NTT Technical Review

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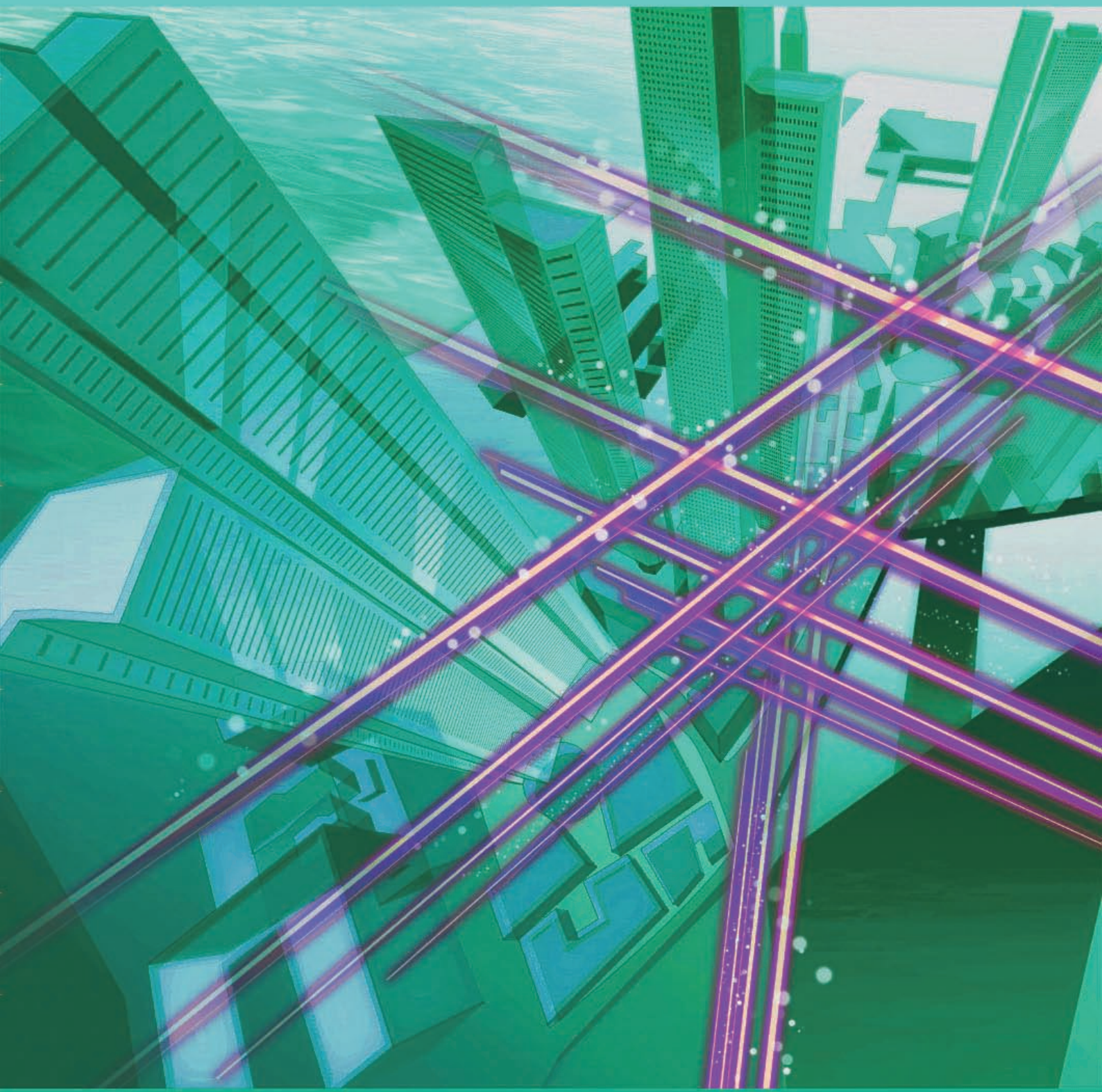

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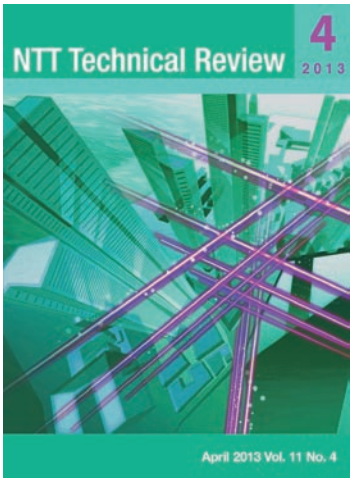


From a Provider to a "Value Partner"

Hiroo Unoura
President & CEO, NTT

Abstract

In the fall of 2012, the NTT Group announced a new Medium-Term Management Strategy titled *Towards the Next Stage*. This article introduces the NTT Group's new approach to business based on this strategy and presents the progress made so far in achieving established objectives. The content of this article is based on the keynote speech given by Hiroo Unoura, President and Chief Executive Officer of NTT, at NTT R&D Forum 2013, held on February 14–15, 2013.

1. The "value partner" that customers continue to select

The basic concept of the NTT Group's new Medium-Term Management Strategy can be summed up as a transition *from a provider to a "value partner"* (**Fig. 1**). Since taking up my post as president, I have been constantly highlighting the importance of this transformation from being a provider to a value partner especially in terms of "supporting the business model transformation of our corporate customers" and "supporting the enriched lifestyles of our individual customers." To achieve this transformation, the Medium-Term Management Strategy describes two key initiatives:

(1) Make global cloud services the key pillar of NTT's business operations to drive growth and change throughout the NTT Group.
(2) Raise the competitiveness of network services.

In the era of cloud computing, I believe that customers have more choices than ever before; that is, customers are no longer tied to one provider but can switch from one service to another as desired. Under such conditions, the ability to become the value partner that customers continue to select is exactly what being competitive is all about. There are various points to consider in becoming such a value partner, but I believe that we need to provide our customers with services that fit their needs (*suitable*), that are easy to use, including their charging schemes and user interfaces (*simple*), and that are safe and secure to use, especially in today's cloud era (*secure*). In this way, I think that customers will come to view us as a value partner.

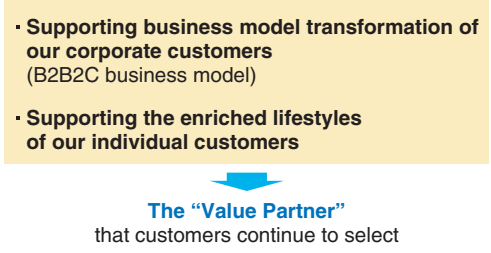


Fig. 1. From a provider to a "value partner".

2. Enhancement of cloud services

At present, the NTT Group provides services to over 10,000 global corporate customers. These, however, include customers to whom we provide only some portions of their systems. So our next challenges will be determining how to uncover the needs of such customers and how to increase the total number of customers.

In addition to its large customer base, the NTT

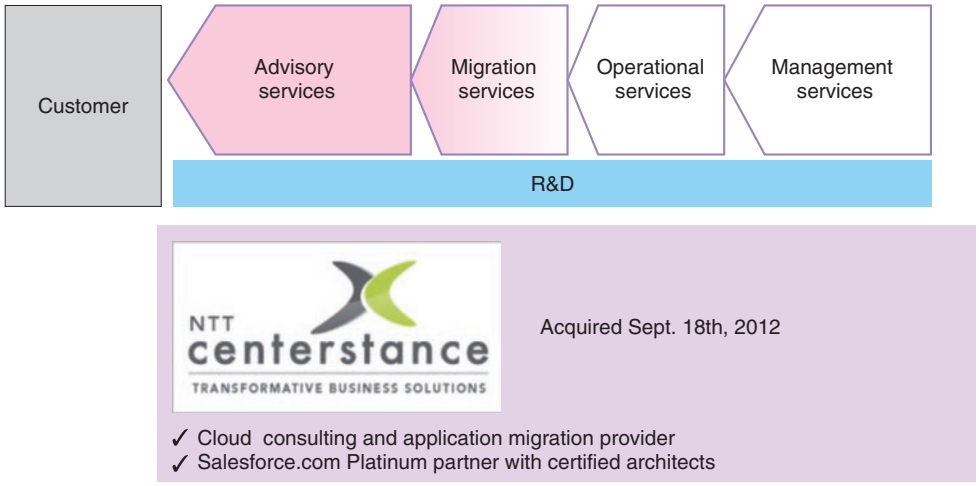


Fig. 2. Cloud migration support through R&D and M&A.

Group also has other strengths. Our world-class and high-quality datacenter is the largest in Japan and the second largest in the world. We also operate the second largest global IP (Internet protocol) backbone network in the world.

An evaluation provided by the industry analysis firm Gartner Inc. is well known as an index of service competitiveness on a global level. The NTT Group is presently evaluated as having a leadership position in the fields of cloud IaaS (Infrastructure as a Service), network services (Asia-Pacific region), and communications outsourcing and professional services. As we go forward, I would like to get the word out about the abilities of the entire NTT Group and to increase the number of fields in which we have a leadership position.

I would now like to talk about our strengths in the cloud business.

2.1 Cloud migration support

In migrating from customers' on-premise IT systems to the cloud, a corporate customer, especially its Chief Information Officer (CIO) and Chief Operating Officer (COO), will have a variety of concerns. These include *What will the IT cost be? What is the migration procedure? Can operations be performed safely and securely? and Can follow-up support be provided?* A cloud services provider must have the ability to offer the customer ample support to assuage these concerns.

NTT Group companies have been centered on operational services and management services, but with our acquisition in September 2012 of Centerstance Inc., a company specializing in cloud migration consulting, we now have the ability to provide full support with regard to cloud migration (**Fig. 2**). I am proud to say that we have become an all-around player that can provide a full-range of services from operational management to advisory services. As we look to the future, I would like to use the full power of alliances, mergers and acquisitions (M&A), and research and development (R&D) to enhance our ability to provide the various elements in the value chain and to provide full support.

2.2 Further strengthening of our cloud business

2.2.1 Enhancing the security platform

We are already providing information security services to over 50 countries. In this field, we possess cutting-edge R&D and a Computer Security Incident Response Team (CSIRT) befitting a world-class communications carrier. We also recognize that building a global security platform is a necessary condition for enhancing our existing platform. This is because the gathering of risk-related information and intelligence data globally gives us a significant advantage. And based on this global security platform, we plan to set up local platforms with the aim of fortifying our position as a top player in security services. To achieve our goals, it is essential that we tailor our security services to the needs of each country by adapting to local laws and regulations and establishing mechanisms for protecting personal information.

To give an example, we have developed a Security

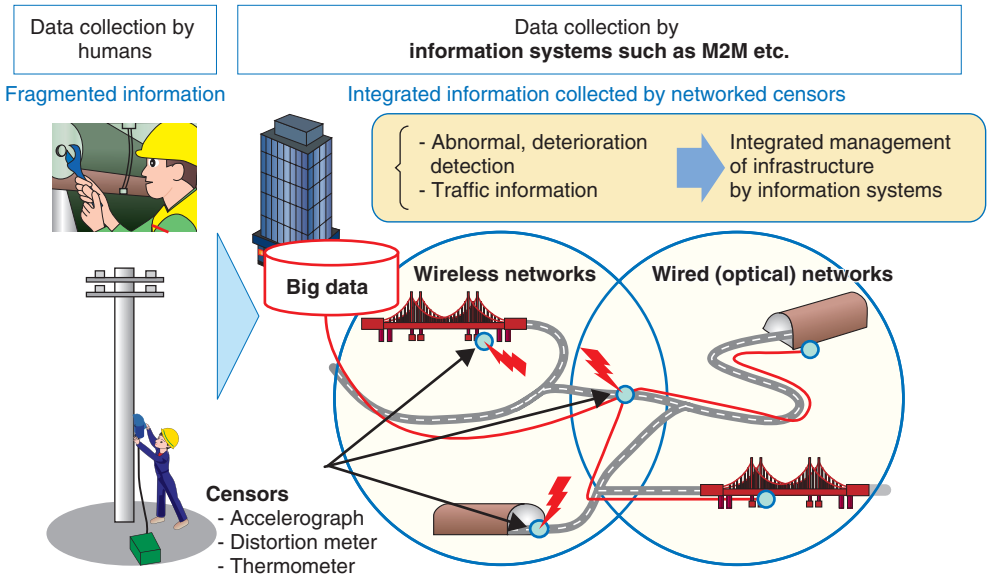


Fig. 3. Infrastructure management by big data.

Information & Event Management (SIEM) engine to provide a global security platform. This engine, which we announced in a February 7, 2013 news release [1], will be launched in North America and Japan in March 2013 and then expanded throughout the world. It will be used to visualize new threats and respond to region-specific threats, and, through the sharing of threat information, to make predictions and take preventive countermeasures.

2.2.2 Big data

Services related to big data are predicted to become a trillion-yen business in Japan by 2020, increasing by five times its current level. The value of big data lies in the derivation of knowledge not just from the data possessed by a single company but also from large volumes of composite data gathered, for example, from multiple enterprises.

However, making good on this great business opportunity will require solutions to a number of problems such as how to handle personal information and what type of business model to build upon. In particular, because risks related to personal information increase when handling composite data, data anonymity is extremely important. At NTT laboratories, researchers are developing "secret sharing" and "secure computation" technologies that fragment data and make it extremely difficult to identify individuals. We are now preparing to use these technologies to protect personal information in a platform for big data analysis.

Infrastructure management, as in fault monitoring by machine-to-machine (M2M) systems, is one example of how big data can be put to use. It is said that Japan's public infrastructure will be aging considerably over the next 20–30 years and that the aging infrastructure should be renovated. In assessing the safety of the nation's tunnels, bridges, and expressways, we propose that the government adopt big-data processing technology to check for distortions and faults using the wireless networks and optical wired networks of the NTT Group. Such technology can also serve as Japan's value-added point when exporting infrastructure to developing countries (**Fig. 3**).

2.2.3 Wi-Fi platform

The demand for Wi-Fi platforms is increasing rapidly. For example, the Seven & i Group has installed Wi-Fi facilities in stores around the country and has launched a platform service for delivering information to customers. Likewise, Tokyo Metro has launched a service called MANTA (Metro Amusement Network Trinity App) to deliver information within subway complexes (**Fig. 4**). NTT Broadband Platform, Inc. (NTTBP) provides access points and platform services for each of the above Wi-Fi platforms.

