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Special Discussion

Looking at the future of information and telecommunications

Kazuma Yamane (Nonfiction Writer) × Hideo Miyahara (President of NICT) 1

NiCT

Kazuma Yamane
(Nonfiction Writer)

Hideo Miyahara
(President of NICT)

Looking at the Future of Information and Telecommunication

Kazuma Yamane: Born in 1947. Graduated from the Faculty of Foreign Languages, Dokkyo University. A nonfiction writer, Mr. Yamane anchored a NHK TV program "Midnight Journal" (1990-1992) and "Mirai-ha Sengen (Declarations of a Futurist)". His serial articles "Metaru kara no jidai (An Era of Metal Color)" for a weekly magazine won the Japan Creation Award 2008. General Producer for Aichi Prefecture Pavilion at EXPO 2005 Japan. He is the author of many books, including Dejitaru sangyo kakumei (The Digital Industrial Revolution), Supa shosai no yugi-jutsu (Play Skills for Super-Studies), Metaru kara no jidai (An Era of Metal Color).

NICT NEWS asked Dr. Hideo Miyahara, our President and Mr. Kazuma Yamane, a nonfiction writer to talk about the present status of information and telecommunications and NICT's outlook on future developments in the field.

Hideo Miyahara: Born in 1943. Graduated from the Division of Electrical, Electronic and Information Engineering, Faculty of Engineering, Osaka University. Studied in the Doctoral Program of the Graduate School of Information Science and Technology, Osaka University. Assistant Professor at the Faculty of Basic Engineering, Osaka University (1980). Director of the Large Computer Center (1995). Dean of the Graduate School of Basic Engineering, Osaka University (1998). Director of the International Student Center, Osaka University (2000), Dean of the Graduate School of Information Science and Technology, Osaka University (2002). President of Osaka University (2003-2007). Current post since September, 2007.

Information and telecommunications is a technology which "reliably communicates with others to reward their hearts"

Yamane: Since about 15 years ago, we have become more deeply dependent on mobile phones and e-mail to the extent that we are now forced to use them despite their many problems. It seems to me that these systems lack something which is the most essential for human beings. This has happened, don't you think, because nobody took the care to develop technologies which would enable real human-to-human heartfelt communication that truly connected people?

Miyahara: I agree. Allow me to cite here the words of my teacher, Prof. Nobuaki Kumagaya, a former President of Osaka University, in the order of three Presidents back from my period as President at that university. Prof. Kumagaya said that Information and Telecommunications (Jo-ho-tsu-shin in Japanese) is a technology which "reliably (shin) communicates (tsu) with others to reward (ho) their hearts (jo)." I totally agree with this.

Yamane: I also started my book Jo-ho no shigoto jutsu (Information Working Skills) with the sentence, "Information (jo-ho in Japanese) means to reward (ho) hearts (jo)," and thus "Information should connect the hearts of people."

Miyahara: As we speak, our communications are heart-to-heart communications, or brain-to-brain communications. Communication is a concept on a higher level than a simple exchange of data or characters.

Yamane: But the word "jo-ho," information in English, has somehow acquired a rather cold image, don't you think?

Miyahara: I think that emotion is important, and that the current term 'e-mail' should be called E(motional) e-mail, with an extra 'E', or Ee-mail. We will need to develop technologies which can handle feelings or emotions. People now tend to think that sending an e-mail through the Internet is enough, or taking classes and getting credits can be achieved while sitting in front of a TV screen. They think of communication as being something with a narrowly-defined meaning. That's why many of the problems arise.

Yamane: On the way here today, I looked at a bulletin board in a small park nearby and realized that an actual bulletin board with paper notices on it was really good. The information posted on Internet BBSs will not 'fade', but the notices put up on a bulletin board in a park will become tattered and the colors will fade as they age. We can see quite clearly that the information is old. Also, the workmanship on the posters on the bulletin board gives us some idea of the situation of an organization or its activities, doesn't it? The information, therefore, has very emotional aspects, such as the chronological changes in the information and the script styles. Aspects that information on the Internet lacks.

As a general rule, reliable information is worth paying for.
We should try to perceive the value of things which cannot be seen.

Miyahara: Yes, it's not a good idea to try to replace all information (jo-ho) with ICT (Information and Communication Technology) media. That wouldn't work. The fact that textbooks are created in the form of books has a special meaning. For example, we can't turn over the pages on ICT media to search for specific information. That function doesn't exist. That's why paper media will never disappear. Paper media have ways of containing information and enabling searches for information which are specific to the media. Naturally, it would be very dangerous if we had only one way, the Internet, to acquire information,

Yamane: I have a specific worry about Wikipedia. Of course, it's of great significance for the people of the world to share and accumulate 'knowledge' in the way which Wikipedia does, which is a new form of culture…

Miyahara: Yes, it's a problem when we do not know who wrote a specific article. The point here is how to use it. Reading Wikipedia is fine, but we should not assume that all of the information on Wikipedia is correct.

A bulletin board in a park gives information a more emotional, 'heart-rewarding' feel.

Yamane: I think the identity of information, when it was written, who wrote it, and so on, should always be clearly indicated when the information is shared among a large number of people. Every publication bases its reliability on clear declarations of authorship and publisher and the dissemination of information in a responsible manner. On the Internet, however, anonymity has been implicitly accepted since the earliest stages. What was the reason for that?

Miyahara: From the beginning, the Internet was developed to connect computers and exchange data. The simultaneous use of multiple computers was found to be better and more effective for scientific and engineering calculations than the use of stand-alone computers. That's why the Internet was developed. After a while, researchers started using e-mail for communication and found it very useful. Since then, the Internet has expanded explosively to its current size. The convenient nature of the Internet has been strongly emphasized, and now everybody is using it. The fact is that, in some senses, the issue of rules and regulations for the use of the Internet has been overlooked.

Yamane: "We can make the rules later." When I started to use computer online services in the mid-80s, anyone posting a strange message on a BBS could be easily identified, because everyone's ID was clearly shown by the system. It was not anonymous, and the BBS was healthy in that way. On the Internet, on the other hand, anonymity has been taken for granted and it could easily have become a safe-haven for criminals.

Miyahara: Technology has made even anonymity possible on the Internet. People are clearly abusing this function. They can say in an e-mail things that they would not otherwise dare to say in front of others. Many cases of spiteful abuse are sent as mobile phone e-mail.

Yamane: Yes, this is the dark side of network technologies which nobody expected.

Miyahara: One of the missions of engineers like ourselves is to provide a variety of services, but the rules for using these services, and the abilities required to make full use of them, are not being properly acquired. People usually look at only 0.001% of the total search results obtained from search engines. When hundreds of results are obtained from a search, people naturally do not look at the very lowest items.

Yamane: The rank order of results shown by search engines isn't really very fair, is it?

Miyahara: You're right. It's not fair at all. Display ranking is determined by the number of times with which a certain piece of information has been accessed, and by the number of links to that information. Therefore, the first results may reflect only a minority opinion.

Yamane: The situation might be improved if we could choose the display order for search results, for example, a descending or ascending order by the number of times with which some information has been accessed, or in descending order from the oldest information, and so on.

