers can be used for the lasers comprising the atomic clock, and this promises to help reduce costs and size. Ytterbium metal is also non-toxic and can be disposed with very little environmental load, so it is suitable for mass production in the future.

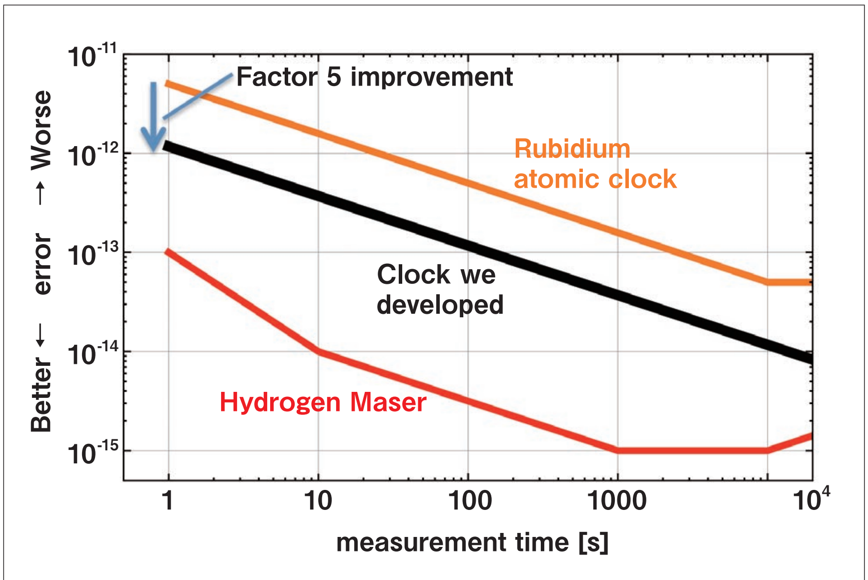


Figure 3 Demonstrated better precision than Rubidium atomic clock

Features of this research (laser cooling and magnetic field measurements)

In this research, we used two technologies to increase the accuracy of the atomic clock. The first is laser cooling. It is called cooling, but it is not like placing something in a refrigerator. The technology removes heat energy from ytterbium ions that are moving around like a gas within the ion trap by exposing them to a laser. It can create the remarkable conditions in which the ions are cooled to near absolute zero, even though the vacuum chamber is at room temperature. This stops the gas-like motion of the ions in the ion trap, increasing the oscillator accuracy.

The other technology cancels the effects of magnetic fields. If the magnetic field at the location of the atoms changes, the standard frequency will change slightly. The magnetic field in the laboratory can change slightly from minute-to-minute due to magnetic fields produced by surrounding electronic devices by near-by train lines and other sources. For this reason, we used the ytterbium ions themselves as a magnetic field sensor and were able to cancel any changes in the standard frequency by measuring the magnetic field periodically.

Future prospects

We will work to popularize the ytterbium ion microwave atomic clock that we have developed and to improve its accuracy, contributing to calibrating precision measurement devices and increasing communications capacity. In the future, we plan to create a more-complete prototype, reducing its size and cost, and transforming it into a practical device.

Wi-SUN Technology Transferred to Measurement Instrument Manufacturer !

Developing a new market in collaboration with the Wi-SUN Alliance

Anritsu Corporation (hereinafter, Anritsu) started in business in 1895 and will have its 120th anniversary next year. It began as a manufacturer of wireless communication instruments and then, building on that technology, developed with measurement instruments as a primary business focus after the war. Its international reputation as a manufacturer of wireless and optical measurement instruments related to IT grew, and now it has grown into a global enterprise with a group of 39 related companies in countries around the world. It holds an over 70% market share in measurement instruments for development of 3G mobile telephones.

Anritsu has received technologies researched and developed by NICT through technology transfer, including a Measurement Software of the physical layer for SUN devices and protocol monitor system (hereinafter, "SUN devices protocol monitor system"), and wireless smart utility network interoperability test equipment (hereinafter, "interoperability test equipment"). It has developed products with them and is selling the products. We visited Anritsu Senior Manager, Mr. Akihiro HARIMOTO, and Senior Manager, Mr. Ken SHIOIRI, to talk about collaboration with NICT and issues with global development. The visit was hosted by Makoto FUKUDA, Coordinator of technology transfers at the NICT Intellectual Property Promotion Office.

