ISSN 0915-3160

平成二十七年一月十日発行（年四回一、四、七、十月の十日発行）通巻百五号 New Breeze

New Breeze

Quarterly of the ITU Association of Japan

No. 1
Vol. 27 January 2015
Winter

New Year Messages

From the Minister for MIC, Secretary-General of ITU, and President of ITU-AJ

Special Feature

Overview of the 10th International Conference on IP + Optical Network (iPOP2014)
iPOP2014 Hot Lectures
Exhibits and Demonstrations at iPOP2014

New Breeze ISSN 0915-3160
Quarterly of the ITU Association of Japan
BN Gyoem Bldg., 1-17-11 Shinjuku, Shinjuku-ku,
Tokyo 160-0022 Japan
Tel: +81-3-5357-7610 Fax: +81-3-3356-8170
http://www.ituaj.jp/english/

Letters to *New Breeze*

New Breeze welcomes readers' opinions. Please send comments with your name, address, and nationality by e-mail, fax, or post to the editor.

E-mail address: newbreeze@ituaj.jp

Subscription forms are available on the ITU-AJ website:
http://www.ituaj.jp/english/subscription_form.pdf

Subscription Fee:

Single issue:	¥1,500
Annual subscription (4 issues):	¥6,000

Disclaimer: Opinions expressed in this publication are those of the authors and do not necessarily represent those of the ITU Association of Japan.

CONTENTS

About the ITU-AJ

The ITU Association of Japan (ITU-AJ) was founded on September 1, 1971, to coordinate Japanese activities in the telecommunication and broadcasting sectors with international activities. Today, the principle activities of the ITU-AJ are to cooperate in various activities of international organizations such as the ITU and to disseminate information about them. The Association also aims to help developing countries by supporting technical assistance, as well as by taking part in general international cooperation, mainly through the Asia-Pacific Telecommunity (APT), so as to contribute to the advance of the telecommunications and broadcasting throughout the world.

2015 New Year Greeting from the Minister for Internal Affairs and Communications

Sanae Takaichi
Minister for Internal Affairs and Communications

Happy New Year!

ICT falls under the jurisdiction of the Ministry of Internal Affairs and Communications, and provides an essential foundation of our everyday lives and social/business activities, where it drives the creation of new innovation and economic growth.

The Information and Communications Council recently delivered a review of systems aimed at furthering the spread and development of the world's highest-level ICT infrastructure in the 2020s. The aim is to stimulate the Japanese economy and improve people's lives by providing an environment where diverse services can be created and used safely and securely through innovative use of the ICT infrastructure.

The Ministry of Internal Affairs and Communications has also set up a forum for joint studies by industry, academia and government in order to promote ICT across the whole of society with a view to achieving continuous growth in Japan during and after the Tokyo Olympics and Paralympics in 2020.

In the future, we will continue to work on studies aimed at realizing our goals, including promoting the development of a free public wireless LAN environment, using ICT to provide support for multiple languages, extending the delivery of broadcast content to overseas, pushing ahead with the introduction of 4K/8K television and digital signage, implementing a fifth-generation mobile communication system, and making use of resources such as open data.

On the global scene, we have been utilizing a top-level approach to international sales activities related to Japanese ICT, such as the Japanese digital terrestrial television (ISDB-T) system, mainly in developing countries. Last year the ISDB-T system was adopted by the Maldives in April and Sri Lanka in May, bringing its global total to 17 countries.

In the future, we will not only continue to promote the international deployment of ISDB-T, but we will also build the cooperative relationships cultivated though ISDB-T into the ICT field as a whole, and we will contribute to the world by striving to resolve diverse issues that face society, such as education, medical treatment and disaster prevention.

Meanwhile, Japan will also contribute to the global development and deployment of ICT by actively contributing to international and regional organizations.

Last year, at the quadrennial ITU Plenipotentiary Conference in Busan, South Korea, we held elections to choose the executives for the next four years, and voted on the ITU's strategic and financial plans. Japan has been elected to the ITU Council member for eleven consecutive periods of office since 1959. In the Radio Regulations Board elections, Yasuhiko Ito (KDDI Executive Adviser) was re-elected by receiving the largest number of votes in the Asia-Pacific region.

Japan recognizes that the ITU is playing a vital role in the realization of an Information Society, and at this conference we expressed our intention to continue making the largest financial contributions to the ITU.

We also approved and supported a new resolution to eradicate the Ebola hemorrhagic fever through the use of ICT, which was adopted unanimously.

This year is particularly auspicious, being both the 150th anniversary of the ITU's founding, and the year of the tenth annual World Summit on the Information Society. In December, Japan will also host the WTIS-15, high-level symposium on international statistics in the ICT field, where we are looking forward to participating in lively discussions. The Ministry of Internal Affairs and Communications is thus actively contributing to the ITU in various ways.

Furthermore, with the aim of conferring the benefits of ICT equally to people in Asia-Pacific countries, an international organization called the Asia-Pacific Telecommunity (APT) is working on human resource development, radio communications and standardization in the telecommunication field, and on the coordination of regional telecommunications policies and other regulations.

As the largest donor country in this region, Japan has actively contributed to the APT since it was first established. At the APT deputy secretary general election in November last year, Masanori Kondo from the Ministry of Internal Affairs and Communications was elected to this position. Japan will continue to support the APT with human resources and financial assistance.

As ICT pervades into our daily lives and its influence increases, an increasingly important role is being played by the ICT that falls under the jurisdiction of the Ministry of Internal Affairs and Communications. The Ministry of Internal Affairs and Communications will continue to promote measures related to ICT and fully mobilize its policy resources so to enhance people's daily lives. I hope for your continued support and cooperation over the coming year.

And finally, allow me to wish you a year of happiness, good health, and success in all your endeavors.

New Year Message from ITU Secretary-General

Houlin Zhao
Secretary-General
International Telecommunication Union

It is a great pleasure to have this opportunity to greet our Japanese community through the ITU Journal. The ITU Association of Japan (ITU-AJ) has proved extremely valuable in enhancing ITU's work in technical standardization and radiocommunications, helping connect the world and bring the benefits of modern communication technologies to people everywhere.

Last year was especially busy and productive for ITU. We hosted major events including the World Telecommunication Development Conference (WTDC-14) in the United Arab Emirates, the Global Symposium for Regulators (GSR) in Bahrain, the WSIS+10 High-Level Event in Geneva, and ITU Telecom World 2014 in Qatar. The most important event of course was PP-14, which took place in Busan, Republic of Korea, from 20 October – 7 November 2014. I am pleased to note that Japan made a particularly strong contribution to this Conference with its call in the formal policy statement from the Government of Japan "to establish a 'smart global connected network', which all people can access freely and easily from everywhere, get and share information and knowledge and create value".

PP-14 was the biggest and best-attended Plenipotentiary Conference yet, with over 2,500 delegates. The Republic of Korea hosted "the ICT Olympics", comprising not just the Conference but also a wide range of exciting side events and activities. The Conference approved the Strategic and Financial Plans for 2016-2019, and elected the new management team, the members of the Radio Regulations Board and the members of ITU Council. PP-14 saw some new resolutions approved on: flight safety and tracking; combating counterfeit ICT devices; disaster management and ICTs; youth empowerment; child online protection; gender empowerment through ICTs; using the power of ICTs to combat Ebola; and on delivering affordable international Internet connectivity for all, in addition to ITU's existing established regular work programme. The telecom and Internet communities continued the rapprochement started at WTPF-2013, and grew closer to each other in understanding. In addition, PP-14 approved the Connect 2020 Agenda for global telecommunication/ICT development, which sets universal, specific and measurable targets for the development of the sector under goals of growth, inclusiveness and sustainability, as well as innovation and partnership.

True to our commitment to being as open and inclusive as possible, all Plenary sessions were captioned and webcast, and all sessions of the substantive committees were open to the media and the public. ITU held regular press briefings and specific briefings for civil society to keep all stakeholders up to date on developments as they happened. And true to our commitment to being environmentally friendly, despite 6,000 pages of translated documents, the Conference was managed in a virtually paperless manner.

ITU continues to work closely with industry leaders, governments and policy pioneers, regulators, civil society, other international organizations and academia, most notably through the ITU Telecom World events and the regular meetings of the ITU/UNESCO Broadband Commission for Digital Development.

PP-14 has helped define the ICT policy agenda moving forward, and will enable ITU to respond more flexibly to future opportunities and challenges in this fast-moving industry.

In late November, ITU published its flagship report, Measuring the Information Society 2014, at the World Telecommunication and ICT Indicators Symposium (WTIS), which explored the promise of Big Data for enhancing policy decisions and monitoring policy outcomes. WTIS confirms ITU as the primary statistics-gathering agency for ICT data, with our data being used extensively in World Bank and World Economic Forum reports, as well as by private sector consultancies and analysts. I am proud that our statistics are widely recognized as the world's most comprehensive, reliable and impartial data on the state of the industry.

Significantly, the final G.fast standard was approved in December, a major development which promises to deliver fibre-equivalent speeds of up to 1 Gbps over 250m of copper wire. This standard moves us from the "last mile" to the "last metres". By pushing fibre out still further into the network towards the distribution point, but retaining copper for the problematic entry-points into customer premises, it has been estimated that this standard could save the global telecom industry in excess of a billion dollars by avoiding the total replacement of copper to the end-point.

As 2015 dawns, ITU looks forward to another busy and productive year committed to serving the needs of its membership. 2015 is a milestone year for ITU, which will celebrate 150 years of international cooperation among governments, private companies, academia and other stakeholders on 17 May 2015. ITU invites you all to join in the ITU's 150th Anniversary celebrations.

We especially look forward to the World Radiocommunication Conference (WRC) 2015, which will review and, if necessary, revise the Radio Regulations, the international treaty governing the use of the radio-frequency spectrum and geostationary-satellite and non-geostationary-satellite orbits. WRC-2015 will deal with many pivotal issues for the industry, including considering: the reallocation of more spectrum to underpin the growth of mobile broadband and satellite services; spectrum for flight tracking; aeronautical issues; maritime issues for onboard communication stations; and radiolocation issues for new car radar systems.

We will also be very much looking forward to the 2015 edition of the WSIS Forum, which will be taking place in Geneva from 25-29 May, as well as GSR-15, which will be taking place in Gabon from 9-11 June 2015.

This year will also see the renegotiation of the Hyogo Framework for Action in Disaster Risk Reduction, a landmark agreement which will provide the framework for all agencies working in this field for the next ten years. All in all, we anticipate that 2015 will prove pivotal for defining global strategies for managing disasters and mitigating climate risk, in combination with the UN's new Sustainable Development Goals (SDGs) and the much hoped-for Climate Agreement.

I am confident that Japan will continue to participate actively in all of ITU's many activities, and I would like to thank Japan for its continuous support ever since joining the Union in 1879. As I enter into office as the Secretary-General, I look forward to engaging with as many of you as possible in this year, through ITU's events scheduled throughout the coming year, and I take this opportunity to wish all of you at ITU-AJ, as well as your families, a peaceful and prosperous 2015.

New Year's Greetings!

Michiaki Ogasawara
President
The ITU Association of Japan

Happy New Year! It is my sincere hope that this year will be productive and rewarding for you all!

Last year, the Plenipotentiary Conference, which is held every four years and is the top policy-making body of the International Telecommunications Union, was held in Busan, Republic of Korea. It was attended by approximately 2500 people from 171 countries around the world, including Japan. At the Plenipotentiary Conference, we had the opportunity to act as Japanese delegation secretariat and to support the Japanese government and all other participants from Japan.

Deliberations went through the night, and many important decisions were made regarding policy directions for the next four years. The election is another major purpose of the Plenipotentiary Conference, and we could not be more pleased that Japan continues to keep the seat in ITU Council, and that Dr. Yasuhiko Ito has been re-elected as a member of the Radio Regulations Board.

This year in May will mark the 150th Anniversary of the ITU, an international organization proud of its long history. In November, the World Radiocommunication Conference (WRC), which makes revisions to the Radio Regulations governing use of radio-frequency spectrum internationally, will also be held at ITU headquarters in Switzerland.

Needless to say, the principal duties of the ITU are (1) allocation of frequencies internationally, (2) standardization of telecommunications and information communication technology (telecommunications/ICT), and (3) supporting development of telecommunications/ICT in developing countries, but under the constitution and convention of the ITU, it must continue to play an important role in the peaceful coexistence of people throughout the world into the future, and sharing the global space with harmony.

In order for the ITU to fulfil these roles, forming consensus in the Asia-Pacific Telecommunity (APT) has also become very important. On a related point, Mr. Masanori Kondo, from Japan, was elected as Deputy Secretary General at the APT elections in November last year, and it is wonderful that, from now on, APT will be led by his strong leadership in which we can place our hopes, promoting cooperation and collaboration in the Asia-Pacific region.

Upon reflection, there have been some outstanding technical advances in the last year, particularly in development of technology related to wireless communications. Wireless technology development is progressing in many aspects, such as cost and convenience, and with advancement in digital technologies and extreme miniaturization of electronic circuits, wireless communications systems overall are rapidly becoming more sophisticated. Mobile phones and smartphones, which have achieved performance increases while remaining extremely compact, are excellent representatives of these advances. Some of the many other keywords related to recent ICT include 5G, IoT, automobile communications technology, geospatial, positioning, wireless power transmission, sensor networks, cloud computing, security technology, and 4K/8K.

The role of the ICT in finding solutions to global issues such as global warming, large-scale natural disasters, infectious diseases, and energy has also grown substantially. The ITU/APT is depended upon to be deeply involved in and contribute proactively to advancing ICT and finding solutions to these types of global issues. Of course, Japan must also cooperate in and support these efforts.

With the cooperation of all supporting members, the ITU Association of Japan will continue to cooperate proactively in ITU, APT and national initiatives with a global perspective, to increase Japan's international presence in the information and telecommunications field.

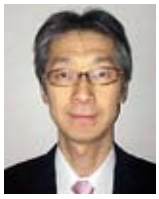
In closing, I wish everyone the very best, in health and all of your undertakings, in the coming year.

Overview of the 10th International Conference on IP + Optical Network (iPOP2014)

Naoki Yamanaka
Professor, Graduate School of Science and Technology
Keio University

Satoshi Okamoto
Professor, Graduate School of Science and Technology
Keio University

Atsushi Hiramatsu
Director, Advanced Products Business Headquarters
NTT Advanced Technology Corporation



1. Introduction

The tenth International Conference on IP + Optical Network (iPOP) was held this year. This event consisted of an international conference and exhibition on next-generation networks combining optical and IP technology, and as the largest conference of its kind it has important influence over dejure and de facto standards. This report describes the features and purpose of this event.

2. Overview of iPOP

To understand iPOP, it is very helpful to understand the event's creation and history. In the United States, there is a well-established event called the SDN/MPLS conference that is concerned with software-defined networking and multi-protocol label switching (originally known as the MPLS conference)[1]. It has been held 17 times now, and is sponsored by Isocore Corporation[2] in the United States (Figure 1).

