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NiCT

Introducing Japan's Time-stamping Technologies to the Global Market

–Approved through the recommendation ITU-R TF.1876–

Tsukasa Iwama

Research Manager, Space-Time Standards Group, New Generation Network Research Center

After completing a master course at the Tokyo Institute of Technology in 1985, entered the Radio Research Laboratory, Ministry of Posts and Telecommunications (reorganized into the present NICT). Engaged in research activities relative to land mobile communications, secure time-stamping technology, and applied time-dissemination technology.
Ph.D. (Engineering)

Threats Hidden in Electronic Documents

The so-called "electronic documents" produced on personal computers or the like have a decisive advantage of degradation-free multiple duplication. However, this advantage may turn out to be a failure, where an evil-minded person can readily alter an original document or act in the disguise of the right author. These acts of "alteration" and "spoofing" are significant threats in the information society on the network.

As a valid means for protecting electronic documents from alteration or spoofing, the combination of an electronic signature and a time stamp can come into play. An electronic signature can prove "who" prepared "what," whereas a time stamp can vouchsafe "when" "what" was prepared. Thus, the combined use of an electronic signature and a time stamp can verify "when" "who" prepared "what."

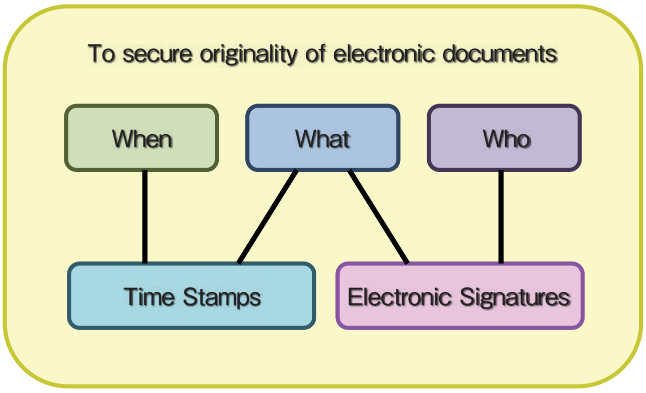


Figure 1 ● A technology to secure originality of electronic documents

Proposal on the Question

Methods for implementing electronic signatures and time stamps have already been standardized, and particularly, the electronic signature systems have been legislated in Japan and in some other countries. Regarding time stamps, the time reliability is another important factor that is involved in addition to the stamping. As to the reliability, however, the traceability* to Coordinated Universal Time (UTC) is solely regulated, although no specific means for implementation has been defined.

NICT, as an organization responsible for the Japan Standard Time, made a proposal at the meeting of the Working Party for time signals and frequency standard emissions (ITU-R SG7 WP7A) of the Study Group on science services in the Radiocommunication sector of the International Telecommunication Union, that is, a proposal from Japan as to how the Time Stamping Authority (TSA) should be warranted for the reliability of the time referred to. The proposed new question has been revised and adopted with the Question ITU-R 238/7.

Institutionalizing Japan's Time Stamping Service

Japan's activities for standardizing the time business including time stamping originated from the time business study meetings held by the Ministry of Internal Affairs and Communications during the period from January to June 2002. At these study meetings, the direction of Japan's time business afterwards was indicated.

Further to the study meeting, the Time Business Forum, which is mainly composed of private concerns, was established in June 2002. Concurrently, NICT carried out a contract study "Research and Development of Time-stamping Platform Technologies" subsidized by the Ministry of Internal Affairs and Communications during the fiscal years 2003 through 2005.

In November 2004, the Ministry of Internal Affairs and Communications announced the "Guideline for Time Business -- for Safe Use of Network and Secured Long-Term Storage of Electronic Data --," which was based on these study results. In conformance to this guideline, the " Accreditation program for time-stamping service " was established to institutionalize the time-stamping systems in Japan.

Japan's Accreditation Program for Time-stamping Service Emphasizing Time Reliability

Japan's Accreditation program for time-stamping service is characterized by its emphasis placed on the time reliability that constitutes the rudiment of time stamps. As to the time used for time

*Traceability: Performance of time stamping system to reach UTC through an alternating chain of exactness and inexactness.

stamping, although the traceability to UTC has so far been required, no specification on exactness of time has been stipulated.

In Japan's Accreditation program, the time traceable to the Japan standard time is transferred to TSAs and other systems, and the Time Authority (TA) has been defined as a trusted third party that audits the accuracy of time used for time stamping. This has clarified the reliable time source system for TSA in Japan's Accreditation program.

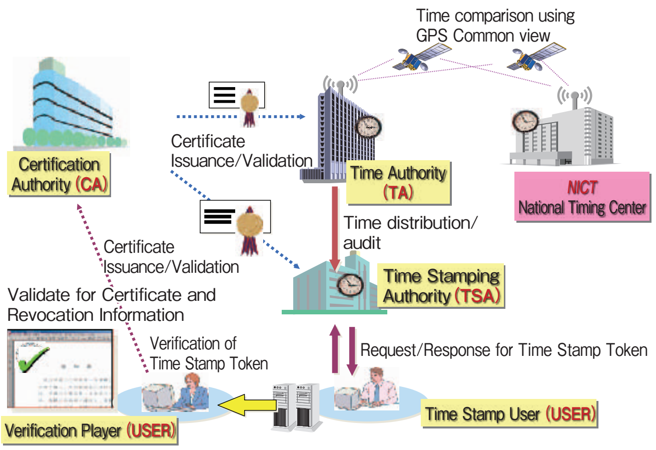


Figure 2 ● Structure of Japanese Time-stamping system(ex. Using digital signatures)

Road To the Issuance of ITU Recommendation

At the ITU-R meeting, the report of the ideal time stamping services in Japan, which had been studied in September 2002 at the time business study meeting, was input as a Report of ITU-R 238/7 studies at the WP7A meeting. Our report attracted keen interest from the participants, particularly from European delegates, although no result report was presented by other participating nations.

Nevertheless, each nation was not necessarily indifferent to the Question ITU-R 238/7. Normally, the ITU-R reviews Question and other issues at intervals of approximately 4 years, and this Question has been subjected to a review in 2003 and 2007. At each occasion of review, two or more nations in Europe proposed to continue this Question, and thus it has been continued to date.

Then, at the ITU-R SG7 WP7A meeting in September 2009, NICT summarized the above-mentioned Accreditation Program for Time-stamping Service actually operated in Japan, which was approved by the domestic committee and presented as the proposed preliminary draft new recommendation from Japan. The proposed draft new recommendation was favorably accepted by the participants and evaluated as an opportune proposal. Later, Japan's proposal as such was given a minor touch-up in literal renderings and then forwarded to the SG7. In January 2010, the draft was adopted by the SG7, and the ITU-R was immediately subjected to the approval procedure, and in April 2010, the recommendation proposal was formally approved as Recommendation ITU-R TF.1876. Thus, the proposal has been treated in an unprecedentedly short period of 7 months for turning into a formal recommendation.