Mr. Akihiro HARIMOTO
Senior Manager
5th Sales Department
Measurement Solution Sales Division, Anritsu Corporation

Mr. Ken SHIOIRI
Senior Manager
Project Team 3, Project Marketing Department Marketing Division,
Measurement Business Group
Anritsu Corporation

Wi-SUN protocol tester

Long history of collaboration with NICT on R&D for Ethernet, EMC, and other topics

FUKUDA: I understand Anritsu has also collaborated on NICT research activities other than wireless networking technology in the past. Could you tell us about some of those achievements?

HARIMOTO: Recently, there was our ultra high-speed signal tester. Currently, 100 Gigabit Ethernet has become common, but our ultra high-speed signal tester, which we developed last year, is for testing the next generation, which will be 400 Gbps Ethernet.

Another past example is EMC related research for measuring electromagnetic emissions leaking from electronic devices. As modulation schemes have become more complex, instruments that are able to efficiently measure signals that change randomly in frequency, amplitude and time, have become necessary. We prototyped such an instrument together and later developed it through contract research for the Ministry of Internal Affairs and Communications.

Wi-SUN device numbers increase and Anritsu test equipment gets excellent reviews

FUKUDA: Today we're talking about transfer of two technologies related to Wi-SUN. One is a SUN devices protocol monitor system, and the other is interoperability test equipment. Can you tell us about the features of these products and how they are used?

HARIMOTO: We are selling the SUN devices protocol monitor system with the software product names, "Wi-SUN PHY Measurement Software" and "Wi-SUN Protocol Monitor." The first is software to automatically measure Wi-SUN wireless modules using our signal analyzer. The second is PC software that takes communication data obtained using the analyzer and analyzes it to determine the type of communication. When communication cannot be established, it helps in investigating the causes and what happened.

On the other hand, the Wi-SUN Alliance has set test specifications for each layer of communications. The interoperability test equipment verifies whether Wi-Sun wireless modules and related devices operate according to these Wi-SUN Alliance specifications, and is used to decide whether to certify the devices or not.

FUKUDA: I understand that these products are already on the market and generating revenue, so could you tell us about the reaction from customers and the industry?

HARIMOTO: Many customers such as wireless module vendors are using them for testing during development, in combination with our signal analyzers and signal generators. We expect that in the future, as M2M and other object-to-object communication increases, devices complying with the Wi-SUN standard will increase, and the demand for testing will also increase. The equipment is also already being used as third-party Wi-SUN standard certification test equipment by two certification authorities in Japan and has been evaluated very highly.

Cooperation with related organizations through the Wi-SUN Alliance

FUKUDA: Can you tell us how you came to cooperate with NICT researchers in R&D related to Wi-SUN?

SHIOIRI: In the early stages of Wi-SUN, NICT researchers were using one of our signal analyzers as a measurement instrument. During that time, they expressed the desire for measurement instrument manufacturers also to join the alliance.

FUKUDA: After joining the Wi-SUN Alliance, what sorts of activities were you involved in and what difficulties did you face?

HARIMOTO: The main area in which we participated actively was a working group for deciding test specifications. There were also periodic events for interconnectivity, where we used our test equipment and performed measurements on various modules and devices.

SHIOIRI: In deciding test specifications, wireless signal specifications and parameters need to be decided. There are many decisions initially, and they need to be made while testing whether they can actually be measured correctly. This requires cooperation from many people.

Interoperability events were held, to which chip and module vendors would bring their prototype devices. Anritsu would provide engineers and measuring instruments and would perform tests. Initially, it took quite a lot of time to isolate the issues.

FUKUDA: At this time, we can attribute the successful spread of Wi-Sun to international standardization and the Alliance. Could you say that a major factor was the good balance of participation from major chip vendors, instrumentation manufacturers, and enterprises with large user bases, with public agencies taking the lead?

SHIOIRI: Yes indeed. The basic specifications are stipulated in IEEE 802.15, but giving consideration to applications and reducing them to concrete specifications is critical. This time we had a very good balance among the four parties, with NICT taking the lead, us as the measurement instrument manufacturer, together with chip and module vendors. As an example of taking a specification created by the IEEE, developing actual products, and building a roadmap for market creation, it worked very well.

Wi-SUN is still in its initial stages, and applications are still expanding into various fields

FUKUDA: Could you tell us about future development, including the current products?

SHIOIRI: The smart meter market is really still in its initial stages. From here, activity connecting all kinds of things using Wi-SUN-related protocols will intensify as M2M networks expand. The range of application of the Wi-SUN standard is expanding, and it may be adopted for gas and water meters and other electronic appliances.