Miyahara: It may be possible to add such functions to search engines, but it is doubtful that such services make any sense for search engine companies. That's why it is better not to be dependent on only one search engine only. Furthermore, the most important thing for us is how to retrieve really reliable information. For example, there is a great deal of information on cancer all around us, but is it correct? We have to determine how reliable the information is by checking it against the opinions of appropriate medical institutions, or the author of the information concerned. NICT is studying ways of providing such information, but it is difficult to teach computers how to check contents and determine their reliability. So we are planning to check and make judgments on whether the information is coming from reliable organizations or simply from any individual's opinion.

Yamane: When I want to find out something, I usually start by checking at reference sites such as JapanKnowledge, which mostly contains encyclopedias. These are charged services, but they are not so expensive. Anyway, I feel safe with these sites because they make it clear who the articles are written by.

Miyahara: As a general rule, reliable information is

worth paying for. We should recognize the value of information in an appropriate manner.
Particularly, Japanese people should be more positive about perceiving the value of things which cannot be seen.
Everybody in Japan should, I think, recognize that some costs are inevitable for safety and security.

Yamane: Yes, but the Internet established the idea that information is free. Many people now say that they will never pay for information on the Internet.
Miyahara: One thing is the cost of communication lines, that is, the costs of broadband service. That cost was the highest in the world in Japan 10 years ago. It was about ten times more expensive than in Europe. But ten years later, the cost has become the lowest in the world. Japan's capability in IT technology has made it possible. However, this point has not been adequately appreciated. Communication charges have become much lower and people seem to think that data coming from the network is free of charge. This situation is causing a variety of problems. How can it be worthwhile for IT engineers to work in such a situation?

Research to enhance the Internet "culture" in 10 or 20 years…

Yamane: It has just been over 10 years since the Internet age began. Here I would like to ask you, President Miyahara, to make positive advances in Internet technologies which will establish over the next 10 or 20 years an Internet with closer similarities to the human life. I am anticipating that NICT will make breakthrough innovations which will change the world in the true sense of the term.

By the way, one of my great expectations for NICT's efforts is quantum communication, because NICT is the world's top runner in this field. Quantum communication is a technology which matches well with mankind's travels out into the universe, and it will also dramatically enable more robust communication security. I am hopeful that NICT will accomplish to open up a new era of communication, which will result in changes not seen since the radio wave communication system was established by Marconi.
Miyahara: At our research laboratories in Kobe, we have some bioscience researchers who are doing research on the brain. They have started a new project with IT engineers to open up new paradigms and innovations.
Yamane: Oh, that's excellent! Right now I'm trying out some experiments with goldfish, and I am really leaning a lot from it. I worked on an experiment tapping ten times on the glass wall of the aquarium before feeding. After 10 days of this activity, the goldfish came up to the surface when I tapped ten times on the glass. They have an amazing capacity for learning. I was really surprised to see that they could find a piece of food which dropped to the bottom of the aquarium without any mixing it up with other objects. Olfactory information should be blocked in water and I wonder how it is possible for them to make such distinctions. We have a lot of things to learn from living beings such as a goldfish.
Miyahara: Living beings are wonderful, I agree. A scientist I knew was studying Bengalese finches. They were originally southern wild birds. After they became human pets, they acquired the ability to sing intricately melodious songs. This meant that their ability to acquire appropriate females increased. Why should that happen? My friend told me that the change occurred when they were released from the stress of predation. The easy life made fine singers out of them.
Yamane: (Smiling) Ah, so, if my stress level goes down, will I be better at Karaoke? By the way, Google has released a new internet browser and it looks like taking the Internet by storm, but I think Google's aim is simply to develop a browser which is advantageous for its business. What do you think? The Internet browser is now a necessary item in our daily lives, but I would be happier if browsers or the Internet had some new functions, such as the browser's appearance becoming a sepia color for older data just as old paper browns, or a filtering function which could indicate at a glance that people have reacted favorably to some particular data.
Miyahara: We are now studying such functions in an attempt to develop interfaces which are truly user-friendly. The point is how to design an IT system which incorporates human sensitivity.
Yamane: I look forward very much to seeing the results of your efforts.
One thing more, when we are browsing data on the Internet, in 99% of the cases there is no sound. Of course, I know that many video sites, like YouTube, enjoy their immense popularity, but most sites consist only of text, photos, and other graphics. It's the same as e-mail. Some sites have strange sound effects, and I have to turn off the sound to avoid the awful cacophony, but I think sites with no sound are very inhuman.
Miyahara: I read a book called Hito-wa Mitame-ga

90% (How You Look is 90% of Who You Are) (by Ichiro Takeuchi, in the Shincho Shinsho series) in which the author says that only 10% of the total information can be communicated by written language, and the rest of the information is gained through non-verbal factors, such as body language, gestures, tone of voice, and facial expressions. An issue facing the implementation of advanced interfaces is how to communicate this remaining 90% of the information.

Yamane: On the other hand, another important issue is how people with visual or hearing disabilities can acquire information as much as people with no disabilities. Is this an important issue for NICT?

Miyahara: You're quite right. I think the values inherent in the sensitivity you mentioned are very important.

Yamane: (Smiling) Your remarks today do not really seem to be those of a digital communications specialist.

Miyahara: It may look as if people would say of me, "Despite the fact that you are working for the Internet, information and communications and the like in digital field." but I'm not so. Digital is always an approximation of phenomena. Everything is really analog.

Yamane: A profound and explicit remark! I was also under the impression that NICT's Japan Standard Time atomic clock was digital, but I've heard that in actual fact the atomic clock is analog, is that right? Is it impossible to fully digitalize the clock?

Miyahara: Well, a clock itself cannot be made as an analog device by virtue of its very nature. After all, the term "digital" originally means "a finger," and the term digital can be applied only to countable things. However, the world is not built in a way that it can be counted "1, 2, 3…" on our "fingers". For example, temperature, does not suddenly step down from 30℃ to 29℃.

Yamane: NICT is well known for its maintaining the Japan Standard Time, and that's fine, but there is one annoying problem I have in relation to clocks. The TV broadcasting system is now in the process of changing from an analog to a digital system. As opportunities to see One Seg and Full-Seg broadcasting increase, I was really astounded to note that there is a time lag. The routing of TV data or the encoding and decoding capacities cause a lag in the time when the video images take to reach their destination.

I've had a similar experience on the Web. When I was watching a live broadcast of a space shuttle launch on the Internet and the live coverage on CNN TV at the same time, the space shuttle was launched on the Web about 40 seconds after the successful launch on CNN TV. It was the first time that I realized that the "delay" on the Internet was so large.

Miyahara: Of course, encoding and decoding cause such delays, but the delays are also generated on the networks. The Internet was originally meant for data transmission, and it is not good at real-time communication, like the telephone. The initial idea for the Internet allowed for some delays in data transmission. The instant transmission of data or images is a very vexing issue. The reason for that is low development costs.

Yamane: Very little money is spent on development.