Summary of the Recommendation ITU-R TF.1876

The purport of this recommendation comprises the following four points:

- The timing centers should have the means to disseminate the UTC(k) time to a TSA at the required accuracy, examples of which are provided in Annex 1(not attached here).
- The traceability of the time of the TSA to UTC(k) should be certificated by continuous monitoring by a TAA.CE6
- TAA may also have a function to audit that the time used in the TSA is consistent within required accuracies.
- The function of the TAA may be performed by the timing center or by a TTP.

The recommendation has defined the function called Time Assessment Authority (TAA). The TAA is a function comprising the conventional TA and indicates a further generalized concept. It should be noted that this recommendation has only defined the function TAA, and thus further reinforcement is required. Introducing the TAA concept has allowed us to build up the fundamentals to export the Japan's time stamping system to overseas countries.

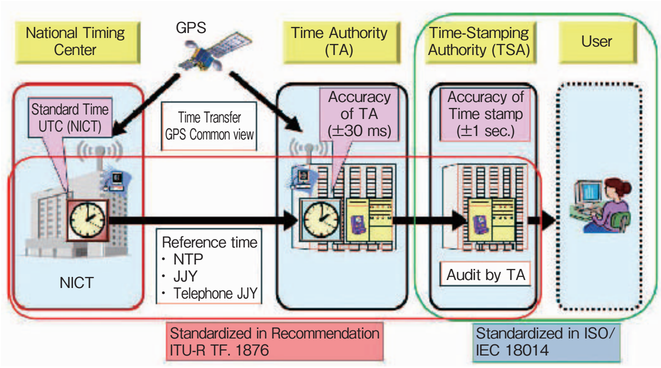


Figure 3 ● Standardization status of Japanese time-stamping system

Current Activities for Further Standardization

Japan's Accreditation program for time-stamping service, which has become the model of ITU recommendation, requires further standardization in order to introduce the system to overseas countries.

Based on the operation results for 5 years of Japan's accreditation program, the standardization activities are carried on by improvising the present technical standards in order to bring them up to the Japan Industrial Standards (JIS). Further, in order to establish standardization by the International Standards Organization (ISO), preparatory work will be started within this fiscal year.

Although time-stamping technology has already been standardized, very few countries have successfully established technology as a time assurance system.

Since the Japan's Accreditation program for time-stamping service has globally been evaluated, we will continue to work on its global standardization by taking advantage of ITU recommendation as a toehold.

Brief Note on ITU Recommendation

ITU formulates a variety of international conventions associated with telecommunications and broadcasting technologies. The ITU-R recommendations are formulated mainly as a result of research activities of ITU-R SGs, and the international standards approved by ITU member states are classified into each field-specific series.

Cognitive Radio Systems: Realizing the Flexible and Efficient Radio Resources Utilization

–Prototype Development and International Standardization for Commercialization –

Kentaro Ishizu, Ph.D.

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

Since completion of a graduate course in 2005, has been serving as an expert researcher. Engaged in the research and development of heterogeneous wireless network, cognitive radio system, and some other projects.

Background

We have been living in a ubiquitous society where people from all walks of life can access anything, anywhere, anytime regardless of time and location for the past 10 years, and consequently, multimedia communications by means of compact mobile terminals have gained popularity. Concurrently, the communication rate and other requirements for wireless communications have dramatically extended. These requirements will increasingly expand, and to meet them, a wide variety of high-speed wireless systems have been developed. However, frequency assignment is getting tighter, particularly the UHF band to 6 GHz band suited for mobile communications can hardly provide frequencies for new wireless operations. To solve the problem, research and development efforts to realize the cognitive radio technologies are being carried on, where ambient radio environment is determined by sensing and the results are used for selecting the optimum radio system of a communication counterpart, or alternatively, by determining the radio communications functions for operating frequencies and communication systems, a wireless unit is reconfigured to realize a faster and more efficient communication.

Cognitive radio technologies can be divided into two groups as shown in Figure 1. A heterogeneous type system aims at the connection with existing radio system that is assigned with a frequency, so that it can positively use a radio system having surplus wireless resources or select a radio system in accordance with the user's purpose to implement desired communications.

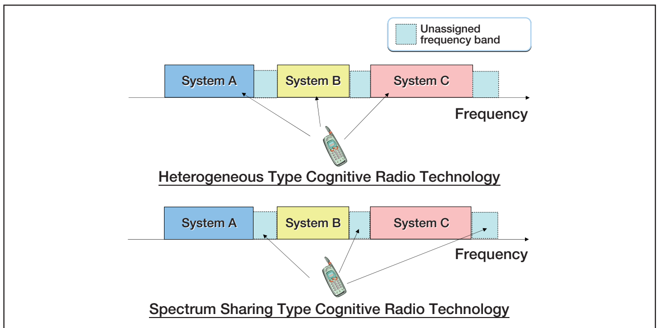


Figure 1 ● Categorizing the Cognitive Radio Technologies

A spectrum sharing type system temporarily employs a frequency band that is geographically or chronologically unused, in order to avail the frequency band that is not necessarily assigned. These unused frequency bands are also called white spaces and are availed as a breakthrough for improving frequency utilization efficiency. Improvement of their engineering standards has been initiated on a worldwide basis. Likewise in Japan, the Ministry of Internal Affairs and Communications organized a study team in November 2009 to make effective use of the white spaces.

Configuration and Trial Run of Cognitive Radio Systems

When a cognitive radio technology is applied to a heterogeneous wire network, an ideal cognitive wireless network can be established where terminals, base stations, and wireless access network can be selected or reconfigured with optimum performance.

In a cognitive wireless network, the measured data of terminals and base stations are reported to the core network, and by conducting the statistic processing and machine learning on the part of the core network, reconstructing requests for the operating frequencies and communication systems can be issued to the radio access network (RAN). Additionally, the network policy for supporting the