One reason for the rapid deployment of these

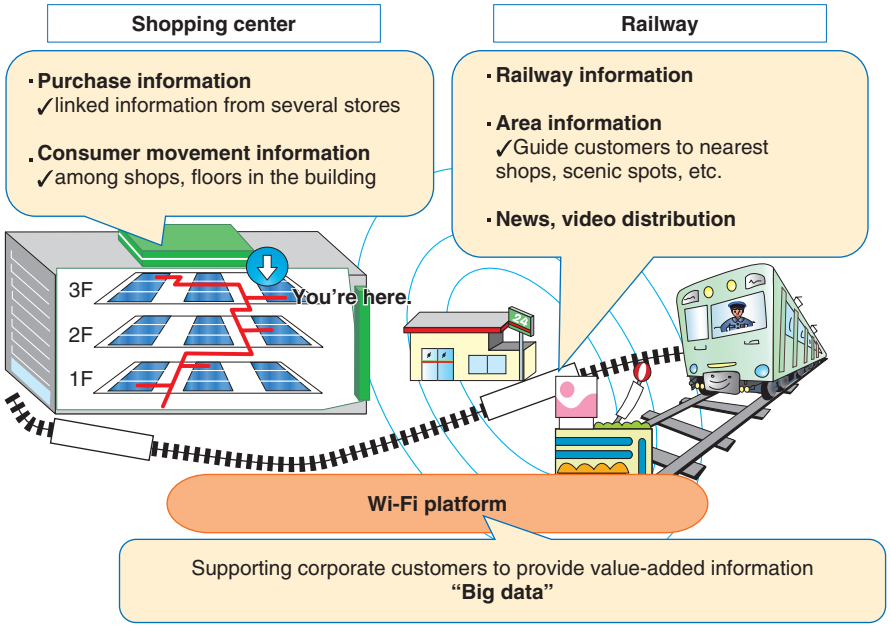


Fig. 4. Expansion of Wi-Fi platform.

services is that approaching and accessing customers via Wi-Fi is an open process. In other words, these Wi-Fi-based services can meet the needs of service providers who wish to reach customers entering their area regardless of the carriers or types of terminals those customers use. Establishing such a business model using Wi-Fi is a business opportunity for NTT. Another reason is that a service provider delivering information by such a Wi-Fi platform can approach customers directly without having to depend on third parties. I realize that the use of a Wi-Fi platform combined with anonymous schemes for protecting personal information as described above can be a valuable business tool even for service providers other than shopping centers and railway companies. From here on, NTT laboratories will be working to enhance technologies and platforms that can help service providers expand their businesses in a safe and secure manner.

3. Acceleration of global development

Overseas sales in the NTT Group broke through the 10-billion US dollar level in the fiscal year ending in March 2011. Although this was due in part to M&A activities, this result was achieved one year earlier than our original plan. And we have set a target of doubling this figure to 20-billion US dollars by the fiscal year ending in March 2017. I would like to achieve this challenging goal by combining M&A with organic growth instead of relying solely on M&A.

3.1 Group formation for global business expansion

We are proud of having an extensive lineup of businesses that includes datacenters, networks, managed ICT (information and communications technology), applications, solutions, and R&D (**Fig. 5**). During the course of recent investor relations activities, a certain investor told us that "I use to think that the NTT Group was just a collection of companies, but on seeing how it confronts the challenges of the cloud era, I am reassessing it as a corporate group having a rare potential even from a global perspective." However, it is also said that "speed is of the essence." How to respond promptly to the needs of our customers, how to create competitive services, and how to carry out operations are all connected to whether we can become a value partner as I mentioned previously. In helping our customers to transform their business models, it is essential that we change ourselves, but figuring out how to speed up this process is an issue that we must address.

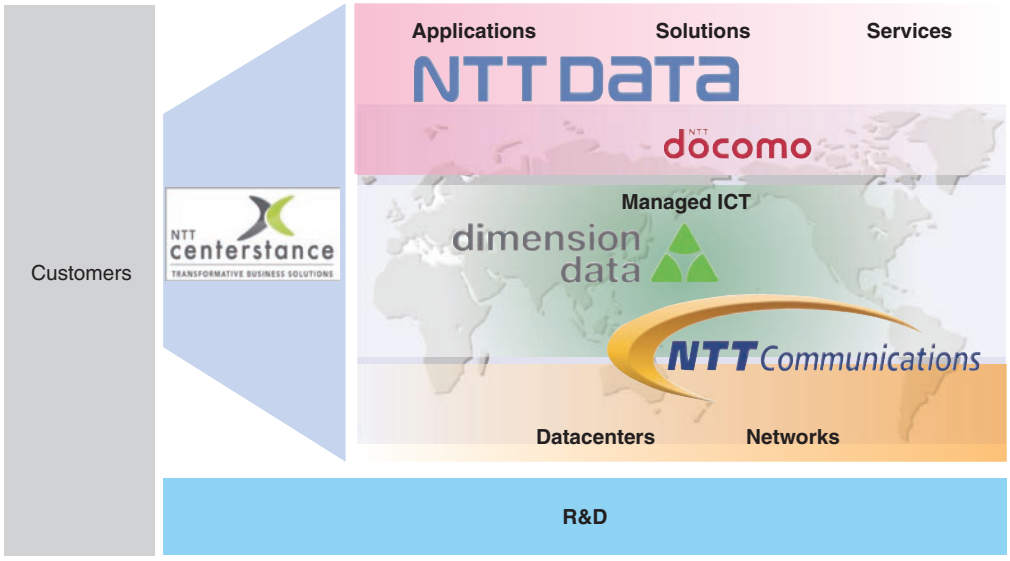


Fig. 5. NTT Group formation.

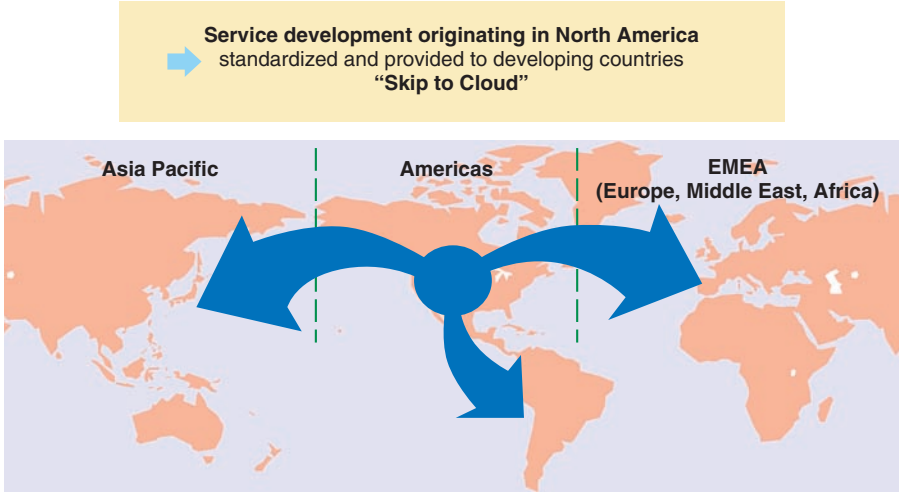


Fig. 6. Acceleration of global development.

3.2 Service development originating in North America

To accelerate the pace of global business expansion, we are promoting service development originating in North America (**Fig. 6**). In addition to being a region with relatively few regulations, North America is an advanced market with many companies to partner with. Our plan is to develop global and standardized products and services in North America, and to provide them first to advanced countries and regions like Japan and North America, and then to developing countries as well. In this regard, the "Skip to Cloud" service, in which a system is constructed from the very start on the cloud, is especially suitable for developing countries. However, it is very difficult to apply existing Japanese specifications without modifying them to the needs of developing countries. Therefore, we are moving quickly to develop such services in North America. On the basis of the keywords *global, market-in*, and *agile*, we plan to fortify

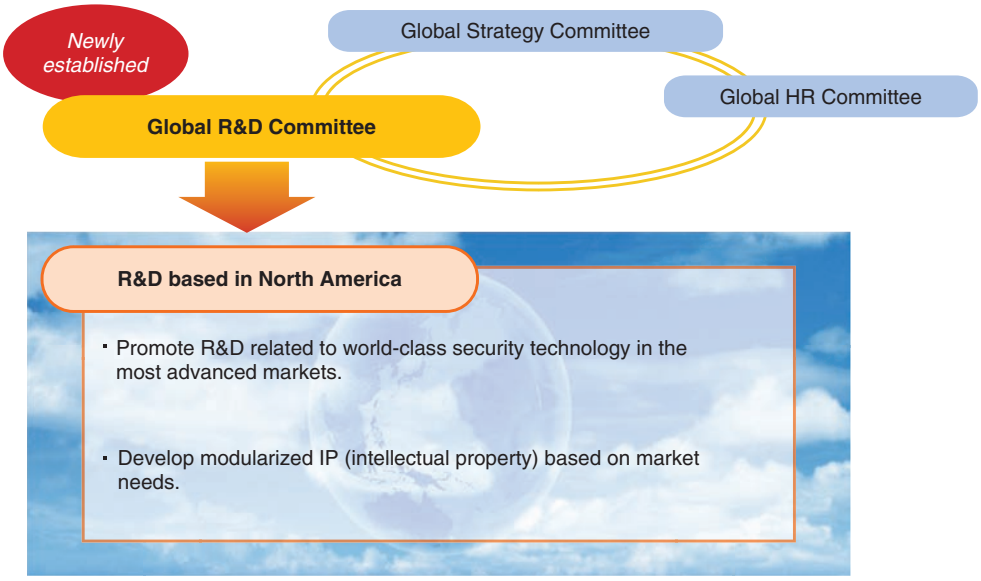


Fig. 7. Strengthen and expand R&D in North America.

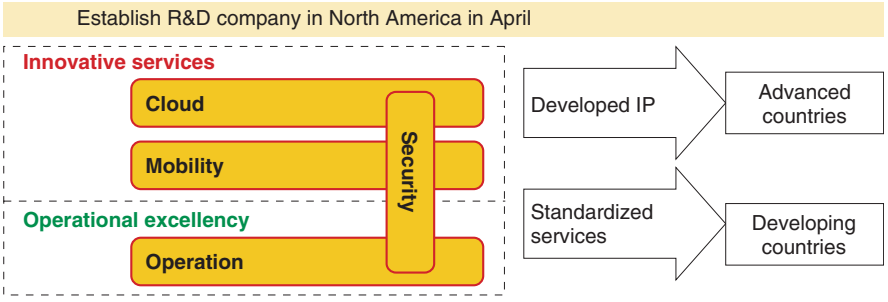


Fig. 8. Priority areas of R&D in North America.

this approach to accelerate the pace of global business expansion of the NTT Group.

A Global Strategy Committee and Global Human Resources Committee are already up and running as a global company. Moreover, we added a Global R&D Committee in the fall of 2012 (**Fig. 7**). The idea is to speed up the development process and to prevent redundant development and investment within the NTT Group.

We will launch our new R&D company in North America in April 2013. This company will target cloud services, mobility, and operations, centered on security, and it will develop intellectual property (IP)* and standardized (modularized) services for these areas (**Fig. 8**). Our initial investment will be on the scale of 100 million US dollars, and we will start with a staff of 30–40 people. For the CEO, we are looking to hire an individual in North America from outside the NTT Group. The name of the company will be NTT Innovation Institute, Inc., or NTT I^3 ("NTT I-cube"). We are planning to have an opening ceremony in May.

* Here, in addition to intellectual property, IP should be taken to include bundles of know-how related to system construction and software development that have been created and modularized over the course of service development by the NTT Group. Such IP is implemented in the form of services (cloud business applications, monitoring/management portals, etc.) and placed on the market.

4. Future vision of the NTT Group

To expand our business globally, we must determine how to build the brand power of the NTT Group. According to a 2012 Brandirectory ranking, the NTT Group ranked 14th in brand power for all worldwide industries. Of interest here is that, while each of our group companies had formerly been evaluated independently, this was the first time we were listed as the entire NTT Group. As I said earlier, the NTT Group is a unique all-around player even from a worldwide perspective, and I believe that raising our ranking here is connected to the competitive power of the NTT Group on the whole. This is where I would like to focus our attention.

As I have been saying constantly since becoming president, our business across the entire group is defined by the phrase "Next Value Partner for Transformation by Total Solutions," which is a pun for our corporate name, NTT. Our task is to devote all our energies to becoming a value partner that customers will continue to select and to improving the brand power of the entire NTT Group (**Fig. 9**).

Fig. 9. NTT Group will become a Next Value Partner.

Reference

[1] NTT news release as of February 7, 2013. http://www.ntt.co.jp/news2013/1302e/130207a.html

Chain Reaction Innovation

Hiromichi Shinohara
Director and Executive Vice President,
Director of Research and Development
Planning Department, NTT

Abstract

This article introduces the activities of the NTT R&D (research and development), Laboratory Group, which is pressing forward to create new value in information and communications technology by initiating "chain reactions of innovations" in order to pave the way to becoming a valued partner. This is the aim of the group's Medium-term Management Strategy entitled *Towards the Next Stage.*

This article is based on the speech presented by Hiromichi Shinohara, Executive Vice President, Director, Research and Development Planning Division, NTT, at NTT R&D Forum 2013, held on February 14–15, 2013.

1. Recent priorities for NTT R&D

Let me start by discussing the priority areas for the NTT R&D (research and development) Laboratory Group (NTT R&D) in the past year from three perspectives: expansion of our network infrastructure, which is the bread and butter of the NTT Group; our strategic foothold for growth; and the improvement in NTT R&D's reputation.

1.1 Expansion of our network infrastructure

Our efforts in the past year to expand our network infrastructure have resulted in significant achievements, including the development of the world's highest-density multifiber optical cable, an anti-disaster wireless system, and the world's highest capacity optical transmission, measured in petabits per second (Pbit/s).

We have developed an optical fiber ribbon that sparsely bonds several optical fibers in order to build a multifiber optical cable. In addition, we have developed the world's highest density cable, which is thinner by about 30% and lighter by about 60% than a comparable conventional cable. This achievement has been instrumental in cutting capital expenditure in access networks, reducing both the purchase and installation cost of new optical fibers and the need to install additional conduits.

Since the Great East Japan Earthquake struck the country two years ago, we have been redoubling our efforts to make our networks resistant to disasters (**Fig. 1**). For the past year, in particular, we have focused on developing anti-disaster wireless systems for use in access networks, which will improve back-up support in both terrestrial and satellite systems.

In the area of inter-office optical transmission, we are now working on the third-generation technology of digital coherent transmission. This follows the development of first-generation technology of electrical multiplexing and time-division multiplexing (TDM) and second-generation technology of optical amplification and wavelength-division multiplexing (WDM). In this fiscal year, by combining digital coherent transmission and multi-core optical fiber technologies, we succeeded, for the first time in the world, in sending an optical transmission at 1 Pbit/s in an experiment. At this rate, about 5000 movies, each 2 hours long, can be sent in a second.