Miyahara: Yes, the Internet has become so widespread because it is cheap. A certain degree of delay is acceptable and even quality lapses are allowed, because it is cheap. However, this level of services will not meet needs of users, and if we continue on like this we will run into technical limits. After I came here, NICT began research on NWGN (New Generation Network), or what the Internet will look like 10 years after.

Yamane: Is this an extension of the existing research?

Miyahara: No. We have started from scratch.

Yamane: Amazing!

Miyahara: Synchronization of all transmitted data, transmitting higher-quality images, and integrating communications and broadcasting in order for billions of families to enjoy Hi-Vision quality visuals, all of these things will never be possible on the current network system.

Yamane: Never possible?

Miyahara: That's why we decided that a new paradigm was necessary and so have started up the new project.

Yamane: If this research advances on NWGN so that we can get a better idea of what human-to-human communication is, or what information it is that we really want to communicate, and if this new network becomes a tool with the power to help create a more desirable world, that will be really wonderful.

Miyahara: The information systems which we create should make for more active human-to-human communications. There really isn't much point in creating an information system which pays no attention to human-to-human communications.

Remote Sensor for the Observation of Greenhouse Gases

Research and Development of a Laser Sensor to Measure Carbon Dioxide

Profile

Kohei Mizutani

Research Manager, Environment Sensing and Network Group, Applied Electromagnetic Research Center

After completing his graduate course, followed by a period as a JSPS (Japan Society for the Promotion of Science) Fellow, he joined the Communications Research Laboratory (currently NICT) in 1993. He has been engaged in the research concerning optical metrology and laser remote sensing. He is also a guest professor at the Tokyo Metropolitan University. He has a Ph.D. in science.

CO_2 is the largest contributor to the greenhouse effect

It is believed that increased emissions of greenhouse gases to the atmosphere, caused by mass fossil fuel consumption and deforestation, are responsible for global warming. Among these greenhouse gasses, CO_2 has the largest impact. Sixty percent of CO_2 emitted by human activities is estimated to remain in the atmosphere without being absorbed in oceans or lands, its impact continuing for as long as a hundred years. This is the reason why we should reduce CO_2 emissions by half immediately. Due to the possible enormous hardship caused by such a radical reduction initiative, it is important to achieve the reduction of CO_2 emissions as effectively as possible. For the planning of effective CO_2 emissions reduction measures, accurate estimates and evaluations concerning individual emission sources and sinks are required, leading to a necessity for technologies to measure the spatial distribution of CO_2 concentration in the atmosphere.

NICT has pursued the research and development of a laser sensor to measure CO_2 concentration, which can monitor the spatial distribution of CO_2 concentration from a remote location, both day and night.

Observation by a 2 micron laser sensor

NICT has previously developed laser sensors to observe wind profiles. We have been using a laser beam of a wavelength of 2 microns, which is safe for eyes (not harmful if the laser light hits the human eye), to observe wind profiles. We found that this wavelength of the laser was also very suitable for monitoring CO_2. Several absorption lines of interesting atmospheric molecules, such as CO_2, are included within the wavelength range of this laser. By controlling the wavelengths of laser pulses which blink only for a very short time, the sensor device sends out pulse laser beams of two wavelengths

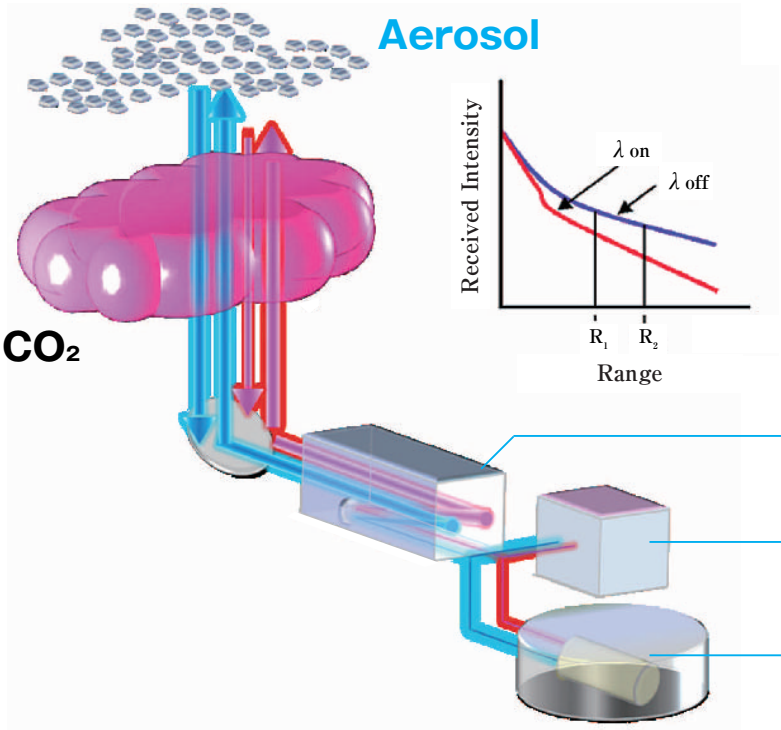


Fig.1: Principle of a Laser Sensor to Measure Carbon Dioxide. By observing the reflected intensity of laser pulses of both strong absorption wavelength and weak absorption wavelength, the sensor measures the distribution of CO_2 molecules within a certain range based on the absorption difference between these two wavelengths.

Note:
LD Pumped and Conductive-Cooled Solid State Laser
LD is an abbreviation for Laser Diode, which is a semiconductor laser. The LD pumped and conductive-cooled solid state laser is a type of laser which generates laser oscillation by pumping solid laser rods with LD beams, conducts laser rod heat away through conductive cooling, and has excellent durability and maintainability features.

alternately into the atmosphere: the on-line, which is strongly absorbed by CO_2, and the off-line, which is close to the on-line, but is not absorbed by CO_2 (Fig. 1).

We can identify where the received light reflected by aerosols (particles, dust, and so on) in the atmosphere is returning from by the time elapsed since transmission of the laser pulse. Furthermore, since on-line laser light is absorbed by CO_2 on both their outgoing and return journeys, the farther away the laser light travels and returns, the weaker it becomes. By comparing the intensity between the received on-line and off-line lights, the distribution of CO_2 concentration can be measured. We use an LD pumped and conductive-cooled solid state laser called a "Tm, Ho: YLF Laser" (YLF is LiYF4, and is read as Lithium Yttrium Fluoride) for this device (Ref. Fig. 1).

There is no more powerful 2 micron-conductive-cooled solid state laser oscillator than the NICT laser.