FUKUDA: What about global expansion?

SHIOIRI: The situation varies in each region overseas. For example, the frequencies that can be used are different by country. The key players are also different, so it will be necessary to research who they are and focus on them while gradually develop sales of applications and test systems.

Leadership from a third-party public agency is the key to unifying standards and specifications pertaining to a diversity of industries

FUKUDA: Please tell us if there is anything NICT can do for you in the future.

SHIOIRI: Regarding extensions to this application, we expect there will be a flood of various standards in the area of M2M communications in the future. The various existing industries have their own established ways of doing things, whether connecting appliances to smartphones or automobiles to smartphones, and with such conditions, a public agency like NICT can take the lead in setting policy from a third-party standpoint, enabling specifications and regulations to be unified and increasing connectivity among the various objects.

NICT, as an entity without particular interests, plays a very important role in unifying those types of standards.

Interviewer
Makoto FUKUDA
Coordinator of Technology Transfers, Intellectual Property Promotion Office, NICT

Enterprise Visit Part 3 will appear in the January issue.

Report on 2014 Ehime Prefecture Comprehensive Disaster Preparation Drill

Resilient ICT Research Center and Wireless Network Institute

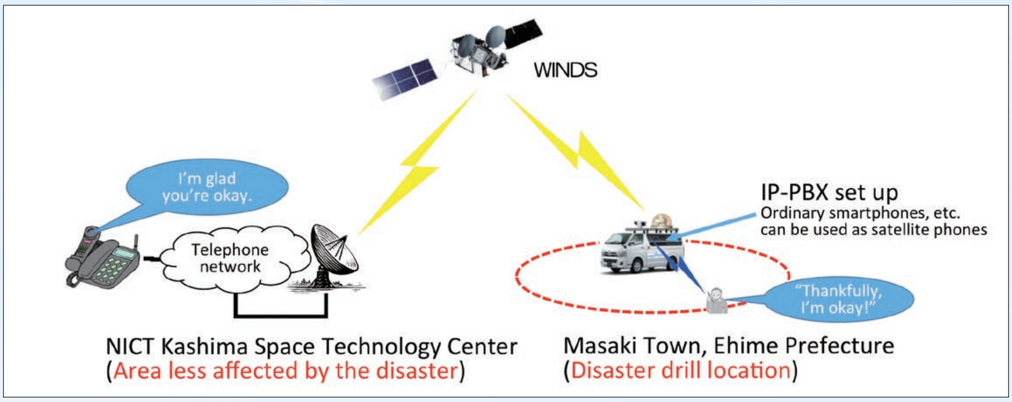
On September 1, Disaster Preparedness Day, the Resilient ICT Research Center and the Wireless Network Research Institute participated in the 2014 Ehime Prefecture Comprehensive Disaster Prevention Drill, practicing communications satellite data transmission using a mobile vehicle earth station for the Wideband Internetworking engineering test and Demonstration Satellite "KIZUNA" (WINDS).

The Comprehensive Disaster Prevention Drill held every year on Disaster Preparedness Day assumes a large scale disaster of the same class as a Nankai Trough megaquake. Approximately 5,500 people from 87 agencies participated in this drill, including Ehime Prefecture, the town of Masaki, the fire department, the prefectural police, and the Ground Self-Defense Forces. The objectives were to check cooperation among related agencies and to raise awareness of disaster prevention.

NICT was requested to participate in the drill by the Ehime Prefecture disaster prevention office, using WINDS as a useful disaster communications technology and building an emergency communication network for distributing video information. The emergency communications network technology involves a compact IP-PBX set up in a small mobile vehicle earth station and connected via a WINDS channel to a telephone network in an area less affected by congestion due to the disaster. Even during emergency, users can use the smartphone they use every day as an emergency mobile phone. For this drill, connections to the phone network were made through the NICT Kashima Space Technology Center. Also, a large-scale in-vehicle earth station was set up in the main venue, Masaki Town Park in Masaki Town, Ehime Prefecture, and small mobile vehicle earth stations followed emergency supply trucks, sending the status of supply transports to the disaster response headquarters. This status was distributed to disaster prevention agencies throughout the prefecture via WINDS and the Local Authorities Satellite Communications Organization (LASCOM) network.

After the drill was completed, the system was evaluated highly by the Ehime Prefecture disaster prevention office, noting that they were able to use the Ka-band satellite channels without interruption, even though it was raining. They also requested that NICT take an important role in the disaster prevention drill next year.