The unified management system (UMS) is in the limelight as a means to improve work efficiency in the field. This system is capable of generating scenarios to automate conventional human operations on

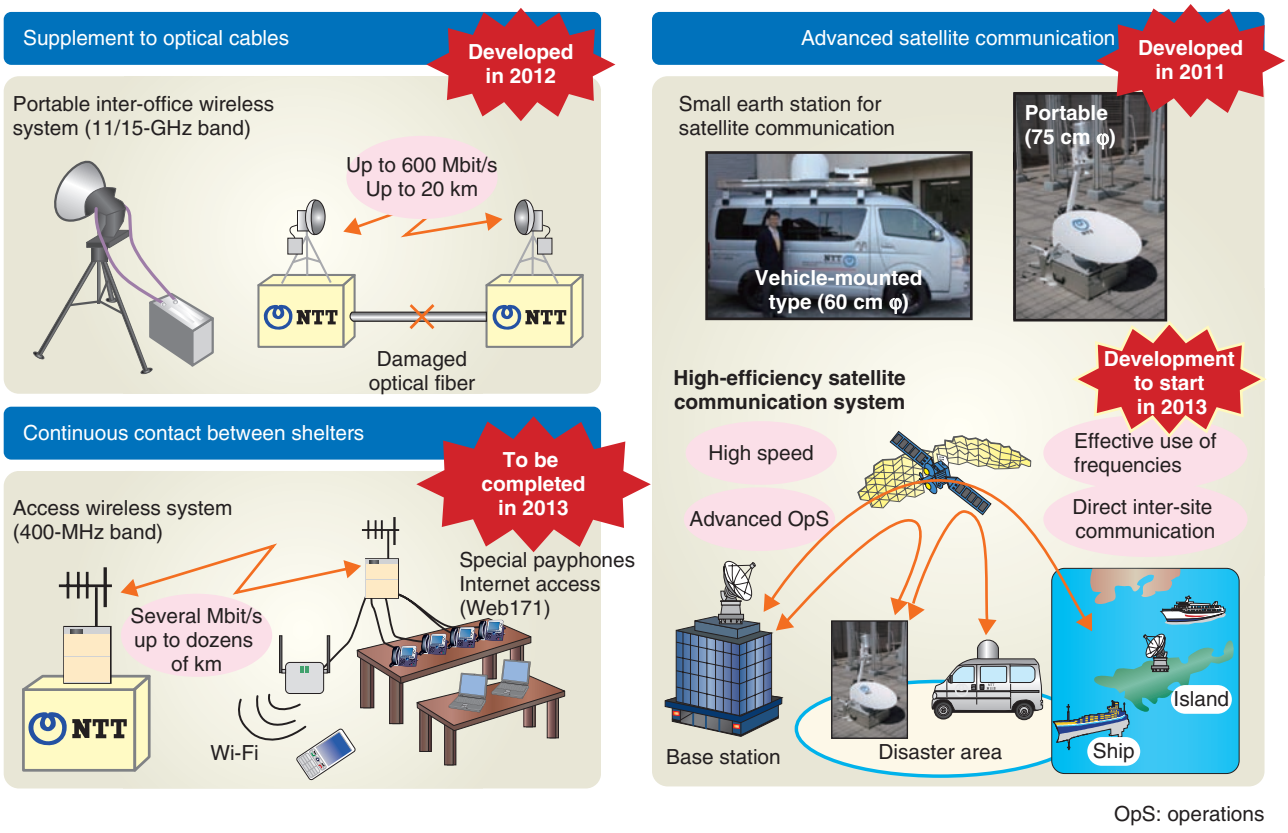


Fig. 1. Development of anti-disaster wireless systems.

a terminal for nonroutine or highly region/field-dependent tasks, which are tasks that are difficult to computerize. The UMS reduces the human workload and improves work efficiency in the field. The use of the UMS has expanded dramatically in the past year, which is enabling NTT operating companies to reduce their operating expenditure.

1.2 Strategic footholds for growth

NTT R&D's technologies that will serve as strategic footholds for growth include natural language processing, big data processing, and an energy management system (EMS). These technologies have begun to harmonize with the business models of NTT operating companies in the past year.

*Shabette Concierge** (Talking Concierge), an extremely popular application provided by NTT DOCOMO, uses our natural-language processing technology to understand a question posed by a user, and to extract the correct reply from a database.

In the area of big data, an area with great business potential, a technology called *Jubatus* is attracting attention because it satisfies the competing requirements of intelligent and real-time analysis (**Fig. 2**). In 2012, NTT DATA concluded a contract with Twitter for its firehose, which is the full stream of data coming in the form of tweets, so that Jubatus can be used to classify tweets in a variety of categories such as type of business or product. This capability is already being used for real-time customer relationship management (CRM).

The NTT Group, the Hanshin-Hankyu Group, and Hakuhodo, Inc. are jointly conducting a trial on big-data-based O2O (online to offline) marketing in a commercial facility in Osaka. The NTT laboratories are involved in this project and are using clustering technology to screen big data for information that is easy to use and valuable for marketing.

In the area of electric power, energy consumption has long been a major social issue. NTT East and NTT West have been carrying out a feasibility test on

* "Shabette Concierge" is a registered trademark of NTT DOCOMO, INC.

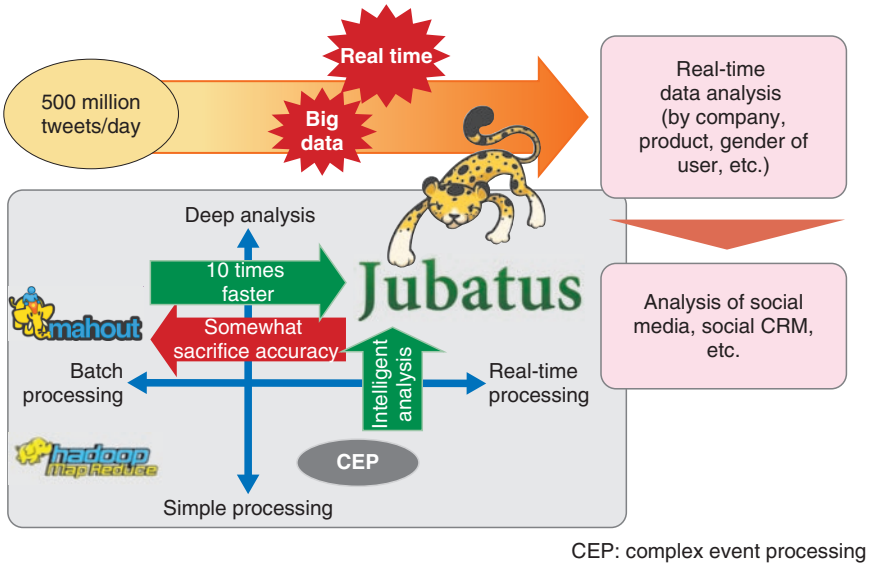


Fig. 2. Realtime big data processing using Jubatus.

visualization of home energy consumption. This test uses NTT laboratories' technology to estimate the power consumption of all the appliances in the home. Instead of requiring a power sensor to be attached to each appliance, this technology requires only one sensor to be installed on a distribution board. It analyzes the waveform of the current from each appliance and displays the power consumption of each appliance. This technology reduces the cost of introducing a service to visualize power use, and thus, this technology is expected to promote the widespread use of the power consumption visualization service.

1.3 Rise in external reputation

The laboratories in the NTT R&D Group have been producing outstanding results in the field of basic research in recent years, as demonstrated by the publication of leading-edge studies on quantum memory and a GaN (gallium nitride) semiconductor device in Nature, and the publication of research related to a quantum computer in Science. These remarkable activities have contributed to NTT being ranked second in the world in the number of citations in the field of physics.

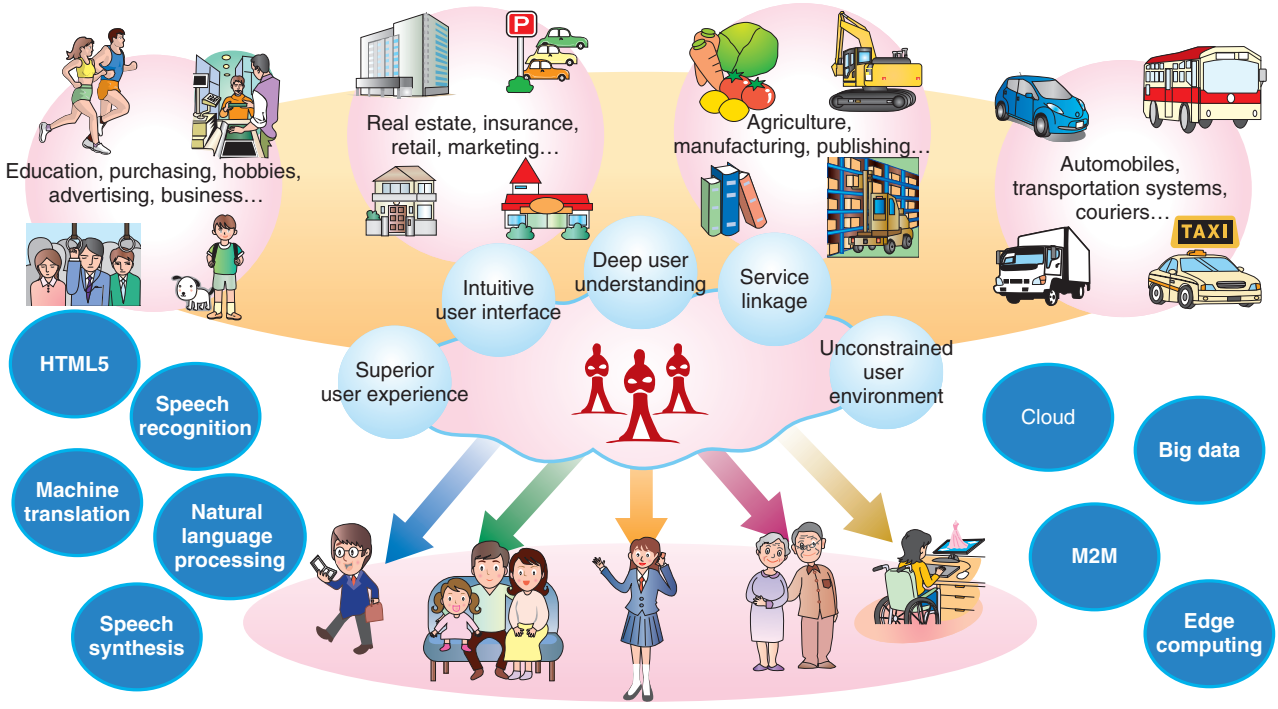
In the world of industry, for two years in a row NTT has received a Top 100 Global Innovators Award from Thomson Reuters, which selects the world's most innovative enterprises from the aspect of intellectual property. NTT also received the Master of Sound Award for its reverberation control technology from the Japan Audio Society.

Professor emeritus Yoshihisa Okumura (Kanazawa Institute of Technology), a past researcher at NTT, received the Charles Stark Draper Award, which is known as the "Nobel Prize of Engineering," from the National Academy of Engineering in recognition of his pioneering contributions to the development of the cellular telephone service in its early days. In addition, NTT received the IEEE Milestone Award for its contributions to the international standardization of the G3 (Group 3) facsimile.

As research laboratories of a national flag carrier, NTT R&D will continue not only to contribute to the growth of the NTT Group, but also to fulfill its responsibility for the development of industry as well as our academic society.

2. Activities towards a new stage

The directions NTT R&D will take to fulfill the NTT Medium-term Management Strategy are described below. This strategy declares our determination to evolve from being a telecom provider to a valued partner for our customers. This involves changing from the conventional stance of providing information and communications technology (ICT) services to a new stance in which we identify our value in using ICT to support our customers' activities on the Internet and in the real word, thereby becoming a sought-after partner for our customers.



HTML5: hypertext markup language, fifth revision
MTM: machine to machine

Fig. 3. Concept of personalized services.

For this transition, we believe that in addition to our conventional efforts to make ICT services faster, larger in capacity, and lower in cost, NTT R&D needs to advance in three directions: *personalization*, to enable anyone to use any service conveniently, *value creation*, to link all data to provide direct benefits to users, and *adaptive access*, to enable anyone to use all types of network and information processing easily and at an affordable price. These three aspects are described in more detail below.

3. Personalization

3.1 Personalized services

To achieve personalization, it is necessary to satisfy three requirements. (1) The user interface (UI) should be able to learn and should be intuitive and optimized for individual users, including seniors and small children; (2) information suitable for user preferences and special purposes should be available anywhere and anytime; and (3) a service environment should be in place that is transparent to terminal specifications or type so that the latest applications can be accessed using even an old personal computer (PC).

Personalized services would provide valuable user experiences regardless of the age or sex of the user, and would enable them to freely access a variety of services. For this to happen, we need to build three environments. (1) an environment that understands the needs of individual customers and delivers appropriate information in a manner appropriate to individual needs; (2) an environment that links several services to provide value to customers; and (3) a user environment that provides an intuitive, user-friendly interface and is not constrained by terminal specifications (**Fig. 3**). The activities we are energetically working on to build these environments are described below.

3.2 User interface technologies

Voice input/output technology is growing in importance as a user-friendly interface. The NTT laboratories are working to enhance recognition accuracy in voice input and listenability in voice output despite the presence of noise, both of which are critical features in practical situations (**Fig. 4**).

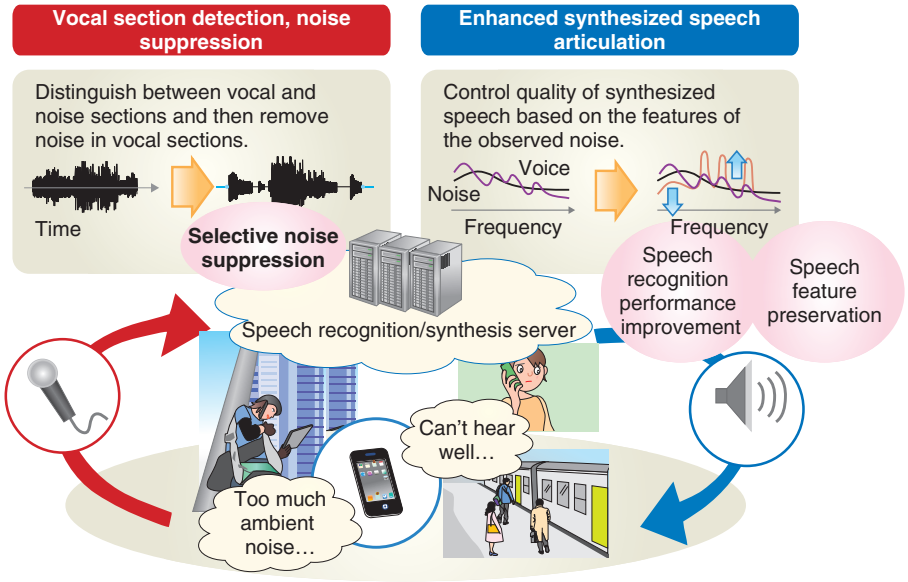


Fig. 4. Speech recognition/synthesis in presence of noise.

A forte of the NTT laboratories is statistical machine translation, which is a technology that uses machine learning to automatically create (and use) probabilistic models from data available on the Internet and written in different languages. We will strengthen our research into this technology and combine it with other speech technologies with a view to developing a telephone that automatically translates in real time.

An example of our research into intuitive interfaces is a unique technology that records the speed and intonation with which the user reads the characters shown on a display, and reproduces these features to convey the feeling of the writer to the reader. Conveying information that is hard to express in characters in this way will expand the breadth of communication even in short messages such as email.

Edge computing, which we have begun to develop recently, is intended to provide an entirely new user experience by placing a microcloud near the customer (**Fig. 5**).

4. Value creation

With regard to value creation, we are focusing on a cloud that can be provided quickly, securely, and at low cost, and big data handling that creates value from all types of data.

NTT R&D has been studying cloud computing and big data from five perspectives: security, economy, speed and flexibility, value creation, and scalability.

4.1 Cloud computing

The development of an integrated cloud controller based on a virtual network and open source software technologies has resulted in the establishment of infrastructure technology for seamless global clouds, in which user environments can be transferred between datacenters or between on-premises sites and clouds. From 2013 onwards, we will aim to develop completely virtual clouds that can securely store confidential data based on dynamic optimization of resource allocation, computation with privacy, and secret distribution technologies. In the slightly more distant future, our target will be to achieve autonomous distributed clouds by developing a distributed OS (operating system), a distributed processing language, etc. (**Fig. 6**).

One of our activities in this area is an open source technology called *Sheepdog*, which combines multiple general-purpose PC servers and bundles their local disk drives to form a huge storage unit. This technology is inexpensive due to its use of general-purpose PCs. It also has the capacity for flexible growth and is highly resistant to failure due to its distributed configuration. Sheepdog can often perform better than conventional storage systems that use dedicated hardware.

