NICT NEWS

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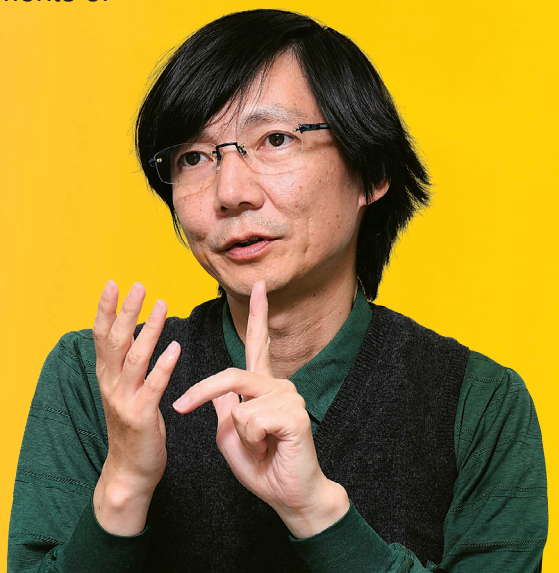


NiCT

2010 New Year's Greeting

National Institute of Information and Communications Technology
President **Hideo Miyahara**

A Happy New Year to all of our readers!

As the population of Japan continues to age and shrink, we have been still experiencing sluggish economy resulting from the financial crisis the year before last. Federal financial conditions are more severe and the budgetary situation for science and technology seems the same. Still, these conditions might provide a good opportunity for reform, producing new social structure.

Japan's hope for the future are closely related to research and development in the fields of information and communications, and seeds of new research are sprouting over all. Our role at NICT is to diligently care the technological seedlings that would bloom in the future, and to imagine a broad vision and a path for that future while also nurturing and promoting the use of ICT needed by society in Japan.

To accomplish this, it is very important to conduct research connecting the excellent, individual technological elements with a perspective on the systems used in society. Going forward, we will endeavor to reform our framework to enable systems research, and to fulfill an important role in promoting collaborations among industry, academia, and government.

NICT added a leap second in the transition from last year to the New Year 2009. We had several additional initiatives last year, while everyone in Japan was watching the total eclipse, including observations of the ionosphere and live video relay of the eclipse. Whole-sky video of the eclipse observed at Amami Ooshima was captured and transmitted over long distances using JGN2plus. It was then projected on a planetarium screen at the venue, creating a powerful presentation and giving the impression of actually being there. A video relay of the eclipse from Iwo Jima was also sent via the Kizuna, or Wideband InterNetworking engineering test and Demonstration Satellite (WINDS). Television stations picked this up; so many audiences must have seen this.

Our achievements in radio-wave remote sensing technology have also been widely recognized. We have the highest-precision aircraft-mounted synthetic aperture radar in the world, able to capture imagery of the ground day-or-night and regardless of weather. The fact that NICT Executive Research Supervisor Harunobu Masuko received the Medal with Purple Ribbon gives further evidence that society widely recognizes the significance of R&D at NICT. This should be an encouragement to other researchers as well. NICT is the only facility in Japan able to develop and maintain such an important remote sensing technology, which is able to measure factors of global environment such as rain and cloud distributions.

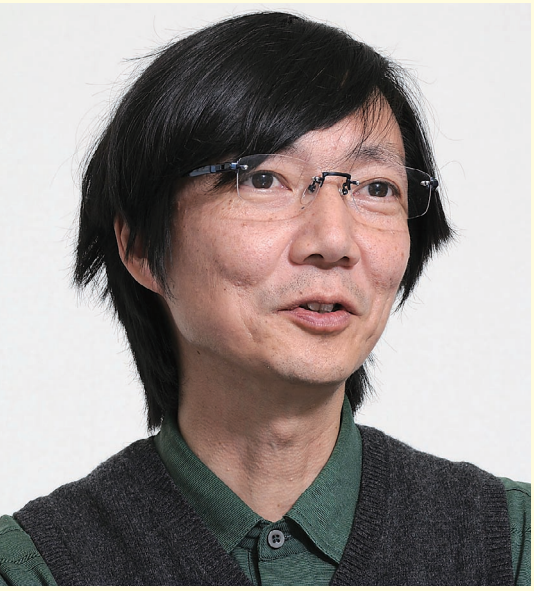
In another research area, cultivating un-exploited frequency bands such as tera-Hertz waves, study is progressing on ways they could be used to analyze the interior of substances such as foods, or to examine objects such as classic paintings in non-invasive ways. We are also researching current information and communications technology and how humans interact with it, and have made brain communication technologies; a priority research area. We hope to use brain research to solve problems and raise the level of ICT. We are also starting collaborative R&D efforts with other research facilities in industry, academia and government.

I am personally involved in R& D on New Generation Networks as the chief of headquarters, and at the end of last year, we outlined development targets and research problems toward the "New Generation Network Vision" which was created in 2008. As a foundation for these results, we will promote collaboration with other R&D facilities and other countries in the future, and also promote discussion in the New Generation Network Promotion Forum regarding international strategies and issues that could be advanced through collaboration with industry, academia and government.

This is the last year of NICT's second mid-term planning period. We will try achieving the goal planned and publish the results of this R&D in way the public can verify them, while engaging in creating the third medium-term plan.

We strongly believe that the R&D results produced by NICT are resources for future growth in Japan and we are working hard so those results would also be helpful for finding solutions to other global social issues such as the environment, population, and the hunger.

To conclude, I would like to take this opportunity to wish everyone a wonderful year.



Discovering two new proteins involved in "telomeres"—the end structures of chromosomes

Elucidating the molecular mechanisms that control the "bouquet arrangement" of chromosomes in meiosis.

Yuji Chikashige
Research Scientist, Biological ICT group, Advanced ICT Research Center
After completing graduate school, joined the Communications Research Laboratories (current NICT) in 1992. Engaged in research on the visualization of biological information and related control mechanisms. Doctor of Science.

In the Biological ICT group at NICT, his work is focused on telomeres-the end structures of chromosomes-which resulted in the discovery of two telomere-associated proteins. With this new discovery, he has elucidated the mechanisms involved in the formation of the "bouquet arrangement*1", a characteristic nuclear orientation of chromosomes associated with telomeres in meiosis.