Figure 1: History of iPOP

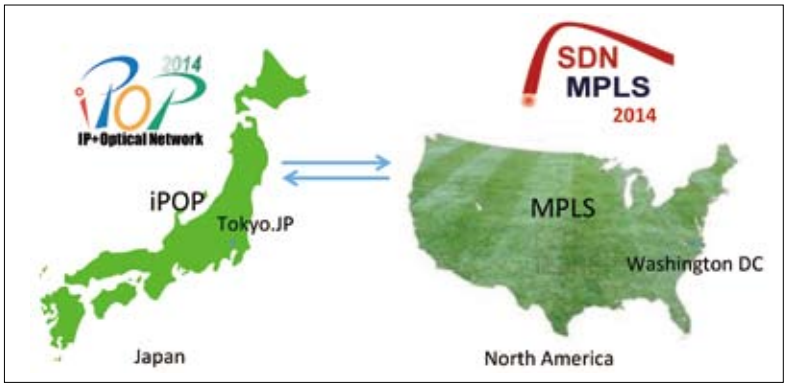
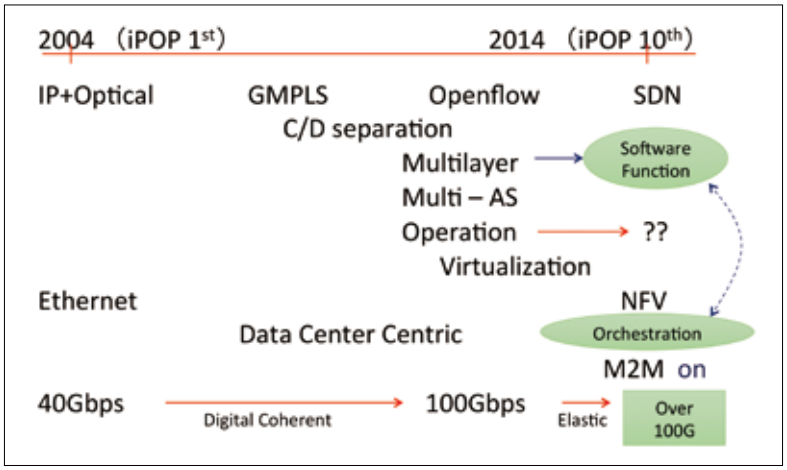


Figure 2: Technical trends in iPOP



Isocore is North America's test and validation site for communication protocols and service interoperability. In practice, it performs pre-verification of protocols specified by the Internet Engineering Task Force (IETF) and fabricates test sample protocol implementations (running code).

The IETF regards running code as essential, and requires that it forms the basis of a consensus. In general, the basic concepts are implemented as test code without considering the occurrence of faults or abnormalities (called irregular systems), and the validity and issues of a system are extracted based on inter-operability. After standardization in the IETF, the protocols are combined into a Request for Comments (RFC), and development proceeds on this basis. Here, network products also require interconnectivity with some interfaces. Consequently, activities like ISOCORE and the Photonic Internet Lab (PIL) at Keihanna Information and Communications Open Labs are very important to the developer community. PIL is a virtual research organization consisting of universities, communications carriers and communications equipment vendors with the shared aim of standardizing and commercializing GMPLS technology through partnerships between Japan's industrial, academic and government sectors, centered on Keio University and NTT Research Laboratories.

The SDN/MPLS conference is an event held by Isocore to provide a forum for exhibition booths and presentations on the hottest topics of published research. This is a huge conference with as many as 1,000 participants from various countries in Asia, Europe and America, most of whom are executives and engineers from communications equipment vendors and communications carriers.

The iPOP and SDN/MPLS conferences have built up a complementary relationship, with iPOP held in Japan in the spring, and SDN/MPLS held in the United States in the fall. With 200–300 participants, the iPOP conference is smaller in scale than SDN/MPLS.

3. iPOP issues

Whereas SDN/MPLS provides a forum for discussions on the carrier backbone technology that forms the basis of the Internet, the iPOP conference is concerned with carrier backbone technology based on the combination of optical and IP technology. Figure 2 illustrates how these technologies have evolved over the

last ten years.

When iPOP started, its main topic was an extension of MPLS called GMPLS (Generalized MPLS)[3, 4], which tied in with the introduction of WDM (wavelength division multiplexing) networks and the concept of a wavelength path (λ path). GMPLS aims to provide a consistent way of handling not only C-plane and D-plane separation and packets but also all λ paths and TDM (time division multiplexing) paths as RSVP (Resource Reservation Protocol) extension parameters (i.e., integration of operations). At the same time, techniques such as PBB-TE (Provider Backbone Bridge Traffic Engineering) have emerged with the aim of applying Ethernet LAN (local area network) technology to carrier backbone networks. A common feature of these technologies is the fact that the provider backbone requires OAM and traffic control techniques that are lacking from the LAN protocol. That is, it has not been easy to implement functions that will allow a network to automatically identify the location of a new fault or automatically switch communication paths around the fault. This has led to complicated protocols and has limited the scope of large-scale network applications.

The next topic that came up was the application of data center network technologies such as Openflow and SDN to carrier networks. Over half of iPOP is still concerned with issues related to SDN. In recent years, the hot topic for applications has been next-generation networks, especially data/content-centric network technology. On the other hand, advances in these network technologies have been consistently supported by optical transmission technology, which has evolved from 10 Gbps to 40 Gbps and 100 Gbps leading to lower costs and an increasing tendency for complex processes and services to be run in the cloud. As a result, network traffic has been converging on data centers and instead of aiming to reduce costs by using traffic applications with electronic packet switching (Ethernet switches or IP routers) in carrier networks without any spare bandwidth, it is instead considered that staying within the allocated bandwidth is used to bring down the operating costs, and there is a tendency for applications to be discarded.

4. iPOP configuration and participants

The iPOP conference is an intensive event that normally runs for just two days.

(1) The first day starts with plenary and keynote sessions featuring world-renowned members such as the IETF working group chairs. These are followed by a closed lunch meeting aimed at establishing cooperation with ISOCORE and PIL.

(2) There is often a business session in the afternoon. This is a popular session in which the leading companies in the field introduce their latest product developments and corporate strategies.

(3) A major feature of iPOP is the exhibition booths and live demonstrations (exhibition). These are quite different from commonplace exhibitions, with exhibition booths showing actual equipment produced by leading companies, national research institutions and universities, while holding in-depth discussions with visitors.

Figure 3: iPOP schedule

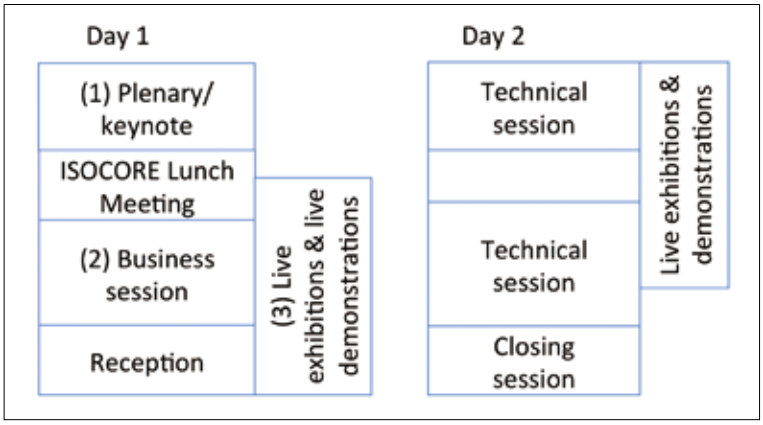
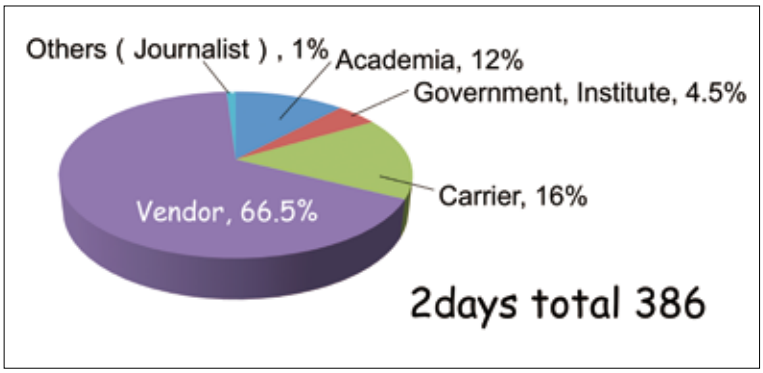


Figure 4: Visitor statistics for iPOP2014



They include interconnection demonstrations of the latest protocols (e.g., in 2014, multi-matching of metro/access/core networks at SDN speeds of over 100 Gbps), as described in more detail in a separate article. These exhibitions are definitely worth a look.

Figure 4 shows a breakdown of the visitors in 2014. Over 80% of the visitors were members of communications equipment vendors or communications carriers, and we have seen none of the recent tendency for businesses to stay away from international conferences.

5. Conclusion

This article has presented a summary of iPOP (International Conference on IP + Optical Network). This year's tenth conference was a quite unique event in Japan, and has had an impact on the communications industry and on the latest standardization efforts. While establishing ties with the IETF and ISOCORE in the United States, the event featured extensive exhibitions and demonstrations as well as technical paper presentations. In Japan, we need this sort of consortium-type research and development style and global impact in order to enable the creation of de facto standards.

REFERENCES

[1] http://www.isocore.com/sdn-mpls/

[2] http://www.isocore.com/

[3] E. Mannie (Editor), "Generalized Multi-Protocol Label Switching (GMPLS) architecture", IETF RFC3945, Oct. 2004.

[4] N. Yamanaka (Editor), "Understanding MPLS, GMPLS, photonic networks and SDN" (in Japanese), Ohmsha (2014)

iPOP2014 Hot Lectures

Eiji Oki
Professor, Graduate School of Informatics and Engineering
The University of Electro-Communications

Kohei Shiomoto
Project Manager, Information Network Laboratory Group
Nippon Telegraph and Telephone Corporation

Hiroaki Harai
Director of Network Architecture Laboratory
Photonic Network Research Institute
National Institute of Information and Communications Technology

1. Overall

For the tenth iPOP (International Conference on IP + Optical Network), the iPOP program committee planned a program comprising keynote lectures, invited lectures, general lectures and poster presentations centered around the subject of software-defined networking (SDN) for communication carriers, where high reliability, monitoring and operability are the prime concerns (Table 1). There was a fairly even balance of Japanese and foreign presenters, with ten from Japan, seven from the United States, one from Italy, and one from South Korea. In this article, we first describe one of the keynote lectures and one of the invited lectures, focusing on the lectures about trends in large-scale network administration and control techniques for collaboration with data centers and collective administration of multiple domains in systems built around SDNs for the transport network. We also introduce the technical sessions relating to the application of SDNs in packet transport and optical networks, which are the central topic of iPOP each year, and two new trials that were performed at iPOP to mark its tenth anniversary — a joint session on network virtualization and network function virtualization (NFV) with the IEICE Technical Committee on Network Virtualization, and a discussion entitled "Current status and challenges of SDN and NFV toward future of transport network" with panelists invited from Japan and overseas.

2. Keynote speech

Yukio Ito of NTT Communications gave a keynote speech with the title "Next Steps in the SDN/OpenFlow Network Innovation". He started out by discussing how increases in traffic and equipment/operating costs can impact on revenue growth in communication service providers, and showed how a fast, high-capacity and instantly reconfigurable network can resolve this issue. He then described how a total line capacity of 8 Tbps (100 Gbps per wavelength × 80 wavelengths) is provided between Tokyo

Table 1: iPOP2014 technical program

Thursday 22, May 2014	
	iPOP Plenary Presider: iPOP Organizing Committee Co-Chair ***Opening Address*** - Naoaki Yamanaka, iPOP General Co-Chair, Keio University, Japan - Bijan Jabbari, iPOP General Co-Chair, Isocore, USA ***Keynote*** K-1 Yukio Ito, SVP Service Infrastructure NTT Communications, Japan K-2 Justin Dustzadeh, Ph.D. CTO & VP Technology Strategy Networks, Huawei, USA ***iPOP Exhibition introduction*** - iPOP Exhibition Co-Chair ***Local arrangement / Lab tour introduction*** - iPOP Local arrangement Co-Chair
Exhibition Showcase	***Technical Session 1: SDN for Optical Networks*** Chair: Motoyoshi Sekiya, Fujitsu Labs America, USA T1-1 Xiaoyuan Cao, KDDI R&D Labs., Japan T1-2 Takaya Miyazawa, NICT, Japan T1-3 Sota Yoshida, Mitsubishi Electric Co., Japan
	Business Session Chair: Akihiro Nakamura, TOYO Corporation, Japan B-1 Chris Liou, Infinera Corporation, USA B-2 Atsushi Iwata, O3 Project, Japan B-3 Alex Henthorn-Iwane, QualiSystems, USA B-4 Toshal Dudhwala, Ixia, USA B-5 Hiroaki Harai, NICT, Japan B-6 Hidenori Inouchi, Hitachi, Japan B-7 Allen Umeda, Spirent Communications, USA
	Poster Session / Exhibition P-1 Julien Thieffry, Keio University, Japan P-2 Sam K. Aldrin, Huawei Technologies, USA P-3 Masa Iwashita, A.I.Corporation, Japan P-4 Shaheedul Huq, Coriant, USA

Friday 23, May 2014	
	Technical Session 2: Software-Defined Networking and Network Virtualization Chair: Itaru Nishioka, NEC, Japan T2-1 Shinya Ishida, NEC, Japan T2-2 Shuji Ishii, NICT, Japan T2-3 Takumi Oishi, Hitachi, Japan
Exhibition Showcase	***Invited-talk Session:*** Chair: Kohei Shiomoto, NTT, Japan I-1 Young Lee, Huawei, USA I-2 Ming Xia, Ericsson Research, USA I-3 Jin Seek Choi, Hanyang University, Korea
	Technical Session 3: Traffic Engineering and Resource Optimization Chair: Shoichiro Seno, Tokushima Bunri University, Japan T3-1 Paparao Palacharla, Fujitsu Laboratory of America, USA T3-2 Asato Kotsugai, Keio University, Japan T3-3 Gianmarco Bruno, Ericsson Telecomunicazioni, Italy T3-4 Victor Yu Liu, Huawei Technologies, USA
	Joint session of IEICE Technical Committee of Network Virtualization and iPOP Chair: Katsuhiro Shimano, NTT, Japan J-1 Hirokazu Takahashi, NTT, Japan J-2 Michiaki Hayashi, KDDI R&D Laboratories Inc., Japan J-3 Akihiro Nakao, The University of Tokyo, Japan J-4 Yasunobu Chiba, NEC, Japan
	Closing Panel Session by iPOP Technical Program Committee "Current status and challenges of SDN and NFV toward future of transport network" **Panelists**: Akihiro Nakao (Univ. of Tokyo), Shuji Ishii (NICT), Shinya Ishida (NEC), Young Lee (Huawei), Meral Shirazipour (Ericsson), Katsuhiro Shimano (NTT), Xiaoyuan Cao (KDDI Labs) **Coordinator**: Kohei Shiomoto (NTT)
	Closing by iPOP Organizing Committee Co-Chair

and Osaka as a packet transport network (PTN) that provides a next-generation high-capacity network, and how a colorless, directionless, contentionless (CDC) reconfigurable optical add/drop multiplexer (ROADM) can switch traffic to another path even when two paths have failed, taking the experiences of the Great East Japan Earthquake as an example. He also showed how an economical network providing fully meshed packet paths at edge routers can be implemented by introducing packet transport, instead of the conventional method where packets are aggregated together with a core router in order to make the network more economical.

As a flexible network architecture, he described the efforts being made to implement SDN/NFV, which allows uniquely differentiated services to be provided very quickly. He described how NTT Communications provides cloud services from data centers spanning ten different countries around the world, and is able to use network controllers and OpenFlow switches to provide network resources rapidly within data centers and between data centers when there is a request from a customer. End-to-end communications are implemented using a virtual local area network (VLAN) and multi-protocol label switching (MPLS), with settings made automatically by the SDN controller to form a VPN.

He also described a concept whereby various services can be provided by using an SDN controller to control hardware such as OpenFlow switches, gateways and packet optical nodes, and providing NFV functions such as WAN access routers and firewalls at the edges, and a VOLT system that allows SDN networks to be designed and tested under the same conditions as their actual operating environment.