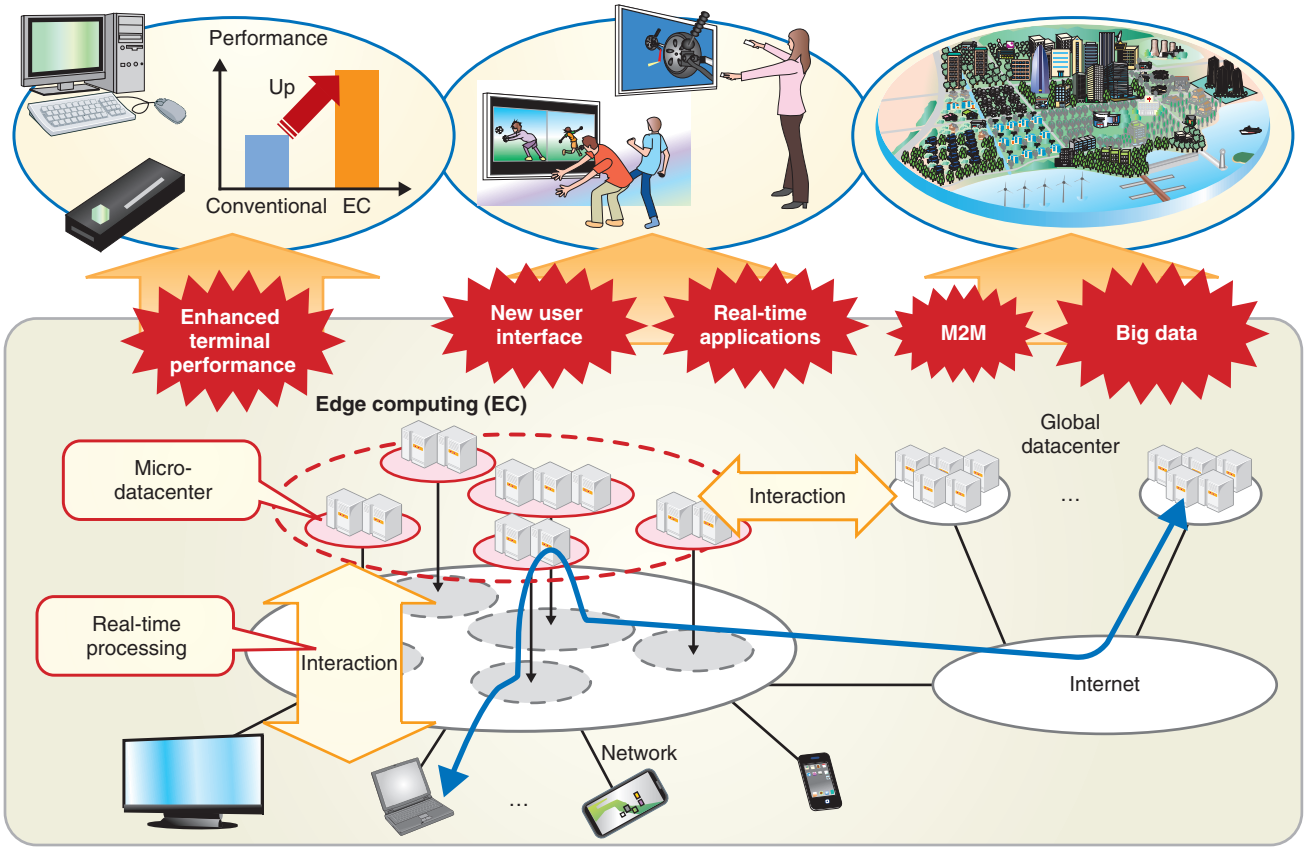


Fig. 5. Edge computing.

We have released an open source technology named *Ryu* as an integrated development tool kit for a virtual network controller. By using Ryu as a platform, the user can develop application programs for virtual networks without worrying about the control of virtual network devices.

4.2 Big data

Up to now, NTT has only been analyzing its own big data, such as traffic data, for internal use. However, we are going to utilize technologies owned by NTT laboratories such as those for real-time analysis, machine learning, and computation with privacy, to broaden the scope of the analysis of big data to new areas where no significant efforts have so far been made in order to exploit big data in such areas as finance, transportation and distribution, agriculture and fisheries, and drug development and medical care (**Fig. 7**).

For example, with a view to promoting the use of Jubatus, we held a contest called the "Jubatus Challenge" as a way to solicit ideas from outside NTT for real-time analysis of big data using Jubatus. We will accelerate open innovation activities like this.

We have developed the world's fastest algorithm for the analysis of graphical data. This technology is 10 times faster than existing technologies in clustering and several tens of times faster in page ranking. For example, it can compute links between individuals in the entire Japanese population in as little as three minutes. It can be used in a broad range of fields such as drug development, where an enormous amount of computation is required to discover the factors that provide the highest efficacy.

We are also developing a technology that can process at high speed the multidimensional analysis of big data that involve multiple attributes. Usually, the amount of computation grows exponentially with the number of attributes handled. By using machine learning, the NTT laboratories have dramatically reduced the amount of computation required, making it possible to efficiently discover hidden links, which are hard to detect at a glance, between items of data.

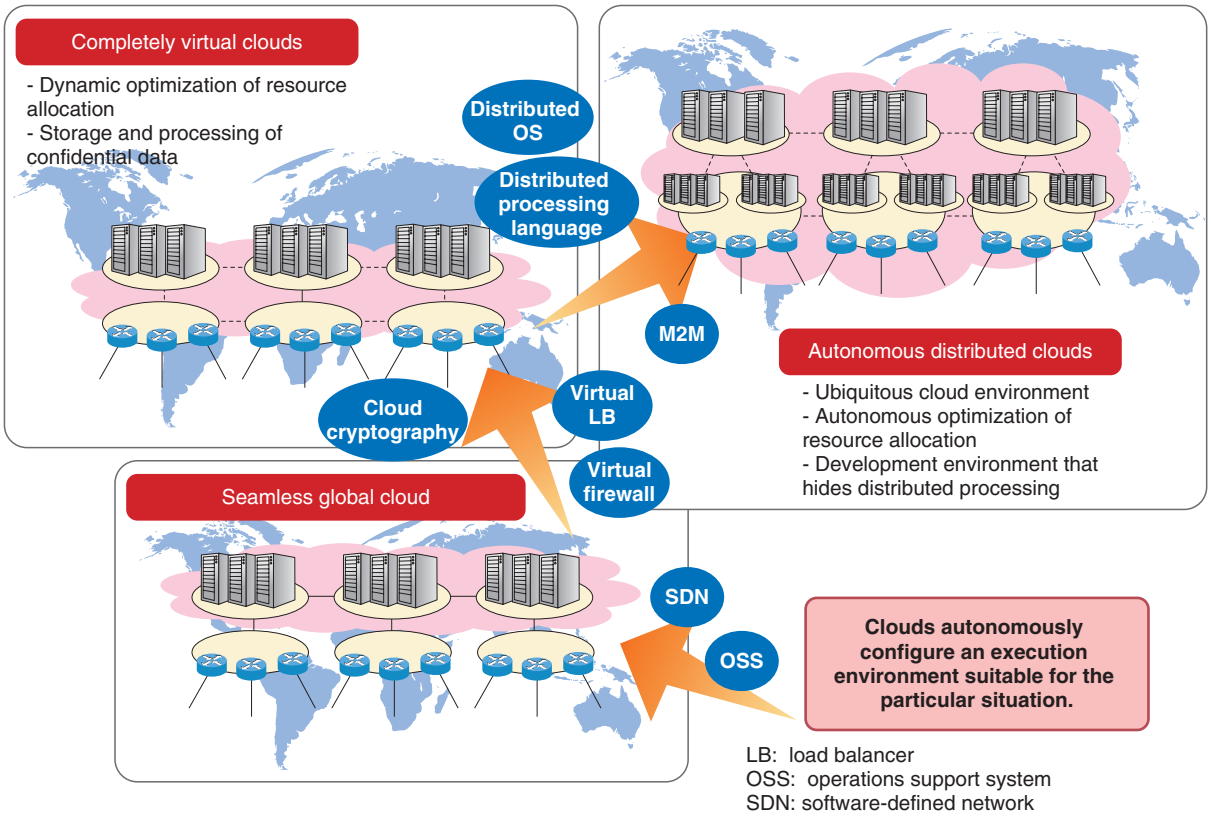


Fig. 6. Future development of NTT R&D's cloud technology.

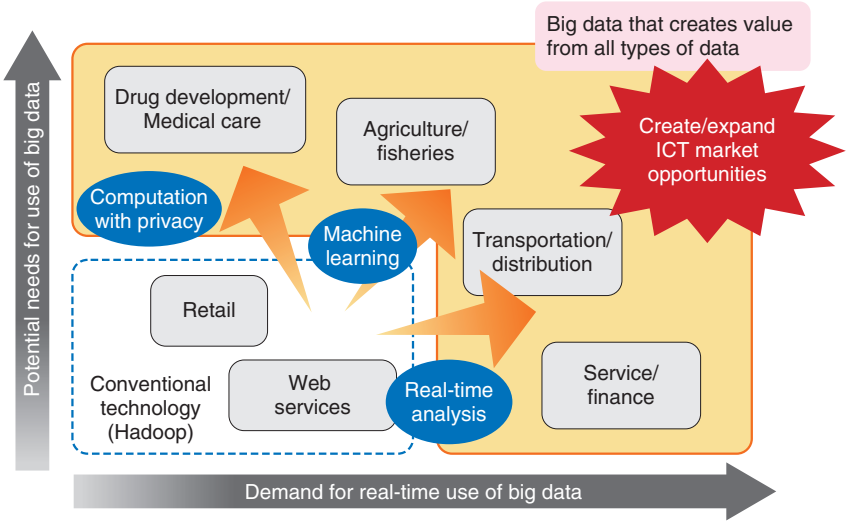


Fig. 7. Use of big data aimed at by NTT R&D.

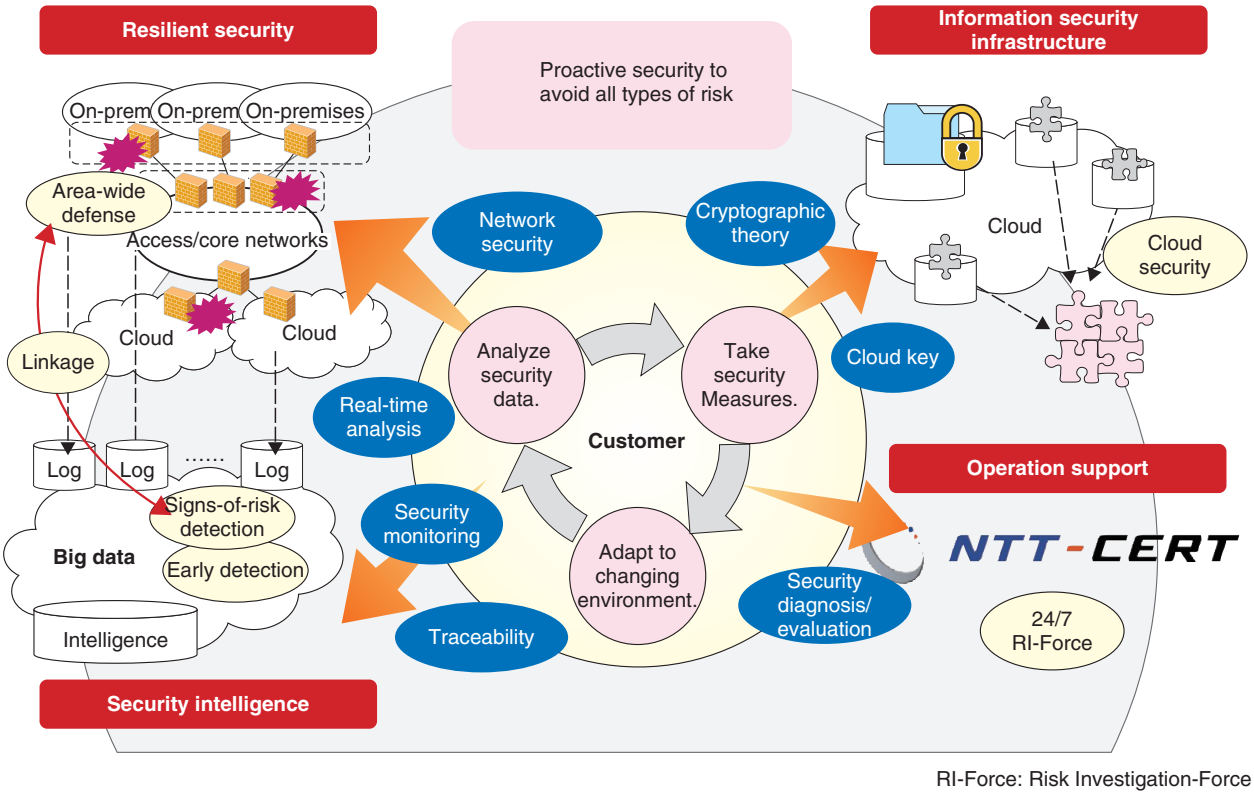


Fig. 8. Security environment NTT R&D is aiming for.

5. Adaptive access

We are approaching adaptive access focusing on three key factors: strengthened security, easy network access, and reduced network cost.

5.1 Security

There have been three important aspects of security services in recent years: analyzing threats to security, taking security measures based on the analysis, and adapting to the changing environment, for example, changes in government policies regarding information security.

NTT R&D is developing proactive security technologies to avoid all types of risk through four activities that address these aspects (**Fig. 8**). Security intelligence is a technology enabling early detection of a risk or detection of signs of a risk through techniques such as malware analysis. Resilient security is a technology to ensure that customer facilities such as networks and clouds are well protected by optimally allocating and operating security devices such as firewalls based on the information obtained above. We are also developing technology for an information security infrastructure such as cloud cryptography to defend user data from attacks, and are hosting NTT-CERT, which ensures proper operation of security services. It is important in the security field that both R&D and operation teams move forward together like the two wheels of a cart. We will manage research into security in a way that such an ecosystem will emerge.

In building a platform for security information and event management (SIEM), an endeavor that is being strengthened by the NTT Group, the NTT laboratories are developing three engines: chronological analysis, co-occurrence analysis, and social log analysis engines (**Fig. 9**). The SIEM platform makes sophisticated security operation possible by analyzing a variety of logs to detect, early on, security threats that have so far been difficult to identify, such as targeted attacks, and to produce security intelligence.

To counter malware, we are developing a technology that dynamically analyzes items of malware that have been collected using a decoy system (honeypot),

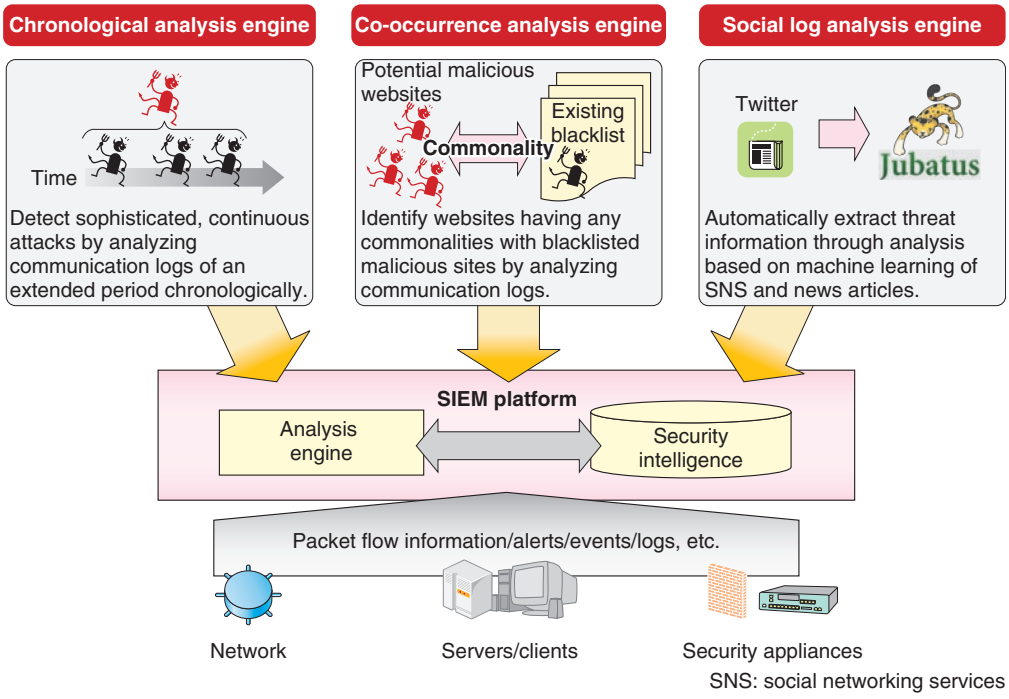


Fig. 9. Detection of security risk and creation of intelligence over SIEM platform.

with tangible results. The performance of our technology is surpassing that of major Internet providers in terms of the number of items of malware detected from honeypots and of the number of items detected by dynamic analysis and entered into the blacklist.