Working on the visualization of protein dynamics in living cells

— First of all, please tell us about the current research organization and the central research in which you are presently engaged.

Chikashige: The Advanced ICT Research Center at Kobe Research Laboratories contains the Biological ICT and Nano ICT groups. Together with a total of about 15 researchers and technicians in the Biological ICT group, we deal with biological information in the Cell BiologyProject.

We have been working continuously on the visualization of biological information. Using microscopes and other tools, we measure different kinds of information that are exchanged within a cell. In the beginning there were many technical difficulties, but as a result of our devotion to developing and advancing visualization technology, we have recently been able to obtain a considerably higher quality and quantity of the desired information to a considerable degree.

— Is it possible to observe cells at the molecular level even with a light microscope?

Chikashige: While we use electron microscopes, we more often use light microscopes as well. When certain stimuli are applied to a cell, it responds in various ways depending on the stimulus. If we track this across time, we are able to know what kinds of events are taking place within the cell. To do this, it is necessary to continue culturing living specimens on the microscope stage. It was difficult to do this previously, that is, to continue observations while keeping the specimens alive.

— What types of cells do you use?

Chikashige: Cultured mammalian cells, the ciliated protozoan Tetrahymena, and yeast cells, among others. I deal primarily with fission yeast.

— What led you to select yeast?

Chikashige: First, it is easy to perform genetic analyses in yeast. Since we need to link genetic information to the behavior of molecules within the cell, genetic analysis is essential.

— Was it that DNA analysis of this yeast was advanced?

Chikashige: In the case of fission yeast, the DNA sequence had been deciphered about 10 years ago. This was about the same time that the human genome was also deciphered. According to those experiments, it was found that fission yeast has approximately 5000 genes. But of course, this does not mean that we understand all of the functions for each of those genes.

Genes are the blueprint for proteins. Broadly speaking, the fact that there are 5000 genes in this species of yeast means that there are 5000 types of proteins.

In the Cell Biology Project, we have been working on the visualization of these proteins. We have been visualizing about 1000 ~ 1500 of the 5000 proteins. It will become possible to observe, one protein at a time, how each visualized protein behaves when a certain stimulus is applied to a cell.

— You mention the behavior of proteins, but this is hard to picture mentally.

Chikashige: Fluorescent proteins, for which Dr. Osamu Shimomura received the Nobel Prize in Chemistry, are conventionally used in biological visualization. For example, to visualize protein A, we fuse the gene for protein A to the gene for a fluorescent protein, and transform cells with this fusion gene. This produces a single protein consisting of both protein A and the fluorescent protein expressed within the cell, and the behavior of A in the cell can then be visualized by monitoring the location of the fluorescence.

For example, suppose that a certain protein is normally located at the edge of a cell. If you view this with a microscope, you will see fluorescence at the edges. When a stimulus such as a temperature difference is applied to the cells, you can observe, for example, a protein move from the edge of the cell into the nucleus, depending on the stimulus. Actually, complex events occur within living cells. We try to describe carefully, the flow of information in these events by observing

*1 Bouquet arrangement: A special arrangement in which the ends of the chromosomes (telomeres) assemble in one location beneath the nuclear membrane during sexual reproduction. This name was given because the telomere assembly takes on a bunched-like structure that resembles a bouquet of flowers.

the behavior of each protein.

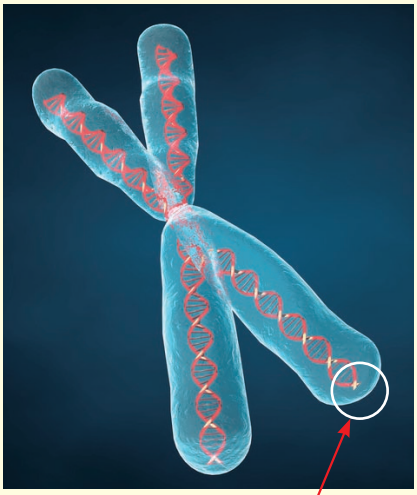
Telomeres, the key to heredity in higher organisms

— And so, now you have discovered two types of proteins associated with telomeres. This has been hailed as an extremely important discovery concerning the structure of chromosomes, but first, please tell us about telomeres.

Chikashige: Last year, 3 researchers involved in telomere research received the Nobel Prize. DNA exists within the cell as chromosomes. The chromosomal DNA of lower organisms such as bacteria is often in the form of a circle. In contrast, the chromosomes of higher organisms are in the form of a straight linear chain, and the structure at the end of this linear chromosome is called a telomere.

When chromosomal DNA is converted into a straight linear chain, free ends are inevitably created. The presence of these ends is associated with a number of significant problems. First, when a piece of linear DNA undergoes replication, one strand of the DNA is used as the template or guide for replication, but due to the nature of the molecular replication machinery, replication at the ends of the chromosome cannot take place completely. This is called the DNA "end replication problem," and for a long time it was unknown how replication at the ends occurred. Dr. Blackburn and others, who received the Nobel Prize last year, solved this end replication problem with the discovery of an enzyme called "telomerase."

— How was the problem solved?



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The ends of chromosomes are called "telomeres."

Chikashige: If the chromosome ends are not replicated completely, they will become shorter every time the cell divides. How is this prevented? This is the end replication problem. My feeling is that at the time, those considering this problem may have been thinking of how to replicate the ends with 100% accuracy. It turns out that because the DNA at the ends of the chromosomes does not code for any important protein product, 100% accuracy in replication in this area is not absolutely essential. But the key to overcoming the end replication problem is a unique method the cell uses that swiftly extends the ends which would otherwise have gradually become shorter with each cell division. By doing so, the chromosome ends are able to be maintained at a largely constant length. The researchers who won the Nobel Prize discovered that this unique method was due to the action of an enzyme called telomerase.

— Like DNA is replicating the ends in a flexible way?