We plan to continue to build understanding and cooperation with regional communities in this way, through cooperation with regional governments.



Emergency communications network using WINDS

WINDS mobile vehicle earth stations set up at the disaster response headquarters

Video that has been delivered to all the prefectural agencies (image from mounted camera in WINDS mobile vehicle station)

Report on The 41st Int. Home Care & Rehabilitation Exhibition 2014

Information Barrier-free Office, ICT Industry Promotion Department

NICT exhibited a booth at the 41st Int. Home Care & Rehabilitation Exhibition held on October 1 to 3, 2014 at Tokyo Big Sight. We presented outcomes and held demonstrations from information barrier-free projects receiving grants from NICT and for people with disabilities.

These outcomes were reported and demonstrations given by participants in FY2013 subsidy projects and others, for a total of ten different services and devices for the disabled. There were also performances from the NICT Universal Communication Research Institute, using the KoeTra and SpeechCanvas applications, which support communication between people with hearing-impairment and those with normal hearing. A UWB high-precision indoor positioning system from NICT Wireless Network Research Institute was also introduced.

During the event, we also received visitors from the Ministry of Internal Affairs and Communications, Mr. Toshiyuki MINAMI, Director-General of Policy Planning, and other accomplished scholars. People from a wide range of fields also visited our booth, including those related to social welfare, those with disabilities, manufacturers, and students. Everywhere, people were asking questions enthusiastically, getting hands-on with devices, and checking their usability.

Even though the weather was not good for the first half of the event, the Int. Home Care & Rehabilitation Exhibition had approximately 128,000 visitors—even more than the previous year—and with the increased number of presentations and demonstrations, the NICT booth also had over 2,000 visitors.

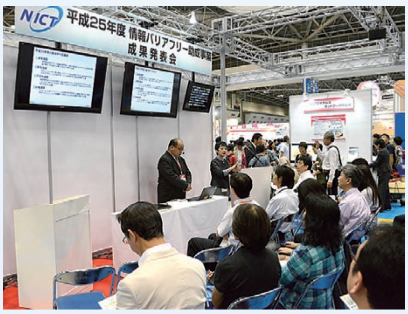
We also received 200 responses to a visitor survey, and most of them responded with "Useful," indicating the content of the exhibits was beneficial, that subsidies had been used in meaningful ways, that the services being provided by businesses were contributing to convenience for disabled persons, and that it had been a good chance to see how NICT R&D is broadly beneficial in society.

In the future, we will continue to use this and other exhibitions as an opportunity to present outcomes from NICT initiatives to support people with inadequate access to information, to further promote an information barrier free society, and to disseminate results from NICT activities.

Exhibitor booth

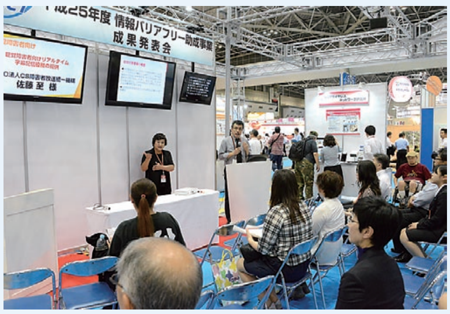
NICT booth

Exhibitor booth



Presentation of outcomes


Hands-on demo



Presentation of outcomes

Report on CEATEC JAPAN 2014 Exhibit

Entrepreneur Support Office, ICT Industry Promotion Department

As part of its activities supporting information and communications ventures, NICT had a booth in the venture area of CEATEC JAPAN 2014, held from 7 to 10 October, 2014, in Makuhari Messe, Chiba Prefecture, exhibiting contents from four ICT venture enterprises that were announced at 2013 Kigyouka Expo.

Two of the companies gave presentations of their products on a mini-stage set up in the venture area, and using a new approach, they actively appealed to visitors and pursued business-matching efforts.

During the event, there were visitors from a wide range of fields, including ICT manufacture, scholarly researchers, government agencies, and students, who could be seen in front of each exhibit, enthusiastically asking questions about the new services from the ICT venture companies and exchanging business cards. ICT venture companies could also use the seminar venue in the venture area to present new services if they desired. This event attracted over 120,000 visitors and the NICT booth had over 600 visitors, so both exhibits and seminars ended successfully.