Finally, he introduced the Okinawa Open Laboratory for the promotion of SDN and cloud computing research, and the O3 Project, which aims to implement an SDN with multi-layer network integration functions that speed up the reflection of data between physical and virtual networks, and recommended promoting the spread of SDNs while contributing to the Open Networking Foundation (ONF).

3. Invited session

At the invited session, Young Lee (Huawei, USA) made a presentation on the subject of Abstraction and Control of Transport Network (ACTN), which is the theme of a new discussion started by the Internet Engineering Task Force (IETF) (Photo 1).

The aim of ACTN is to visualize a transport network consisting of vendor islands with (each with their own set of technologies) as a single entity, and to create a virtual environment for managing this network in order to achieve virtualized network operations.

The transport networks of communication carriers generally consist of multiple domains, with each domain forming a vendor island (a network domain configured from equipment made by the same vendor). The transport network is configured from multiple vendor islands in this way because different vendors use different

Photo 1: Invited talk on ACTN

technologies with different operating policies. The difficulty of operating between different vendor islands has for many years presented a challenge to communication providers that operate transport networks. When a new service is introduced, crossing between multiple vendor islands entails a great deal of design work and manual maintenance.

At ACTN, deliberations are under way with the aim of scaling up existing services by speeding up the deployment of network services and improving conventional network operations. ACTN defines the methods and capabilities that are used to operate transport network resources. Its provisions include a function for abstracting network resources on lower layers and showing them to applications and users on higher levels, a function for slicing infrastructure resources and connecting customers in order to satisfy the requests of specific applications and users, calculation methods for servicing diverse customers requesting connectivity or network resources via an information model, virtualized network controllers, and an open interface with virtualized topology.

Virtual network operation is a use case of ACTN, for which ACTN aims to establish a standard API and virtualization techniques. Another possible use case of ACTN is its application to a global data center. At the IETF, an ACTN BoF (Birds of a Feather) is being planned, and is expected to coordinate requests from diverse carriers.

4. Technical sessions

The application of SDN to optical networks is been studThe application of SDN to optical networks has been studied. The lectures on this subject, including a live ShowCase demonstration, are introduced below.

Xiaoyuan Cao (KDDI R&D Laboratories) discussed an optical packet switching application of SDN (for a technical overview, see the lecture presented by Takaya Miyazawa (NICT) in the same session), as a study into accommodating dynamically fluctuating traffic levels.

Sota Yoshida (Mitsubishi Electric) examined architectures where OTN is applied to SDN, and discussed methods for using a SDN adapter to utilize GMPLS signaling. The SDN adapter transfers the control frames of conventional network elements to a network management system. He also introduced three factors including signaling in each domain, which makes it easier to identify fault locations and allows optical paths to be set up faster and more easily.

There is a demand for uninterrupted transfer from IP/MPLS networks to SDN-based packet transmission networks. Shinya Ishida (NEC) discussed a technique for using stateful path computation elements (PCEs) to migrate from IP/MPLS networks to packet transmission networks. He introduced an IP-integrated transport network (ITN) as a solution for implementing a software-defined transport network.

Takumi Oishi (Hitachi) proposed a method for using network virtualization technology to migrate diverse existing networks such as IP networks, ATM networks, SDH networks and frame relay networks to a network with multiple integrated services.

Shuji Ishii (NICT) discussed the design and implementation of the RISE 3.0 OpenFlow/SDN test bed, which was started in 2011 as a public service on the JGN-X (Japan Gigabit Network eXtreme) network.

5. Joint sessions

The joint sessions were planned by the IEICE Technical Committee on Network Virtualization and the iPOP Program Committee with the aim of stimulating technical fields that cross over between the domains of cutting-edge network virtualization technology and optical IP network technology. This session comprised four lectures.

The lecture on Lagopus (Hirokazu Takahashi, NTT) introduced the design of a software-based OpenFlow switch called Lagopus (version 1.3), and a prototype implementation of the switch. The main target of Lagopus is providing the performance and functions needed when applied to wide-area networks. It was revealed that a Lagopus prototype with a flow processing performance of the order of 10 Gbps can be implemented on Intel x86 server equipment by using the latest multi-core CPU and a network input/output interface.

In the lecture on inter-domain virtualization (Michiaki Hayashi, KDDI R&D Laboratories), an inter-domain virtualization technique was introduced whereby SEP is introduced to establish connections between different virtualized domains. In an inter-domain architecture using SEP, it is possible to connect control planes and to convert between the data frames of different virtual domains by defining a common application interface (API) and slices.

The lecture on FLARE (Akihiro Nakao, University of Tokyo) introduced the FLARE architecture for making data planes programmable. FLARE uses a many-core processor instead of ASICs, thereby making the processing of packets programmable. The lecture reported on the FLARE design concept, which facilitates hierarchical resource management using general processors, many core processors and many types of processor, and on a prototype implementation and its performance.

The lecture on management and orchestration architecture for NFV (Yasunobu Chiba, NEC) discussed the issues of implementing NFV in practice, and the management and orchestration architecture needed to provide service level guarantees. Concentrated management and orchestration functions are needed to configure network services in NFV. It was reported that providing service level guarantees entails estimating the logical computing resources and controlling their allocation to physical resources.

Photo 2: Closing panel session

6. Panel sessions

Although packet-optical transport (the main theme of iPOP) is a transport network architecture of the future, communication providers have a choice of transport technologies. Candidate technologies for the packet transport include IP, MPLS(-TP) and Ethernet, and candidate technologies for the optical transport include OTN and WSON. With the availability of these choices, communication providers are looking closely into what sort of packet-optical transport to design, and how it should be operated.

SDN is a technology that has attracted attention in recent years, and it is believed that it will play an important role in the operation of transport networks by telecom operators in future transport networks. By using SDNs, communication carriers can separate the control frames from network equipment and implement their own independent operational policies.

NFV is another technology that has attracted interest in recent years. When network functions such as SGSN/GGSN (Serving General packet radio service Support Node/ Gateway General packet radio service Support Node), firewalls, NAT (Network Address Translation), CDNs (Content Delivery Networks), load balancers and DPI (Deep Packet Inspection) are virtualized and deployed on a transport network, these network functions can be selected and connected together to implement a wide range of network services. NFV allows communication providers to configure a wide variety of network services by implementing network functions in software, and commercial IT virtualization technology can be used to consolidate these services in a data center on the carrier cloud. In the carrier networks of the future, NFV and SDN are expected to be promising enablers of service orchestration. In other words, they enable the integrated management and control of multi-technology transport networks and network services.

This subject formed the background of the panel discussion. The facilitator of the panel discussion was Kohei Shiomoto (NTT), and the panelists were Akihiro Nakao (Univ. of Tokyo). Shuji Ishii (NICT), Katsuhiro Shimano (NTT), Xiaoyuan Cao (KDDI Labs), Shinya Ishida (NEC), Young Lee (Huawei) and Meral Shirazipour (Ericsson). The panel held lively and thought-provoking discussions on the following topics: (1) Do we have enough software development resources in the SDN/NFV era? (2) Standard-driven or Open-source-driven? (3) What do operators say about the real pain points? (4) Multi-domain issues? Vendor islands? Organization domains? Virtual network operation? (5) Is it easy to deploy and operate a nationwide SDN/NFV network? (6) Should IP be integrated into the transport network (O-PTN)? (7) Should optical nodes be controlled by a SDN? (8) What is the role of optics in the SDN/NFV era? (Photo 2)

Nakao argued that the success of SDN/NFV depends on the creation of talented programmers, and introduced the concept of toy blocks as an example of the foundations necessary for the construction of an ecosystem where this can happen. Shimano talked about open-sourcing the Lagopus high-performance SDN/OpenFlow software switch for wide-area networks. Ishii introduced the operation and current state of RISE (the national wide-area SDN/OpenFlow network), and discussed how troubleshooting in a wide-area integrated environment will become more refined. Cao introduced European projects such as STRAUSS, and discussed how a SDN can be very useful as a means of connecting between domains with diverse optical transport integration and domain interconnection. Shirazipour introduced some examples of the use of NFV in optical networks.

Cover Art

Meisho Edo Hyakkei Fukagawa Susaki Jumantsubo

(Jumantsubo Plain at Susaki in Fukagawa Province, from the series One Hundred Famous Views of Edo)

Utagawa Hiroshige (1797-1858)

Woodblock print:
Courtesy of Sakai Kokodo Gallery

Exhibits and Demonstrations at iPOP2014

Masaki Fukui
Vice President Business Unit Manager, Applied Network Integration Business Unit
NTT Advanced Technology Corporation

Yoichi Sato
Director, Technology Development,
NTT Communications

Takehiro Tsuritani
Senior Manager, Photonic Transport Network Lab.,
KDDI R&D Laboratories Inc.

1. Introduction

The iPOP 2014 exhibition was held in the Convention Hall at the NTT Musashino R&D Center. As shown in Figure 1, this event featured a showcase exhibition in addition to the exhibition booths set up by a total of 21 different businesses and organizations. Most of the exhibitors had come to introduce their work on Software Defined Networking (SDN) and OpenFlow technology. This article introduces the exhibit relating to the O3 (Open Organic Optima) project, where research and development is being done on the SDN technology needed for wide-area networks, and the Software Defined Transport Network (SDTN) interoperability demonstration. A brief introduction to some of the other exhibits is also provided.

2. O3 Project exhibition

The O3 Project is researching and developing SDN technology needed for wide-area networks (NWs). At this year's event, it exhibited integrated visualization technology for wide-area NWs using an abstract NW model, and unified management technology for multi-layer NWs consisting of packet/optical transport. In SDN technology for wide-area NWs, the key consideration is how to absorb the discrepancies of the diverse NWs that constitute the wide-area NW. In the O3 Project, individual NWs are represented by the abstraction of an object-oriented data model, and the operator functions that process objects aim to resolve this abstraction by extending to conform with the characteristics of the user. In the integrated visualization technology exhibited here, the topology of the NW is represented as a graph consisting of nodes, ports and links, where information about the communication and paths in each NW (Flow information, MPLS/optical paths, overlay tunnels, etc.) is abstracted as flow information. Furthermore, since these abstract NW models are used to perform inter-NW control functions such as virtualization and hierarchization, they also define control models such as Aggregator (aggregates an entire NW as a single virtual node), Slicer (splits a NW into multiple virtual NWs), Federator (integrates multiple NWs into a single entity) and Layerizer (condenses multiple layered NWs into a single hierarchy). Among the centralized management technology for multilayer networks, exhibitors presented multi-layer management control technology and optical cut-though technology aimed at packet transport NWs and optical core NWs. In the multi-layer management control technology, resource management control is performed to allocate the traffic of upper layers by searching for resources from the resource pool of lower layers to satisfy a request in response to a NW resource request from an application. In optical cut-through technology, the user is provided with low-latency communication quality by making proper use of packet and optical core NWs according to user requests, and by setting end-to-end optical direct paths where necessary. Outline descriptions of these technologies were given at the business session presentations, and at the O3 booth it was exhibited as a demonstration using panels and video footage.

3. SDTN interoperability demonstration showcase

At the iPOP2014 showcase, a 100Gb-class core metro access optical network (simulated) was built between data centers (also simulated) belonging to six businesses, and was used to demonstrate how unified transport control can be achieved using Software Defined Transport Network (SDTN) technology. Photo 1 shows the booths of each company participating in the interoperability demonstration. The optical network connecting

Figure 1: Booth allocations and a photo of the event in progress

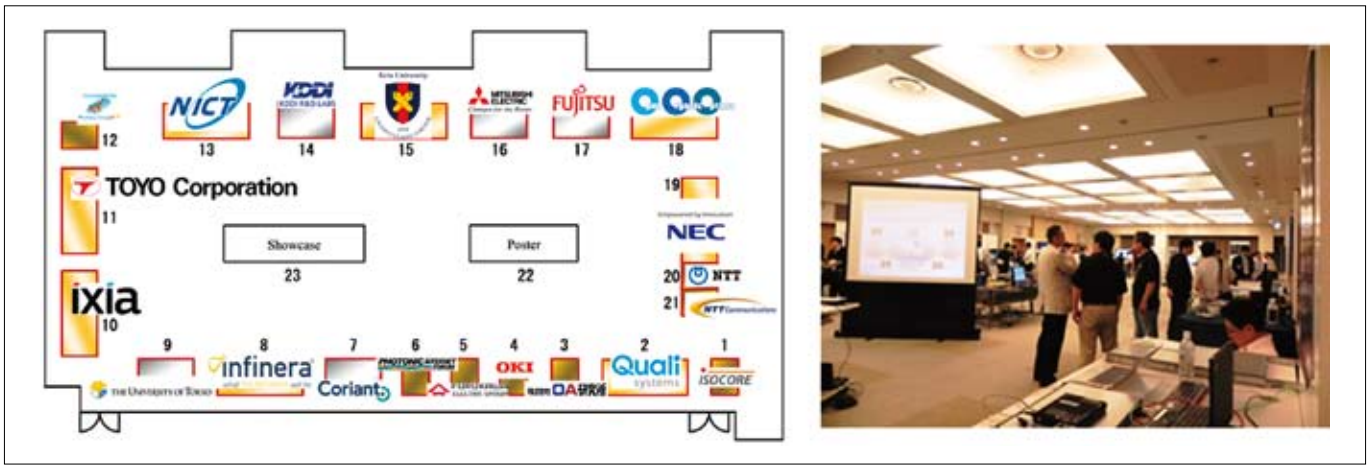


Photo 1: The O3 project exhibition

between the data centers consisted of a 100 Gbps optical wavelength division multiplexing (WDM) transmission system (provided by Mitsubishi Electric Co., Ltd.) and a 100Gbps-class optical packet/optical circuit integration node (provided by the National Institute of Information and Communications Technology) as a metro core optical network, and the access part connecting the simulated data centers (provided by Ixia and Toyo) was made from prototype next-generation optical aggregation network equipment (provided by Keio University) with elastic properties. These different types of equipment were centrally controlled by SDN/OpenFlow-based integrated control equipment (provided by KDDI R&D Labs), and the system successfully configured individual virtual optical networks according to requests (bandwidth requests) from the simulated data centers. The core, metro and access optical networks each have their own network control equipment, and supply information about their own managed physical networks to the integrated control equipment (SDN controller) as simple logical networks, enabling the control of large-scale optical networks including 100Gbps-class transport networks. The companies participating in the showcase brought actual equipment to the exhibition hall, and performed demonstrations by connecting with the booths of other companies. Details can be found online at http://www.pilab.jp/ipop2014/exhibition/whitepaper.html

4. Other exhibits

In addition to the organizations participating in the showcase and the businesses participating in the O3 project, two overseas vendors of transmission systems — Coriant and Infinera — also joined in to introduce their SDN systems called "Packet Optical SDN" and "SDN for Multi-Layer Core Networking", respectively. The overseas software vendor QualiSystems also took part, and introduced software for automating Agile networks (SDNs, cloud networks, etc.) and test environments under the theme of "Automation for Agile Infrastructure". The University of Tokyo performed demonstrations of technology including high-speed processing on real equipment by implementing Software Defined OpenFlow version 1.3 on the "FLARE" Deeply Programmable Network Node architecture. Also, Oki Electric Industry and Furukawa Electric, exhibited technologies called "SDN access area network for fixed and mobile services with virtualized PON", and "Wavelength Selective Switch", respectively.