Chikashige: Yes, in a logical, or rather, in a quintessentially biological way. The biological problems associated with telomeres, such as the end replication problem, initially arise because the chromosomal DNA assumes the form of a straight linear chain with free ends. Therefore, when you think through the telomere problem, you end up with the question of why the chromosomal DNA of eukaryotes is a linear-chain in the first place, that is, why it has ends (telomeres). On this issue, I feel that one can think of many possibilities. One of them is the relationship to sexual reproduction.

— It's an important issue in the field of biology, isn't it?

Chikashige: We have visualized fission yeast cells and observed meiosis*2 during sexual reproduction. In the course of these observations, we found that the ends of all chromosomes assembled in a specific location in the nucleus. This is the phenomenon of the "bouquet arrangement."

Bouquet arrangement: A rediscovery which attracted worldwide attention a century later

Chikashige: When you look at the old literature, many articles had been published on this phenomenon from around the end of the 19th century, but for about a century afterwards, they had largely been forgotten. If you read textbooks on telomeres, you will undoubtedly find the term "bouquet arrangement" somewhere. However, compared to the end replication problem associated with telomeres, studies on bouquet arrangements were relatively rare.

We discovered the bouquet arrangement in fission yeast meiosis in the beginning of the 90's and reported it in Science magazine. From the fact that an article describing a phenomenon known 100 years ago was published recently in Science magazine, you can imagine how that caused a highly sensational stir. We worked with fission yeast cells; thereafter, similar reports were reported in corn and mice.

— It was treated like a new discovery even though it was not the first report?

Chikashige: Yes. And during this period, a German group reported that this phenomenon also occurs in humans. Before that, the phenomenon had been found only in organisms with relatively large chromosomes such as newts. Since meiosis in human cells occurs in a visually inaccessible location, observation was quite difficult. However, with new technologies, its visualization has now become possible.

— The technology has advanced remarkably compared to 100 years ago.

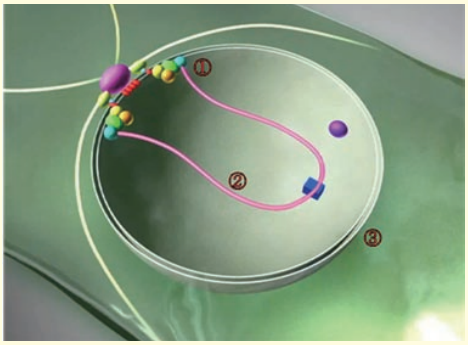
Chikashige: The rediscovery of bouquets in the 90's was a blessing borne out of advances in visualization technology. We next came to be able to induce the formation of bouquets by applying a certain stimuli to cells, and to investigate the behavior of various proteins by observing this process. Furthermore, in addition to visualization technology, with use of a technology called DNA microarrays *3, we were able to understand which genes were activated when certain stimuli were applied. Of the 5000 or so genes present in the yeast genome, we found that about 100 ~ 150 of them were up-regulated during bouquet formation.

Furthermore, to identify which of the activated genes act to produce bouquets, we created deletion mutants for each gene.

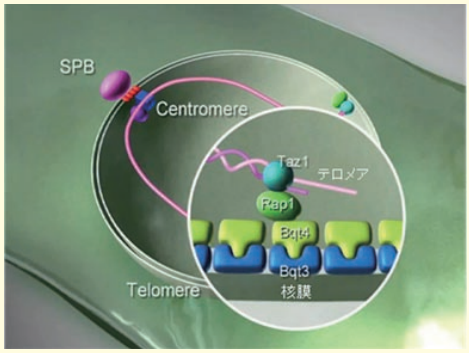
— So that is how you find them!

Chikashige: When we studied around 80 deletion mutants, we found several in which bouquets were no longer able

*2 Meiosis: During sperm or egg cell production, the phenomenon by which the number of chromosomes in a cell is halved prior to cell division so that it becomes identical to the original number after fertilization.



Bouquet arrangement
①Telomere ②Chromosome ③Nuclear membrane



Bqt3, Bqt4
Bqt3 protects Bqt4 from enzymatic degradation, Bqt4 is a protein which anchors telomeres to the nuclear membrane.

to be formed. Because these mutants could no longer form bouquets after the corresponding genes were deleted, this means that the genes which were deleted in these mutants are normally required for bouquet formation. Eventually, we discovered 4 such genes and named them "Bqt 1 ~ 4" after the fact that they were responsible for forming bouquets. "Bqt1" and "Bqt2" were published in 2006, and we have just published the 2 additional proteins; "Bqt4," which anchors telomeres to the nuclear membrane, and "Bqt3," which protects "Bqt4" from enzymatic degradation. We are at the point where we think that we have largely figured out the sequence of events controlling bouquet arrangement.

The primary point of this work is that telomeres are anchored to the nuclear membrane through these proteins, and we revealed the mechanisms of how telomeres were connected to the nuclear membrane.

— Meaning that you found out how the bouquet structure or bouquet is formed?

Chikashige: Yes. However, while we were able to find out how they are made, it is still unclear why they are made. Meiosis, during which bouquets are observed, creates sperm cells and ova. In this case, the two chromosomal DNAs from the father and mother undergo what is known as crossover. For this to occur, the two DNAs must be aligned in an orderly manner. This fact may be related to the problem I previously mentioned of why the chromosomal DNA of eukaryotic cells forms a straight linear chain. An entangled string is more easily disentangled if it has ends. And if you try to align the two strings, you first find the ends and then line them up. Similarly, I think we can suggest the possibility that bouquets likely hold the ends to bunch the chromosomes.

To know the "comfortable conditions" for organisms

— What was the impetus for becoming engaged in this research?

Chikashige: The context was that I wanted to know the "proper state of affairs" of organisms. In the beginning, the idea was to at least try to visualize the chromosomal DNA in the genetic information transfer process during meiosis. So when we discovered bouquets, we were astonished. Although, it is quite difficult to explain why we were so surprised to have rediscovered something that was known 100 years ago.

— How will this research proceed in the future?