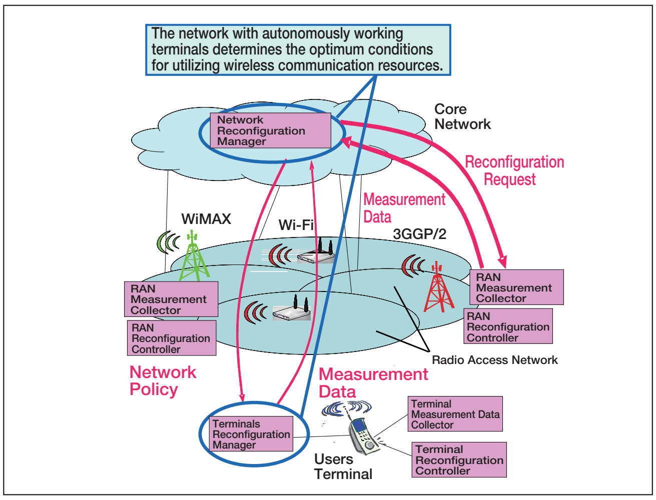


Figure 2 ● Configuration of Cognitive Radio Network

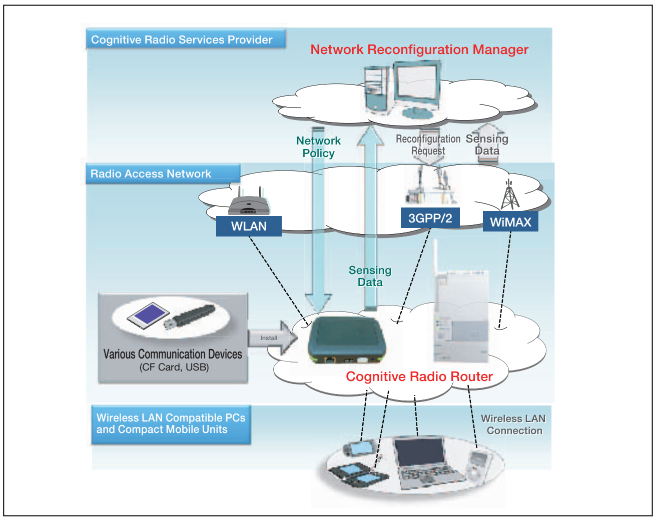


Figure 3 ● Cognitive Radio Router System that can select and control radio communication devices following the network policy (an example of heterogeneous type systems)

terminals to select the RAN and base station is provided from the network.

This allows the use of wireless resources that can be determined by two or more decentralized units, so that suppression of radio interference and traffic load balancing from the viewpoint of an entire area can be effected through collaboration of units, and consequently, such a decision making that cannot be conducted for a single radio system. A cognitive radio network is organized with two or more cognitive radio systems. As examples of implementation, the prototype models of heterogeneous type and spectrum sharing type are described below:

First, we developed a cognitive wireless router system as an example implementation as shown in Figure 3. This system relays public wireless networks with a local wireless LAN, and by selecting a public wireless network in collaboration with a network reconfiguration manager, it makes the use of radio of an entire area while taking into consideration the user preference of wireless systems. This system has such an advantage that it allows not only a cognitive radio technology to give effect at an early stage, but also facilitates the actual deployment without causing a user to be aware of switching wireless systems, as it can directly develop on an existing radio communications network at work without the need for remodeling of existing facilities. The technology transfer of this system from NICT to private enterprises has already completed, and thus when a Mobile Virtual Network Operator (MVNO) employs it, the extended utilization of radio resources including the paradigm shift of radio communications network can be expected.

In contrast, Figure 4 exhibits an example implementation of spectrum sharing type system, developed by ourselves, consisting of a base station and terminals that can be reconfigured. In this system, the base station conducts radio strength determination, communication method identification, and radio interference detection at each frequency band within the range from 400 MHz to 6 GHz, and by reporting on the sensing information to the network reconfiguration manager, the manager determines the optimum operating frequency and communication system by using a frequency assignment database and radio system selecting algorithm. The base station and each terminal perform the reconfiguration in accordance with the instructions of the network reconstruction manager, and carry on communications at an open frequency free from radio interference. For example, when the base station detects an intense radio interference at an original radio LAN frequency band of 4 GHz, the system can avoid any radio interference by switching the operating frequency to 2.5 GHz in order to resume the operation.

Efforts for Implementing the International Standardization

We have utilized a portion of results obtained from the development process of a cognitive radio system for our proposal of the NICT's original technology at various organizations of international standardization. IEEE 1900.4 is the fundamental architecture for the world's first cognitive network, in which NICT has participated since its establishment and successfully formulated the specifications in February 2009. Besides, NICT takes part in a variety of international standardization activities related to cognitive radio technologies, and has presented proposals since the initial stage of discussion for ITU-R WP5A/WP1B, IEEE 802.11af/802.19.1/1900.6 (U.S.A.), and ETSI RRS (Europe).

Future Perspective

In an area centered in Fujisawa City in Kanagawa Prefecture, we are now building up a test bed for broad area cognitive radio test bed to install approximately 500 cognitive radio routers. The radio network in commercial services has extremely complex characteristics, and thus cannot necessarily be evaluated by simulation approach. Thus, we will use this test bed to verify the feasibility and performance of the radio system selection control that has been devised by ourselves. Concurrently, we carry on the research and development of solutions for technical problems by assuming the commercial deployment of white spaces including television broadcasting frequency bands. Further, we will integrate the virtual network technology and other various technologies that have been developed around wired network into the cognitive radio technology in an organic manner, and study the framework for new-generation communication networks of both wired and wireless.

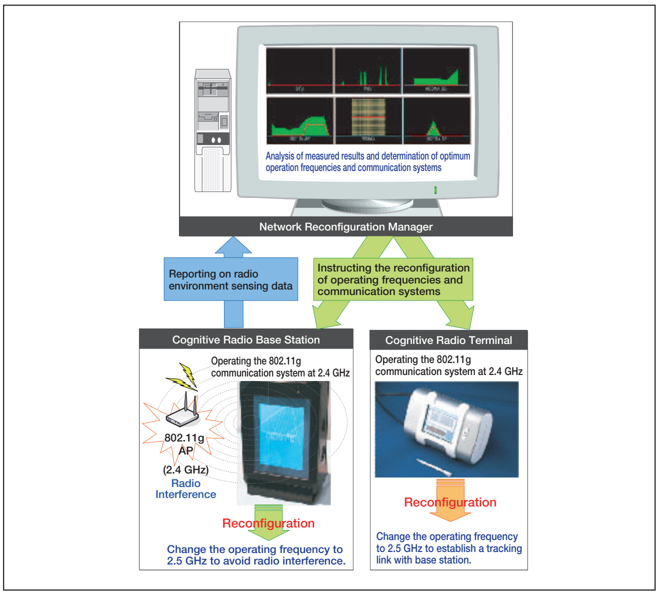


Figure 4 ● Cognitive Radio System enabling the reconfiguration of operating frequencies and communication systems (PHY/MAC) based on the radio environment sensing (an example of spectrum sharing type systems)

Wireless Grid Technology Creating Innovative System Infrastructure

– Research and Development of the Low-Power SUN and its Standardization –

Fumihide Kojima Ph.D.

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

In 1999, completed the 2nd half doctorate course at the Graduate School of Osaka University. In the same year, entered the Communications Research Laboratory (reorganized into the current NICT). Then engaged in the research and development of 384 kbps high data transfer rate PHS, low rate real-time transfer of motion images, ROF multiservice road-vehicle communications, and VHF band customer-provided mobile communications. Currently participating in the research and development of PHY/MAC technologies and standardization activities at the SUN.