5. Summary

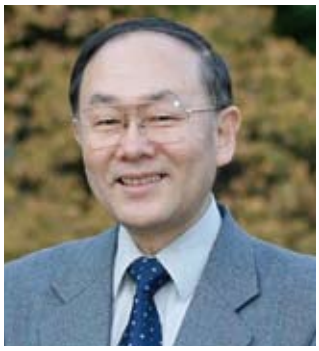
The themes dealt with at iPOP have evolved over its ten-year history, starting with cooperation between optical and IP networks, and then moving on to GMPLS (Generalized Multi-Protocol Label Switching) control, data planes such as MPLS-TP (Transport Profile) and 100Gbps optical transmission, and then network control based on SDN. But although these technologies have changed, it is expected that technical developments will continue to be made in the enhancement of networks through collaboration between data planes and control/management planes. The idea of OpenFlow with a separate D-plane and C-plane is thought to have provided the idea that it is possible to make independent advances in each area of expertise in hardware and software. In the future, we can expect independent developments in each technical field. For example, to cope efficiently with increasing levels of traffic as on the Internet, the further increases in capacity of transmission technologies such as 400Gbps optical transmission and 400Gbps packet transport are mainly the result of advances in hardware technology. On the other hand, to adapt flexibly and promptly to increasingly diverse services, it is expected that SDN/NFV technologies that implement software-defined data planes and network functions in commoditized switches and servers will be further enhanced by incorporating software technology cultivated from cloud technology. Having passed its ten-year milestone, iPOP is expected to continue driving the evolution of new network technology for the next ten years.

Photo 2: Booths of companies participating in the SDTN interoperability demonstration using 100Gbps-class optical network equipment

Ixia Communications K.K. | TOYO Corporation | Mitsubishi Electric Corporation | National Institute of Information and Communications Technology (NICT) | Keio University | KDDI R&D Laboratories, Inc.

WASEDA University

Waseda University's Relationship with the ITU



Mitsuji Matsumoto
Professor
Department of Electronic and Photonic Systems
School of Fundamental Science and Engineering
Waseda University

1. Introduction

Nowadays, the environments of our daily lives are shaped by diverse rules and standards that are the same all over the world. Standards are now as ubiquitous as the air we breathe. At the same time, the global environment is also changing year by year, and there is a need for the construction of diverse new frameworks.

The ITU is an international organization that promotes international standards for networks, systems and services that make it easier for people to use telecommunications. However, now that the world is facing various problems due to global changes in the environment, it is seeking out new alliances with academia, especially universities.

The first such opportunity arose at a consultation meeting on cooperation between ITU-T and universities, which was held in Geneva in January 2007. For ITU-T, the purpose of this meeting was to explore the policy of reflecting the wisdom of universities in the process of international standardization, while the universities also wanted to discuss the details of their contributions and the benefits of an alliance with the ITU. At this meeting, it was decided that an international Kaleidoscope academic conference would be held jointly by the ITU and academia. The first of several Kaleidoscope conferences was held in May 2008, and the sixth was held in June 2014.

2. Setting up an academic membership system

The ITU also reviewed its membership system and introduced a new academia membership category with reduced annual fees. The first 17 academic members were admitted in January 2011 and their number has now increased to 87. The activities of academia members in the ITU can be broadly summarized as follows:

(1) Participation in ITU standardization meetings
(2) Participation in Kaleidoscope academic conferences
(3) Education about standardization

In particular, the participation in Kaleidoscope academic conferences has from the beginning involved the submission of many academic papers, which are submitted and presented in the same way as at conferences held by international academic societies. The name Kaleidoscope was chosen to reflect how current issues are explored from a multitude of different viewpoints at these conferences. In addition to basic ICT technologies, Kaleidoscope conferences also invite papers on applied technologies including aspects of media design, systems theory, and social environment issues.

3. Examples of Waseda University's activities

Waseda University joined in response to the first call for academia members in January 2011. This decision was made partly because there were many people at the university with experience in international standardization activities in telecommunications and partly because Waseda University had signed a memorandum of understanding with ITU headquarters, ITU-T, ITU-R and ITU-D.

Since the university offers courses about standardization, we were also involved in ITU standardization activities and recognized the need for education about standardization.

(1) Participation in standardization activities by specialists in ITU-T activities

Since we took up academia membership, our faculty staff and students have participated in SG meetings and have submitted written contributions on ITU standardization

Due to the growing number of faculty staff participating in ITU Study Group meetings, we recently set up an on-campus ITU standardization liaison committee to exchange information between the related parties.

In the future, the attendance and written contributions of academia members are likely to increase if Web meetings are held more widely.

(2) The importance of education about standardization at the ITU

At the ITU, the contents, syllabuses and model examples of standardization courses are discussed in workshops and in ad hoc groups that are under the direct control of the standardization director. Education and research are the university's basic activities, of which education about standardization forms a part. Education about standardization is provided at many Japanese universities. Here at Waseda University (both independently and in partnership with Osaka University) we have introduced courses by standardization specialists in the field of ICT, with lectures covering the viewpoints of standard technology, fields of application, systems and communication policy. Academic societies (IEICE, IIEEJ, etc.) in Japan are also exploring how to implement standardized education in conjunction with ITU activities, but Waseda University has also taken the initiative in this field.

(3) Participation in Kaleidoscope conferences

Japan has from the very beginning submitted many written contributions to the Kaleidoscope international conferences. In the past, papers submitted from Japan have featured among the awards for the top three papers and young scientist encouragement awards every year. Waseda University has featured three times in the top 3 paper awards, and three times in the young scientist encouragement awards. We are also supporting international activities by holding internships at the ITU headquarters.

4. Conclusion

We have discussed our involvement in the ITU as an academia member, from the viewpoint of education and research.

Amid calls for more internationalization in Japan, the system of academia membership is highly effective as a forum for research into various issues on a global scale, and for providing an educational setting for active involvement in the international community by the next generation of young scientists.

= A Serial Introduction Part 2= Winners of ITU-AJ Encouragement Awards

In May every year, the ITU Association of Japan (ITU-AJ) proudly presents ITU-AJ Encouragement Awards to people who have made outstanding contributions in the field of international standardization and have helped in the ongoing development of ICT.
These Awards are also an embodiment of our sincere desire to encourage further contributions from these individuals in the future.
If you happen to run into these winners at another meeting in the future, please say hello to them.
But first, as part of the introductory series of Award Winners in 2014, allow us to introduce some of those remarkable winners;

Yasuyuki Hatakawa
KDDI Corporation
ya-hatakawa@kddi.com http://www.kddi.com/english/
ITU-R SG5 WP5D

My experiences working with the ITU

The author's first experience of an ITU meeting was the inaugural WP5D in January 2008. This was followed by four other meetings, in which he was assigned the task of revising the recommendations relating to unwanted emission in IMT-2000. During this period, he not only took part as the Japanese delegate at the meetings, but was also involved in joint negotiations with China and South Korea at the CJK meetings. He also worked on investigations and proposal requests for additional provisions to the standards developing organizations (SDOs) to avoid affecting the operation of existing systems. He finally succeeded in having the content of these amendments aligned with the Japanese radio equipment regulations, contributing to the effective use of radio resources, and made a small but significant contribution to international roaming on IMT-2000 terminals brought into Japan from overseas.

During this activity at the ITU, he gained three impressions.

- In standardization, it is very rare for the assertions of one's own country to pass unopposed, and in almost all cases it is essential to ascertain the permissible range of the other negotiating parties and strive for a relaxed outcome that overlaps with the permissible range of one's own country.
- Regardless of one's own interests, it is far more exciting to bear a large responsibility and take on topics at the center of a discussion instead of being a calm bystander. It also enables the formation of human networks.
- In off-line negotiations and the like, the distances between one's own standpoint and those of the other negotiators are very important, as is the need for a confident attitude. To achieve this, it is of course essential to be fully prepared before taking part in the meeting.

The author is currently removed from standardization and is in a position to make business strategy, but to enable him to fuse standardization strategy and business strategy in the future, he would like to support the promotion of standardization that can thrive in business by taking on a role that connects between the two.

The author would like to thank everyone who helped out during the author's period of activity at the ITU.

Anand R. Prasad
NEC Corporation
anand@bq.jp.nec.com http://www.nec.com/
3GPP SA3, GISFI and TSDSI

Security and Standardization for Successful Mobile Communications

Standardization paves the way to global markets. This is particularly evident in the field of mobile communication, where standardized technology is used all over the world. Since mobile communication is an integral part of human society, security / cyber attacks can have major implications, thus making secure solutions a must. But the risk of attacks is not the only reason for elevating the importance of security. Security — in the form of subscriber authentication — is an integral part of mobile communications businesses to ensure that subscribers are billed correctly for the services they use. This is done using standardized security tools, which are of key importance to the success of mobile communications on a global scale. This is where my role comes in. I am the chairman of 3GPP SA3, the group that specifies mobile communications security, and I have been active in Indian security standardization for several years in GISFI (Global ICT Standardisation Forum of India) as chairman of the Security & Privacy working group. Recently, I have also been involved in TSDSI (Telecommunications Standardization Development

Society, India).

Mobile communications technology is evolving so fast nowadays that the technology on the market changes completely every ten years, and thus requires new standards. Today we are once again in the phase where new standardized technology for mobile communications is needed. The use cases for this new technology will be very different from what we have today, because mobile communications has already penetrated into the deepest parts of human society all over the world. This means that the security requirements and the requirements of security will also change. In the future, I will therefore continue to apply my skills in security and standardization to the development of the next generation of mobile communications technologies.

Last but not least, I am really grateful to ITU-AJ for this award. I would never have got this far on my own, so I must also thank my colleagues, friends and family for their support in making this happen. I will carry on doing whatever I can to develop mobile communications and security solutions to make life better for everyone.

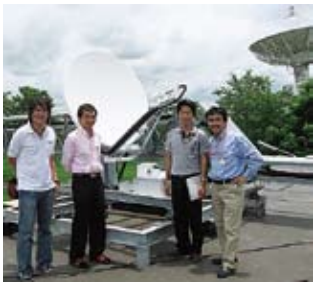
Hidetoshi Saito
KDDI CORPORATION
hd-saitou@kddi.com http://www.kddi.com/english/
Satellite Communications Engineering and Consulting, ITU-R SG4 WP4A, WP4C

A bright international community where it is possible to learn and develop with close international cooperation and collaboration

I have participated in transmission trials of the Kizuna (WINDS) ultrafast Internet satellite to provide everyone in the international community with equal access to high-speed telecommunication services, and observation data distribution trials for the new Himawari 8/9 meteorological satellites, which aim to provide better disaster prevention capabilities. Through this work, I have learned the importance of maintaining an attitude of close cooperation, collaboration and shared learning with people in the local country in order to establish fruitful international partnerships. In southeast Asia and Pacific island countries, trials have been performed to verify the effectiveness and feasibility of bringing parabolic antennas and high-speed communication equipment to the local area in order to implement services such as e-learning trials and transmission trials of high-resolution/high-quality cloud imaging and weather information. These trials have continued to entail hard work such as carrying measuring equipment around in field studies of radio interference, getting high-performance test equipment accepted through customs, and then setting up and performing experiments in the rain. But with the tremendous support of local partners, we were able to clear all the experimental tasks.

The unfailing support of our local partners has been a common theme in all our experiments, allowing us to respond quickly and appropriately to a series of unforeseen situations. As a case in point, when satellite communication is afflicted by rain attenuation (its worst enemy), we teamed up with local partners to investigate, learn and discuss the issues to find how they could be addressed. Cases like this where problems were solved in together with local partners are too numerous to mention.

Though we may speak different languages and live in different cultures with different customs, we have equally large expectations of realizing new initiatives aimed at the development of a better lifestyle and society for everyone. Through this activity we have built a mutually educational and sympathetic relationship with the local people, and have experienced how international cooperation is a driving force that can overcome diverse issues.



Around the "Kizuna (WINDS)" user earth station

In the future, I hope we can keep on contributing to the international community to share the benefits of international friendship while making a sincere effort to make the most of expertise that has so far been built up.

Yumiko Takano
KDDI CORPORATION
yumi@kddi.com http://www.kddi.com/english/
ITU-R WP5D

Report ITU-R M.2243 (Services for IMT systems and future market trends) approaching completion

I have been involved in the activities of ITU-R SG5 Working Party 5D since the ninth meeting in Chongqing, China, which was held in October 2010. Since the tenth meeting, I have mainly been working towards the completion of the new report ITU-R M.2243 ("Assessment of the global mobile broadband deployments and forecasts for international mobile telecommunications").

Since April 2011, I have also been working as chief investigator for the ARIB standardization committee, where I have been

studying various factors (technological, market-related, etc.) with a bearing on the advancement of mobile broadband, and preparing contributions to new reports setting forth Japan's policies and the prediction of future traffic based on these factors. The concept of future traffic prediction turned out to be the hardest thing I had to coordinate, and there were constant discussions on this issue. This is because smartphones and other such devices became popular in many different countries during overlapping periods, so every country had a clear set of ideas and proposals relating to this matter. As Japan's representative, my job was to set forth Japan's contributions, and during this period I gained valuable experience of the skills needed at an international conference — (1) listening, (2) speaking, (3) reading and (4) writing.

We have now moved forward from these discussions, and are currently discussing the shape of the new future vision of society that will be invited in by mobile technology. We have also laid out the pathway to a future world based on advanced technology, which is very interesting. Given the opportunity, I would really like to do whatever I can to take part in future standardization activities as a member of this new global movement.

The scarcity of Japanese women in the International Telecommunication Union (ITU) is, I think, a matter of some concern. I feel that it is my duty to actively participate in the International Telecommunication Union (ITU) to raise the profile of Japanese women and vigorously engage in various standardization activities in the future.

Takeshi Yamamoto
NEC Corporation
t-yamamoto@bu.jp.nec.com http://www.nec.com/
ITU-R WP5A, AWG

Standardization of advanced Intelligent Transport Systems (ITS)

In the area of ITS, electric toll collection (ETC) systems using Dedicated Short Range communications (DSRC) have been deployed in many countries. According to ITU-R Recommendation M.1453, DSRC at 5.8GHz only supports a maximum data transmission rate of 4Mbit/s.

To extend existing ITS applications and achieve traffic safety combined with a reduction of environmental burden in the transportation sector, R&D and standardization projects on advanced ITS radiocommunications have been actively conducted in several regions, including Europe, North America and Asia-Pacific. For example, in Japan, Safe Driving Support Systems have been studied intensively as a way of reducing traffic accidents. Part of the 700MHz frequency band has been assigned for use with these systems in the new Digital Dividend spectrum allocation and the relevant ARIB standard (ARIB STD-T109; "700MHz band ITS"). These works include not only vehicle-to-infrastructure (V2I) communication but also direct vehicle-to-vehicle (V2V) communication with latency of no more than a few hundred milliseconds and a range of a few hundred meters or more. To accommodate hundreds of vehicles in the communication range and allow them to exchange information with such low latency, higher data rate wireless access technology is needed for advanced ITS radiocommunications.

To share the progress in standardization and relevant activities in each region, Japan proposed the creation of a new report on Advanced ITS radiocommunications in 2009. Since then, I have been working as the editor of the report in WP5A, and developed Report ITU-R M.2228 on advanced ITS radiocommunications in November 2011. This report describes the characteristics and requirements of Advanced ITS. It also describes the situations in Japan, Korea and Europe to share standardization and relevant activities.

Since standardization and the relevant activities on advanced ITS are still ongoing in each region, Report ITU-R M.2228 is now under revision. The revision will be completed in July 2015.

Japan also proposed the development of a new recommendation on V2V and V2I communications (ITU-R M.[V2X]) in 2013, in order to prepare for their efficient deployment on advanced ITS. This recommendation is expected to identify specific radio interface standards of V2V and V2I communications for ITS applications. The technical and operational characteristics described in the recommendation are to be based on current and existing frequency bands already identified for ITS and its applications.

I am also working as editor of ITU-R M.[V2X], and the work in WP5A is expected to be completed in July 2015.

I am delighted to be able to work as editor of the ITU-R recommendation and report on advanced ITS.

I am also attending Asia-Pacific Telecommunity Wireless Group (AWG) meetings to introduce the ITS activities in WP5A, and I would like to contribute closer cooperation between WP5A and AWG on further ITS activities.