Chikashige: For the Cell Biology Project, the goal is to investigate genetic information while diligently recording events within cells. While there are many technologies suitable for this purpose, we are analyzing the genetic information using DNA microarrays—the technology we also used to discover the Bqt genes. We have considerably raised our level of competence using foundational technologies which allow us to monitor the expression conditions for all 5000 genes in the yeast genome, and we are on the verge of being able to visualize biological information globally. The people in the Biological ICT group often mention the term "bio-inspired," which means to learn from biology. Using our measurement technologies, my goal is to figure out how cells live in their proper state of affairs.

Bio-inspired communications technology

— So the idea, basically, is to analyze the functions of information transmission in organisms, and hopefully apply the knowledge to the field of information communication?

Chikashige: That is correct. When I first became employed here, the NICT was still the Communications Research Laboratory of the Ministry of Posts and Communications (MPC). Since I had graduated in biology, many people asked me "what are you going to do at the MPC?" But since the Communications Research Laboratory was advertising information and communications as its mission, to me it was rather odd that the CRL would not be working on biology while doing so.

Generally, it is thought that the world of radio waves, communication, and the internet, does not relate to biology. I have long been dealing with biological information, so I think that it is important to learn from living organisms if we are to understand the nature of communication. This is because biology is made up of information, whether it is the communication of organisms, of groups and individuals, of cells, or the molecules within them. Therefore, I feel that there is hardly any rationale for distinguishing between communication and biology.

— Taking it to the logical extreme, does this mean that "all organisms are communicating?"

Chikashige: Recently, it has often been said that the barrier between broadcasting and communication is disappearing. However, I feel that they were not so different to begin with. It was just that their appearances that differed. I think that it was the progress of ICT that removed this apparent difference. Communication and living organisms are indeed identical; while they may differ in appearance, they are highly similar in essence. Ambitiously speaking, I feel that it may be our role at the Biological ICT to abolish the differences in appearance between communication and living organisms.

— Perhaps this is a transition period?

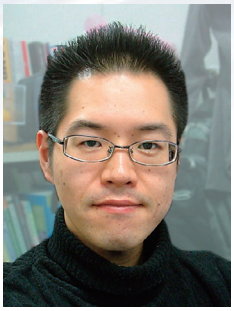
Chikashige: My hope is that we can superimpose the smoothness and flexibility of living organisms upon the ICT of so-called personal computers and networks.

— In that sense, we could say that the Biological ICT group is conducting cutting-edge research on communications. Thank you very much for your time today.

*3 DNA microarrays: An analysis instrument in which DNAs with known sequences are arranged on a solid glass substrate to which a specimen is added to determine its DNA sequence. Generally, each solid substrate contains several thousand to tens of thousands of spots. By adhering DNA molecules from individual genes to each spot, an analysis of every human gene, said to number in the tens of thousands, can be performed on a single microarray.

3D Images on Your Palm and Shared with Friends

Research on gCubik, a Cube-shaped Auto-stereoscopic 3D Display



Shunsuke Yoshida

Expert Researcher, Multimodal Communication Group, Universal Media Research Center

After completing graduate school, worked as a researcher at the Telecommunications Advancement Organization of Japan (TAO) and the Advanced Telecommunications Research Institute International (ATR) before taking his current position in 2006. Engaged in industrial applications of VR technology and research on applications and displaying technologies of 3D image media. Ph.D. (Human Informatics)

Roberto Lopez-Gulliver

Expert Researcher, Multimodal Communication Group, Universal Media Research Center

After completing graduate school, worked as a senior technology researcher at the Advanced Telecommunications Research Institute International (ATR) before taking his current position in 2006. Engaged in research on multi-user interactive virtual environments and 3D video media and presentation technologies. Ph.D. (Engineering)

A more familiar 3D display

Creation of 3D image content and development of devices for displaying it has been increasingly popular recently. For example, 3D movies are becoming more and more familiar, and it is now easy to see them by simply going to a nearby theatre.

On the other hand, there are also many amazing mobile devices, including media players, mobile phones, and portable game consoles. These mobile devices are becoming personal terminals, enabling users to perform basic tasks such as listening to music, playing games, communicating with others, or obtaining information.

Recently however, it has become common to use them as tools to mediate communication among several people. For example photographs or video stored on them are shared in a gathering of friends to stimulate conversation, or they may be used to set up a temporary cyber space among people gathered at a park to play an adventure game together.

In the near future, 3D video technology will have advanced sufficiently to provide it at low cost, and when the displays in mobile devices are replaced by 3D displays, 3D will move from a novelty to being used seriously as medium for promoting communication.

gCubik's objectives as a 3D display

We have proposed the gCubik, a cube-shaped auto-stereoscopic 3D display. The gCubik is a new type of 3D display with the following four features, symbolized by the letter "g" (Figure 1).

(1) Glasses-free - No special glasses are required
(2) Group-sharing - Provides images with correct perspective that many people can view from their various viewpoints at the same time
(3) Graspable - It can be grasped directly, handled and looked at from various directions like a real object
(4) Glazed-showcase - The display appears as though the object is inside a transparent glass case

All of these features are required in order to handle 3D media in a natural way. For example, considering an ordinary communication situation, (1) and (2) are important for natural eye-contact, and to show a new person entering the conversation what is being discussed. They are required for natural and easy communication and to preserve continuity. The ability to feel and handle an actual object and to view it from various angles as with (3) and (4) is also important if digital 3D images are to be used as substitutes for