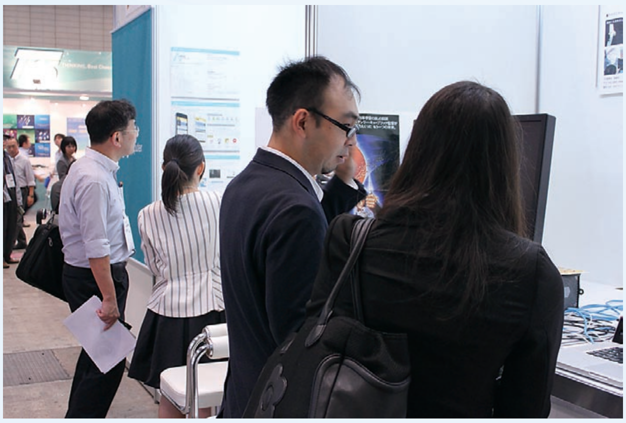
In a survey of the companies exhibiting at the NICT booth, we received responses such as "Smart devices and cloud services were quite popular with visitors that used them" and "We gained some interested customers," indicating that the exhibit was a good opportunity for the ICT venture companies to promote their new services widely in the industry.

In the future, NICT will use this event and others as opportunities to promote business matching for its ICT venture support initiatives, and work to promote the ICT industry and to disseminate outcomes from NICT activities.

NICT booth

Seminar


Exhibit being covered by the media


Visitors

Awards

Recipients ● **Kenji SUZUKI**/ Senior Researcher, Space Communication Systems Laboratory, Wireless Network Research Institute
Morio TOYOSHIMA/ Director of Space Communication Systems Laboratory, Wireless Network Research Institute

Co-recipients:
Mitsuhisa YAMAJI, Yuichi YAMAGUCHI, Masayoshi YONEDA
(NEC TOSHIBA Space Systems, Ltd.)

◎Award Date: May 14, 2014

◎Name of Award: Satellite Communications Research Award 2013

◎Details:
The Digital Modulation System with The Concealed Data Recovery Method

◎Awarding Organization:
Technical Committee on Satellite Communications, IEICE

◎Comment from the Recipients:

We have published and applied for a patent for a new method for guaranteeing security in satellite communications. It prevents a third party from regenerating the carrier and decoding the content without the encryption key that is known only to the legitimate sender and receiver, even if they can receive the signal from the satellite. This paper received Satellite Communications Research Award 2013 and we would like to express deep gratitude to all those involved. We intend to continue to work on the research and development of these technologies further.

From the left: Kenji SUZUKI, Morio TOYOSHIMA

Recipients ● **Hisayuki SASAKI**/ Research Expert, Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute
Yasuyuki ICHIHASHI/ Researcher, Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute
Kenji YAMAMOTO/ Director of Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute
Takanori SENOH/ Senior Researcher, Ultra-realistic Video Systems Laboratory, Universal Communication Research Institute

◎Award Date: July 10, 2014

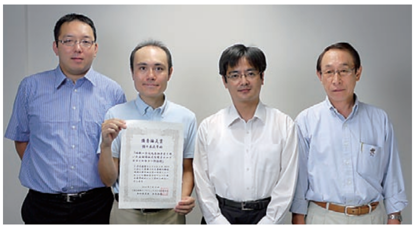
◎Name of Award:
3D Image Conference 2013 Best Paper Award

◎Details:
Multiple SLMs and optical system for colorized electronic holography with large 3D image

◎Awarding Organization:
3D Image Conference Executive Committee

◎Comment from the Recipients:

It has been difficult to achieve both the viewing zone (the range over which the 3D image can be viewed) needed for large 3D images, and color at the same time. This award recognizes our achievement of the largest-ever full-parallax color motion electronic holography with diagonal size of 63 mm and viewing angle of 5.6 degrees.



From the left: Yasuyuki ICHIHASHI, Hisayuki SASAKI, Kenji YAMAMOTO, Takanori SENOH

Recipients ● **Keita EMURA**/ Senior Researcher, Security Fundamentals Laboratory, Network Security Research Institute
Akira KANAOKA/ Invited Advisor, Security Architecture Laboratory, Network Security Research Institute
Satoshi OTA/ Limited Term Technical Expert, Security Architecture Laboratory, Network Security Research Institute
Takeshi TAKAHASHI/ Senior Researcher, Security Architecture Laboratory, Network Security Research Institute

Co-recipient:
Kazumasa OMOTE (Japan Advanced Institute of Science and Technology)