Background of the Study and Technical Subjects

The Smart Utility Networks (SUN) that automatically performs the consumption data collection of electricity, gas and water by means of wireless communications attracts public interest of its contribution as a new wireless communications system for streamlining business operation and improving services. For its PHY/MAC (Physical•Medium Access Control specifications, the formulation of international standards is rapidly conducted, whereas some movements have started to treat the subject standards as a candidate for the radio communication standards applied to smart meters in the next-generation smart electric power grid.

Figure 1 gives the imaginary configuration of SUN. The consumption data from the SUN wireless unit attached to each meter of household are collected by wireless communications within a service area of SUN, and further transferred to the collection station as required by way of a global wireless access system such as wide area networks (WAN). A service area of SUN in Japan corresponds to a building of composite residence or a section of an independent house, and is considered to cover an area with a maximum diameter of 1 kilometer or thereabouts.

For commercialization and further penetration of the SUN, the following technologies are assumed:

Multihop Communications Technology

As shown in Figure 1, the radio wave attenuation due to propagation distance between wireless units and shield effect of buildings may cause to restrain the coverage within a service area. In this case, such a form of relaying communications between wireless units as a bucket relay operation is proven effective. Depending on changes in situations such as a new meter installation or removal, the relay paths should desirably be established in an autonomous manner.

Low Power Consumption Technology

In the case of a battery-driven meter (gas meter, for example),

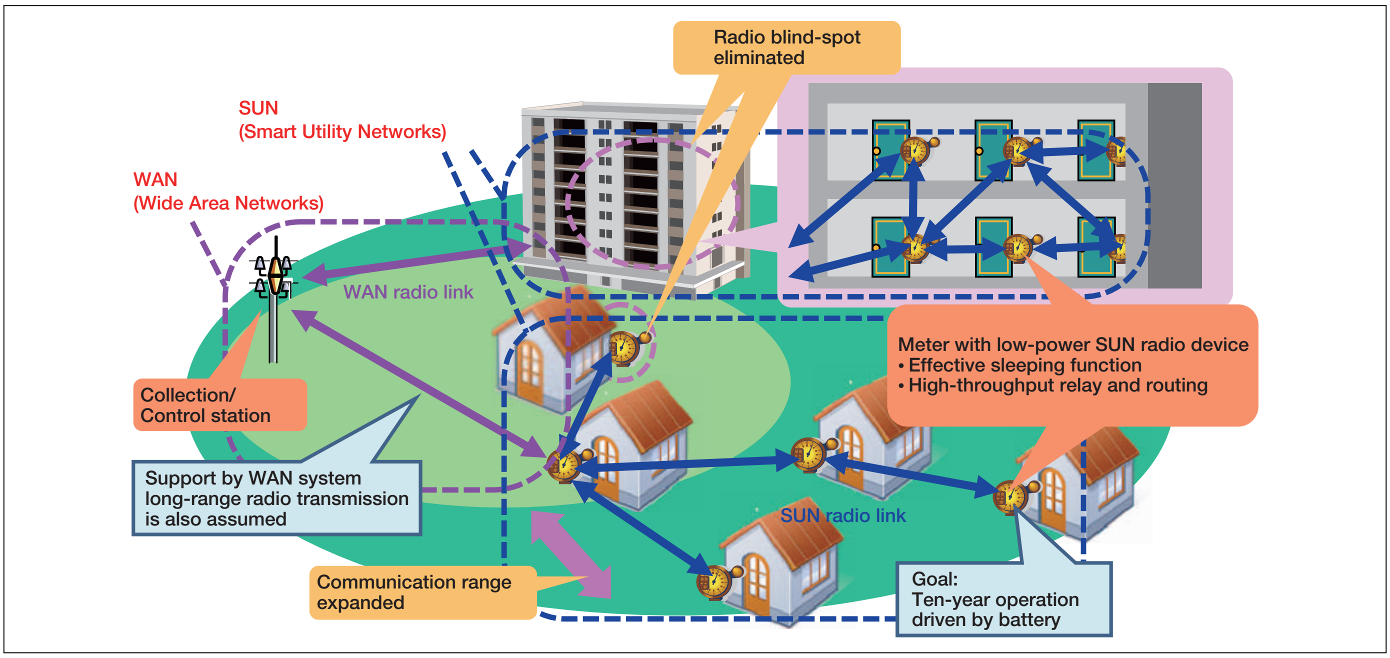


Figure 1 ● Image of SUN System

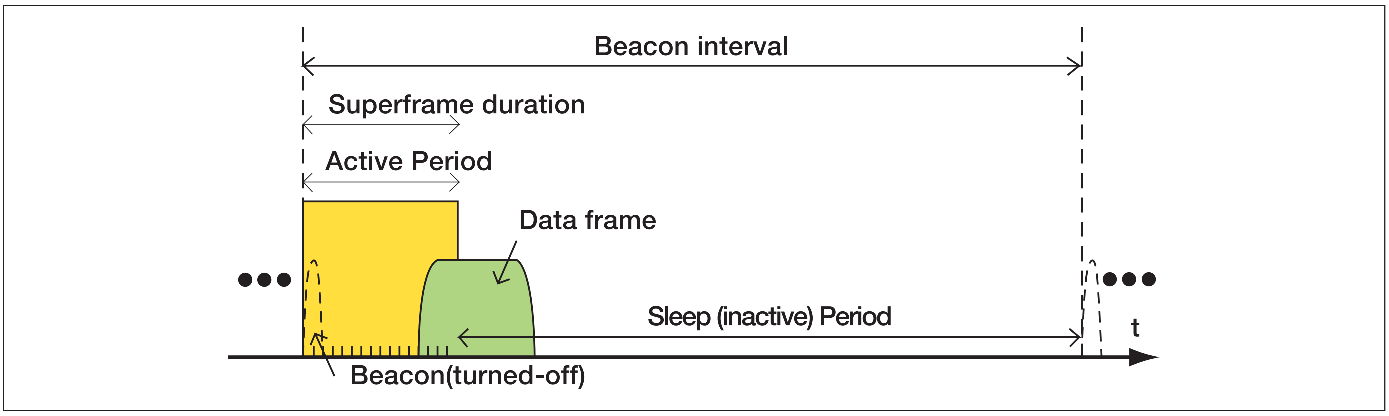


Figure 2 ● Superframe structure for low-power consumption

the low power consumption operation of the wireless unit is desired to suppress the cost for battery replacement. As a specific numeric objective, operation for a stretch of 10 years without battery replacement can be assumed.

Based on the above-mentioned background, the Ubiquitous Mobile Group carries on the research and development on extensive PHY/MAC technology for the realization of low-power type SUN.

PHY/MAC Technology for Realizing the Low-Power SUN

PHY Technology

Conceivable operating frequencies for the SUN in Japan, the 400 MHz and 950 MHz bands are used for the specific lower-power systems and the wireless tag systems, respectively. The data transfer rates are assumed to be around 100 kbps in accordance with the preconditions of the system. Since the number of meters installed within a SUN service area reaches 10,000 units, the installation of low-cost wireless unit is required, and thus the application of FSK system that is one of the single carrier modulation systems is being studied.