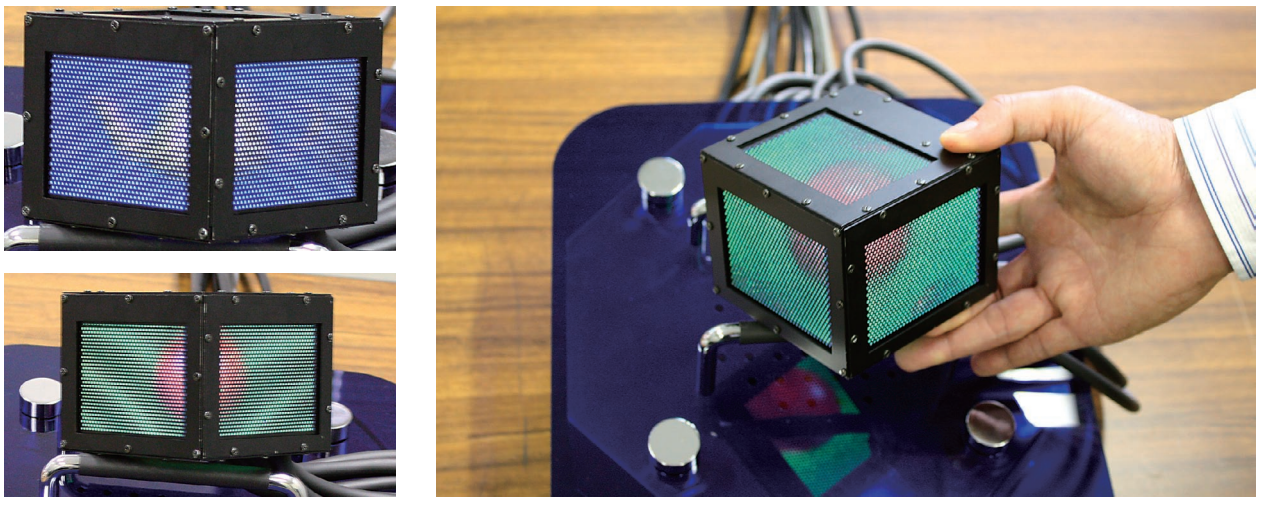
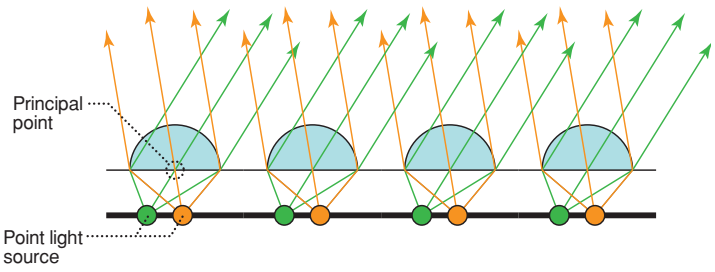
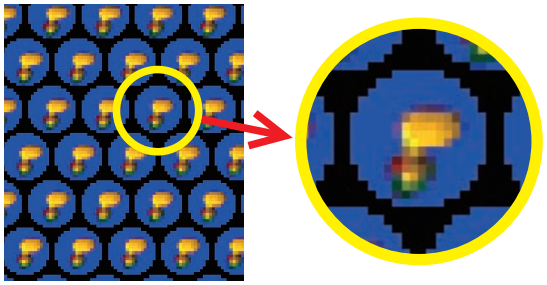


Figure 1 ● 3D Image Produced by gCubik (Top left: Teapot. Bottom left and right: Sphere shown inside the cube and viewed from the side and from an elevated angle)



· A convex lens has a function to condense and radiate light emitted at points at the focal distance.
· The light is radiated in the direction parallel to the line connecting the point light source and the lens's principal point.
· When the lens is observed from that certain direction, only the light corresponding to that specific point can be seen.
· The figure illustrates the effect. When the lenses are observed from the upper-right, the lenses will appear completely green. In contrast, from the upper left, they appear completely orange.



. A large number of elemental images are displayed on the LCD.
. Each circle contains the elemental image corresponding to one lens (approx. 18x18 pixels).
. When observed through the convex lens from a certain direction, only one particular pixel from the elemental image can be seen.
. By employing this effect appropriately, a scene that appears to be inside the cube can be reproduced, regardless of the cube surface or viewing angle.

Figure 2 ● Lens effect and elemental images (partially magnified)

physical models.

Many other 3D display technologies have been proposed in past years, but they generally force viewers to wear special glasses and sit in a specific position, they are large or require mechanical displaying gimmicks. This has prevented 3D images from being handled, and only allows seeing them from a distance. We are pursuing R&D on the gCubik as a new form of display along the concepts outlined above, and are exploring its potential as a medium for 3D imagery.

gCubik Implementation Technology

Each face of the gCubik is an auto-stereoscopic 3D display composed of an LCD and a honeycomb-packed micro-lens array. Directly under each lens, the LCD displays an image called an elemental image (Figure 2). If this image is observed through the convex lens, only the light from a specific pixel is visible from a given direction. Using this principle, an image is reproduced that appears as though looking through the surface into the cube, according to the angle from which it is observed.

This technology, called Integral Photography, has actually been known for a long time, but there is more to the gCubik implementation than simply combining six such displays in a cube shape. One issue was that existing technologies were only designed to be viewed from directly in front of the panel, and the image could not be seen well from other angles. To implement the gCubik, the displays needed to allow viewing from any direction, and particularly needed to maintain continuity when viewing a 3D image over multiple surfaces. Thus, we determined the conditions that would allow an image to be formed inside the cube and to be viewed with continuity at a distance as when being held in the hand. Our solution required lenses that preserved viewing at angles up to at least 120 degrees, and we implemented such lenses.

Another reason we employed the integral photography principle was to allow for manufacture of a compact device. The current prototype 3D display is a cube about 10 cm on each side, so it is a good size for holding in the hand. A 3.5-inch VGA-resolution LCD is used to display the elemental images, allowing an image of approximately 35x30 dots to be displayed on each surface, which supports viewing from over 300 directions vertically and horizontally.

Future Prospects

At the moment, the gCubik is just a proof-of-concept prototype device. The current prototype is a test bed for considering what could be done with a "crystal cube" communications tool about 4 cm to a side and able to display 3D images when this technology would be well-developed in the near future. As an example, we have proposed a new platform called gCubik+i, with additional interactive functions. gCubik+i provides a sharing experience in which images arranged on a table using a 2D medium can be picked up using the 3D medium, shared, and observed from various angles. Figure 3 shows content developed using the concept of a "3D Aquarium in the palm of your hand". It allows fish in the water to be "scooped up" and their movements inside the gCubik can be observed. As an example application, internet shopping items could be downloaded to gCubik so that they could be shared and examined from various angles by family members using this platform.

We are proposing new ways to communicate with 3D-image media in the future, with gCubik. This is our challenge for the future.