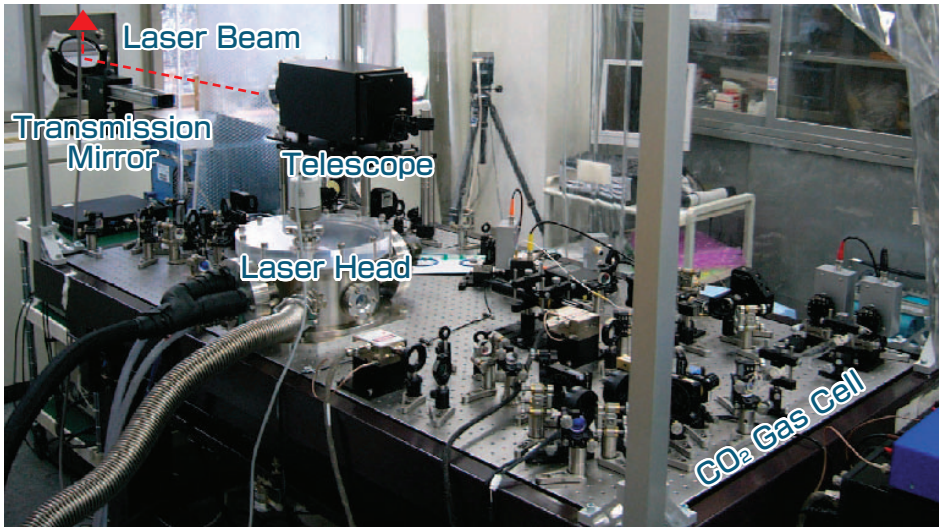


Fig.3: Laser Sensor System for CO_2 Measurement in the Laboratory

The current status and future of CO_2 concentration distribution observation

Fig. 3 shows an overall view of the system. The system consists of a telescope and laser mounted on an optical bench. This was installed at the Headquarters in Koganei for the above-mentioned observation. Fig. 4 shows the horizontal CO_2 concentration distribution within a range of 1.5 km. We can find that CO_2 is highly concentrated close to the ground from evening to night, but becomes lower in daytime due to mixing of the atmosphere and the impact of plant photosynthesis. As shown in the figure, the laser sensor developed by NICT allows us to observe the CO_2 concentration distribution up to a range of 2 km. We intend to advance this research and development in order to be able to measure the CO_2 concentration distribution more precisely and over longer distances. Furthermore, in its current configuration, this system is not sufficiently compact to be portable for making observations in locations outside the laboratory. To respond to this requirement, we will develop a more compact device, which can be transported by car or airplane. It would indeed be interesting if we could measure the CO_2 concentration distribution in urban areas, or load the device onto an airplane and observe the changes in the CO_2 concentration distribution all around the Japanese islands and the surrounding areas.

Aiming to develop a more easy-to-use device

Next year, two satellites will be launched, from Japan and the United States, to observe global CO_2 concentration distribution. The devices installed in these satellites do not contain their own light source. We hope to use the laser sensor for CO_2 measurement developed by NICT to validate the data collected by these satellites, and contribute to the improvement of their data quality. Furthermore, the technologies which we have developed will serve as the basic technology for sensors to be installed in future satellites. We also intend to make these devices more compact and easy to operate so that the 2 micron-laser sensor technology developed by NICT will come to be used by many people.

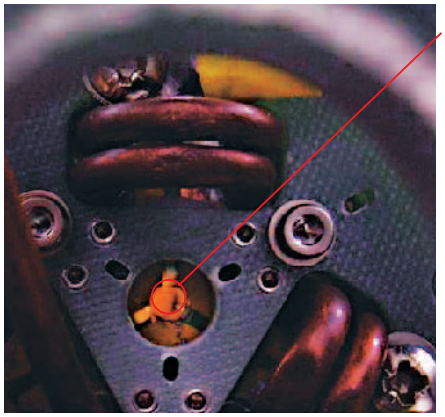


Fig.2:
Tm, Ho: YLF Laser Rod
The Laser Rod (a crystal of Tm, Ho: YLF) is cooled to -80°C and pumped by LD (Laser Diode).

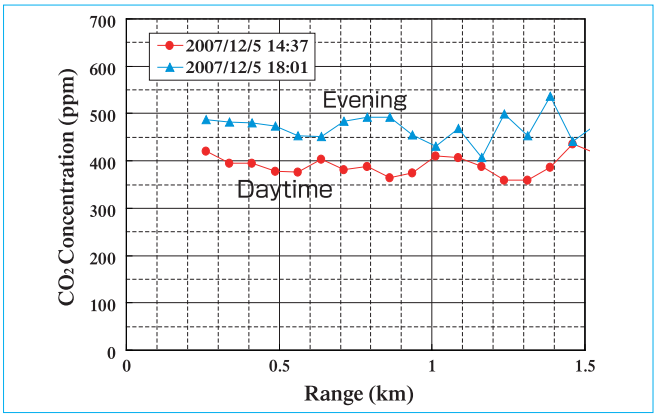


Fig.4: Horizontal Observation of CO_2 Concentration Distribution

Evolution of Optical Communication towards High Spectral Density Transmission Technologies

Profile

Tetsuya Miyazaki

Group Leader, Photonic Network Group, New Generation Network Research Center

Tetsuya Miyazaki received the M.S. and Dr. Eng. degrees from the Tokyo Institute of Technology in 1987 and 1997, respectively. He joined KDD (currently KDDI) R&D Labs, where he was engaged in the research and development of coherent optical communication systems and WDM optical networks. In 2002, he moved to the Communications Research Laboratory (currently NICT), where he has been engaged in ultra-fast and multi-level modulation techniques.

Information traffic demand has increased 10,000 times during 20 years

The number of household optical fiber access service subscribers has increased to over 10 million, and the total estimated internet traffic (total traffic volume) has grown to almost one terabit per second (10^{12} = 1000 gigabits per second). Optical fiber communication technology was employed commercially approximately 20 years ago by using the optical intensity modulation technique to transmit binary digital information signals, namely "1" and "0," to indicate that light is on and off, respectively. In 1989, the first-ever international communication service via optical submarine cables was started between Japan and USA. However, the information transmission capacity per fiber at that time was not significant—specifically, 280 megabits per second (the order of 10^8 bits per second)—almost equal to that supported by the optical fiber access service currently provided to each household. This implies that the information transmission volume has grown nearly 10,000 times within 20 years.

Conventional technology has reached its limits

Various innovative new technologies have been developed and put into practical application in order to accommodate rapidly increasing traffic demands; such technologies include wavelength division multiplexing (WDM) systems that multiplex multiple wavelengths containing individually modulated optical information signals into a single optical fiber; and optical fiber amplification technologies that act as repeater amplifiers for wavelength multiplexed optical signals without requiring electrical termination for regeneration.

Previously, the increase in demand for traffic had been resolved by increasing the optical On/Off rate (bit rate) per wavelength channel and the WDM channel number; however, such conventional technologies alone cannot be employed to meet the current fast-growing demand. If we insist only on increasing the bit rate, the following problems occur: (1) Optical signals suffer serious distortion during transmission via optical fiber characteristics; (2) In order to avoid interference between neighboring channels due to overlapping of wavelength bandwidth per wavelength channel, channel spacing must be increased; and (3) As a result, all the wavelength channels demanded cannot be accommodated within the limited amplification bandwidth of the optical fiber amplifier.

R&D on multi-level optical transmission technologies to be extremely critical

Immediate development of technologies to transmit information in a highly efficient manner has become critical. Because more than one bit of information per optical pulse (per time slot) cannot be transmitted by using an optical on/off scheme alone, research and development on multi-level optical transmission technologies that can transmit two or more bits of digital information per optical pulse by conveying information also on phases (angles), another characteristic of optical waves, is, extremely important.