Security is one of the major issues to be tackled by the new R&D site to be established in North America, called NTT I^3 (NTT Innovation Institute, Inc.). The location of this site is very strategic, and we plan to capitalize on that to provide a market-in service quite soon, and to strive to achieve our target of becoming one of the world's top-notch operators in the field of security by 2014.

5.2 Networks

In Japan, the NGN (Next-Generation Network) and the LTE (Long-Term Evolution) network have already been deployed. They have evolved from the phase of building their infrastructures to that of making full use of them. An issue that will grow in importance is how to make the networks, including the above two networks and a Wi-Fi network, easy to use and useful for our customers (**Fig. 10**).

With a view to making the networks flexible and accessible by anyone, the NTT laboratories are developing technology to standardize applications of different networks in order to make them easily accessible from any network. In addition, we are studying a mechanism to facilitate the federation between functions in different networks and to allow efficient network operation by making network functions programmable.

However, reducing network costs is also one of our major goals. Our efforts to reduce our capital expenditure in networks include increasing network speed and capacity, for example, through the use of petabit transmission, to handle ever-growing traffic, and consolidating network facilities by extending the intervals between repeaters in optical fiber links.

To reduce operating costs, we have been working on ways to visualize the network operation state in order to facilitate traffic forecasting and to detect signs of impending network failures.

A key for these activities is virtualization technology. For example, in cooperation with NTT DOCOMO Research Laboratories, we are developing a technology that will allow us to respond to changes in demand efficiently and to recover from large-scale failures rapidly by applying software-defined network (SDN) technology to carriers' networks.

We are also studying how to use virtualization technology in the platform for network systems. Currently,

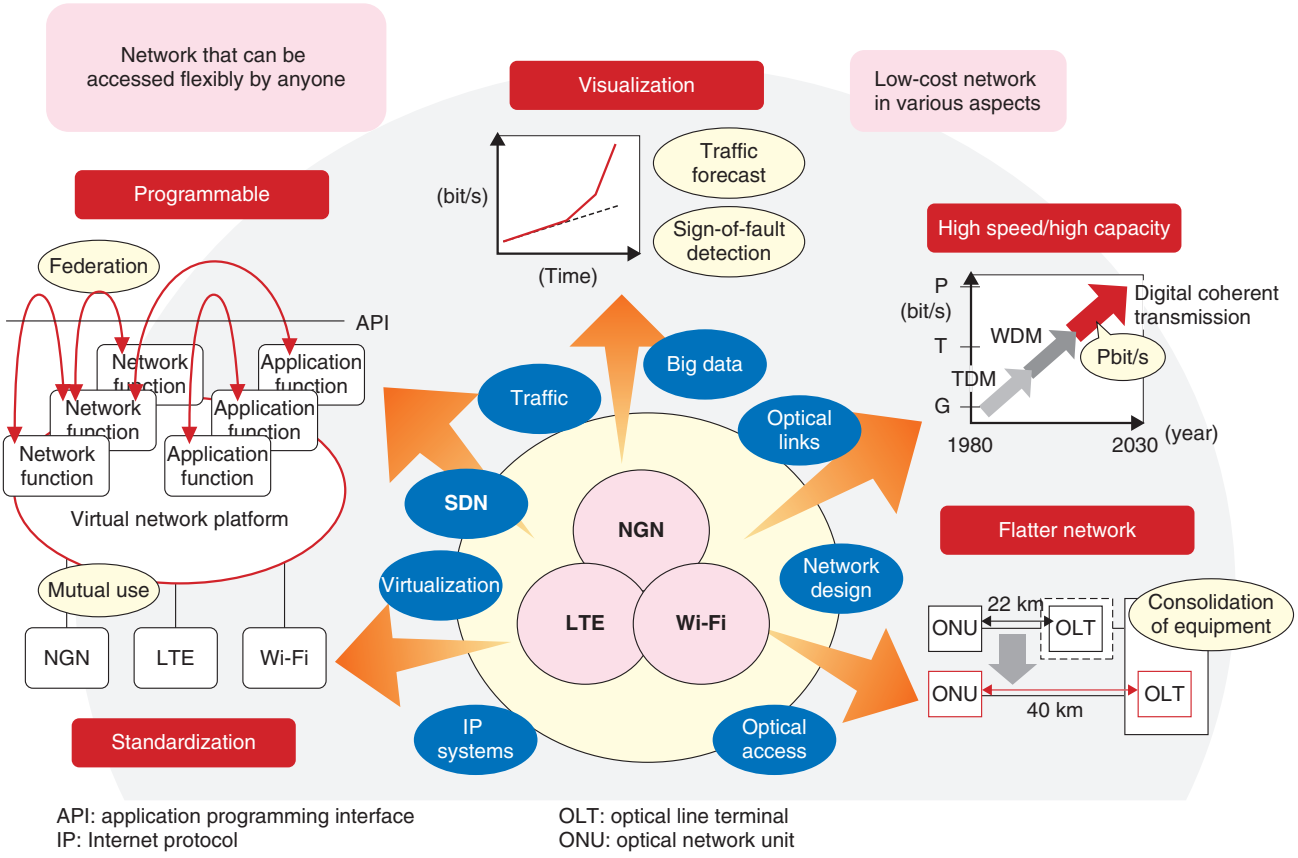


Fig. 10. NTT R&D's target network.

communication servers are designed to serve a specific region and a specific service, which raises the cost and reduces the flexibility of these servers. NTT R&D is undertaking research into a platform that uses off-the-shelf PC servers for any services and on which the number of servers can be scaled up or down in response to fluctuations in demand. For example, in times of a disaster, such as the Great East Japan Earthquake, it will be possible to prevent network congestion or disruption if servers handling communication to disaster-hit areas can be increased in number instantaneously and flexibly.

Further, it is also imperative to utilize big data that have an impact on networks.

6. Chain reaction of innovation

Lastly, the directions in which the management of NTT R&D is advancing are described below. The laboratories in the NTT R&D group used to cover the complete cycle of innovation from research into leading-edge technologies to development of devices and systems that use them, enhancement of reliability and scalability, and commercial introduction. However, in the current state of telecommunications, in which changes in the business environment and technical trends continue to accelerate, such a closed-loop approach is no longer effective. We believe that it is necessary to add the following three links to the conventional cycle of innovation in order to initiate chain reactions of innovations.

6.1 Boundary crossing

Boundary crossing means that innovation activities go beyond the conventional framework of NTT laboratories. These activities can be broadly classified into the following patterns (**Fig. 11**).

The first occurs in a case where the circle of innovation within the laboratories is incomplete, and the missing links are filled by introducing external technologies to speed up innovation. Specific examples of this case include activities related to clouds and SDN,

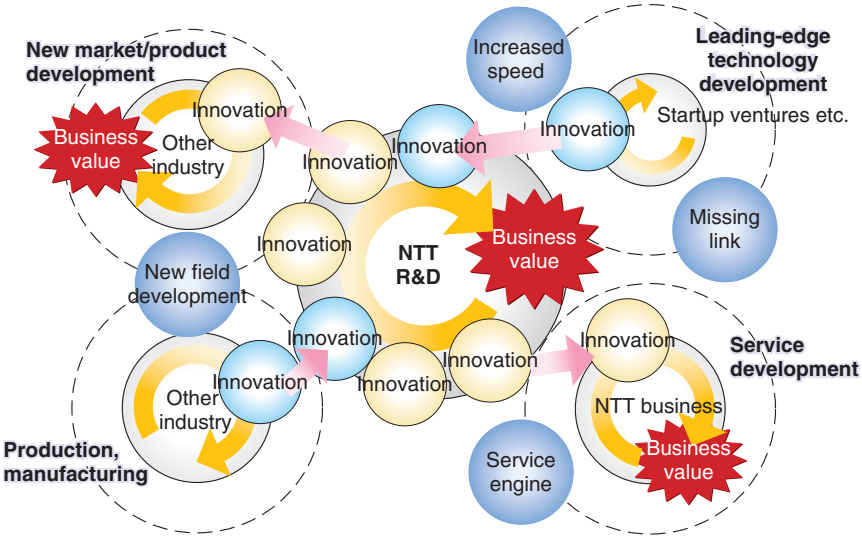


Fig. 11. "Boundary crossing" in the chain reaction of innovation.

both of which capitalize on open-source software, and the development of Jubatus to analyze big data.

In the second pattern, technologies developed in the laboratories are inserted into the cycle of innovation within NTT operating companies. Instead of providing a complete system, the laboratories offer individual technical elements as service engines. The natural-language processing technology offered for Shabette Concierge (talking concierge) is such an example.

The third pattern is to have technologies originally developed at the laboratories for telecommunications purposes used in other industries as part of their cycles of innovation so that these technologies will create value in fields entirely different from telecommunications. An example of recent R&D results that fit this pattern is the production of body-friendly bioelectrodes, which are made by blending a conductive polymer, PEDOT-PSS (poly(3,4-ethylenedioxythiophene) poly(styrenesulfonate), into a fabric such as silk. Just by wearing a shirt made of that fabric, a person can have his/her electrocardiogram signal recorded (**Fig. 12**). This was a result of the intensive interactions between our researchers and medical doctors in the field in a joint endeavor. However, before this result can be introduced commercially, it will be necessary to address many issues that are completely outside the expertise of NTT laboratories, for example, mass production of the relevant thread and introduction of the relevant product into actual medical settings. We therefore find it necessary to accelerate boundary crossing.

6.2 Cohesion

Cohesion in promoting the chain reaction of innovation means that a very strong innovation will be connected to related innovations, which will synergistically produce more and greater innovations.

For example, the NTT Nano-Photonics Center, which consists of members from different NTT laboratories, is creating innovations by combining the world's top-class photonic crystal technology with cutting-edge technologies from different laboratories (**Fig. 13**). The Center has produced a number of outstanding results in recent years. This is thanks to the fact that a powerful technology has been combined with other cutting-edge technologies, and all the members involved in developing these technologies have come together in pursuit of a common grand dream (putting a high-density optical network onto a chip, in this case).

6.3 Fusion

Fusion in encouraging the chain reaction of innovation means that multiple innovations are made to interact with each other on an equal basis so that problems not solved by one innovation can be solved by other innovations, thereby creating more value than the simple sum of all the innovations. For this to happen, it is extremely important that researchers engaged in different innovations share a common understanding of the issues and different innovations

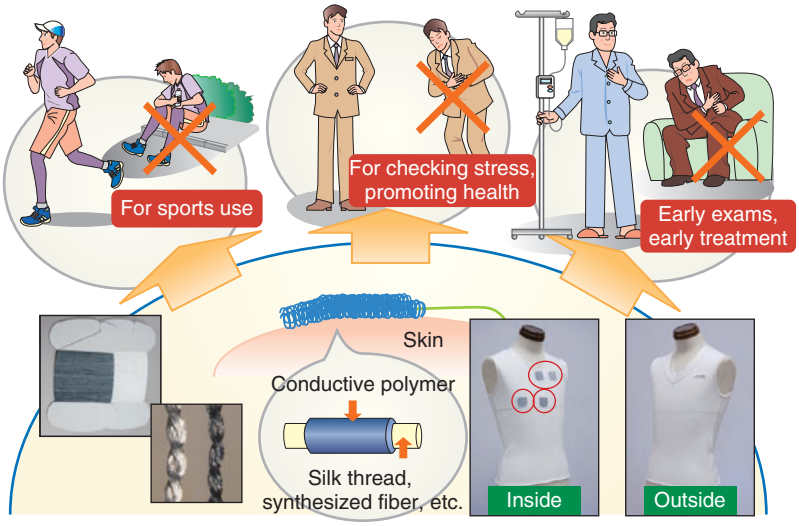
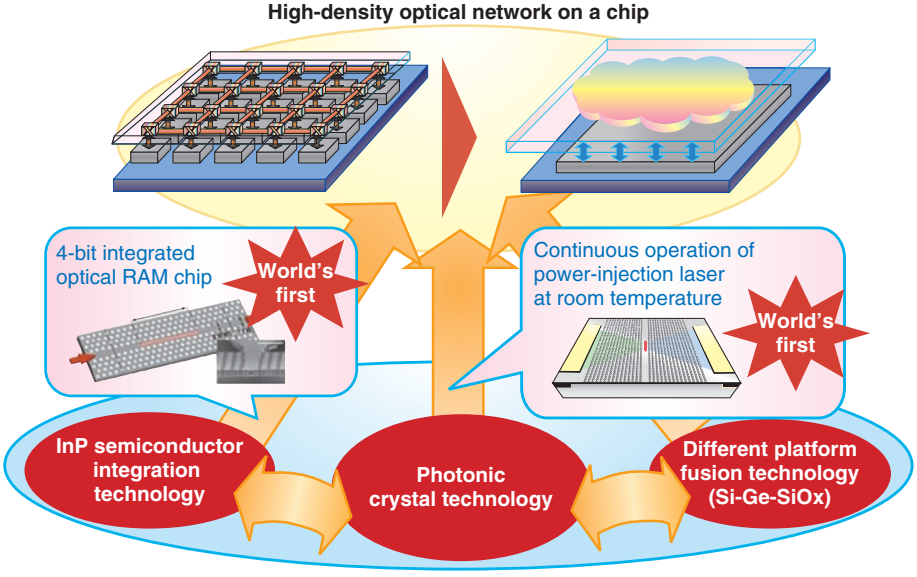


Fig. 12. Bio-electrodes using conductive polymer/fiber material.



InP: indium phosphide
RAM: random access memory
Si-Ge-SiOx: silicon-germanium-silicon dioxide

Fig. 13. Innovative technology developed by the NTT Nano-Photonics Center.

involved.

For example, our small-diameter, low-friction indoor optical fiber cable is an unparalleled innovation that resulted from a fusion of the small-diameter technology developed by the Optical Fiber Research Group and the low-friction technology developed by the Materials Research Group. In a simulation conducted to calculate radio propagation loss, the Wireless Communication Research Group achieved automatic extraction of terrain and building information, but it took 100 hours to extract relevant information for each office. By fusing this technology with the

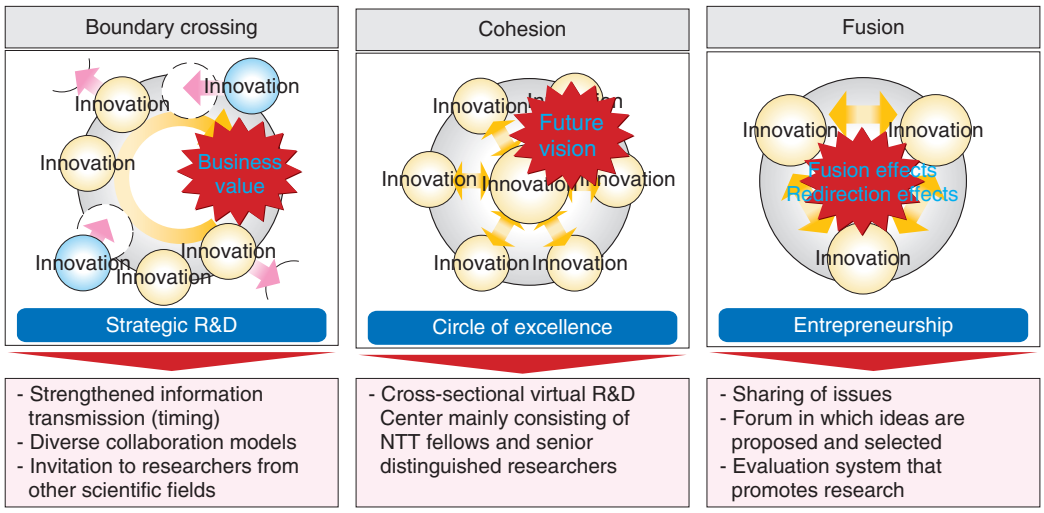


Fig. 14. New chain reaction of innovations.