MAC Technology

Figure 2 schematically indicates the superframe configuration that should be studied. The superframe is a time period that should be set within an interval of synchronizing beacon signals for periodic sends. In the present study, the beacon is designed to undergo suspensions for minimizing power consumption, and is sent on demand only when synchronization is required. While setting a superframe as an active period as shown in Figure 2, the interval between the termination of a superframe and the start of the next superframe is termed as an inactive period that is used as a sleep period. This study tolerates data frame transmission that only begins in the active period and could finish before the next active period, not the end of the current active periods, as depicted in this figure. This situation means only receiver of the data frame continues receiving till the frame end, and other device can falls into sleeping as soon as active period ends. By this assumption, we can reduce such active period length where all devices are awake and standing-by, regardless of frame length, thereby improve power consumption performances.

Figure 3 gives the tree structure for multihop communications and an example of data frame relaying. The wireless unit of a collection station (or wireless units linked with a WAN) constitutes the root, and the wireless unit of each meter participates in the autonomous configuration of the tree structure. The consumption data collected from each meter in this structure is unidirectionally relayed to the collection station. In the communications between wireless units, the wireless unit functioning as master defines the superframe for every slave.

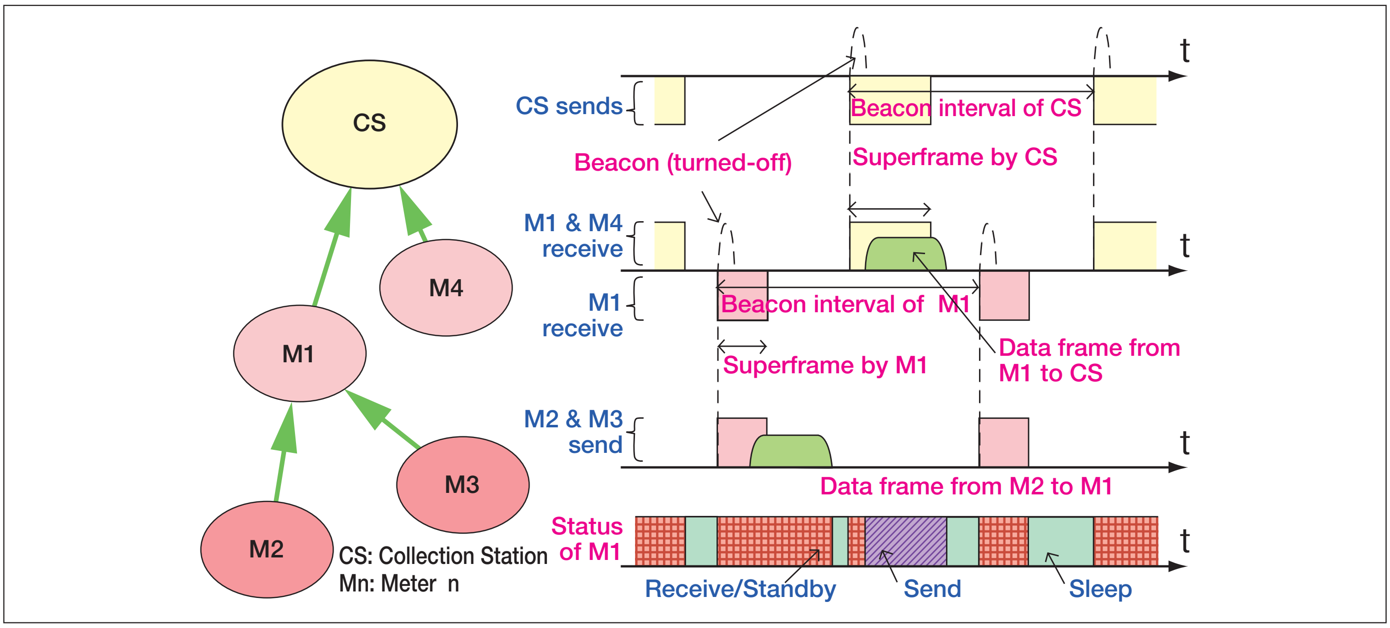


Figure 3 ● Multi-hop transmission in the tree shaped topology

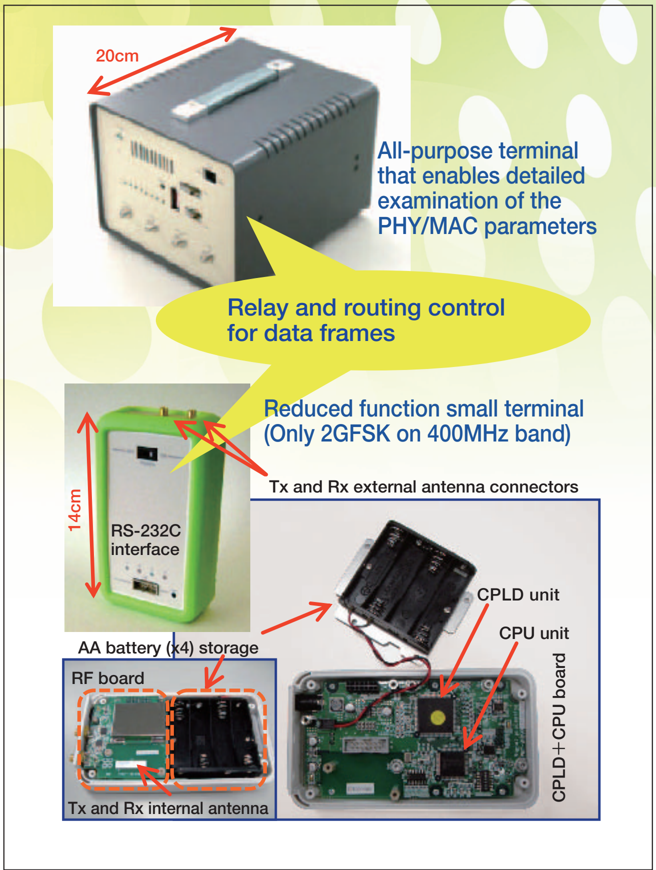


Figure 4 ● Prototypes of Low-Power SUN Wireless Terminal

Prototype Unit Development and Characteristics Evaluation by Field Tests

Figure 4 illustrates a prototypes of Low-power SUN wireless terminal, and Table 1 gives the specifications for them. Frequency bands are 400 MHz and 950MHz bands, and the transmitting power is 10 mW. The all-purpose terminal with all the specifications as given in Table 1 provides detailed validations under the assumed SUN utility situations. On the other hand, the reduced function small terminals with limited functions of which some PHY specifications have been eliminated allow macroscopic performance evaluation such as multihop communication by increasing the number of terminals developed.