As shown in Fig. 1, by using the status of a phase plane that has four (2^2) phases (four levels) with an angular separation at each right angle, if information is assigned using the four angles, 00, 01, 11, and 10, two bits of information can be transmitted per time slot, thus allowing the transmission of information with greater speed and efficiency.

Furthermore, by combining the intensity and phase characteristics, 4 bits of information with 16 (2^4) levels, and 6 bits with 64 (2^6) levels in one time slot (in the same bandwidth) (Fig. 2) can be transmitted. By using this technology, even if traffic demands significantly increase, it will be possible to transmit double, fourfold, sixfold, and higher volumes of information signals via the same bandwidth per channel. In other words, the wavelength bandwidth occupied by a certain volume of information transmission can be compressed to half, one-fourth, and one-sixth (bandwidth compression).

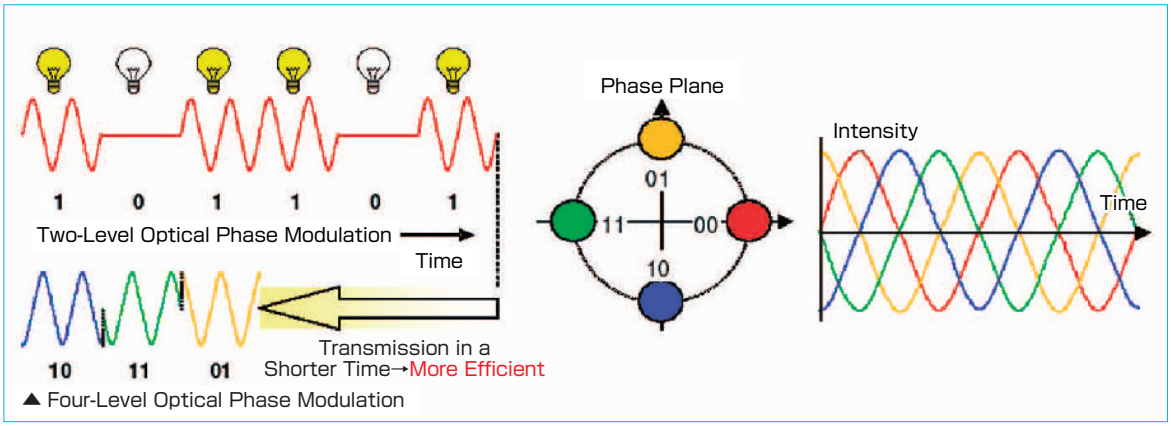


Fig.1:
Binary Optical Intensity Modulation and Four-Level Optical Phase Modulation

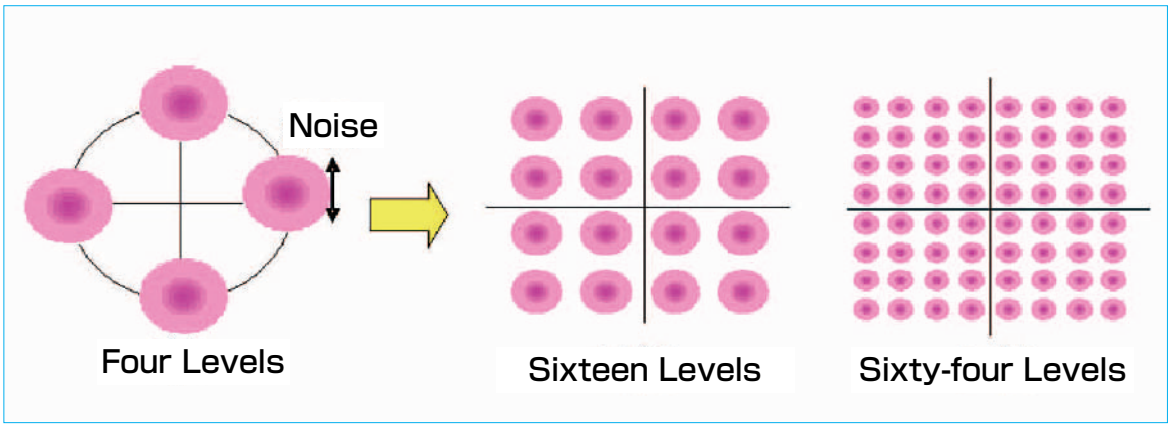


Fig.2:
Relationship between Optical Wave Noise and Degree of Multi-Level

Achieving technologies for cancellation of phase-noise and waveform distortion

Multi-level transmission technologies have already been implemented in the practical application of wireless communication systems such as mobile phones. However, in order to realize multi-level transmissions, particularly with 16 or more levels, by using optical fiber transmissions, several technological issues must be resolved.

I would like to introduce a technology that can be employed for canceling phase-noise and waveform distortion, which is being studied by our research group. In multi-level optical transmissions, which employ both intensity and phase characteristics of optical waves, the larger the multi-level number, the more necessary it is to reduce the amplitude and phase distortion (noise) of the optical wave in order to transmit the information accurately (Fig. 2). To solve this problem, we successfully developed a unique noise cancelling technique, which is analogous to headphones allowing us to enjoy music even in very noisy places.

Fig. 3 shows the measurement results of phase planes before and after application of the proposed noise canceling technology to a 64-level (6 bits/optical pulse) multi-level optical transmission.

By applying the proposed noise and waveform distortion canceling technology, the phase plane status (constellation) is significantly improved, thus enabling us to observe 64 stars blinking clearly, from supernova explosion-like constellations. This confirms that the information can be accurately transmitted. Applying our multi-level optical transmission technology to WDM transmission systems will provide wavelength bandwidth compression per channel to achieve high spectral efficiency. Even if traffic demands grow rapidly, increase in electrical power consumption in cascaded optical-repeater-amplifier transmission systems can be suppressed.

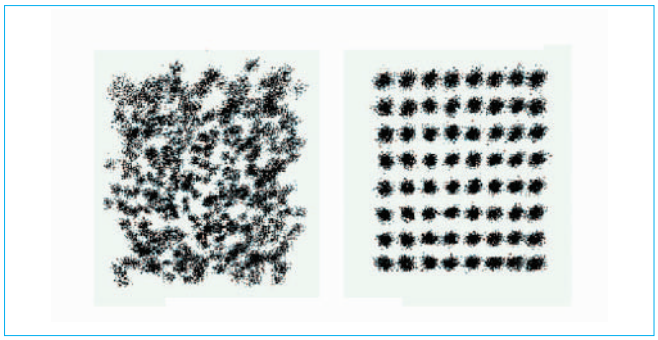


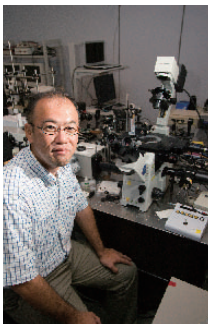
Fig.3:
Measurement Results of Phase Planes with 64-Level Optical Wave Signals before (Left) and after (Right) Application of the Proposed Noise and Distortion Canceling Technology

Practical applications of highly efficient multi-level optical transmissions continue to face challenges that must be resolved, such as the development of low-noise laser optical sources, ultrafast low-distortion modulators, as well implementation of the noise and distortion canceling technology. We will proceed with our research activities in a stepwise manner in order to achieve a practical and integrated application of the various technologies mentioned above.