UMS, an innovation of the Operations Research Group, it has become possible to reduce the extraction time to just one hour per prefecture.

We will also pursue what is called a *redirection effect* in innovation, which is a synergistic effect derived as a byproduct of research that was originally aimed at something else.

6.4 Management approaches that accelerate new chain reactions of innovation

Finally, let me summarize the gist of the three above-mentioned management approaches that are intended to accelerate a new chain reaction of innovation (**Fig. 14**).

Boundary crossing is intended to initiate a cascade of innovation, and to achieve this, NTT R&D needs to seek to become an R&D partner selected by external bodies, including those in other industries, just as the NTT Group seeks to become a valued partner for its customers. To achieve this purpose, we will establish a variety of collaboration models and strengthen efforts to transmit information to the public about our R&D results in a timely and effective manner. Furthermore, we will do away with perfectionism, which places too much emphasis on perfection at the cost of missing prime introduction opportunities, and will invite participation from researchers in other scientific fields.

In *cohesion*, which is intended to promote a cascade of innovation, the key is to form virtual R&D centers that primarily consist of NTT fellows and senior distinguished researchers from different laboratories. We are expanding this approach from the nano-photonics field to other technical fields.

In *fusion*, where the goal is to produce a cascade of innovation, we find it necessary to establish a forum in which ideas that have succeeded or failed are disclosed and chosen by others. We will also study a new personnel evaluation system that will encourage such interactions.

NTT R&D is striving to become a valued partner and an engine powering the growth of the NTT Group by developing new mechanisms to initiate cascades of innovation, in addition to following the conventional approach to innovation.

Aiming to Build a New Service Mashup Platform on the Next-generation Web

Takashi Oka, Katsuhiko Kawazoe, Hideo Suzuki, and Hisashi Ibaraki

Abstract

A variety of services is available over the Internet, and these services have become a fundamental part of our life. The use of mobile terminals has exploded in the last few years, and ever wider arrays of services are being introduced throughout the world. HTML5 (hypertext markup language, fifth revision), the standard specification for next-generation web browsers, has been gaining much attention. These Feature Articles discuss the business impact of HTML5 and introduce examples of related NTT Group company activities and R&D initiatives.

1. Introduction

Over the past 10 years, telecommunications operators have expanded the content distribution business on their own networks. The NTT Group has provided many services in order to increase the value of the network for their customers. For example, the i-mode service provides digital content for cell phones via the i-mode network. The IPTV (Internet protocol television) service lets people enjoy broadcasts and movies on their home TV by connecting a set-top box (STB) to NTT's content delivery network (CDN). Thus, the content distribution business has grown as a value-added aspect of communication carrier networks ((a) in **Fig. 1**).

Today, however, the advances and spreading use of Internet technology have led to new businesses entering the content distribution market. For example, YouTube and Netflix distribute video over the Internet and have captured a large share of the market. These services, called over-the-top (OTT) video services, do not require their own network and, can therefore be easily used by anyone who has a device connected to the Internet. In recent years, the exponential increase in the number of mobile devices connected to the Internet, for example, smartphones and tablets, has led to a new business area that involves selling the numerous applications created to run on those mobile devices. Companies such as Apple, Google, and Amazon are building their own vertically integrated business models by launching their own mobile devices and/or operating systems to execute the applications they sell ((b) in Fig. 1).

These OTT video services and mobile application services have changed the business model for content distribution services that had initially been led by the telecommunications operators. As mentioned above, the telecommunications operators provided those services as a value-added aspect of their networks. However, the OTT service companies and mobile application service companies do not need their own network and are taking the initiative in the content distribution market. This has changed the business model of telecommunications operators to one in which the operators are only able to provide network functions and are deprived of the added-value that other services bring by the OTT service companies. This kind of business model the telecommunications operators are experiencing is known as the *dumb pipe* model.

Under these circumstances, many industries, not only the telecom industry but also the consumer

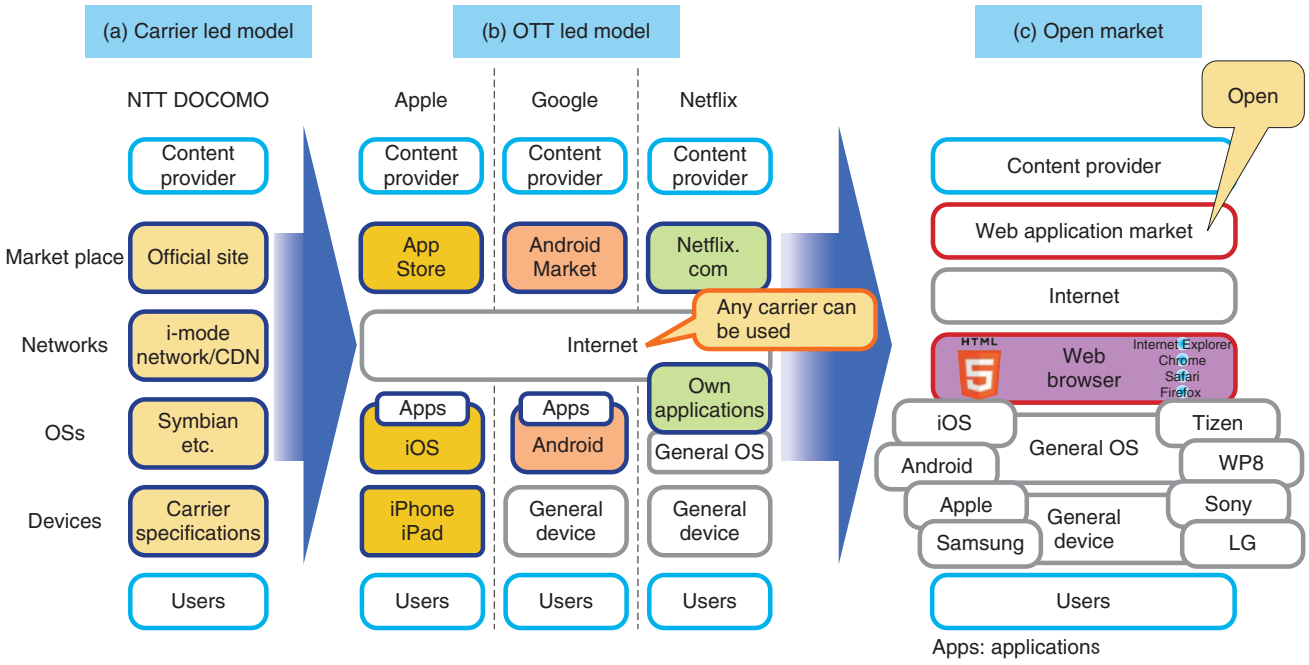


Fig. 1. Changes in content distribution resulting from HTML5.

electronics industry, broadcasters, publishers, and advertisers, are focusing their attention on the standardization of HTML5 (hypertext markup language, fifth revision) since this new standard has the potential to disrupt the current vertically integrated content distribution business model and to create a new market for content distribution on the next-generation web ((c) in Fig. 1).

2. Open Web Platform

HTML5 is the newest standard specification for next-generation web browsers and is being developed by the World Wide Web Consortium (W3C). The last version the W3C recommended was 4.01 in 1999, so HTML5 will be the first update in over a decade. The web platform was originally designed for sharing text documents over the Internet. The main purpose of standardizing HTML5 is to evolve the web platform to enable it to share a wider variety of applications over the Internet. To accomplish this, W3C is standardizing not just the markup language itself, which is the set of rules for handling text documents, but also functions for drawing graphics, playing multimedia files, communicating, and for accessing terminal devices (cameras, GPS (global positioning system), etc.) on a web browser (**Fig. 2**). When we hereafter refer to HTML5, we mean all of these functions covered by the W3C standardization process.

In addition, W3C envisions the installation of HTML5-compliant web browsers not only in personal computers and mobile devices but also in a wide variety of other devices such as automobiles and home appliances. To achieve this, they selected the functions to be standardized in HTML5. Further, through these HTML5 standardization activities, the W3C is aiming to make the web browser an open platform for distributing content and applications. This *Open Web Platform* will make it easy to share a single content file on multiple types of devices (one-source multi-use), to use content by linking multiple devices (multi-device), and to overwhelmingly increase the number of customers that receive the content and applications (**Fig. 3**).

For example, applications that are currently provided for smartphones cannot be used on other devices such as personal computers (PCs). In the future, however, if an application is provided for a web browser on a smartphone, then it will be possible to use it on any device, for example, a tablet, PC, or TV installed with a web browser. This will not only reduce the effort required to adapt the content to each type of device, but will also greatly increase the market scale for supplying the content. From the user's

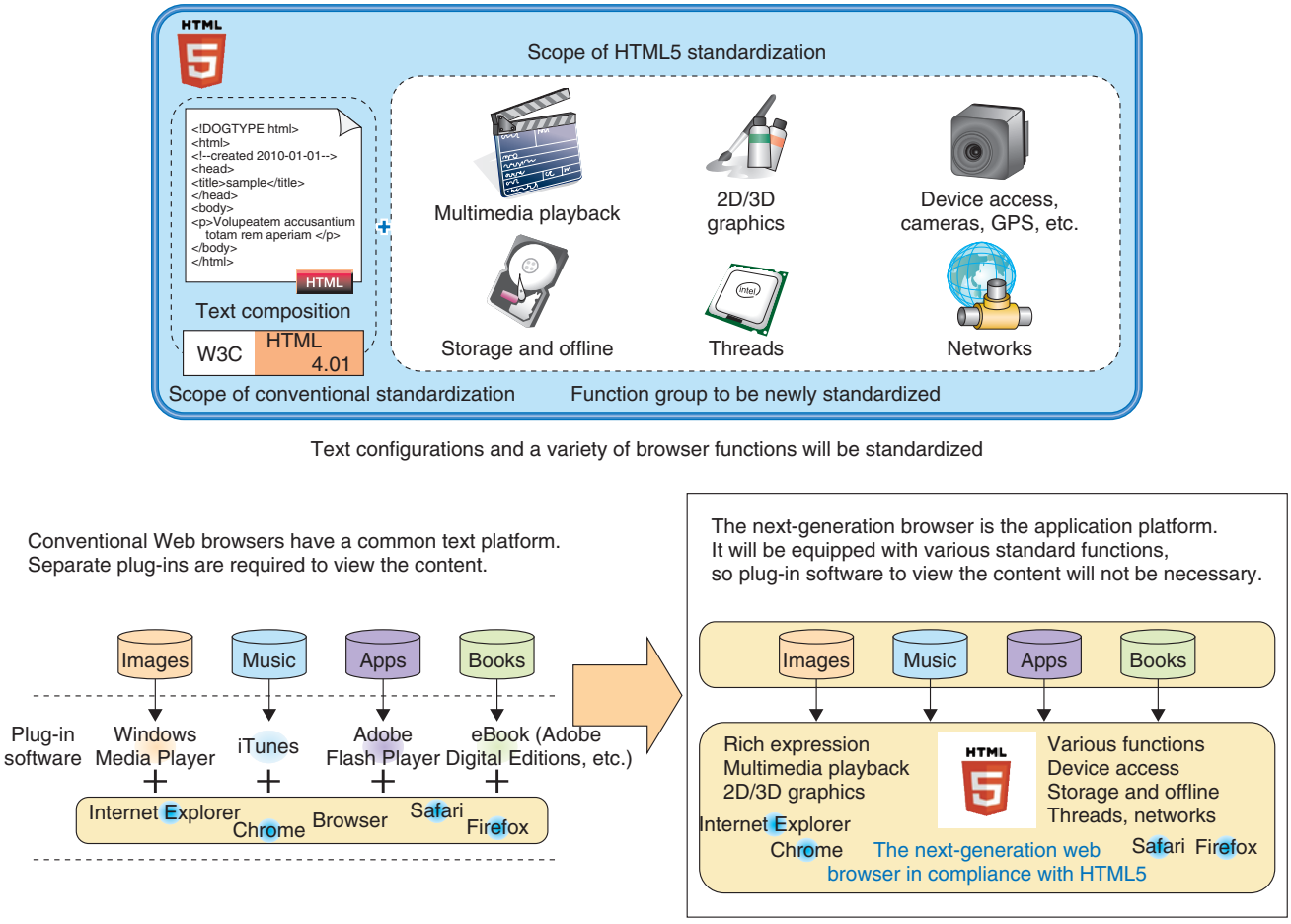


Fig. 2. Scope of HTML5 standardization.

perspective, this will improve the convenience of using the content since the users can enjoy it on any device desired. It is also expected to offer a new user experience where the users receive the content through multiple devices linked over the web.

3. Impact of HTML5

Achieving the Open Web Platform will weaken the vertically integrated business model, where OTT businesses have their own devices or operating systems; this will subsequently open up the content distribution market (Fig. 1(c)). Many companies around the world are focusing on this new platform as a new business opportunity and have begun undertaking new initiatives. In particular, telecommunications operators throughout the world have announced new projects to turn their business model around from a dumb pipe to a smart pipe model. For example, AT&T announced it will establish a marketplace where applications created using HTML5 will be sold for any type of device. In addition, they opened up some of their proprietary technology such as network functions for billing and authentication, cloud functions for storage, voice recognition, etc., for applications developers to use for their applications. Their objective is to attract many users by improving the attractiveness of their marketplace by offering many desirable applications. Other companies are also undertaking a variety of activities in anticipation of the next-generation web with the objectives of establishing their own market on the Open Web Platform and creating new business opportunities.