◎Award Date: August 19, 2014

◎Name of Award:
Multimedia, Distributed, Cooperative, and Mobile Symposium (DICOMO2014) Best Paper Award

◎Details:
For "A Secure and Anonymous Communication Protocol and its Prototype Implementation"

◎Awarding Organization:
IPSJ Multimedia, Distributed, Cooperative, and Mobile Symposium (DICOMO2014) Program Committee

◎Comment from the Recipients:

In this research, we focused on the following problem: Pubic key certificates in PKI violates anonymity, and it is difficult to achieve anonymous communications and end-to-end encryption simultaneously. To cope with this problem, we proposed a secure and anonymous communication protocol, and confirmed its feasibility. We would like to thank to all who supported us in this research.

From the left: Satoshi OTA, Keita EMURA, Takeshi TAKAHASHI

Recipients ● **Kentaro ISHIZU***i **Keiichi MIZUTANI***ii **Hirokazu SAWADA***ii
Takeshi MATSUMURA*i **Homare MURAKAMI***i **Hiroshi HARADA***iii

*i Senior Researcher, Smart Wireless Laboratory, Wireless Network Research Institute
*ii Researcher, Smart Wireless Laboratory, Wireless Network Research Institute
*iii Managing Director, Social ICT Research Center

Co-recipients:
Keigo HASEGAWA, Kei YANAGISAWA, Keat-Beng TOH, Seishi SASAKI, Masahiro ASANO
(Hitachi Kokusai Electric Inc.)

◎Award Date: September 9, 2014

◎Name of Award: BEST PAPER AWARD

◎Details:
Paper title: "Field Experiment of Long-distance Broadband Communications in TV White Space Using IEEE 802.22 and IEEE 802.11af"

◎Awarding Organization:
17th International Symposium on Wireless Personal Multimedia Communications (WPMC2014)

◎Comment from the Recipients:

Serious study of technologies for sharing television broadcast bandwidth (White Spaces) that does not affect broadcasts, for use in mobile communications or to satisfy needs in areas that are difficult to reach with wired communications, has begun. This award recognizes our laboratory for success in the first-ever long-distance, multi-hop communications using prototype equipment based on standards that we have been involved in developing. In July this year, LTE high-speed communications using the same band was also successful in the U.K., further meeting expectations for wireless communications.

Kentaro ISHIZU (right)

Employment Information for FY2015: Permanent Engineer Positions

National Institute of Information and Communications Technology (NICT) is an independent administrative institution. We would like to invite excellent and enthusiastic applicants regardless of age, gender, or nationality to promote R&D on information and communications technology.

Number of positions ● Several permanent engineers

Start date ● April 1, 2015 (negotiable)

Desired qualifications (example):

Seeking personnel with experience such as the following to meet the challenge of learning and using new information and communication technologies as they advance daily, and constantly implementing new, advanced technologies.

○Software, device, and/or system development

○Test system building and operation, measurement and analysis

○Field operations introducing new technologies into society

○Technology management; collecting, transferring and developing organizational know-how

Application deadline ● Must be received by 17:00, December 5, 2014 (Fri.)

For details, see the Employment Information section on the NICT Web site (Permanent Engineer).

http://www.nict.go.jp/employment/permanent/perm-technical.html (Japanese only)

Inquiries ● TEL: +81-42-327-7304 e-mail: jinjig@ml.nict.go.jp

Exhibit at the National Museum of Nature and Science "HIKARI—The Wonder of Light— Special Exhibition"

Dates: Oct. 28, 2014 (Tue.) to Feb. 22, 2015 (Sun.).

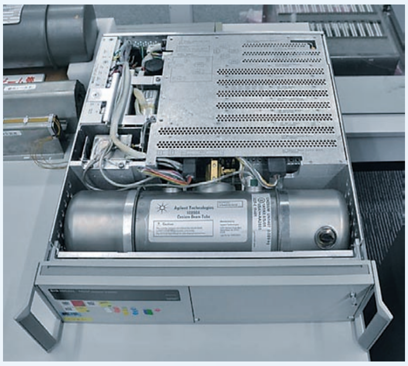
Location: National Museum of Nature and Science (7-20 Ueno Park, Taito-ku, Tokyo)

Details: **"Measuring Time using Electromagnetic Waves"**

"Space Weather Forecasting"

See the following URL for details:

http://www.kahaku.go.jp/english/exhibitions/ueno/special/2014/hikari/



Cesium (Cs) atomic clock

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〈Recycled Paper〉