A Paper Created from an Innovative Idea is Now Attracting World Attention

Working towards an Optical Device to Run on Very Little Energy

Profile



Kazuyoshi Kurihara, Ph.D.

Expert Researcher, Nano ICT Group, Kobe Advanced ICT Research Center, having completed his doctoral course at the University of Tokyo. And after working as a researcher at the Kanagawa Academy of Science and Technology, he joined the National Institute of Information and Communications Technology in 2004. He was engaged in R&D concerning semiconductor excited laser spectrometry, near-field optical microscopes, and surface plasmon resonance sensors.

Making possible optical switches with far lower energy consumption

"Here at our institute, we are engaged in the research and development which will be relevant to the information communications field in 10 or 20 years from now." said Dr. Kazuyoshi Kurihara, Expert Researcher, who is now promoting basic research on the "surface plasmon." A surface plasmon is an optical wave propagating on a metal surface. At the tip of tapered metallic waveguides smaller than the optical wavelength, the plasmon generates a strong electric field even with a weak optical beam, which makes switching possible at very low energy. "If we use this mechanism, we maybe are able to create an optical switch with far lower energy consumption than that of conventional models." These ideas are said to have recently been attracting attention, especially in Europe and the United States.

Despite many critical comments, our paper highly evaluated

Previously, these phenomena could not be described by mathematical formulas. However, Dr. Kurihara solved this problem with a new method. His two papers (*J. Phys. A* **40** (2007) 12479 & *J. Phys. A* **41** (2008) 295401) were published in an academic journal of the Institute of Physics (IOP). According to Dr. Kurihara, a large number of critical comments were sent back to him by the referees at the screening stage for the first paper. "In electromagnetics, we use the separation of variables method to solve a partial differentiation equation, but I proposed a new method, in which we used incomplete variable separation of variables, which had rarely been used before, to solve the question." Consequently, the second paper shortly after the first one was highly evaluated, and also was published in the "IOP Select," for which the IOP selects papers from more than 60 journals issued by the IOP.

Dr. Kurihara joined NICT four years ago. At the beginning of his career at this institute, he was engaged in the research on neutral atomic cooling systems. Since he originally had basic knowledge about the surface plasmon from studying bio-sensors, he began his current research about two and half years ago. "It was that a problem which could be solved, but which no one had yet tried to solve, just came to me by chance, rather than that I had to force myself to solve that problem. Since I had not been engaged in pure physics during my career, it was easier for me to approach the problem with new ideas," He notes that it was due to the excellent research environment at the Advanced ICT Research Center, where it is possible to concentrate on research in comfortable conditions without being interrupted by small jobs, that he was able to write a paper good enough to be included in the IOP Select.

PrizeWinners

PRIZE WINNER	GROUP OF PARTICIPATOR	NAME OF WINNING PRIZE
Tetsuya Ido		Young Scientist Award
Youzo Syouji		Young Scientist Award
Koumei Sugiura		Championship of RoboCup @Home League
Yoshitoshi Murata	Hiroshi Harada, Shuzo Kato, Mikio Hasegawa, Homare Murakami	The best paper award, "Innovations in NGN" Kaleidoscope Academic Conference Genova,12-13 May 2008
Tomoyuki Mishina	Ryutaro Oi, Makoto Okui	2007 HODIC Suzuki-Okada Prize
Liu Juan	Hiroshi Ando	The Best Paper Award
Hideaki Furukawa	Naoya Wada, Tetsuya Miyazaki	IEICE Photonic Network Research Award
Takanori Seno		The Best Paper Award
Koumei Sugiura		First Place in RoboCup@Home
Hironori Iwai		Hirono Award

PRIZE WINNER ● Tetsuya Ido

Senior Researcher, Space-Time Standards Group, New Generation Network Research Center

◎DATE :
4.15.2008

◎NAME OF THE WINNING PRIZE :
Young Scientist Award

◎CONTENTS OF THE WINNING PRIZE :
Laser Cooling and Recoil-free High Resolution Spectroscopy of Neutral Strontium Atoms

◎NAME OF GROUP :
Ministry of Education, Culture, Sports, Science & Technology

◎Comment by the Winner :

Recoilless high-resolution spectroscopy precisely makes use of the same principles as the 'optical lattice clock,' an optical atomic clock system developed in Japan. I heard that this prize was awarded because after the verification of these principles in Japan and the subsequent realization of the clock's performance in the United States, the optical lattice clock was adopted as the "secondary expression of the second" by the committee, "Le Comité Intemational des Poids et Mesures" in French. A "secondary expression" in the field of optics is equivalent to becoming a potential candidate for redefining the second in the near future. On the occasion of this award, not only would I like to extend my sincere gratitude to all those who have supported my research up to this time, but also renew my commitment to realizing an international standard with this system.

PRIZE WINNER ● Youzo Syouji

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

◎DATE :
4.15.2008

◎NAME OF THE WINNING PRIZE :
Young Scientist Award

◎CONTENTS OF THE WINNING PRIZE :
Research on High-efficiency Millimeter-wave Communications Technology in Wireless Communications Engineering Area

◎NAME OF GROUP :
Ministry of Education, Culture, Sports, Science & Technology

◎Comment by the Winner :

I'm very happy to have the honor of winning this excellent prize for the research results concerning millimeter waves. I have been engaged in this research for eight years since I joined the institute. First of all, I'd like to extend my sincere gratitude to Dr. Hiroyo Ogawa, the former Executive Director of the New Generation Wireless Communication Research Center, who constantly provided valuable instructions, which I believe led to the award of this prize, for my research and development concerning millimeter waves. I would also like to extend my sincere gratitude to Dr. Hiroshi Harada, Leader of the Ubiquitous Mobile Group, and to my co-researchers.

PRIZE WINNER ● Koumei Sugiura

Research Expert, Spoken Language Communication Group, Knowledge Creating Communication Research Center

◎DATE :
5.5.2008

◎NAME OF THE WINNING PRIZE :
Championship of RoboCup @Home League

◎CONTENTS OF THE WINNING PRIZE :
eR@sers (Team name)

◎NAME OF GROUP :
RoboCup Japan 2008 Numazu Host Committee

◎Comment by the Winner :

In order to demonstrate the performance of the unregistered language learning technology, we participated in this competition as a joint team with Tamagawa University and The University of Electro-Communications, and won the championship in the @home league, the section for domestic robots.

PRIZE WINNER ● Yoshitoshi Murata

GROUP OF PARTICIPATOR Hiroshi Harada, Shuzo Kato, Mikio Hasegawa, Homare Murakami

Expert Researcher, Ubiquitous Mobile Communication Group, New Generation Wireless Communications Research Center

◎DATE :
5.13.2008

◎NAME OF THE WINNING PRIZE :
The best paper award, "Innovations in NGN" Kaleidoscope Academic Conference Genova,12-13 May 2008

◎CONTENTS OF THE WINNING PRIZE :
ARCHITECTURE AND BUSINESS MODEL OF OPEN HETEROGENEOUS MOBILE NETWORK

◎NAME OF GROUP :
The Telecommunication Standardization Sector of ITU(ITU-T)

◎Comment by the Winner :

I am very glad to receive an award this time because I have never received an award as a main researcher for more than ten years. I knew that there was a possibility since I had been nominated in advance to receive this award. However, quite honestly I was very surprised when my name was actually called. By participating in the conference and finding that there were several other papers besides ours which emphasized user oriented services, I felt quite strongly that "the CWC concept is correct!"