In addition, the Open Web Platform will also greatly change the style of viewing conventional media such as TV. If next-generation web browsers are installed in both TVs and mobile devices, then it is expected to be easy to not only link multiple devices

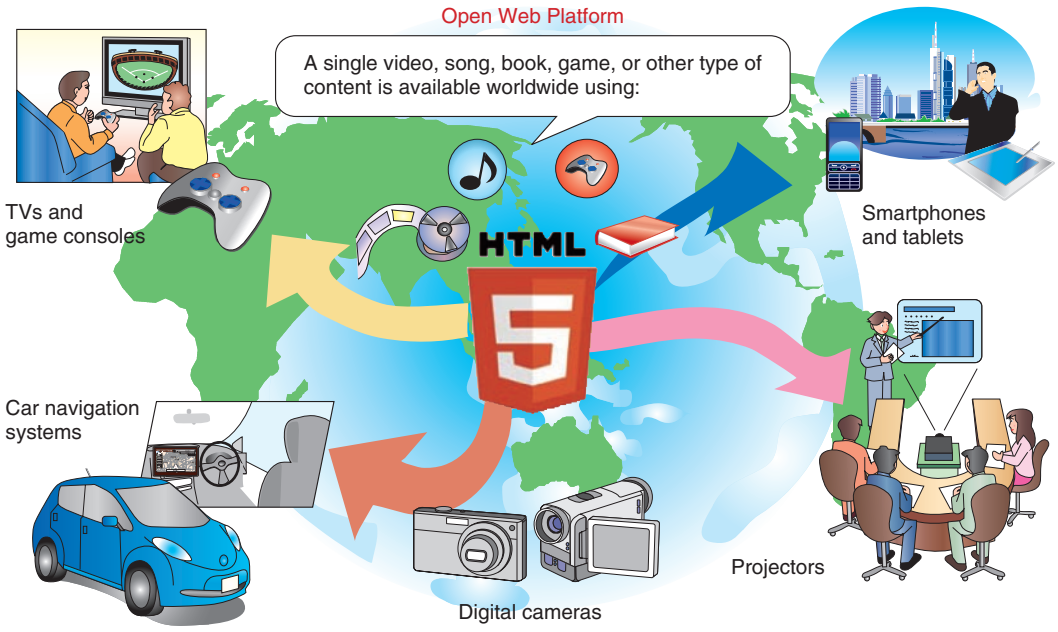


Fig. 3. The world of the Open Web Platform envisioned by W3C.

but also to link various types of content on the TV and on the web to create a new user experience. The technology for mobile devices has evolved a great deal recently, and very small, stick-shaped STBs have been introduced. Such technology will accelerate the installation of next-generation web browsers in TV terminals. This will in turn strengthen the impact that HTML5 makes on conventional media.

4. Building a new service mashup platform over the next-generation web

For the next-generation web, we think the NTT Group, as a telecommunications operator, will need to increase its presence in the open market to escape the dumb pipe business model, so we are suggesting three major policies to accomplish this. In this feature article, we introduce some examples of NTT Group activities in accordance with the respective policies.

4.1 Strengthen fundamental technology

The first policy is to strengthen the fundamental technology related to the distribution of content and applications over the next-generation web. We think this will require distinctive functions that other companies do not have. The development of the Open Web Platform will make it easy to link multiple devices or to mash up content and applications and thus make it possible to provide a more diverse range of services. However, it will make it more difficult from the user's perspective to find the desired services from among the huge number of services and devices existing on a single platform. Consequently, we need to establish appropriate links to the various devices and services and provide functions to users that match their preferences and circumstances (**Fig. 4**). If we realize this function, the user will be able to find the appropriate service via the appropriate device. In addition, the service providers will also be able to reach a large number of users via a wide range of devices, which will increase the value of the service as a platform.

NTT's R&D (research and development) laboratory group (NTT R&D) is already developing several elemental technologies in preparation for improving services on the next-generation web distribution infrastructure. For example, a *device-linking server system* can provide a new user experience where, for example, a smartphone can be used as a TV remote control. This system uses WebSocket, a function of HTML5, and enables multiple devices to be linked in real-time over the web. A *cross recommendation system* can provide the user with suitable suggestions gleaned from the massive number of services and products available on the web platform. When using a video distribution service, for example, users can

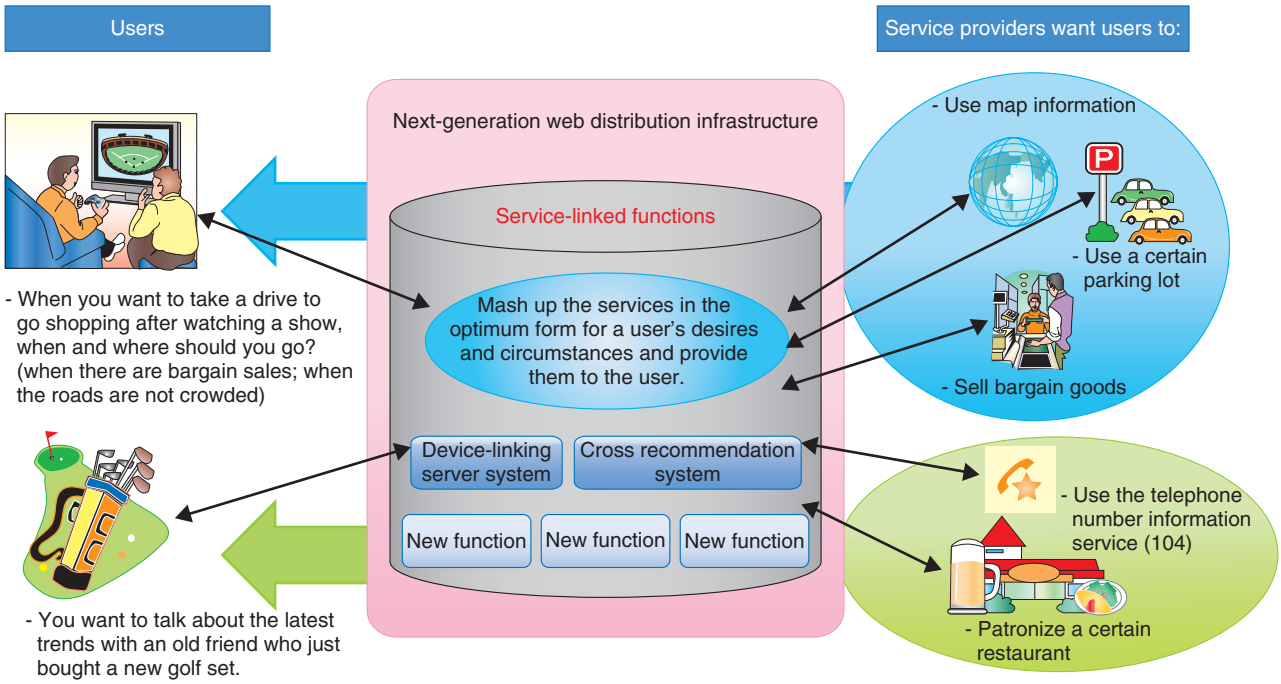


Fig. 4. Illustration of the next-generation web distribution infrastructure.

get recommendations of products from an electronic commerce site linked to the videos the users are viewing, or they can receive notifications of applicable new services based on their service use history or web viewing history. In parallel with this, NTT is proceeding with more advanced elemental technologies. We introduce some of these research themes in the feature article in this issue entitled "Personal Information Style" [1].

4.2 Expand market share of consumer services

The second policy is to utilize the characteristics of the next-generation web in order to expand the market share of the various consumer services offered by the NTT Group. The NTT Group provides high-quality services such as a content distribution service for mobile devices and a video distribution service for fixed networks. We think the experience gained in operating these services and the expanded customer infrastructure resulting from these services will result in NTT becoming a major competitive force in the next-generation web. In addition, the merits of scale possessed by the next-generation web will lead to improvements in services and expansion of the market size. The article entitled "HTML5-related Activites of NTT Group" [2] gives specific examples of some of the activities NTT Group companies are undertaking for the next-generation web.

4.3 Realize the Open Web Platform

The third policy is to create an open content distribution market that is easy to use for both the service users and the content and application providers. To do so, the Open Web Platform envisioned by W3C should be realized. The W3C standardization utilizes the method called a consortium standard where progress is made through the agreement of participating companies. In addition, this standardization process utilizes the proving ground concept where the web browser functions covered by the standardization are expected to be implemented in the market before they are recommended by the W3C as standard functions. Therefore, a wide range of participating companies should cooperate in order to achieve the open content distribution market. NTT has also participated in W3C standardization and has offered its opinions as a telecommunications operator regarding the standard functions. It should continue its activities aimed at realizing an open content distribution market. The article entitled "Standardization Trends in W3C Relating to Next-generation Content Distribution Services" [3] introduces examples of NTT R&D activities in the W3C.

5. Conclusion

HTML5 standardization exceeds the boundary of web browser technology specifications and will have a major impact on the content distribution market. We are focusing on this major development as a huge business opportunity, and as a telecommunications operator, we are working to enhance our presence in the content distribution market.

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Takashi Oka
Chief Producer, R&D Produce Group, NTT Research and Development Planning Department.
Since joining NTT in 1991, he has been engaged in corporate planning, corporate sales and marketing, and developing technologies, etc. He assumed his present position in 2012 and has been engaged in producing services in the content field.

Katsuhiko Kawazoe
Executive Producer, R&D Produce Group, NTT Research and Development Planning Department.
He received the B.E. and M.E. degrees in engineering from Waseda University, Tokyo, in 1985 and 1987, respectively. Since joining NTT in 1987, he has mainly been engaged in R&D of radio communication systems, satellite communication systems, and the personal handy-phone system (PHS). His specialty is forward error correction systems. He is currently a co-chairman of the ARIB Working Group for Broadcasting Systems based on a Home Server. He received the Young Engineer's Award from the Institute of Electronics, Information and Communication Engineers (IEICE) in 1995. He is a member of IEICE. He moved to his current department in July 2008.

Hideo Suzuki
Executive Research Engineer, Supervisor, NTT Service Evolution Laboratories.
He received the B.E. and M.E. degrees in material engineering from Tohoku University, Miyagi, in 1984 and 1986, respectively. After joining NTT Communication and Information Processing Laboratories in 1986, he was engaged in R&D of optical information processing and a web-based collaborative learning system. From 2004 through 2006, he was a Senior Manager in the R&D Center of NTT EAST. In 2006, he joined NTT Network Service Systems Laboratories, where he was involved in an NGN service trial. He is currently engaged in R&D of a metadata platform system for IPTV and multimedia broadcasting services.

Hisashi Ibaraki
Director of NTT Service Evolution Laboratories.
He received the B.E. and M.E. degrees in electrical and electronics engineering from Kobe University, Hyogo, in 1982 and 1984, respectively. He received the D.E. degree in electrical engineering from the University of Tokyo in 1996. In 1984, he joined the Electrical Communication Laboratories, Nippon Telegraph and Telephone Public Corporation (now NTT), Kanagawa, where he has been engaged in R&D of still image and video coding, video communication systems, networked appliances. He is a member of IEICE, the Institute of Image Information and Television Engineers, and the Institute of Image Electronics Engineers of Japan.

Personal Information Style

Shunichi Seko, Manabu Motegi, Masayuki Ihara, Toru Kobayashi, and Ryoji Kataoka

Abstract

NTT Service Evolution Laboratories has developed the *personal information style*, which is a technique of providing an IT (information technology) usage environment that is customized to each user's individual style. This article introduces a technique for obtaining information related to a video that a user is watching and casually displaying the information on the terminal in front of the user. This related information can be personalized at the touch of a fingertip, as in the interaction between a television and a tablet terminal.

1. Overview of personal information style

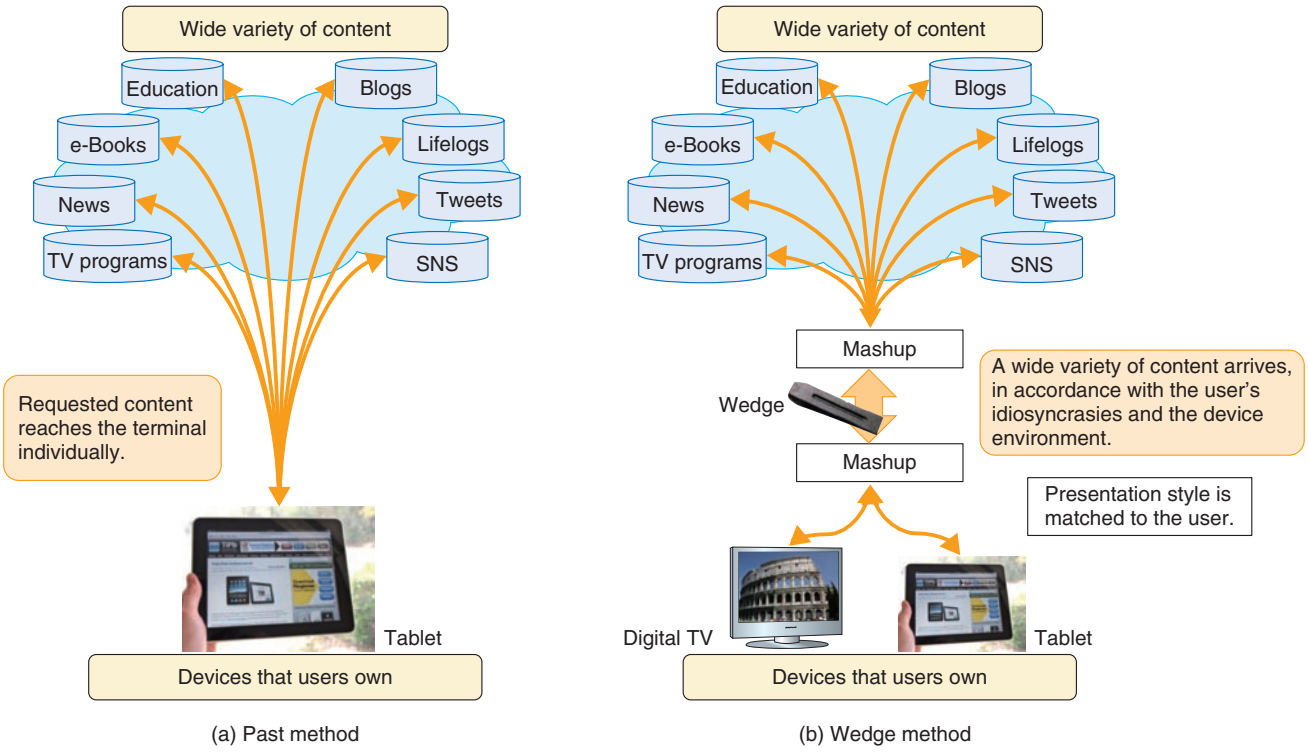
Recent technological advances have resulted in a huge explosion in the amount of available information, and along with this, there has been a rapid increase in content and web services that are attractive to users. At the same time, the widespread use of smartphones and tablet terminals is enabling users to use web services to access information on the web that was virtually inaccessible to ordinary people in the past, and as a result, the user layer is clearly expanding.

There is a range of environments that enable users to utilize web content and services effortlessly. This has been spurred by factors such as improved usability of terminals. However, there is still no environment that will efficiently enable any user, no matter how much experience they have in using the web, to readily track down the content or web services that they want from among the huge volume of information. There is a difference in the information that can be acquired by people who can effectively combine suitable keywords that should be input to the search engine, for example, and those who cannot. Thus, a problem exists in which searching out necessary information from among the huge quantity of content and web servers depends on the skills and information technology (IT) literacy of the user.

This article introduces a personal information style that is aimed at a user-centric information acquisition environment that is closer to the user than content providers and services. This personal information style provides content and services that are matched to factors such as the user's profile, context, and the device environment. We implement an information acquisition environment that reduces the load on the user by bringing that information closer to the user rather than making the user get closer to the content and services, and that does not depend on skills or IT literacy.

2. Approach

To implement a personal information style, a wedge method is first used to create associations between the user and the content (**Fig. 1**). Conventionally, the configuration is such that users actively search for their own preferred content and web services, and only the requested content is delivered to the device that made each request, as shown in Fig. 1(a). With the proposed approach, a wedge is inserted between the devices owned by the user and the content, as shown in Fig. 1(b). The wedge acts as a gateway when information on the Web is accessed from devices owned by the user, with the format being such that the wide variety of content on the web arrives in accordance with the user's idiosyncrasies and the device environment. This gives rise to the following



SNS: social networking service
TV: television

Fig. 1. Approaches for implementing personal information style.

three benefits:

(1) Integrated provision of related content from other media sources: Up to now, content was provided from a single media source specified by the user. However, inserting this wedge makes it possible to integrate and provide related content that is thought to be of interest to the user, from other media sources.