Table 1 ● PHY and MAC Specifications

Frequency band	400 MHz and 950 MHz bands	
Transmission power	10 mW	
Modulation schemes	2GFSK	4GFSK
Data rate	50 k, 100 k, 200 kbps	400 kbps
Maximum length of PHYpayload	1500 octets	
Access control scheme	CSMA/CA limited in the active period	
Routing scheme	One-way routing from each node to the root in the tree shaped topology	

As a result of conducting a field test by selectively using prototype units, secure data-frame collection was implemented by means of the multihop communication in three stages in a service area with a radius of approximately 500 meters or so, even when shield effect of buildings occurred.

Implementing in the Standardization Process

The IEEE 802 Committee currently examines the modification of PHY specifications of IEEE 802.15.4 standard adapted to the operation form of SUN by specifically sharing the work by Task Group IEEE 802.15.4g, while the Task Group IEEE 802.15.4e is responsible for the MAC specifications. Figure 5 shows the organization of IEEE 802 Committee. Our Ubiquitous Mobile Group has proposed the respective PHY/MAC technology to the Task Group IEEE 802.15.4g and IEEE 802.15.4e, and by the results of being employed by the latest draft document of each group, our group is thus contributing to the standardization activities. Each of the two task groups called for proposals in May 2009, and plans to complete the standardization by the end of March 2011 (confirmed the status as of June 2010).

Further Development

In parallel to the standardization activities, a comprehensive systems evaluation is planned to be conducted within fiscal year 2010 by taking into consideration for the connection with operational meters. The results of this study will not be limited to SUN system, but also be utilized as a wireless grid technology to support the system infrastructure, and thus will prove it to be significant.

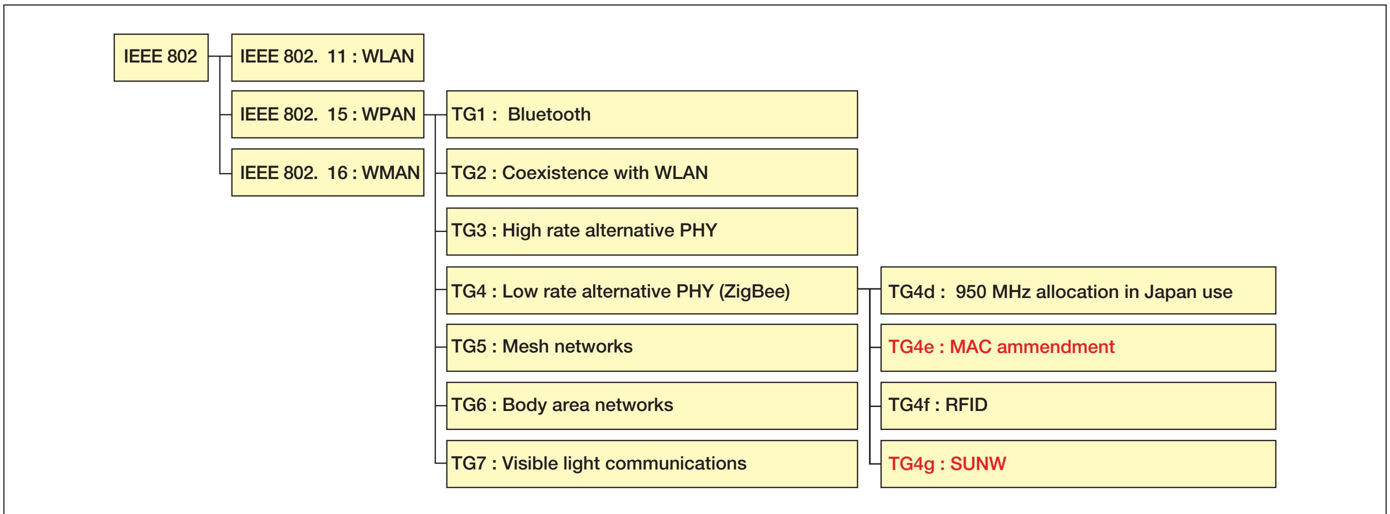


Figure 5 ● SUN standardization in IEEE 802 committee

Prize Winners

Prize Winner ● Takaya Miyazawa / Researcher, Network Architecture Group, New Generation Network Research Center

◎DATE : April 17, 2010
◎NAME OF THE PRIZE : **FUNAI Young Researcher Award**
◎DETAILS OF THE PRIZE :
Researches on Next-Generation and New-Generation Optical Access Technologies
◎NAME OF THE AWARDING ORGANIZATION :
FUNAI Foundation for Information Technology

◎Comments by the Winner :
It is a great honor for us to receive the laureate Funai Young Researcher Award. We have so far been engaged in the research activities on the optical access architecture intended for providing highspeed network access and diversified services in the future. We are indeed delighted to understand that the details and merits of our research have been acknowledged and thus given the award. We extend our heartfelt appreciation to the members of the Network Architecture Group and other people concerned, and commit that we will devote ourselves to further research activities.

Left: President, Funai Tetsuyoshi, Funai Foundation for Information Technology Right: Takaya Miyazawa, Researcher

Prize Winners ● Kentaro Ishizu / Expert researcher, Ubiquitous Mobile Communication Group, New Generation Wireless Communications Research Center
Homare Murakami[*i] **Stanislav Filin**[*ii] **Ha Nguyen Tran**[*ii]
Chen Sun[*ii] **Yohannes Demessie Alemseged**[*ii] **Hiroshi Harada**[*iii]
*i) Senior Researcher, Ubiquitous Mobile Communication Group, New Generation Wireless Communications Research Center
*ii) Expert researcher, Ubiquitous Mobile Communication Group, New Generation Wireless Communications Research Center
*iii) Group Leader, Ubiquitous Mobile Communication Group, New Generation Wireless Communications Research Center

◎DATE : May 20, 2010
◎NAME OF THE PRIZE : **2009 Special Technical Award in Software Radio**
◎DETAILS OF THE PRIZE :
"SR2009-30 Prototype of Spectrum Sharing Type Cognitive Base Station" was nominated as the best technical demonstration.
◎NAME OF THE AWARDING ORGANIZATION :
IECE Technical Committee on Software Radio

◎Comments by the Winner :
We have made a prototype radio communications system that can be operated by sharing frequencies with other systems ranging from 400 MHz to 6 GHz, in order to evade the depletion of radio wave resources. This technology is directly linked with the utilization of "white spaces," of which strategy has been started by the Ministry of Internal Affairs and Communications since last year and the systems improvement has been started world-wide. We believe that our efforts for the feasibility study on the system by contributing to the international standardization and early prototype development got applause from the technical committee. We will aim at the realization of required functions while grasping the trend of commercialization.