PRIZE WINNER ● Tomoyuki Mishina

GROUP OF PARTICIPATOR Ryutaro Oi, Makoto Okui

Research Expert, 3D Spatial Image and Sound Group, Universal Media Research Center

◎DATE :
5.23.2008

◎NAME OF THE WINNING PRIZE :
2007 HODIC Suzuki-Okada Prize

◎CONTENTS OF THE WINNING PRIZE :
Electronic holography for real object using hologram calculated from integral photography

◎NAME OF GROUP :
Holographic Display Artists and Engineers Club

◎Comment by the Winner :

We have been pursuing the research of electronic holography, a field of holography using electrical methodology, aiming to apply the holography, which makes natural stereoscopic displays adaptible to stereoscopic televisions and communication media. This time, by making calculations from the images taken by a compound multifaceted lens (integral imaging), we have achieved the electronic holography replay of live-action videos, which had previously been difficult to realize. We now intend to continue our research to make more natural and realistic stereoscopic displays available.

PRIZE WINNER ● Liu Juan

GROUP OF PARTICIPATOR Hiroshi Ando

Research Expert, Multimodal Communication Group, Universal Media Research Center

◎DATE :
5.27.2008

◎NAME OF THE WINNING PRIZE :
The Best Paper Award

◎CONTENTS OF THE WINNING PRIZE :
Emotion Eliciting and Decision Making by Psychodynamic Appraisal Mechanism

◎NAME OF GROUP :
IEEE Human System Interaction Conference 2008

◎Comment by the Winner :

I am very glad to win the Best Paper Award in this IEEE Conference for interactions between human beings and systems. In this paper, I modeled the roles that emotions play during the development of recognition and interactions with human beings. In the future, I would like to develop further this model, and clarify the emotional recognition mechanism in more detail in order to work towards the development of the technology to convey emotional information.

PRIZE WINNER ● Hideaki Furukawa

GROUP OF PARTICIPATOR Naoya Wada, Tetsuya Miyazaki

Expert Researcher, Photonic Network Group, New Generation Network Research Center

◎DATE :
6.12.2008

◎NAME OF THE WINNING PRIZE :
IEICE Photonic Network Research Award

◎CONTENTS OF THE WINNING PRIZE :
IP over Optical Packet Switch Network with Novel 10Gigabit-Ethernet/80Gbit/s-Optical-Packet Converter

◎NAME OF GROUP :
Technical Committee on Photonic Network of IEICE

◎Comment by the Winner :

I'm extremely honored to receive this dignified award, the PN Research Prize in 2007. I would like to extend my sincere gratitude to Dr. Tetsuya Miyazaki, Leader of our group and the coauthor of the award-winning lecture, our Research Manager Dr. Naoya Wada, and other members of our group who have supported me in many ways. The award-winning research is a report concerning the interface connecting the next generation optical packet switch network and the existing IP network. With this award as a springboard, I hope to be able to make further contributions to the practical application of optical packet switches.

PRIZE WINNER ● Takanori Seno

Expert Researcher, 3D Spatial Image and Sound Group, Universal Media Research Center

◎DATE :
6.21.2008

◎NAME OF THE WINNING PRIZE :
The Best Paper Award

◎CONTENTS OF THE WINNING PRIZE :
A Study on Disparity Compensated Prediction for Multi-view Video

◎NAME OF GROUP :
The Institute of Image Electronics Engineers of Japan

◎Comment by the Winner :

We began this study inspired by the start of the initiative to create coding standards for multiple-view videos in the MPEG group, an affiliate under the ISO. In this study, we raised the estimate accuracy by integrating the compensation based on affine transformation with the existing estimate, which was mainly based on parallel translation. We spent half a year validating the system mathematically, and another half a year validating its efficiency by experiments. This has been one of the most memorable papers for us. Encouraged by this award, I am committed to continuing research which will be both meaningful and useful for society.

PRIZE WINNER ● Koumei Sugiura

Research Expert, Spoken Language Communication Group, Knowledge Creating Communication Research Center

◎DATE :
7.20.2008

◎NAME OF THE WINNING PRIZE :
First Place in RoboCup@Home

◎CONTENTS OF THE WINNING PRIZE :
eR@sers (Team name)

◎NAME OF GROUP :
RoboCup Federation

◎Comment by the Winner :

Following the Japanese competition, we participated in the world RoboCup competition. In the preliminary screening session, our high-precision voice recognition technology working under a noise environment helped us to gain a high score. In the final screening session, the demonstration of unregistered language learning technology, which had been unavailable in conventional robots, was highly evaluated and enabled us to become the overall champion.

PRIZE WINNER ● Hironori Iwai

Researcher, Environment Sensing and Network Group, Applied Electromagnetic Research Center

◎DATE :
9.12.2008

◎NAME OF THE WINNING PRIZE :
Hirono Award

◎CONTENTS OF THE WINNING PRIZE :
Doppler Lidar Observations of Downslope Wind "Zao-oroshi"

◎NAME OF GROUP :
Laser Radar Society of Japan

◎Comment by the Winner :

The Hirono Prize, a new prize for the encouragement of younger researchers initiated this year, was founded in the name of the late Dr. Motokazu Hirono, a pioneer of the observation of stratospheric aerosols by lasers, and who also belonged to the Radio Research Laboratory, the former institute of NICT. I feel extremely honored and humbled to receive this prize. I pledge continuing commitment to my research, and would like to take this opportunity also to extend my sincere gratitude to everyone who provided me with kind support during the observation experiments.

NICT's Facilities Opened to the Public in Fiscal 2008

The open house event for our facilities, scheduled every year during the summer holidays of elementary and junior high schools, was held at the NICT facility-sites this year as usual. About 6,500 visitors in total were admitted to there. We hope our displays and handcraft classes, which explain the most leading edge technologies in a way which is easy to understand, were helpful to complete the "free research" for children to do their summer assignments. We will also plan to hold this event again next year, in order to give people living nearby the NICT facility-sites a better understanding of NITC's activities, as well as conveying the fascinations of science to the children who will become leaders in the future.

Headquarters (Koganei)

(July 25 to 26 / 3,149 visitors)

Children Enjoying Electronic Handcraft

Kashima Space Research Center

(July 26 / 1,207 visitors)

Children Enjoying to Make Paper Telescopes

A Lot of Surprises! The Most Leading Edge Technology!