State of Initiatives for 5G Mobile Communications Systems in Japan

—White paper, promotional organization, and international workshop—

Yoshinori Ohmura
Director
Land Mobile Communications Group
Research & Development Headquarters
Association of Radio Industries and Business (ARIB)

1. Introduction

Recently, mobile traffic has been increasing rapidly due to the spread of smartphones, tablets and other devices in daily life and business, and the expansion of services using mobile broadband. Further increases in traffic are also expected, with increasing new demand from smart meters and other M2M communication.

Also, as mobile broadband develops, demand from society is increasing, with demand for even more communication, and for more advanced functions and higher performance in the mobile communications environment expected.

Preparation to introduce the IMT-advanced, 4th-generation mobile communications systems is currently under way, and it is expected to handle future mobile communications requirements, in quantity and quality, and also contribute to further development of mobile services.

To build a mobile communications system to meet these kinds of demands, study of a 5th generation mobile communications system ("5G mobile") with a target of 2020 and beyond has begun in Japan and internationally in the past year or two.

There is much activity internationally, with International Telecommunications Union (ITU) conducting studies and Forums and other promotional organizations being established one-after-another in various countries.

Study is intensifying in Japan as well, covering the work at ITU-R and various countries, and the "2020 and Beyond AdHoc" Committee (20B AH) was established in September 2013 to facilitate cooperation with other countries, under the Advanced Wireless Communications Study Committee of the Association of Radio Industries and Businesses (ARIB).

A very important issue in implementing 5G mobile is to plan communication and cooperation among people in a wide range of fields, not only those related to information and communications. To promote this, the Fifth Generation Mobile Communications Promotion Forum (5GMF) was established in September, 2014. The Fifth Generation Mobile Communications Systems International Workshop 2014 (5GWS) was also held in October 2014 to commemorate establishment of the 5GMF. ARIB and The Telecommunication Technology Committee (TTC) serve as the secretariat.

This article reports on initiatives for 5G mobile in Japan, including the organization of study within 20B AH and outcomes from 20B AH: publication of a white paper, establishment of the 5GMF promotional organization, and the 5GWS event. This article was written by a member of 20B AH and 5GMF secretariat.

2. 20B AH and White Paper

The leader of 20B AH is Mr. Takehiro Nakamura (NTT DOCOMO), and deputy-leaders are Mr. Akira Matsunaga (KDDI) and Mr. Takaharu Nakamura (Fujitsu). There are 32 participants (as of Sept. 30, 2014). One of the outcomes of its activities is the production and publication of a white paper in English.

2.1 Organization of Study in the 20B AH

Two Working Groups (WG) were established to conduct study, as follows.

1) Service and System Concept WG (WG-SC)
   Studies terrestrial mobile communications service and system concepts for 2020 and beyond, not limited to IMT. Mr. Akira Matsunaga (KDDI) acting as chairperson.
2) System Architecture & Radio Access Technology WG (WG-TECH)

Figure 1: Maximum system capabilities of 5G RAN

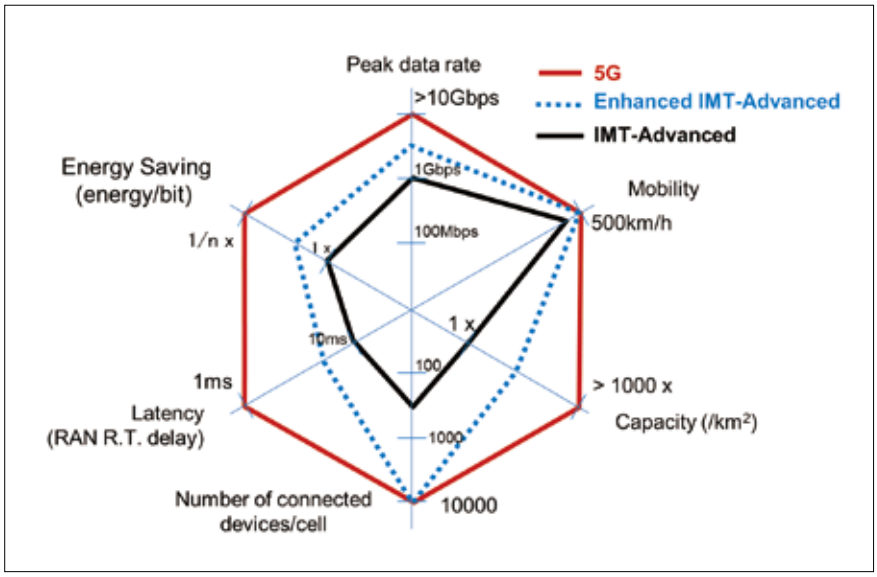
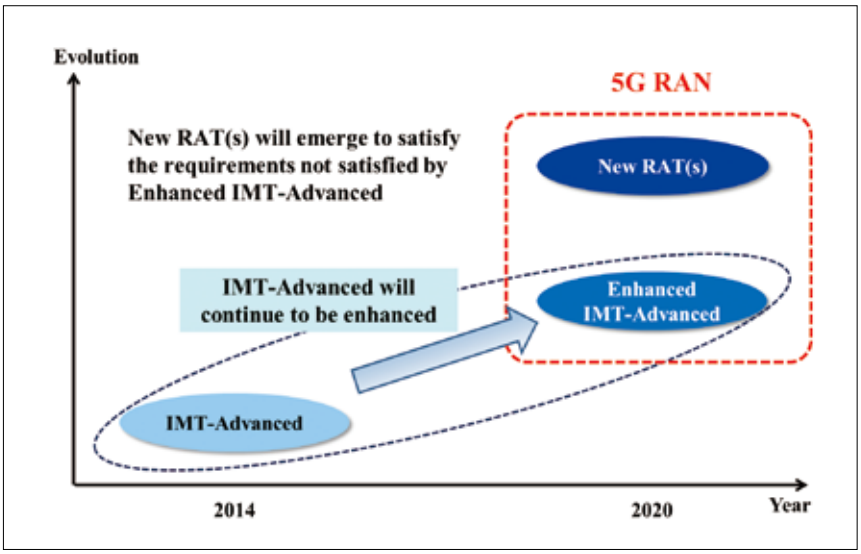


Figure 2: Road to 5G Mobile



Surveys and studies expected technology trends, in light of the study being done by the WG-SC, regarding candidates for technologies that will need to be applied when building terrestrial mobile communications systems for 2020 and beyond. Mr. Takaharu Nakamura (Fujitsu) acting as chairperson.

2.2 White Paper Content

The "Mobile Communications Systems for 2020 and beyond" white paper summarizes study results related to system concepts and technology trends for mobile communications systems in 2020 and beyond.

In terms of system concepts, it incorporates results regarding market and user trends, traffic trends, costs, frequency spectra, usage scenarios, requirements and characteristics of mobile communications systems in 2020 and beyond. In terms of technology trends, it incorporates results regarding wireless access and networking technologies that could be used for mobile communications systems in 2020 and beyond.

This white paper has been published on the ARIB web site and can be downloaded at the following URL:

http://www.arib.or.jp/ADWICS/2020bah-E.pdf

Figure 1 shows the maximum system capabilities required of the 5G Radio Access Network (5G RAN), indicating major performance improvements in capacity, communication speed, number of connected devices, and latency. Figure 2 shows the road to 5G, including implementation of complementary interworking among Enhanced IMT-Advanced and new radio access technologies (New RAT). Both figures are excerpts from the white paper.

2.3 Future Activities

Study of services and technologies for 5G mobile has been taken over by technical committees established in 5GMF.

20B AH will function as point-of-contact for exchange of information related to 5G mobile, between 5GMF and the Advanced Wireless communications Study Committee.

3. Establishing the 5G Mobile Communications Promotion Forum

The Radio Policy Vision Council organized by the Ministry of Internal Affairs and Communications (MIC) gives the roadmap for 5G mobile, including establishing a promotion organization within 2014, to strongly promote collaborative initiatives among industry, academia and government, under "Medium-term Arrangement" (July 2014).

With this background, ARIB in collaboration with the Telecommunications Technology Committee (TTC), established preparation office to prepare for establishing the 5GMF.

3.1 Founding General Assembly

On September 30, 2014, the founding general assembly of the 5th Generation Mobile Promotion Forum was held at the Meiji Kinen Kan in Moto-akasaka, Minato-ku, Tokyo. A total of 125 people participated, from 42 companies including telecommunications operators and wireless communication device manufacturers, as well as universities and other research facilities and the Ministry of Internal Affairs and Communications (MIC).

Photo 1: Guest and key persons at 5GMF

Hiroomi Kira
Director-General of the Telecommunications Bureau, MIC

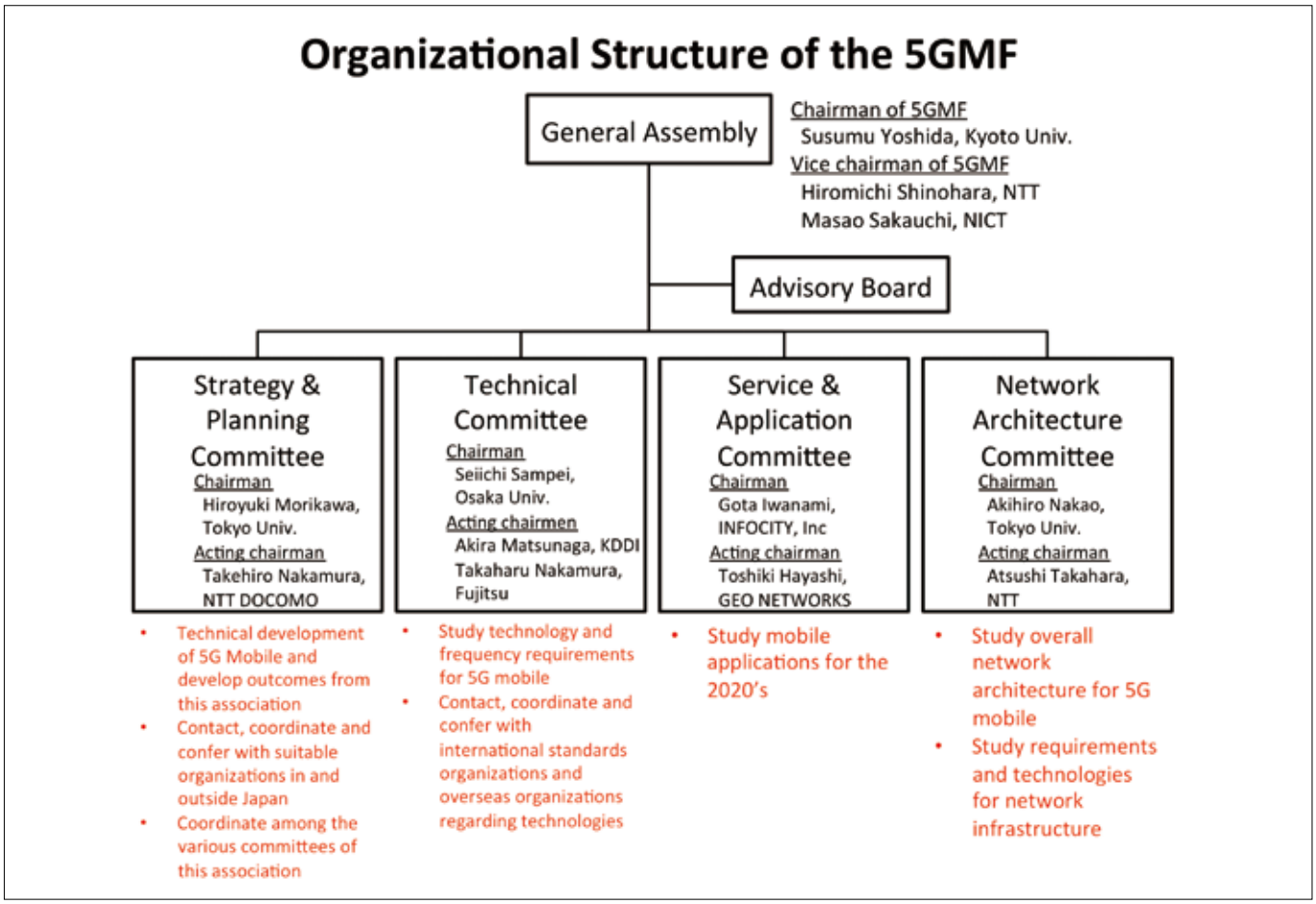
Mitsutoshi Hatori
Representative of the Founders

Susumu Yoshida
Chairman

Masao Sakauchi
Vice chairman

Hiromichi Shinohara
Vice chairman

Figure 3: 5GMF Promotion organization



It began with a greeting from special guest Hiroomi Kira, Director-General of the MIC Telecommunications Bureau.

Then, representing the promoters of the 5GMF, Mitsutoshi Hatori, Professor Emeritus from University of Tokyo, explained the significance of the event, the resolutions establishing the 5GMF were adopted, and the Articles of Association were approved.

Next, the officers were elected, with Susumu Yoshida, specially-appointed professor emeritus at Kyoto University, as chairperson, and co-vice-chairs, Masao Sakauchi, President of NICT, and Hiromichi Shinohara, Senior Executive VP of NTT.

The principles for establishing the committees were adopted and the chairpersons were designated. The promotion organization of the 5GMF and the main roles of each committee are shown in Figure 3.

Also, the business plan and income and expenditure budget for FY2014 were adopted and advisors were delegated.

Membership, as of January 6, 2015, included 13 experienced academic individual members, 52 ordinary members, and three special members (from MIC, ARIB, and TTC), totaling 68 members.

3.2 Founding Celebration Ceremony

After the founding general assembly, a founding anniversary ceremony was held, also at the Meiji Kinen Kan, with approximately 160 people attending, with an opening by Mr. Hatori, representative of the founders, and a report on the establishment of the 5GMF.

There was a congratulatory greeting from State Minister for Internal Affairs and Communications, Kousaburo Nishime, followed by a greeting from Chairman Yoshida. In the reception, the various committee leaders spoke about their aspirations, and there was enthusiastic talk about the new user scenarios that will come with 5G mobile among the many attendees.

Photo 2: State Minister for Internal Affairs and Communications, Nishime giving a greeting

4. 5G Mobile Communications International Workshop

4.1 Date, Time, and Location

1) Date and time: October 8, 2014 (Wed.), 14:00-17:30
2) Location: Makuhari Messe, Chiba, Japan

4.2 Objectives

During CEATEC JAPAN 2014, and prompted by the establishment of the 5GMF, the "International Workshop on 5G Mobile Communications Systems-2014" ("5GWS") was held, oriented to the viewing public, with the goal of developing the public understanding of international trends and future prospects for 5G mobile.

4.3 Workshop Overview

5GWS was held jointly by the MIC and ITU, bringing together representatives of organizations studying 5G mobile from Japan, Europe, China, and Korea, as well as international standardization organizations working on wireless communications. It included presentations and panel discussions on prospects for 5G mobile concepts, services and technologies.

It began with a greeting from Parliamentary Vice-Minister for Internal Affairs and Communications, Gaku Hasegawa, representing the sponsor, and from the Chief of the Study Groups Department, Radiocommunication Bureau of the ITU-R, Colin Langtry, representing the co-sponsor.

Then a keynote speech was given by Chairman of the 5GWS Organizing Committee and Chairman of the 5GMF, Susumu Yoshida, regarding the significance of the workshop and hopes and initiatives of the 5GMF for 5G mobile.

Five people gave presentations on the state of study in various countries, proposed services, contributions to wireless technologies and other topics.

This was followed by a panel discussion, with the presenters as panelists and Mr. Waichi Sekiguchi, editorial writer for Nikkei Inc., as moderator. Participants exchanged views from a range of perspectives regarding the implementation of 5G mobile, expansion into various Asian countries by enterprises from Europe, China, Korea, and Japan, activities of American companies like Apple and Google, and potential new business models.