Left: Kazuhiro Uehara, Chairman of the Specialized Software Radio Research Committee Right: Kentaro Ishizu, Expert researcher

Prize Winner ● Fumihide Kojima / Senior Researcher, Ubiquitous Mobile Communication Group, New Generation Wireless Communications Research Center

◎DATE : May 21, 2010
◎NAME OF THE PRIZE : **The Young Researcher Study Encouragement Award**
◎DETAILS OF THE PRIZE :
Award for the excellent paper contribution that is entitled ``Long-Life Supported Low Power Radio Communication Network based on IEEE802.15.4MAC."
◎NAME OF THE AWARDING ORGANIZATION :
IEICE Technical Committee on Ad Hoc Networks

◎Comments by the Winner :
Since the standard IEEE 802.15.4g of the Smart Utility Network (SUN) to which the present study contributes is concurrently considered promising as a candidate for the radio communication standards applied to the next-generation smart electric power grid, it is increasingly attracting interest for both domestic and overseas concerns. We sincerely wish that the results of NICT's research and development efforts will effectively be utilized so that the users' needs are properly implemented in the course of formulating the SUN standards.

Prize Winner ● Kazumasa Enami / Vice President Member of the Board of Directors

◎DATE : May 28, 2010
◎NAME OF THE PRIZE : **Niwa-Takayanagi Award**
◎DETAILS OF THE PRIZE :
Contribution of R&D Promotion of Ultra-Realistic Communications
◎NAME OF THE AWARDING ORGANIZATION :
The Institute of Image Information and Television Engineers

◎Comments by the Winner :
I understand that the award was given to the accomplishments of "implementing the research and development of the next-generation broadcasting media typically including the Super-Highvision" as the research manager of NHK and the "proposal of the ultra-realistic communications of being in an actual scene as a innovative concept of communication means in the information and telecommunications technology in the future and the establishment and leading of a collaborative forum of industry, academy, and administration" at NICT. From now on, I will make our best efforts toward the progress of Japan's information and telecommunications technology.

"Monozukuri" Production Systems Satisfying the Researchers

NICT Workshop

(Part I)

Studies conducted by NICT often require parts that are not available on the market. When unavailable, there is no choice but to manufacture them ourselves. The NICT Workshop is the expressly organized department where required parts are internally manufactured by analyzing the needs of researchers. Thus, the NICT Workshop is indeed the "supporting staff in the background" who supports NICT's leading edge studies by speedily taking actions while keeping good communication with each researcher. This issue and the next one describe the detailed profile of the NICT Workshop staffed with specialists who perform activities ranging from improvising a simple fabrication to a sophisticated work including concept formation, design, and high-quality fabrications.

Left: Jun-ichi Komuro,Expert　Right: Kenji Nakamura, Chief

The Role of NICT Workshop Supporting State-of-the-Art Studies

── First, please give us the overview of the NICT Workshop.

Komuro: The NICT Workshop, which is a popular name and should formally be called "Outcome Promotion Group, Research Promotion Department," is responsible for the development of prototypes. Regarding any of the NICT's diversified research activities, whenever any device or part that is not found in the market is required, we, the staff members of NICT Workshop, prepare it. Even if ample budget and time are provided and a required item may be procured by subcontracting to a manufacturer, researchers are not always satisfied with such outsourced products because our researchers often want them immediately and usually no vendor can undertake the prototype manufacture because of its prohibitively high level of technology. As long as you would make use of this in-house function of the NICT Workshop, your study will flow.

── What sort of items have you so far created?

Komuro: We make a wide variety of items ranging from a simple fixture by machining an aluminum block to a filter for super conductance device subjected directly to a study, which requires high-precision fabrication. More precisely, we make such an item that serves as a required means for implementing studies, rather than an item that has unique characteristics and thus is directly subjected to a specific study. Typically, a jig (or fixture that holds an objects to be machined in place), case, or a component that joins a part and a device together is what we usually prepare. If a component exemplified above cannot be readily provided, the progress of a study may significantly be holded up.

Meeting Demand for Parts with a Broad Spread of Size or Precision

── Have you recently manufactured any characteristic items?

Komuro: The one that is not supposed to be readily made by others is the stainless steel plate fabricated by our Nakamura.

Nakamura: That is a plate (Figure1) used as a base for nano-imprinting*1, and the plate must have both flat surfaces in parallel so that pressure can be applied evenly. We have fabricated it to meet the requirement, "Please make a plate with its irregularity of flat surfaces infinitely close to zero." The part we made for evaluating the performance of a milling machine that has recently been introduced has a surface precision of approximately 0.5 m. The magnitude of 0.5 m is at an ultimate level that can only be determined by a proper testing device.

── As a researcher, one can only conduct a study with that quality on surface at that level, right?

Nakamura: Definitely. We may say that a smaller error is better and zero error is far better. In addition to the precision of one surface, this part must have an evenly distributed thickness. Thus, this is already at the limit from the technical point of view.

── Is a certain level of skills and proficiency required for such precise fabrication?

Nakamura: Although the NICT Workshop is provided with machines that can perform high-precision fabrication without a skilled craftsman. Still a certain degree of know-how is required when it comes to grinding operation at a micrometer level.

A subcontractor equipped with the same machines may be able to make it, but such an item usually must go through a trial and error process. This requires a long period of time, which boosts cost, and thus the subcontractor will not take on the manufacture.

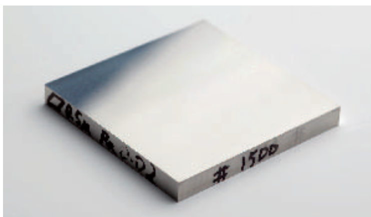


Figure 1 ● Stainless Steel Plate Fabricated for nano-imprinting process (2-inch square, 5-mm thick, surface precision 0.5 μm)

Figure 2 ● Inclined Array of Laser Reflector (Diameter 130 mm, height 43 mm)

Engaged in the Manufacture of a Part on Board of a Satellite from Design Stage

── I understand that you have made some parts that are installed on an artificial satellite.

Komuro: That is a component called inclined array of laser reflectors (Figure2) used in our joint study with the Japan Aerospace Exploration Agency (JAXA). At first, we subcontracted a breadboard model*2, it turned out that its prism went fractured, and finally the NICT Workshop made all the parts except the prism.

We machine out from a metal rod and give it a somewhat special fabrication. As to the method for fixing a prism, we presented ideas, design and manufacture, and the product has successfully passed the impact and vibration tests.

── Is the part designed by the NICT Workshop to be launched into the space?

Komuro: The part we have made this time is the engineering model*2.

It is not yet determined if we are to make the flight model*2, we shall be delighted when we can make it and the product actually goes out there in the space.

── Is there any other item that has been prepared including its design?