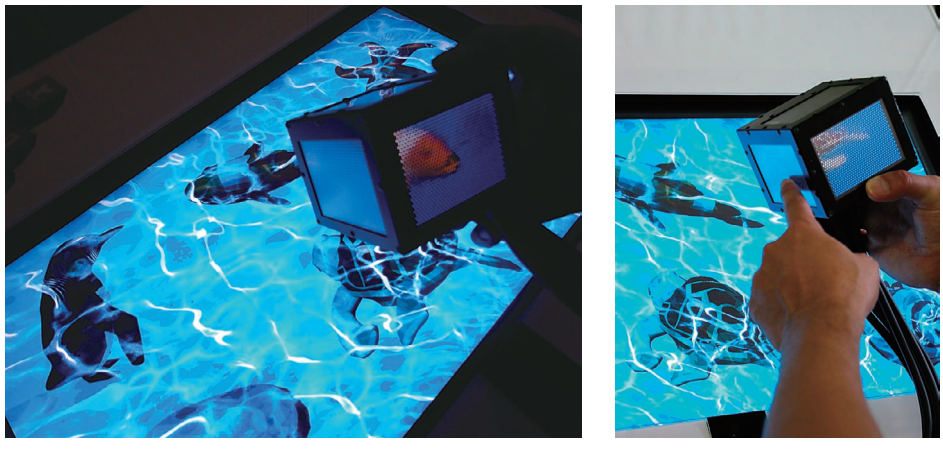


Figure 3 ● Interaction with images using gCubik+i (Virtual 3D Aquarium).
When the gCubik is brought near the tabletop LCD display, a 3D image of a fish enters the gCubik as though it was scooped up out of the fish tank. The fish inside the gCubik can also be manipulated using touch panels on the surface of the gCubik.

Toward the Realization of New Generation Networks

Strategic Promotion Office for New-Generation Network R&D, Strategic Planning Department

What will Networks be like in 2020?

New Generation Network is a key word getting attention as we look forward to networks 10 or 20 years in the future.

In the 21st century, Japan has become known as the top broadband country in the world due to the dissemination of mobile phones and high-speed network services with ADSL and optical fiber.Gradually, we are beginning to see the limits of the Internet in its current form. As a result, research and development on the New-Generation Network has begun in many countries.

The New-Generation Network will be designed, not by making improvements to the Internet, but by building a new network, starting from a clean slate. In Japan, research and development is progressing with the target of implementing such a network in the time frame from 2015 to 2020. In the next decades, we hope to find radical solutions to technical issues and limitations in the required ICT infrastructure by planning for it without restriction from existing technology.

The New-Generation Network must resolve various problems in current society, but it must also contribute to development of global culture in the 21st century. To achieve this, a bold and focussed research and development strategy is necessary. The starting point for setting such a strategy is to describe a vision for the sort of society we want to realize in the future, and what the role of the New-Generation Network will have in this society.

Mission of the Strategic Headquarters

To accomplish this, NICT initiated the New-Generation Network R&D Strategic Headquarters (hereafter, Strategic Headquarters) on October 1, 2007. The mission of the Strategic Headquarters is to create mid and long-term strategies for directing research and development on the New-Generation Network in Japan, in the context of international collaboration and competition. Strategies were created, mainly through the strategy working group within the Strategic Headquarters. This group also proactively accepted participants from industry, and gathered elite researchers from within NICT for an intensive study of New-Generation Network R&D strategies that would contribute to Japan's overall strategies.

Deciding on a Vision

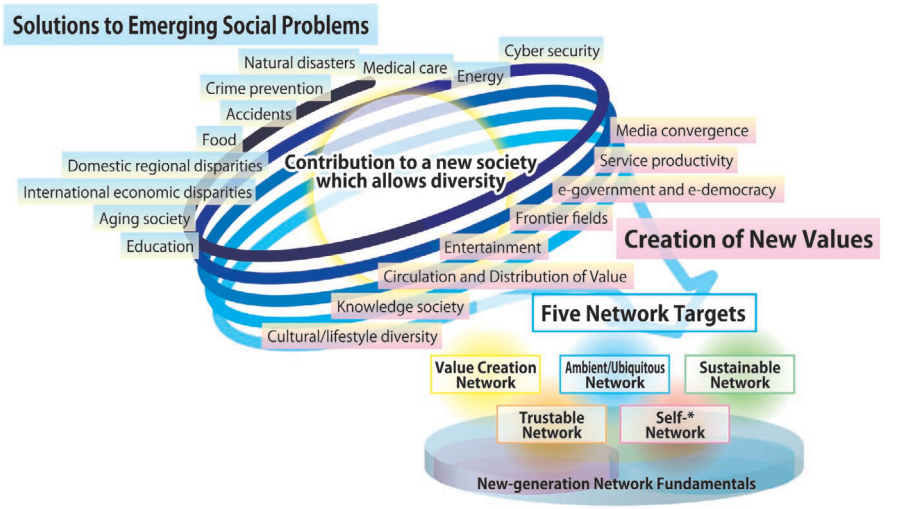
To decide on a vision, the study first analyzed the technical requirements of the New-Generation Network to create new value in society and to solve roughly 20 societal problems, such as health care and Japan's shrinking and aging population. Three objectives were then selected to express the vision. These are: (1) Minimize the negatives; to minimize societal problems we are facing directly today, such as the energy problem; (2) Maximize the potential; to create new value by maximizing potential of people and society; and (3) New diverse and inclusive collaborations, to build a new society that contributes to inclusion.

The New-Generation Network Technology Strategy takes this study further, by selecting functional requirements that could not be realized through the Internet or Next-Generation-Network extensions, carefully examining and grouping these more-than-100 technical requirements, and summarizing them into representative categories.

New-Generation Network Technology Strategy

In this summary work, we reviewed issues in detail, including connections between the network, people and things in the world; its relation to the earth and sustainable society, and trust and support relationships between people and the networked society. The study produced a list of five network targets, representing features that the future network must possess.

Starting with this month for the coming three issues, we will cover fundamentals of New-Generation Network Technology, and the five network targets packaged as technical strategy solutions. The five network targets are: (1) a value-creation network, (2) a reliable network, (3) a network that supports living conditions, (4) a network free of apparent constraints, and (5) a network that is easy on the environment.