The event was attended by more than 500 people—with standing room only—and ended as a great success. Table 1 shows the list of presenters.

5. Conclusion

This article has reported on the state of 5G mobile in Japan. The contributions of Japan to 5G mobile in the future, centered on the 5GMF, are much anticipated, including research on the details in the white paper, cooperative efforts with overseas organizations, and international standardization.

Table 1: List of presenters

Presentation	
Keynote Speaker	Dr. Susumu Yoshida (Professor Emeritus of Kyoto University) Chairman of 5G Workshop-2014 Organizing Committee
Speaker 1	Dr. Hakan Ohlsen (Ericsson) Vice Chairman, ITU-R Working Party 5D
Speaker 2	Dr. Werner Mohr (Nokia) Chair of the Board of The 5G Infrastructure Association, 5G Public-Private Partnership (5G PPP)
Speaker 3	Ms. Zhiqin Wang (CATR) Vice Chairman, IMT-2020 (5G) Promotion Association, China
Speaker 4	Prof. Youngnam Han (KAIST) Chairman of Steering Committee, 5G Forum, Korea
Speaker 5	Mr. Takehiro Nakamura (NTT DOCOMO) Leader, ARIB 2020 and Beyond Ad Hoc, Japan
Panel Discussion	
Moderator	- Mr. Waichi Sekiguchi (Editorial writer, Nikkei Inc.)
Panelist	- Dr. Hakan Ohlsen - Dr. Werner Mohr - Ms. Zhiqin Wang - Prof. Youngnam Han - Mr. Takehiro Nakamura

Photo 3: Opening greetings by representatives and panel discussion moderator

Gaku Hasegawa
Parliamentary Vice-Minister for
Internal Affairs and Communications (MIC)

Colin Langtry
Chief of the Study Groups Department,
Radiocommunication Bureau
(ITU-R)

Waichi Sekiguchi
Editorial writer, Nikkei Inc.

Preparation for V-Low Multimedia Broadcasting

Naruhiko Nihira
Multimedia Broadcasting Department
Tokyo FM Broadcasting Co. Ltd.

1. Introduction

V-Low multimedia Broadcasting is a new type of digital broadcasting being introduced in Japan in the VHF frequency band previously used for analog television. It is anticipated for developing a great variety of new services through a flexible system, utilizing the advantages of digital broadcasting. Preparation of the system was completed last year, and preparation to begin offering services is currently ongoing. Below, we give an overview of V-Low multimedia broadcasting and introduce some of the services being planned for the future.

2. The V-Low Multimedia Broadcasting System

According to the Radio Law, V-Low multimedia broadcasting is regulated as a core terrestrial broadcasting service for mobile receivers, using the 99 MHz to 108 MHz band. This definition indicates that it is a core broadcasting service intended to be installed and used in automobiles and other terrestrial vehicles, as well as portable receivers, it excludes satellite core broadcasting services. It does not indicate what will be broadcast, as did conventional television (video and audio) and radio (audio), so the system is able to broadcast various other types of content in addition to real-time broadcast of video and audio, such as stored broadcasts, which store data on the receiver and use it later, and IP datacasts (IPDC), which transmit IP packets used on the Internet as-is over the broadcast signal.

Another major feature of V-Low multimedia broadcasting is that broadcasting is done over broadcast regions called regional blocks, which span multiple prefecture-level areas.

3. V-Low Multimedia Broadcasting Technology

V-Low multimedia broadcasting uses the ISDB-Tsb system, which is based on ISDB-T, the system used for digital terrestrial television broadcasting. While digital terrestrial television broadcasting uses 6 MHz bands divided into 13 segments, V-Low multimedia broadcasting uses 4.5 MHz bands divided into nine segments. Receivers receive these nine segments in either three-segment or one-segment units. It implements broadcasting that can be received easily by smartphones or in vehicles by selecting a transmission mode that facilitates such reception, similar to One-Seg among the many broadcast modes of the ISDB-T system.

The base band is in the MPEG-TS format, so in addition to broadcasting audio and video in real time, it can use technology that embeds IP packets in MPEG-TS to deliver a diversity of digital content and services from the Internet over broadcast channels. Thus it can provide an information infrastructure able to distribute to many receivers at once.

V-Low multimedia broadcasting also has the following original technologies.

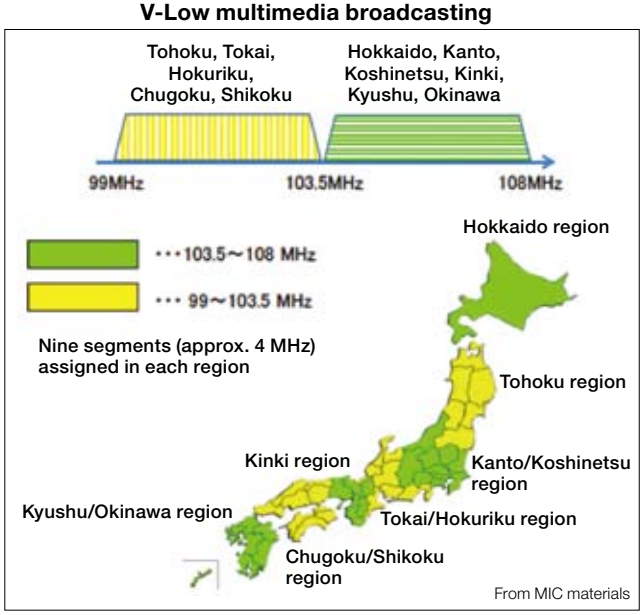
(1) High-quality audio broadcasting

Since V-Low multimedia broadcasting is oriented to mobile and vehicle reception, one of its focuses is audio services, which do not require viewing the screen. Recently, "high-resolution audio" ("Hi-Res"), with quality exceeding that of CD, has been attracting attention. To meet high sound quality needs of this sort, V-Low multimedia broadcasting eliminates the 48 kHz upper-bound on audio sampling rates and enables broadcast of sound sources at higher sampling rates such as 96 kHz. CD audio can only reproduce frequencies up to 22.05 kHz, but V-Low multimedia broadcasting can reproduce tones as high as 44 kHz at a bit rate of 256 kbps when using HE-AAC audio compression.

(2) Disaster-prevention and security information

Another focus of V-Low multimedia broadcasting is to continue the role that radio has had, as a means of delivering information in times of emergency or disaster. Radio is a familiar medium that is portable and can run on batteries, so it has an important role when disaster strikes. Using digital broadcasting technology, V-Low multimedia broadcasting promises to expand that role. One way it does so is with an automatic receiver wake-up function. An emergency earthquake warning can be sent on part of the digital broadcast signal called the auxiliary channel (AC). The AC signal is on the

Figure 1: Frequencies and broadcast regions for V-Low multimedia broadcasting



OFDM pilot carrier, so it can be received without demodulating all of the OFDM carriers. Thus, the automatic receiver wakeup can operate by demodulating only the AC signal, even when the receiver is turned off (or in standby).

In addition to warnings about earthquakes, tsunami, and flooding, V-Low multimedia broadcasting can be used to distribute regional disaster-prevention and security information such as instructions for finding shelter or refuge. The combination of this automatic wake-up signal and transmission of information will enable reliable transmission of information to more people.

4. V-Low Multimedia Broadcasting Services

V-Low multimedia broadcasting focuses on providing services in the following three categories.

(1) Smartphone and tablet Services

In addition to high-quality audio broadcasting, as an advanced form of radio, data broadcasts linked to programs can be provided using HTML5. If the terminal has a communication function, more-detailed content can be viewed by using links on the data broadcast screen to go to sites provided through communications. Video can also be transmitted according to the size of the terminal screen.

Stored-content services could also include distribution of a variety of content such as e-newspapers, e-books, e-pamphlets, coupons and game items.

(2) Vehicle information services

In addition to radio channels for drivers, traffic, tourism, event and other information can be distributed in real time. Update information for maps, location data, navigation system firmware and other components can also be provided as a vehicle engineering service.

(3) Disaster-prevention and security information distribution

Disaster information in text and image form can be provided in addition to the audio on the radio. Information is also marked with an area code, so it can be apportioned in even smaller regions within the same broadcast area. The V-Low multimedia broadcasting station is able to add voice or text information from local authorities directly to the broadcast, which also contributes to delivering information rapidly during emergency or disaster.

Figure 2: High-quality audio with HE-AAC

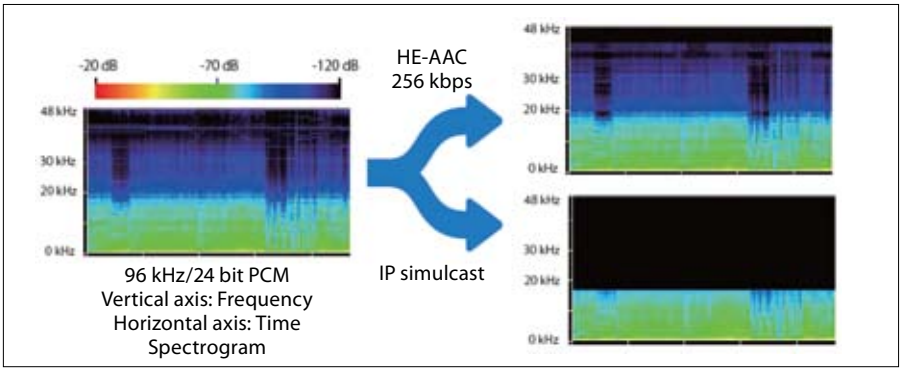
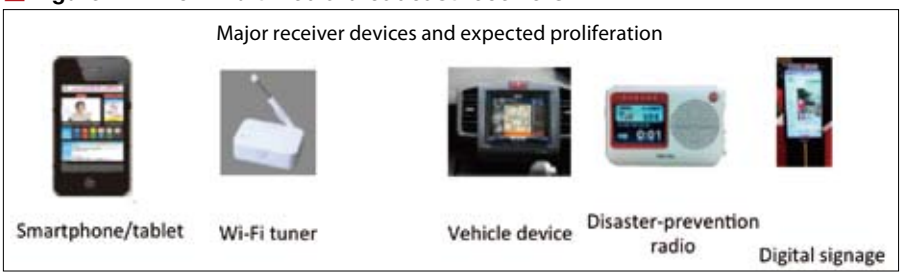


Figure 3: V-Low multimedia broadcasting service examples

Figure 4: V-Low multimedia broadcast receivers



5. V-Low Multimedia Broadcasting Receivers

Smartphones and tablets with the ability to receive V-Low multimedia broadcasts have already been developed. Devices able to receive V-Low multimedia broadcasts and send them to smartphones and tablets via Wi-Fi have also been developed.

Smartphones and tablets receive programs using an application provided by the broadcaster. Broadcasters can broadcast using new data formats by updating the application. V-Low multimedia broadcasting has an architecture that allows broadcasts to evolve as digital content technology advances.

V-Low multimedia broadcasting also anticipates use in public spaces, such as in digital signage and public wireless LAN. V-Low multimedia broadcasting also has potential to provide disaster information to many people during emergency and disaster, when other forms of communication are interrupted.

6. Conclusion

V-Low multimedia broadcasting has been conceived and designed to be flexible, surpassing the bounds of conventional broadcasting and covering domains of communication typified by the Internet. This new broadcast medium must become a part of the information infrastructure, unifying broadcasting and telecommunications in Japan. We will continue our initiatives developing these services.

Recent Standardization Activities in the Terahertz Communication Field

Akifumi Kasamatsu
Director, Terahertz and Millimeter wave ICT Laboratory, NICT Advanced ICT Research Institute

Iwao Hosako
Director General, NICT Advanced ICT Research Institute

Hiroyo Ogawa
Guest Expert Researcher, NICT Advanced ICT Research Institute

1. Introduction

In the Radio Regulation (RR), footnote No. 5.565 stated that the frequency band above 275 GHz can be used for experimentation with various passive services and active services, but in accordance with Resolution 950 (Rev.WRC-07), footnote No. 5.565 was revised in WRC-12 Agenda item 1.6 to add specific frequencies for use in passive service applications (earth exploration-satellite service (passive), space research service (passive), radio astronomy service), and to protect these passive services from harmful interference until the Table of Frequency Allocation for active services in the 275–1000 GHz band has been established.

On the other hand, the research and development of devices capable of operating at 275 GHz and above has made rapid progress recently, and advances are being made in the understanding of propagation characteristics in these frequency bands and the study of short-range high-capacity communication systems that can achieve data transfer speeds of 100 Gbps and above. In particular, in the field of short-range radiocommunication, it is expected that IEEE802.15.3d (standard for Wireless Personal Area Network (WPAN) systems) will be completed in the next few years. It is envisaged that this standard will be applied to systems that transmit data at 1–100 Gbps using frequency bands of 60 GHz or more in four use cases including kiosk and tollgate downloading systems.

To reflect these R&D and standard activities towards using the spectrum above 275 GHz in ITU-R studies, ITU-R WP 1A has already started a preliminary study aimed at facilitating sharing and compatibility with passive services in frequency bands above 275 GHz. This report overviews the current activity of ITU-R WP1A and discusses possible allocation of active services in the bands above 275 GHz.

2. Efforts of ITU-R WP 1A (Spectrum engineering)

2.1 New Study Question

Since other international standardization organizations have also been studying spectrum usage above 275 GHz, it is essential that the ITU-R study of spectrum use in various services clarifies issues such as the technical and operational characteristics of active services operating in the bands from 275 GHz to 1000 GHz, and the conditions whereby services for which frequencies have already been identified in RR footnote No. 5.565 can coexist in these frequency ranges without causing interference. Therefore, to address the research of the frequency spectrum above 275 GHz, at the ITU-R WP 1A meeting held in June 2012, Japan proposed a new study Question relating to the technical and operational characteristics of active services in the 275–1000 GHz band. This study Question involves studying the technical characteristics and operational characteristics required of active services using frequencies in the 275–1000 GHz band, and the need for sharing and compatibility studies on such issues. Information about this new study Question was provided to the other related WPs (Working Parties), and documents requesting the following information were sent out.

(1) Propagation data required for the planning of active services operating above 275 GHz
(2) Technical and operational parameters and the characteristics of active services operating above 275 GHz
(3) Sharing studies required for active services operating above 275 GHz

As a result, since information on Recommendations ITU-R P.676, P.838 and P.840 was provided from WP3M, and Report ITU-R RA.2189 from WP7D, a new study Question reflecting this information was submitted by Japan to WP 1A in June 2013, and was adopted by SG1 after its approval by WP 1A. Then, after it had been circulated to the ITU member states for approval, final approval was given in November 2013.

2.2 Preliminary draft new Report ITU-R SM.[THZ.TREND]

In June 2013, while a new study Question was being prepared, Japan submitted to ITU-R WP 1A a working document towards preliminary draft new Report ITU-R SM.[THZ.TREND] introducing technical trends of active services in the band above 275 GHz (focusing on technical trends such as terahertz wireless communication, sensing and imaging). At this meeting, the document proposed by Japan was carried forward to the next meeting as an attachment to the chairman's report.

At the meeting in June 2014, Japan made the following additional proposals.

- Revising the constitution of the Report with terahertz communication as a major theme, and revising the preamble based on the current state of affairs, including the presence of Resolution 118 (Marrakesh, 2002), changes to RR footnote No. 5.565 by Resolution 950 (Rev.WRC-07), approval of a new study Question regarding terahertz spectrum issue and the state of progress of IEEE802.15.3d.
- Adding a new section containing RR information from RR footnote No. 5.565 amended by WRC-12 Agenda item 1.6.