Komuro: Among a number of items, it may interest you that, for example, we made a specimen holder (Figure3) that enables the determination of various substance constants by using a terahertz band radio wave. It measures two spots by sliding the specimen in the vertical direction in vacuum. The material characteristics determined by this device have been stored on a terahertz database and disclosed online. Researchers of universities and private enterprises seem to access the database almost every day, and they evaluate the holder as an indispensable item. Later, we manufactured a device (Figure4) that determines the substance constants of frozen specimens in a terahertz band radio wave. We devised a method for arranging a variety of parts within a limited space, and fabricated all the parts at the NICT Workshop except the cooling temperature control section that has been outsourced. For this section, we had such a request that no condensation should occur while the specimen is measured in the nitrogen gas.

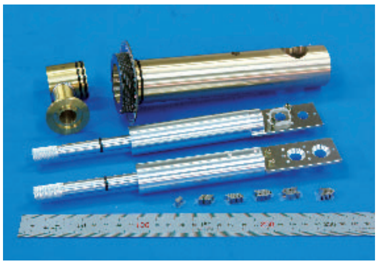


Figure 3 ● Specimen Holder for Terahertz Spectroscope (Full length 255 mm)

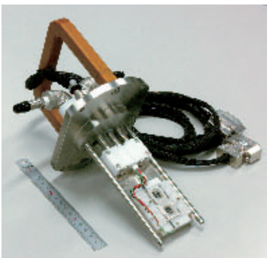


Figure 4 ● A Device Determining Substance Constants of Frozen Specimens (Full length 254 mm)

To Meet a Variety of Requests from Researchers

── Does every researcher not present a drawing for each request?

Komuro: We face such cases, while others want us to meet their expectation without giving any drawing.In the latter case, we give thoughts to strength and other factors and design, but it would be a big advantage that we can incorporate manufacturing method in the design from scratch.

── Which case is more frequent, with or without drawing?

Nakamura: I would rather say that cases with drawing are more likely.

Komuro: Yes, cases with drawing are common in these days. It used to be such that we, the NICT Workshops, would first design and go on manufacturing, but recently we feel that cases with drawings are on the increase. Such a drawing sometimes comes in as CAD data or as primitive as a punch sketch.

── How long a completion deadline would you demand for a requested prototype?

Komuro: Someone give us a week, whereas another wants it tomorrow. It varies widely with the type of prototype. For example, when surface precision is required, we must take time, whereas a simple item can be fabricated on the spot. As we provide frequently used materials, we can work on an item right away except for a part that requires special materials. The most frequently used materials in these days are aluminum and aluminum alloys, which must be made available from inventory by replenishing them, otherwise they run out in no time.

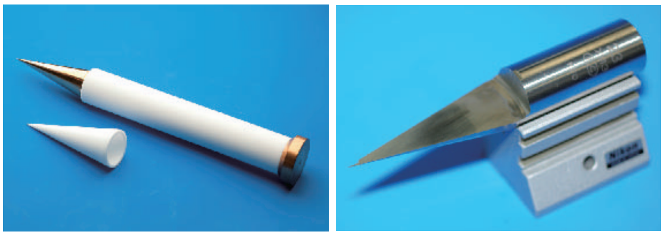


Figure 5 ● Teflon coating (white parttside diameter 36 mm, full length 325 mm) and a tool made in-house to bore the cone

── Have you come across any case where an item was supposed to be too difficult to fabricate, but you have successfully made it?

Nakamura: In the case of fabricating a slot antenna shaped as a combination of a cone and a cylinder (Figure5), wherein the requirement was to line the entire core with a 3-mm-thick Teflon layer, we first subcontracted the fabrication. However, precision of the thickness was limited within 0.03 mm, which was beyond the capability of those subcontractors. While machining the outside is easy, finishing the inside surface is too difficult to meet the requirement. Then, we prepared the tool to bore the core of the cone. Likewise, we made the fixture for uniformly machining of the cylinder by ourselves.

Part of the work to determine what sort of tools and jigs are required for the fabrication can be achieved with our experiences accumulated over the period of time. In the initial stage, however, we get started at any rate, without a solid idea.

(To be continued to the next issue)

Terminology

＊1: Nano-imprinting

A technology providing sub-micro surface irregularity with an intrusion/protrusion size of several tens to several hundreds of nanometers to effect an offset print of a shape by impressing a synthetic resin material, enabling pattern forming at a lower cost than conventional technologies such as lithography and etching. Application to the manufacture of optical parts in particular is anticipated.

＊2: Breadboard model/Engineering model/Flight model

A breadboard model refers to the original prototype in an artificial satellite development project. In many cases, a prototype is prepared for verifying satellite functions by combining parts that are available on the market. An engineering model is a prototype used for conducting functional performance and environmental tests, in order to verify the validity of a design. A product that is subjected to qualification tests and then actually launched into the space is called a flight model.

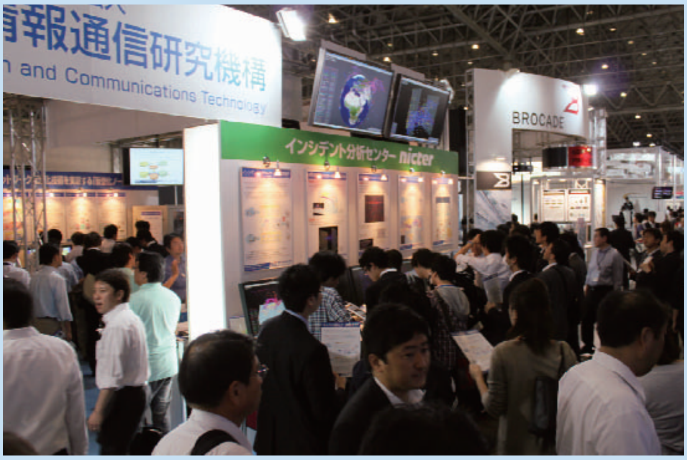
＊For details of the painting materials analysis with the use of terahertz band radio wave, refer to NICT News, June 2009 issue. The back numbers can be reviewed on the following web page: http://www.nict.go.jp/news/nict-news.html

Report on Our Exhibits at the "Interop Tokyo 2010"

NICT has presented its exhibits at the Interop Tokyo 2010 fair held at the Makuhari Messe from Wednesday, Jun. 9 to Friday, Jun. 11 The Interop as a whole hosted over 130,000 visitors, of which 20,000 or so stopped over the NICT's booth.

In addition to the exhibits of the Information Security Research Center that has been participating in the fair yearly, the displays presented by the New Generation Network Research Center, New Generation Wireless Research Center, and a Collaborative Research Department (the Hokuriku Research Center) made a wide variety of the content available. In this issue, the exhibits of the New Generation Wireless Communications Research Center are described through Pages 3 to 7.

NICT's overall activities for the fair this year have been evaluated as "important fundamental researches that constitutes a cornerstone for the development of information and telecommunications in the future," and our organization received the jury special award in the "Future Technologies Section" of the Best of Show Award.



NICT's booth full of visitors

The visitors listening to presentations and intently watching the exhibits

Information for Readers

In the next issue, we will cover the "wind" observation system that is a vital parameter of weather disasters and report on our facilities open to the public.

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