Network targets derived from social requirement conditions

The detailed report can be downloaded from the following URL: http://nwgn.nict.go.jp/report/NWGN-RD-Strategy-NICT-Report-V1-2009.pdf

New Generation Network Targets "Value Creation Network"

Toshio Soumiya
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Strategic Promotion Office for
New-Generation Network R&D
Strategic Planning Department

Kazuhiro Otsuki
Senior Strategic Manager
Strategic Promotion Office for
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Creation of User-oriented Network Services

The New-Generation Network R&D Strategic Headquarters has drafted policies to support advancement of strategic research and development. These are the first edition of the New-Generation Network Technology Strategy, in which we set R&D targets for the New-Generation Network covering the five network targets and technology fundamentals.

In this article, we will introduce the "Value Creation Network" as one of the five network targets.

A Value Creation Network is one that has evolved beyond simply providing a path that connects applications with users. It brings applications and network users together into one and adds knowledge from network users and objects such as sensors with the goal of becoming an essential part of peoples' lives.

As an example, the various services and knowledge that scattered around the world can be combined in a highly-reliable, real-time way, making possible tasks that were previously difficult. Examples of such tasks include real-time automatic multi-language translation, use of networks to personalize media distribution that is now being done by broadcast networks, and implementation of new media services through these information connections, which would then lead to further new discoveries.

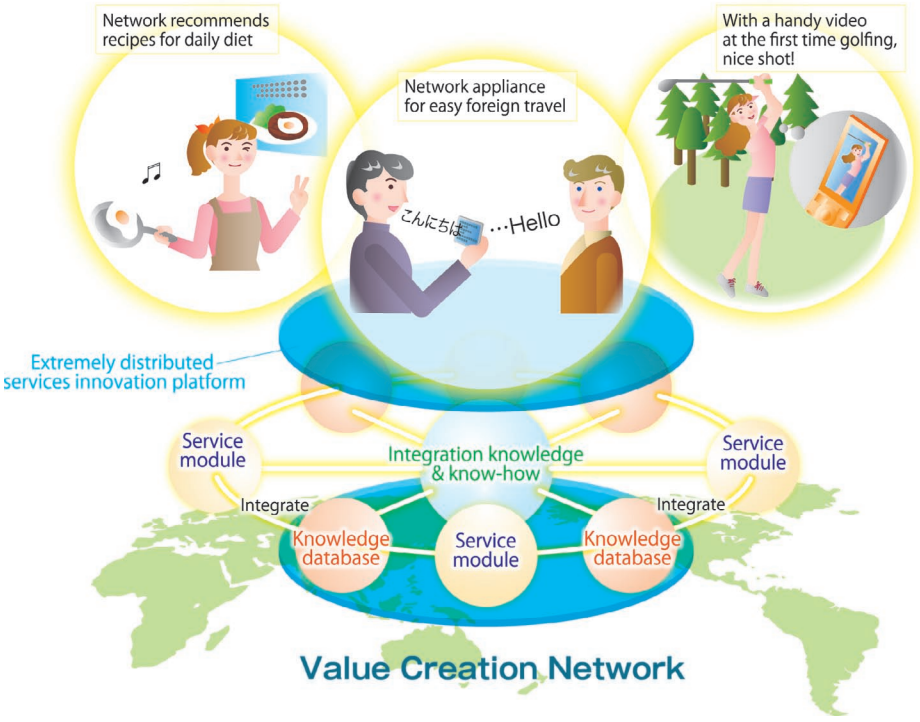
Two Technical Objectives

A Value Creation Network gives rise to two technical objectives. The first is service-creation network technology, combining the network with applications and services, and the second is media-creation network technology, which is a user-centered media-distribution technology.

Service creation network technologies can include those that encourage modularization, making network services easier to create, and knowledge processing technologies, which will be needed in the intellectual society of the future.

On the other hand, media creation network technologies include environment-independant data transmission technologies that handle both wired and wireless environments, technologies that help find meaningful and reliable information within the flood of information available, and technologies that generate media services depending on the user's situation. These address the expectation that user-contributed information will continue to advance.

Technology for building large-scale databases will also be very important for both of these areas. Value Creation Networks must be a place for creating innovation, so they must be easy to use for the end-user, and must aim to provide network infrastructure that facilitiates new ideas and implementation of these ideas.



Expert Researcher, Security Fundamentals Group, Information Security Research Center

Lihua Wang

●Profile
After receiving a Master degree of Science (Mathematics) from Harbin Institute of Technology in the People's Republic of China, came to Japan in 2001.
After completing a doctoral degree at University of Tsukuba in 2006, worked as a researcher at that university before joining NICT in November, 2006.
Engaged in designing and evaluating of cryptography and authentication protocols. Ph.D in Engineering

Cryptography Originates and is Developed from the Requirements of Application

Design and Evaluate Cryptography Protocols in Response to the Demands of the Real World

Designing cryptosystems with hierarchical confidentialities

Cryptography is the unique function behind familiar technologies like user authentication, SSL, and e-Money. In the Security Fundamentals Group, which works on cryptography theory and algorithms, Expert Researcher Lihua Wang is conducting research on ID-based proxy cryptosystems. ID-based cryptography is a cryptographic approach which uses identity information, such as a user's name, email address or employee identification number, as a public key*.

"We will use an example of exchanging data within a company to illustrate but the same can apply to external communication. When an employee sends data to a delegator (e.g., the employer), depending on the content, the delegator may want his/her assistant to check it. Alternately, the employee may want only the delegator to read it, or the delegator could authorize a delegatee to process the data, and want the assistant to re-encrypt the data before sending it to the delegatee. In the latter case, some mechanism to prevent the assistant from reading the context would be required. Till now, separate systems have been constructed, depending on the case, but we have created a protocol that enables the employee (the sender) to set appropriate parameters when computing the ciphertexts corresponding to different levels of confidentiality, and allowing the above operations to be done with one system.