- Adding 300 GHz band transceiver technology and terahertz communication use cases, which resulted from the Ministry of Internal Affairs and Communications R&D program for the expansion of spectrum resources ("Research and development program on multi-Gbps wireless communication technology at subterahertz frequencies").
- Adding terahertz cameras, which resulted from an NICT funded project ("R&D of terahertz-wave technology for making society safe and secure with ICT")
- Adding other key terahertz technology trends — light sources capable of emitting terahertz light, material analysis trends, and non-contact evaluation methods.

The above additional proposals were agreed upon, but a new section on initial studies relating to sharing with passive services was provided as a trigger for future sharing studies. Since the contents were significantly updated, requests for comments were issued as liaison statements to the terahertz-related working groups ITU-R WP7C & WP7D, and to IEEE802. Japan also submitted a proposal for upgrading the working document to the preliminary draft Report, and the preliminary draft Report was attached to the chairman's report.

3. Efforts of the APT Wireless Group (AWG)

Frequency bands above 275 GHz are characterized by having shorter propagation distances due to attenuation, but it is possible to secure a wide bandwidth, as shown in Table 1. Therefore, the ITU-R draft Report cites three large-capacity short-range radiocommunication systems as examples of terahertz communication.

Meanwhile, although one of the AWG Task Groups (TG-SRD; TG-Short Range Devices) is researching technologies related to short-range devices, a new work item for study of short-range radiocommunication systems operating in the band above 275 GHz was submitted to TG-SDR from Japan and presented at the AWG-17 meeting on September, 2014.

Assuming that active services such as short-range radiocommunication systems using frequencies above 275 GHz will become globally widespread in a few years, this proposal summarizes the technical trends of short-range radiocommunication systems operating in the band above 275 GHz that are currently being studied by NICT and other companies, and the activities at ITU-R and IEEE 802, and recommends the study of short-range radiocommunication systems operating in the band above 275 GHz within AWG. This proposal also encourages APT member countries to discuss a new frequency allocation for active services in the frequency band above 275 GHz.

Table 1: Frequency range and contiguous bandwidth

Frequency range (GHz)	Continuous bandwidth (GHz)	Attenuation (dB/km)
200–320	120	< 10
275–320	45	< 10
335–360	25	< 10
275–370	95	< 100
380–445	65	< 100
455–525	70	< 100
625–725	100	< 100
780-910	130	< 100

4. Toward frequency identification and/or allocation above 275 GHz

Revisions to RR will be made at the World Radiocommunication Conference to be held in November 2015 (WRC-15), but since there is no WRC-15 Agenda item relating to the spectrum above 275 GHz, it will have to be approved during WRC-15 as a new Agenda item for WRC-19.

Usually when a new Agenda item is proposed for WRC, it is proposed to the APT Conference Preparatory Group (APG) meeting, and then proposed to WRC as an APC (APT Common Proposal). Preparations and negotiation within APT member countries should be made in accordance with this procedure.

In the future, based on discussions in ITU-R WP1A and AWG, a new WRC Resolution for spectrum identification and/or allocation above 275 GHz will be proposed to APG and discussed through negotiations with the other Regions at WRC-15.

5. Conclusion

NICT has pioneered the use of new frequencies at millimeter wavelengths (including the 60, 70 and 90 GHz bands), but there is now an urgent need for the development of new frequencies due to recent demands for high-capacity communication on mobile devices. It is therefore not only necessary to develop spectrum resources to enable the use of new spectral bandwidth, but also to modify the provisions of Radio Regulations that can create new active services in the band above 275 GHz. NICT plans to conduct research and development of terahertz frequencies while taking these points into consideration.

This work was supported in part by the R&D program on multi-Gbps wireless communication technology at subterahertz frequencies of the Ministry of Internal Affairs and Communications, Japan.

Ontake Volcano Observed by Airborne SAR (Pi-SAR2) Craters under the Volcanic Smoke are Found by the Radar Images

Seiho Uratsuka, Takeshi Matsuoka, Shoichiro Kojima
Jyunpei Uemoto, Toshihiko Umehara, Tatsuharu Kobayashi
Makoto Satake, Akitsugu Nadai
Applied Electromagnetic Research Institute
National Institute of Information and Communications Technology

The eruption of Mt. Ontake on September 27, 2014, overwhelmed many climbers and hikers, and 56 lives were lost in the area around the summit. The volcano has become much more active, and it has not been possible to discern conditions surrounding the crater due to smoke and clouds.

Synthetic Aperture Radar (SAR), which is able to reveal terrestrial conditions at night and during poor weather conditions, is particularly useful for determining conditions during disaster. In 1998, NICT developed an aircraft-mounted SAR (Pi-SAR) with resolution of 1.5 m. Pi-SAR is equipped with a polarimetry function, which uses polarization to discriminate details, and an interferometry function, which measures the altitude of the surface using two antennas simultaneously for stereo imaging. For the two volcanic eruptions occurring in 2000 (Mt. Usu in Hokkaido and Miyake-jima), airborne SAR was used for the first time, one week after the eruptions, as a means to determine the state of, and any changes in, the eruption. This also showed the general public, for the first time, how useful SAR observations could be in times of disaster. In these two volcanic eruptions, the ground rose or subsided by from tens to hundreds of meters in some areas due to the volcanic activity. The Pi-SAR interferometry function was able to show such topological changes in 3D. The polarimetry function was able to identify areas that had been blanketed in volcanic ash.

However, for the 2004 earthquake with epicenter in the Nakaetsu region of Niigata Prefecture, Pi-SAR did not have ability to identify the many, but small landslides occurring in the mountainous region. It also took considerable time to get the data to the site, where it was needed most. There is some urgency with a volcanic eruption, but for an earthquake, real-time knowledge of the state of the disaster can be very helpful. With this in mind, NICT began developing the new, Pi-SAR2, in 2006, with the objectives of being able to discern small-scale landslides and to share the data rapidly. Pi-SAR2 has 30 cm resolution, five-times that of Pi-SAR, and like Pi-SAR, has both polarimetry and interferometry functions.

In February, 2011, after performance testing of Pi-SAR2 was completed and full-operational testing had begun, Mt. Kirishima-Shinmoedake in Kagoshima Prefecture erupted, causing great damage to the surrounding region due to the intermittent volcanic ash. Then, in March, 20,000 lives were lost in the Great East Japan Earthquake and Tsunami.

After the Great East Japan Earthquake, preparation for observations began immediately, and the next morning, aircraft and equipment, which were at Nagoya airport, took off and made observations over a wide range centered on the Pacific coastline, from the Tohoku region to the Kanto region. Pi-SAR2 is able to record data continuously for approximately 50 km over a width of approximately 7 km. There are gaps in the data along the coastline due to course changes, but continuous observations of approximately half of the coastline were made. Observation data was partially processed on the aircraft, and after downloading, was sent to Koganei and published the same day. All data was brought back to the laboratory at NICT headquarters in Koganei, where additional processing was done. The ability to handle such a large-scale disaster rapidly shows that the overall objectives of developing Pi-SAR2 had been achieved.

However, through this experience, we realized that there were still outstanding technical issues with using Pi-SAR2 during disasters. Data was processed on the aircraft so that it could be provided rapidly, but the damaged area was larger than imagined and there was only time to process a small amount of the data, and it was difficult to process monochrome imagery (converting only one of the four data combinations obtained through polarimetry to images) in the aircraft. Processing data for this large of an area had not been anticipated in the laboratory, much less on the aircraft, and imagery was not produced till several days after the disaster. Further, the simple increase in resolution resulted in larger image files, so manual effort was needed to find a way to transmit the data, adding to the time required.

For the eruption at Mt. Shinmoedake, the risk of landslides due to the accumulation of volcanic dust had been identified, and there was a need to evaluate the accumulation (the depth) of volcanic dust. Comparing surface altitude measurements using interferometry could be useful for this problem. However, due to the overload of processing for the Tohoku Earthquake, it was not possible to analyze the data in a timely manner.

To resolve these issues and be able to process large volumes of data after an earthquake, NICT increased the speed of processing equipment. These improvements yielded the capability to process more than ten-times previous volumes. These results were applied to the airborne equipment as well. As a result, all polarimetry data from 3 km in all directions can be processed within 15 minutes using on-board processing. This is about the time required for aircraft to make course corrections, so equipment resources can be allocated to processing data during this time, while observations are not being made. We have also made other improvements and tested them, such as adding a function to transmit

from the aircraft to the ground using a commercial satellite (INMARSAT).

NICT conducted Pi-SAR2 observations on October 2, 2014; five days after the Mt. Ontake eruptions began. From 12:45 to 14:30 on that day, Pi-SAR2 took observations along nine courses in various directions surrounding the Mt. Ontake summit, which was billowing smoke and hidden by clouds. The aircraft was at an altitude of approximately 13,000 m, but could obtain imaging resolution of 30 cm, even at this height.

Most of the nine observation paths were along North, South, East or West directions, and after each observation, data was processed into images on the aircraft. All images in a 3 km square centered on the summit were output as color images synthesized from the polarimetry to a resolution of 30 cm. Pixel decimation and data compression was then done to reduce file size, and images were transmitted to earth, via commercial satellite, to the Coordinating Committee for Prediction of Volcanic Eruption (Japan Meteorological Agency office). They were also sent to related agencies through the Ministry of Internal Affairs and Communications.

An example of the transmitted images is shown in Figure 1. Zooming in on the image to 30 cm resolution (Figure 2), the hollow left by the eruption can be seen in detail, following a continuous line. This was only vaguely visible with earlier sensors. The nine sets of observation data, including these reported images, are available to anyone through the NICT Web site*.

NICT is continuing to advance development of technologies that will be useful in times of disaster.

Finally, we sincerely pray that those who were lost in these eruptions may rest in peace.

Figure 1: A Pi-SAR2 image of a 3 km x 3 km area around the summit of Mt. Ontake

The path of the aircraft is from right to left in the figure, and the direction of the radar sweep is from top to bottom. The arrow in the upper left of the figure indicates North. This is a pseudo-color image created using the polarimetry function, with parts shown in green indicating vegetation.

Scene Name	Pos1B
OBS Date (GPS time)	2014/10/2
OBS Time (GPS time)	3:43:07
OBS No.	2014100201
Sensor	NICT-SAR
Polarization Red	RX2-HHm
Polarization Green	RX1-HVm
Polarization Blue	RX1-VVm
Rg Resolution[m]	0.4
Az Resolution[m]	0.3
Range [km]	Rg 2.0 Az 2.0
Early Near (Lat,Long)	+035:53:58.69 +137:28:05.53
Early Far (Lat,Long)	+035:53:47.30 +137:29:24.05
Late Near (Lat,Long)	+035:52:54.81 +137:27:51.52
Late Far (Lat,Long)	+035:52:43.42 +137:29:10.04
Inc.Angle Near[deg]	54.2
Inc.Angle Center[deg]	56.0
Inc.Angle Far[deg]	57.6
Altitude[m]	13145
Flight Speed[m/s]	185
Flight Direction[deg]	190.1
Scene Direction[deg]	280.1

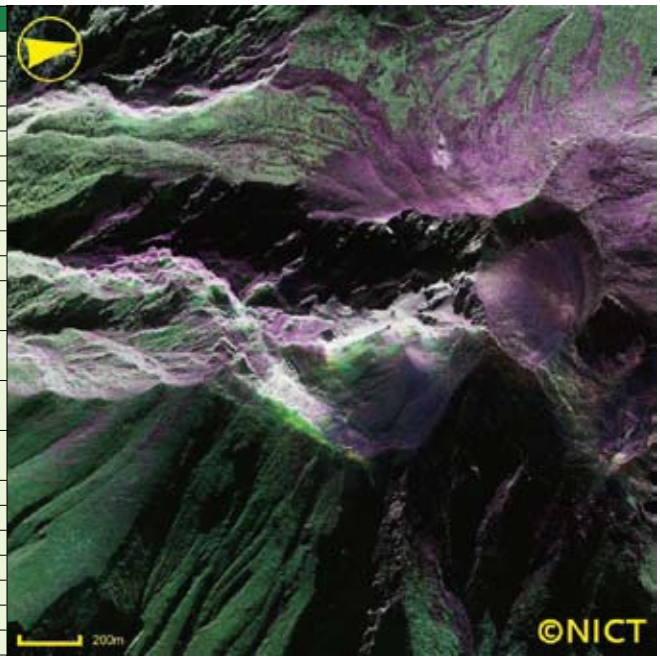
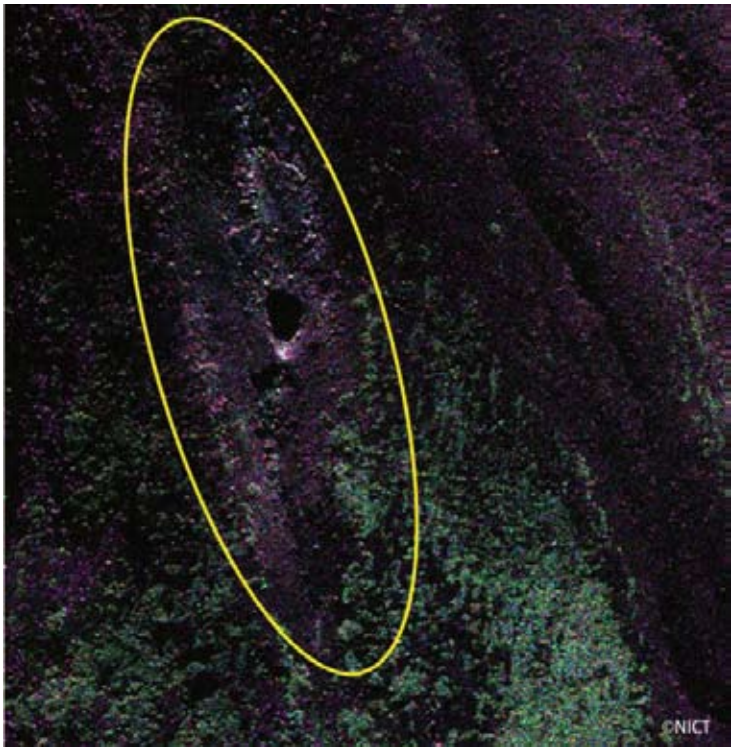


Figure 2: A Pi-SAR2 image of the summit of Mt. Ontake at approximately 12:51 on October 2, 2014

It is a magnification (300 m x 300 m) of part of Figure 1. The condition of the crater, which could not be seen in detail because it was hidden by smoke, can be distinguished clearly (part surrounded by the yellow oval).



* URL: http://www2.nict.go.jp/aeri/rrs/pisar2-ontake/index.html

JICA's Activities in the ICT Sector

Shigeki Miyake
Deputy Resident Representative, JICA Afghanistan Office

1. Diverse forms of offered by JICA

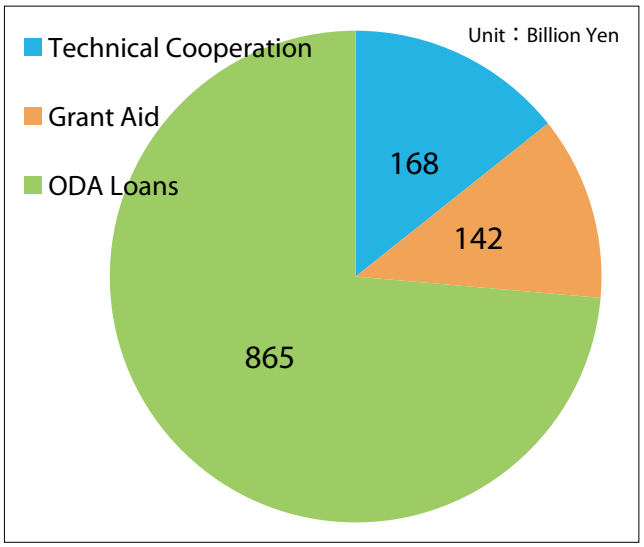
During the eight-year period from 1993 to 2000, Japan's track record in official development assistance (ODA) was the best in the world. However, the ODA budget has been steadily declining since then due to Japan's severe economic difficulties. Among the member states of the Organization for Economic Cooperation and Development (OECD) and the Development Assistance Committee (DAC), we are now ranked in fourth place behind the United States, the United Kingdom and Germany. Meanwhile, emerging donor countries like China and South Korea are also actively expanding their activities. In response to this international situation and the flow of administrative reforms within Japan, the government has worked on reforms including a strategic review of ODA policy and reinforcement of the ODA implementation system. As part of this initiative, with the aim of unifying the agencies delivering ODA, the New JICA was born in October 2008 to take over the overseas economic operations of the Japan Bank for International Cooperation (JBIC) and part of the grant aid work done by the Ministry of Foreign Affairs. This merger made it possible to organically coordinate various aid efforts including technical cooperation, ODA loans and grant aid, thereby allowing aid to be delivered more effectively and efficiently.