Kobe Research Laboratories

(July 26 / 638 visitors)

Experiment to Extract DNA from Broccoli

Okinawa Subtropical Environmental Remote-Sensing Center

(July 27 / 352 visitors)

Simulation Showing How a Rain Gauge Works

Keihanna Research Laboratories

(August 2 / 1,154 visitors)

Children Fascinated by Keepon's Movements

Aalborg University, Denmark
CENTER FOR TELEINFRASTRUKTUR (CTIF) Japan (CTIF-Japan)
Dr. Omori, a Member of the Board of Directors of NICT, Inaugurated as the First Head of CTIF-Japan

●Dr. Omori's Inauguration Speech as Executive Director of CTIF-Japan

●Tape-Cutting Ceremony

●Dr. Miyahara, President of NICT, Speaking Congratulatory Address

●Press Interveiw: (from left) Prof. Prasad of Aalborg University; President Kjearsdam of Aalborg University; Hon. Mellbin, Ambassador to Japan; Dr. Hatori, Chairperson Emeritus of YRP; Dr. Omori, Executive Director of CTIF-Japan

As an outcome of our long-term continuing research exchanges with the Yokosuka Research Park (YRP) and Aalborg University, Denmark, a Japanese laboratory of the CTIF (Center for TeleInFrastruktur), a research and education organization of the university in the ICT field principally including mobile communications, was established in the premises of the YRP.

On October 3, 2008, an opening ceremony, commemorating the foundation of CTIF-Japan, was held at the Hotel Pacific Tokyo in Minato Ward, Tokyo, Japan.

As a global organization with laboratories in Italy, India, and Copenhagen in Demark, CTIF has been pursuing international collaborative activities to contribute to research and development, education, and technological innovation concerning ICT. CTIF-Japan aims at the co-development of world-leading ICT solutions through international collaboration. The Japanese center is expected to take a role as a global portal site to the industries, academic organizations, and standard-setting organizations, via joint-research activities with the collaborating European universities.

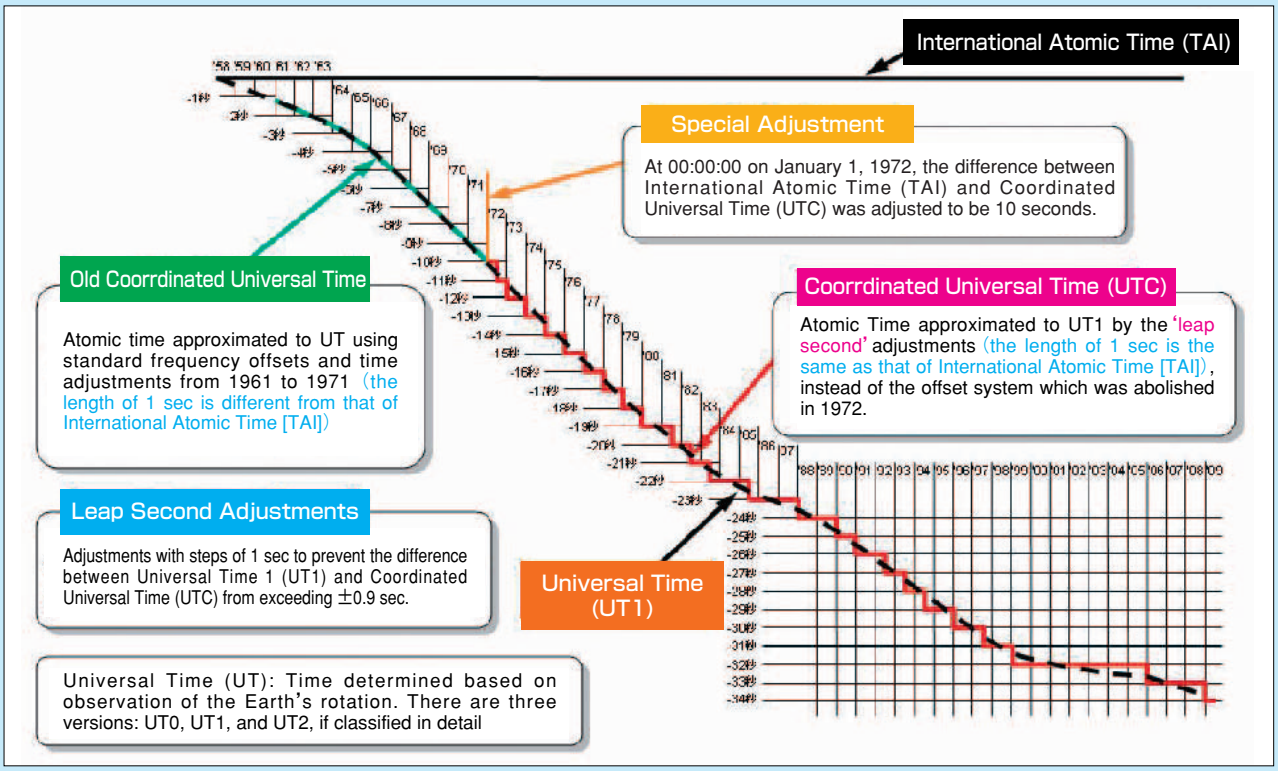
Dr. Omori, Vice President of NICT, who is Vice Chairperson of the YRP R&D Promotion Committee, was inaugurated as the first Executive Director of CTIF-Japan. At the commemorative ceremony, Dr. Omori gave an outline of CTIF-Japan, and a tape-cutting ceremony was performed by the dignitary participators. After that, congraturatory addresses were given by Dr. Hideo Miyahara, President of NICT; the Danish Ambassador to Japan; the Parliamentary Speaker of the North Jutland Region of Denmark and other guests.

"One Second" Longer than Usual on the *First Day in Next Year*

On January 1, 2009, one "leap second" will be added to the day for the first time in three years.
Previously, astronomical time based on the Earth's revolution and rotation was used as standard time. Today, extremely accurate atomic clocks, based on atomic vibration, are used to determine standard time. This, however, has led to discrepancies between atomic time and astronomic time.
Due to this discrepancy, the time adjusted to maintain the difference between the time based on the atomic clock and the time based on astronomical time to within ±0.9 seconds is used as the world standard time. The adjustment requiring the insertion of a "leap second" is planned because the discrepancy with the time based on the Earth's revolution and rotation is approaching 0.9 seconds. The last leap second insertion was performed three years ago, on January 1, 2006. These adjustments are decided by the International Earth Rotation and Reference Systems Service (IERS), which carries out global observations concerning the Earth's rotation.

[The Upcoming Adjustment (Japan Standard Time)]
Thursday, January 1, 2009
On this occasion, one second will be inserted after 8:59:59 a.m. to indicate 8:59:60, followed by 9:00:00.

Besides, for further information, please refer to the following page on the NICT Website, "Q&A on the Leap Second": http://jjy.nict.go.jp/index-e.html (Partially in Japanese)



Relation among International Atomic Time (TAI), Coordinated Universal Time (UTC), Astronomical Time (Universal Time, UT1) and the Leap Second

■This "NICT News" is the 373th issue, but it is also the first issue in the renewed format. We have redesigned the overall layout and are aiming at a wider readership. We hope that you will enjoy reading future issues of this newsletter.
■In the upcoming issue, we will be featuring "MASTAR Project," as the comprehensive project promoting the research into voice and language processing systems, including language speech translation, machine translation, and voice interactive systems.

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