Both the sender and the receiver (delegator) are able to set the degree of confidentiality effectively."

In other words, we have implemented a proxy cryptosystem that allows the proxy to execute both the proxy decryption and the proxy re-encryption.

Dr. Wang demands practical implementations of this research and is guided by the motto: "Cryptography originates and is developed from the requirements of application".

"I believe this sentence exactly expresses the objective of my research, 'Cryptography responding to real-world requirements'. Many of the cryptography methods currently in wide use are gradually becoming insecure as cryptanalysis technology and computing performance improve. Because of this, there is a demand for new cryptographic techniques that overcome these problems in order to implement initiatives like eGovernment."

The struggle to overcome the language barrier

Dr. Wang came to Japan in 2001. While she was in her doctoral program at University of Tsukuba, she had a difficult time with language.

"I went to Japanese classes for about six months in China, but when I arrived in Japan, I couldn't say much more than 'I am a student, I don't work here.' But, I studied hard, continued with several Japanese classes within and outside the university, and now I have managed to improve my speaking quite a bit."

While she was studying as an international student she dreamed of building bridges between China and Japan. This has now come true, and she is involved in research collaboration projects with Shanghai Jiao Tong University and Beijing University of Posts and Telecommunications in China, as well as with University of Tsukuba and Future University Hakodate in Japan.

For her next challenge, she is enthusiastic about pursuing research on next-generation cryptography, preparing for when post quantum cryptography becomes prominent, proposing new methods for signing and encryption and researching ways to evaluate their reliability.

* In public key cryptosystems, a public key is a key that can be made public and is used to encrypt data. Ciphertexts can only be decrypted using a different key, which is called the secret private key.

Prize Winners

PRIZE WINNER ● Kazuhiro Oiwa

Director General, Kobe Research Laboratories

◎DATE: 10.29.2009

◎NAME OF THE PRIZE: Award of peer reviewing on Grants-in-Aid for Scientific Research in Fiscal 2009

◎DETAILS OF THE PRIZE: Contribution to the peer-review process as a committee member of Grants-in-Aid for Scientific Research

◎NAME OF THE GROUP: Japan Society for the Promotion of Science

◎Comments by the winner:

Peer review of grant applications by research experts is an essential system for maintaining the impartiality and soundness of the scientific research. It not only determines how research funds will be distributed for excellent research proposals, it also improves the quality of research proposals by providing feedback to authors. I have been very honored to participate in this process. Peer reviews done by specialists become the basis of evaluation for all grants-in-aid for scientific research. I am happy beyond all expectations and also quite proud to be recognized for this contribution. I look forward to seeing many excellent results from research related to proposals I was involved in evaluating.

President Miyahara and Kazuhiro Oiwa (right)

PRIZE WINNER ● Shigehito Miki

Senior Researcher, NanoICT Group, Kobe Advanced ICT Research Center

◎DATE: 6.16.2009

◎NAME OF THE PRIZE:
146 Committee award, Japan Society for the Promotion of Science

◎DETAILS OF THE PRIZE:
Achievement of excellent research progress in superconducting single-photon detectors

◎NAME OF THE GROUP:
Japan Society for the Promotion of Science

◎DATE: 9.8.2009

◎NAME OF THE PRIZE:
JSAP Incentive Award for Excellent presentation

◎DETAILS OF THE PRIZE:
The publication, "Super conducting nano-wire single-photon detector element using ultra-thin-film NbtiN" was an excellent paper, contributing to developments in applied physics.

◎NAME OF THE GROUP:
The Japan Society of Applied Physics

◎Comments by the winner:

We conducted this R&D on a superconducting single-photon detector device to improve single-photon detection technology, which is essential for quantum information and communications and quantum optics.

I am very happy to be recognized for this achievement. I am deeply greatful for the support of everyone in the Quantum-ICT and Nano-ICT groups, and I hope to develop this research further in the future.

PRIZE WINNER ● Eihisa Morikawa

Senior Researcher, Space Communication Group, New Generation Wireless Communications Research Center

◎DATE: 9.16.2009

◎NAME OF THE PRIZE:
Communications Society: Distinguished Contributions Award 2009

◎DETAILS OF THE PRIZE:
Editorial Contribution to IEICE Transactions on Communications of the Communications Society

◎NAME OF THE GROUP:
Communications Society, the Institute of Electoronics, Information and Communication Engineers (IEICE)

◎Comments by the winner:

Over four years, I acted as editorial committee member for satellite communications and space systems in the Japanese journal B, editing journals, planning special features and selecting papers for prizes. This prize is in recognition of the contribution of this activity to encouraging academic exchange.

Personally, I learned a great deal through this activity, and it has been a particularly valuable experience for me. I would like to take this opportunity to thank all those that supported me in it.

Japan Standard Time is determined and maintained by NICT

National Institute of Information and Communications Technology

Time-Koushien in Koganei

"My 10-seconds" Contest

Application is open to anyone.

SPONSOR:
- National Institute of Information and Communications Technology (NICT)

Collaboration:
- Institute of National Colleges of Technology, Japan (KOSEN)
- Japan Clock & Watch Association
- Japan Radio Institute
- Radio Engineering & Electronics Association
- Denki Tsushin Shinkou Kai (DSK)
- The National Association of Principals of Technical Senior High Schools

Application must be received by:

February 26, 2010 (Fri)

See Website for details **http://www.jsforum.or.jp/event/t-cup/**

t-Cup Challenge Search

Following "Idea Clock and Watch" and "Technology" contests, the Space-Time Standards Group at the New Generation Network Research Center is holding "My 10 Seconds" contest to get participants to express their thoughts about "time".
Happy 10 seconds, Exciting 10 seconds, Breathtaking 10 seconds ... If asked to express something in 10 seconds, what would you choose? Express whatever message you can within the limited time, using either video, photography, animation, sound or other means.
We look forward to your 10-second miracle and the impression it will leave on viewers' hearts and minds.
Winning entries will be published on our website, and certificates and other prizes will be awarded.

Information for Readers

The NICT News has been redesigned starting with this issue. The next issue will feature a round-table discussion of visions for networks twenty and thirty years to come in the future.

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