2. Outline of JICA projects

Figures 1 and 2 compare the JICA's aid (e.g. poverty reduction, peacebuilding, etc.) in developing countries in different schemes and in different regions within each scheme.

About three quarters of the total aid is provided as ODA loans (with repayments) on a larger business scale than other schemes, and the remaining quarter comprises grant aid and technical cooperation (with no repayments). ODA loans and grant aid are apportioned according to factors such as the income level of the recipient countries, and are mainly used to support "hard" projects like the construction of facilities and the procurement of equipment and machines. On the other hand, technical cooperation is used to support "soft" projects like dispatching technical experts and providing training in order to set up administrative systems, developing the capacity of government officials in the recipient countries, and so on.

Figure 1: Fiscal 2012 JICA's Operation Scale



In the breakdown by region, it can be seen that Asia accounts for a large proportion of all schemes. In particular, over 80% of the total amount offered as ODA loans is delivered in Asia, with which Japan has geographical, historical and economic ties, while grant aid and technical cooperation cover a wider geographical area and have a declining regional bias. In particular, since 1993 the Japanese government has been indicating a policy of supporting sustainable economic growth in Africa by way of initiatives such as the Tokyo International Conference on African Development (TICAD), and has thus been increasing its support for this region.

However, of the total amount devoted to technical cooperation, ICT (including broadcasting) only accounts for about 0.5%. This could be because this is a field where the private sector is strong, or because it is a fast-moving innovative field that is incompatible with the speed of ODA schedules, which can take some years to see through from planning to completion. However, ICT is often used as a tool in sectors such as education, medicine and governance, and it is thought that these numbers will increase if the use of ICT in many fields is also taken into consideration.

3. Items requiring action and items requiring attention in the ICT sector

When JICA is involved in the ICT sector, the following action items and attention items should be considered:

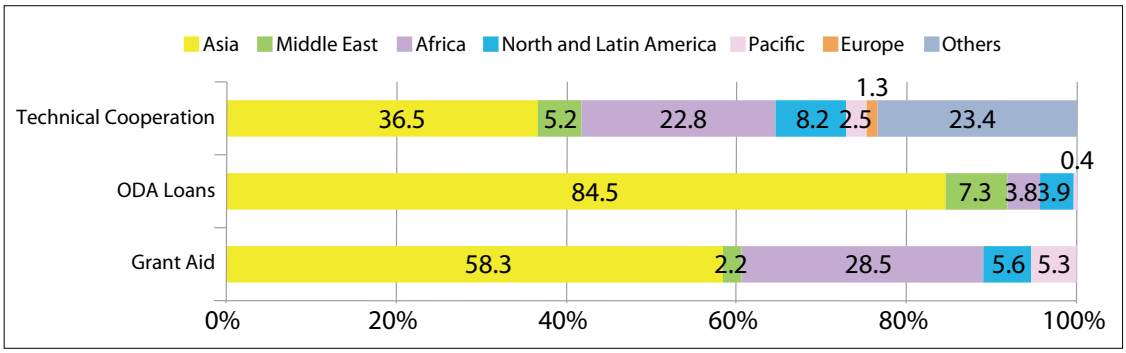
Action items:

ICT must provide a shared infrastructure that can be used effectively in all fields

ICT was once used mainly for fixed telephone and telegraph systems, but with improvements in the speed, capacity and mobility of communication, it is now a common tool used in all fields. For example, in technologies such as Intelligent Transport Systems (ITS) in transportation,

or Electric Data Interchange (EDI) systems in ports, it is expected that Japan's know-how can lead to improved functionality and efficiency in the recipient countries. In the future, it is expected that ICT will be used even more actively due to the development of applications and reductions in the price of terminal equipment, even in educational and medical fields. In practice, technology is evolving in a completely different way in developing countries compared with developed countries. For example, SMS messages sent over 2G mobile phones are being used to deliver services such as agricultural and medical information, and banking transactions. In developing countries, these services not only improve the lifestyle of their users, but are also said to improve the GNI by several percent.

Figure 2: Distribution by Region



Attention items:

Private participation in the ICT industry, and the possibility of transferring to private ownership.

In recent years, there has been intense competition between private-sector businesses in the ICT industry. Since ICT in developing countries is also led by the private sector, and since international organizations such as the World Bank also recommend the privatization of ICT sector, it is important to carefully consider the contents and scope of work in ODA initiatives. JICA also considers private involvement in developing countries to be a desirable movement, but when engaging in cooperative efforts, it is important to carefully consider their relationship to the national development policies of the target nation's government, especially their priority relative to developments in other fields, the intentions of privatization and private administration, and the ownership of the recipient countries at this time.

The need for comprehensive system development

Regarding the need for comprehensive system development, taking terrestrial digital television as an example, with ODA it is possible to provide support for studio equipment, transmitters and radio relay systems, but this is difficult until support has been provided for the distribution of terminal equipment capable of receiving terrestrial digital pictures to be installed at the receiving end. Therefore, when performing system development, it is necessary to check the state of comprehensive system development by public-private partnerships.

Responding to ever-progressing technological advances

Few people could have predicted the explosive spread of mobile phones, especially in developing countries. In this field, there are also concerns about technology rapidly becoming obsolete, but the JICA's cooperative projects also need to continue for a fixed period of time, so it is important to keep up with innovation trends.

4. JICA's efforts

JICA publishes a website containing its accumulated experience and knowledge, such as concerns about how to perform jobs, or the best way to cooperate in 23 different sectors, including ICT, education, transportation and health. We are working in the formation and implementation of cooperative projects based on the following basic policy for ICT.

- Improve the policy-making performance (in the recipient countries)
- Develop human resources and strengthen institutional capabilities
- Infrastructure development

In line with these basic policies, we take the recipient country's income level and technical level into consideration while strategically combining the schemes of ODA loan, grant aid and technical cooperation from the upstream stages, bearing in mind the formation of items that are highly effective and efficient.

- We help to raise awareness of the importance of ICT policy in the recipient country, and promote the active use of ICT by the recipient country.
- It is difficult to provide direct support to citizens of the recipient country with ODA, but with technical cooperation and the like, we can improve the ICT literacy of ordinary citizens at the nation's core by strengthening the governmental and institutional capabilities of the recipient country.
- Our policy with regard to infrastructure development is to build sustainable autonomous systems for maintenance and administration based on the recipient country's technical level and other characteristics.

5. Conclusion

By providing ODA for the development of infrastructure, human resource and the like, JICA should aim to resolve the development issues of target nations while at the same time developing business opportunities for Japanese businesses. In other words, it should preferably create a win-win situation that benefits Japan as well as the recipient country.

In addition to JICA's ICT cooperation policy, we are also sending out details of each project strategy and regional strategy in various meetings as well as publishing them on our website. Thank you for your continued interest in JICA's activities.

JICA Group Training Course 2014

— Construction and design of ICT infrastructure to bridge the digital divide in rural areas —

International Cooperation Department
The ITU Association of Japan

For about 6 weeks from July 24 to September 5, 2014, the ITU Association of Japan (ITU-AJ) held a group training course on behalf of the Japan International Cooperation Agency (JICA). This training course was aimed at cultivating expertise in the creation of infrastructure development plans to rectify the digital divide in rural areas of the trainees' countries and included theoretical and practical training in the establishment of effective and efficient rural communication network facilities and data transmission methods.

In previous business years, the ITU-AJ has held other training courses on behalf of the JICA: Rural telecom engineering (phase I) (1990–99), Rural telecommunication planning (phase II) (2000–04), Networking of rural community information infrastructure course (phase III) (2005–2009), and Capacity building for developing a communication and information environment in rural community (phase IV) (2010–2012). During the 23-year span of these four training courses, we have admitted a total of 243 trainees (including individual trainees).

Starting in the current business year, our latest training course follows on from these previous courses with the second year of phase IV (a three-year course). This year we welcomed twelve trainees from nine different countries — Bangladesh, Ethiopia, India, Myanmar, Pakistan, Peru, Samoa, Thailand and Tuvalu.

In the course lectures, the trainees first learned about the state of telecommunications in Japan (Outline of telecommunications in Japan), and were then given a general introduction to the theory of ICT development in rural areas (ICT development strategy: Global challenges for rural communities, Consideration to provide universal service, Development of rural telecommunications, and Fundamentals of rural telecommunication networks). The course also covered the key technology subjects necessary for network design, including Fundamentals of optical networks, Outline of cellular networks (W-CDMA), LTE technology (LTE Summary), and Sensor Networks. As an example of the implementation of a communication network in a rural area, we included an item on ICT Technology and frameworks needed for the introduction of ICT in villages called Actively Promoting The Use of ICT in Rural Areas. These items also included lectures on the state of recovery of mobile communication services following the Great East Japan Earthquake.

Regarding the analysis of designed networks, there were lectures on the issues that need to be covered in feasibility studies (Scope and Procedure of Feasibility Studies), and on the outline of project cycle management techniques.

As a practice exercise, the trainees performed network planning drills. This item involved a case study of six rural model areas based on the technical knowledge acquired so far in this training course. For each of these areas, the trainees designed and planned an optimal rural communication network. The results were announced each day, and were studied and discussed by each subject's instructor. This training course brought together the techniques acquired throughout the course,

Photo 1: Study group visiting Shintomi town in Miyazaki prefecture (1/2)

Photo 2: Study group visiting Shintomi town in Miyazaki prefecture (2/2)

Photo 3: Lecture at JICA Tokyo

Photo 4: Closing ceremony

and was well received by the trainees who were able to devise and apply plans back in their own countries using the techniques and knowledge acquired in this system design exercise.

As an actual case study of the construction and operation of a network for a rural region, we made a fact-finding visit to the town of Shintomi in Miyazaki prefecture. (Photo 1, Photo 2) In this town, a system called IRU (indefeasible right of user) was introduced in order to close the rural information technology gap. The IRU system is a form of state-funded privatization whereby the local government builds a network, which is then operated by communications providers.

The trainees also visited the Network Communications Factory of Mitsubishi Electric Corporation at Amagasaki to observe the latest ICT products. Furthermore, to inspect state-of-the-art telecommunications, the trainees visited the NTT Kansai R&D Open Room. Each visit was well received by the trainees, who not only experienced the nature of work first-hand, but also gained first-hand experience of the latest telecommunications technology.

On a study visit in the Tokyo area, trainees visited NTT DOCOMO's "Future Station" showroom, which shows the mobile telecommunication services of the near future, and NEC's "Innovation World" showroom, which shows NEC's latest technology. In these two study visits, the trainees also attended lectures on "Current Mobile Service Status" at NTT DOCOMO and "Wireless Broadband Access" at NEC.

At the final stage of the training course, the trainees proposed infrastructure development plans aimed at bridging the digital divide in actual rural regions of their own countries. They submitted these proposals to JICA as interim reports, and also delivered presentations. The interim reports made full use of not only network planning but also project management techniques (PDM: Program Development Matrix), and the network designs included considerations of financial aspects (including profitability), human resources, procurement, environmental effects, maintenance/operation, and future design plans. These were finally summarized as an interim report. When the trainees gave their presentations on the final day, there were active question-and-answer sessions. After the trainees had returned home, this interim report was shared with their companies, where the contents of the reports were brushed up to form (within two months) a final report which was submitted to the JICA.

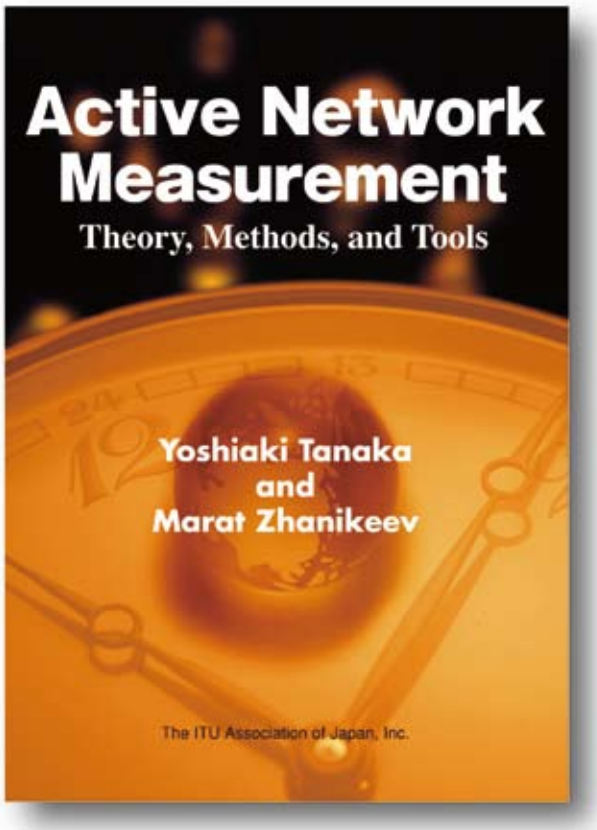
During the period of this training course, we lent PCs to the trainees in the hope that they would as a rule produce electronic text files on CD-ROM.

This training course received a number of good ratings from trainees, but from next year the ITU-AJ plans to clarify any issues that arise during the course by evaluating the content and text of lectures delivered by trainees at the end of the course, and listening to their appraisals, opinions and requests regarding site visits and field trips. By analyzing and investigating these evaluation results, we will shed light on the course's practical problems. (Photo 3, Photo 4)

ITU-AJ's Publication

Comprehensive Explanation of Active Network Measurement

Yoshiaki Tanaka and
Marat Zhanikeev



Ideal for network researchers and graduate students

ISBN978-4-916128-07-2
C3055 ¥2940E
Monochrome, 21×14.8×1.2 cm, 226 pages

CONTENTS

Available at

Amazon.co.jp

You can utilize "Help in English" at

http://www.amazon.co.jp/dp/4916128079/

BOOK DESCRIPTION

Active network measurement is a method and also a software tool that measures network performance as a result of sending probes along arbitrary paths. Each individual probe would normally traverse a certain path with given source and destination addresses thus resulting in the measurement of network performance characteristics along that path. Active network measurement is a basic building block of the technology and may be used as a powerful tool in defining the performance of a network through aggregating measurements from many individual paths. Active measurement is increasingly becoming important for network operation in the NGN era. NGN separates the control plane from the transport plane in new network design. The transport plane is composed of access and core IP networks that will be used to provide global connectivity in all-IP networks. The control plane is used to connect services and is defined in an abstract way so that services do not depend on underlying transport network technology. To provide end-to-end QoS in such networks, active network measurement is the only feasible technology today. Active network measurement is presented in this book both as an independent technology as well as an integral part of large-scale network performance management.

定価 一冊 一、六二〇円（本体価格 一、五〇〇円、消費税 一二〇円） 年間購読料 六、四八〇円（本体価格 六、〇〇〇円、消費税 四八〇円）