(2) Customization of design and interface for each user: The design and interface that has been customized for each user can be modified by interposing the wedge into a design that has been integrated in media units. Content that has been coordinated between devices owned by the user can also be presented by creating a mashup[*1] of the devices.

(3) No interference to service providers: The provision of content that is integrated with other media has no effect on the media provision interface on the service provider side since it is implemented on the wedge side.

*1 Mashup: Integrating techniques and content from a number of different providers to form a new service.

3. Architecture

The architecture for implementing the wedge method is shown in **Fig. 2**. The information style engine acts as a wedge to implement the wedge method. It has a content mashup and filtering engine, full-duplex communication functions between devices, and a sensitive user interface.

(1) Content mashup and filtering engine

This engine acquires a mixture of content from a number of media sources, either based on the user's actions or on the idiosyncrasies or devices owned by the user, and sends the results to the devices owned by the user. This makes it possible to create a mashup of web content and provide it to the user.

(2) Full-duplex communication function between devices

This function provides full-duplex communication

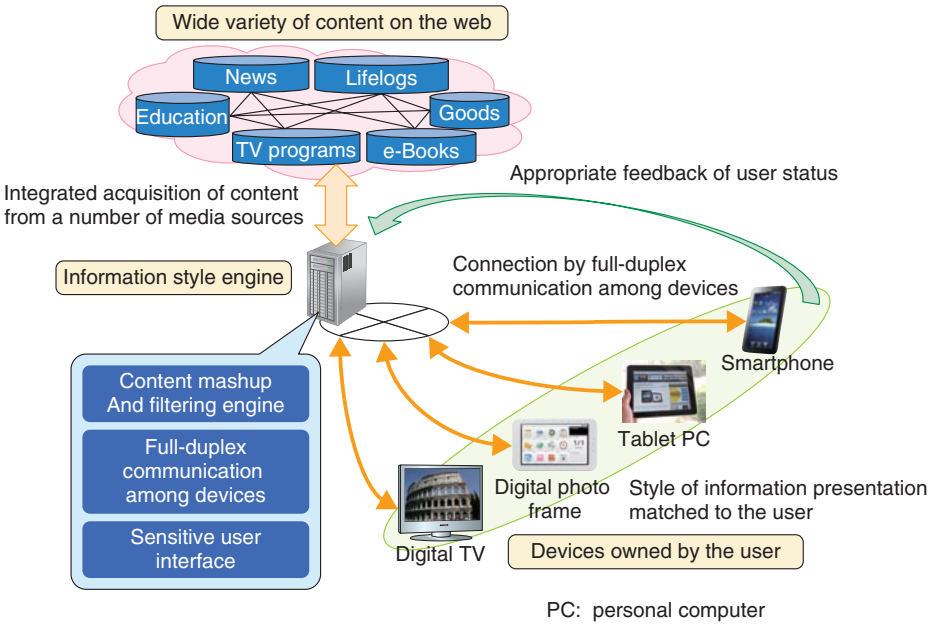


Fig. 2. Architecture of personal information style.

to each of the devices owned by the user to enable data transfer between them. Connecting devices by full-duplex communication enables device cooperation (mashup between devices) so that an action taken by the user on one device acts as a trigger to automatically display content on a separate device.

(3) Sensitive user interface

This interface displays information in a way that is sensitive to the user's direct actions and lifestyle, instead of in the one-sided manner of the past. This enables appropriate review of the content that should be included in the mashup and display of content that matches its status, by responding swiftly with respect to changes that occur on the user side.

As described above, the wedge method performs a cycle of operations that include presenting the result of a content mashup depending on the user's actions or changes in device states, obtaining feedback with respect to that result, and filtering the content on the web.

4. Use case of content recommendation coordinated with currently watched video

Here, we introduce a system that finds content that is related to a video the user is currently watching and displays it on a smartphone or tablet in front of the user, in coordination with the video, as an example use of personal information style. The user can get more information by utilizing this system. The information might consist of details of a restaurant that has been introduced in the video, or access to sites for purchasing the literary works of the performers or the accessories they are wearing, without actively searching for such information. This system is implemented in HTML5 (hypertext markup language, fifth revision), so we give details of the system and explain the advantages of using HTML5.

4.1 System overview

An overview of the content recommendation system that is coordinated with the video that the user is currently watching is shown in **Fig. 3**. The user possesses a digital TV or tablet terminal, and full-duplex communication is enabled for this terminal through an information style engine server by the HTML5 WebSocket[*2].

Using WebSocket reduces communication traffic and the load on the web server, in comparison with conventional full-duplex communication. The information style engine server can access various types of

*2 WebSocket: A standard for providing full-duplex communication by web servers or web browsers. More precisely, it is a technique that has been isolated by HTML5, but in the broader sense it is handled as a technique by HTML5.

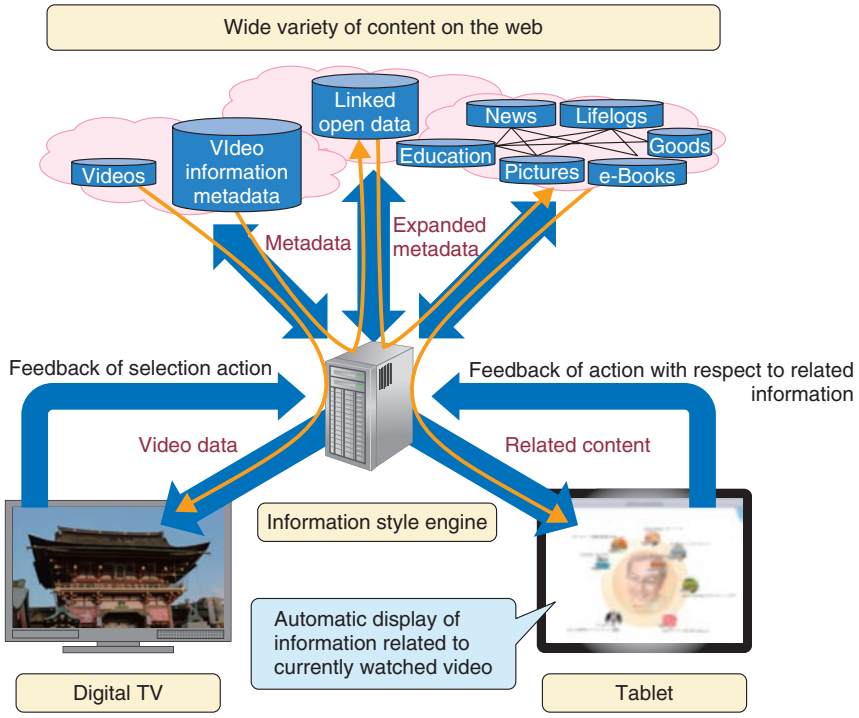


Fig. 3. Overview of content recommendation system coordinated with currently watched video.

content on the Web and is configured to temporarily store the acquired content in the server itself. We describe this operation below.

If the user selects a video on digital television (TV), information on that selection is transmitted to the information style engine server. The server acquires metadata containing pertinent video data and keywords related to that video from the web. The video data are transmitted to the digital TV, and replay is started. The acquired metadata are input as parameters to Linked Open Data (LOD)[*3] applications such as DBpedia[*4], and related keywords in the metadata are acquired from the LOD. Since the metadata will not always exist in sufficient quantity, going through the LOD will expand or bulk out the related keywords. The system uses the expanded metadata to search for content on the web and acquires content related to the video being watched. The acquired related content is displayed on the tablet terminal in front of the user, enabling the user to browse content that is related to the video being watched. The user's actions with respect to the displayed related content are also fed back to the information style engine server. The system acquires new related content based on this feedback, and modifies the displayed related content to match the user's actions. In addition, if the user changes the video he is watching, the system is designed to restart the above processing; then, content related to the new video footage will be displayed.

4.2 Content rejection/selection user interface

Another feature of the system is an interface that is swiftly responsive to the user's actions. This interface operates the feedback cycle smoothly and displays or manipulates the related content. A display screen of this user interface is shown in **Fig. 4**. The image shows the method of manipulation and depicts how the display appears when related content is rejected or selected. Related content is displayed as icons on this user interface, more detailed information will

*3 LOD: Abbreviation of a technique for releasing a data collection that has been optimized by computer processing, onto the web. It is configured so that related data are associated, and is expressed as a uniform resource identifier (URI). Accessing that URI enables acquisition of information related to the data.

*4 DBpedia: Community project that extracts Wikipedia information and releases it as LODs. For example, if the data "Shounan" is input, it is possible to acquire data such as the related place names "Enoshima" and "Yuigahama" as well as the names of famous people who have connections to those places.

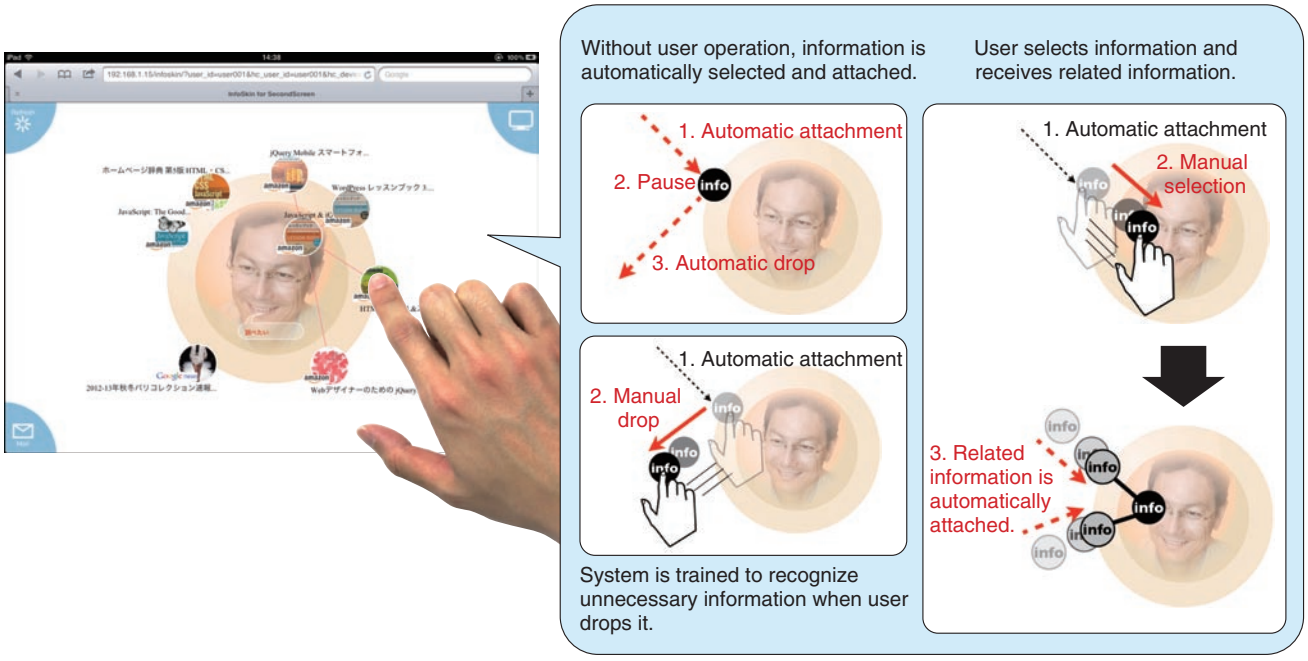


Fig. 4. Content selection user interface.

appear when the user taps the icons. Content icons appear automatically as small animations that congregate from outside the screen into a central circle. These automatically disappear from the screen if the user does nothing, and icons for new content appear as similar animations. This display method ensures that the user need only act when wanting to know more details and reduces the *pushiness* that often exists with recommendation techniques. It is possible not only to tap content icons but also to drag-and-drop them. If an icon enters the central circle, information related to that content automatically gathers around the central circle from outside the screen. This enables the user to collect content of interest by simply moving promising icons into the circle, without having to input keywords. Conversely, the user can deliberately erase content by flicking the icon toward the outside of the screen. Since these actions are also fed back to the information style engine server, it is possible to easily inform the system which information is unwanted. In this manner, the user can readily search for content of interest through the simple actions of *pulling in* or *flicking out* the icons that continue to appear.

This user interface is also implemented in HTML5. Since the icons displayed in Fig. 4 are rectangular images when acquired from the web, they are trimmed into circles by using a Scalable Vector Graphics (SVG)[*5] filtering function for display. The content icon display and animation are all defined as inline SVG[*6], so it is possible to represent any display state as HTML tags. This enables coordination with different systems and interaction with other devices utilizing HTML tags, and will also provide expandability.

5. Future plans

The example of personal information style we described in this article involved interaction with digital TV, but personal information styles can also be applied in the presentation of related content using techniques such as digital signage or position information as the trigger, without using a TV. Note that the NTT Plala video delivery service of Hikari TV has provided a *Nagarami Assist* (assistance while watching) service that utilizes this technology since

*5 SVG: An image format in vector graphic form, described by XML (extensible markup language). Broadly, it is handled as one HTML5 technique.

*6 Inline SVG: Method of displaying SVG by describing it directly as a tag within an HTML file without reading and displaying it as an image file. This has enabled display by inline description from HTML5.

November 2012. However, at this point, the service can only cope with a limited number of contexts, and it has not yet reached the ideal form of the wedge method proposed in Fig. 1. We will therefore continue our research and development in the future, with the aim of implementing a service that is sensitive to a large variety of contexts such as the user's idiosyncrasies, behavior, and preferences, and the environment and state of the devices, to provide the greatest user experience regardless of circumstances.

Shunichi Seko

Researcher, Service Harmonization Project, NTT Service Evolution Laboratories.

He received the B.E. and M.E. degrees in media and governance from Keio University, Kanagawa, in 2006 and 2008, respectively. He joined NTT in 2008 and is currently studying information sharing under disaster situations and a user interface for recommendations. He received the FIT 2010 Young Researcher's Awards from the Institute of Information and Communication Engineers (IEICE) and the IEEE ICCE 2011 Special Merit Awards.

Manabu Motegi

Research Engineer, Innovative Service Architecture Project, NTT Service Evolution Laboratories.

He received the M.E. and Ph.D. degrees from Tokyo Institute of Technology in mechano-micro engineering in 1995 and 2008, respectively. He has been with NTT since 1995. His research interests include multi-robot collaboration, human-machine collaboration, and data mining with multi-sensors. He received the Encouragement Award from the Robotics Society of Japan in 1998.

Masayuki Ihara

Senior Research Engineer, Supervisor, Service Harmonization Project, NTT Service Evolution Laboratories.

He received the M.E. and Ph.D. degrees from Tokyo Institute of Technology in 1994 and 2010, respectively. He worked at the New Media Innovation Centre and at the University of British Columbia in Canada from 2002 to 2003. His research interests include value based design, cognition of human values and preferences, and human-computer interaction. He is a member of the Association for Computing Machinery, the Information Processing Society of Japan (IPSJ), and IEICE.

Toru Kobayashi

Professor of Electrical Engineering and Computer Science Division, Graduate School of Engineering, Nagasaki University.

He joined NTT in 1987 just after graduating from the Graduate School of Mechanical Engineering, Tohoku University, Miyagi. He received the Ph.D. degree from the Graduate School of Information Systems, the University of Electro-Communications, Tokyo, in 2011. During his career at NTT, he was engaged in R&D of software engineering, network platforms, groupware, information security, ubiquitous computing, data mining, etc. He also spent almost four years in Düsseldorf, Germany, where he managed joint research projects and standardization activities related to smart card technologies in cooperation with an EU research institution. He is a senior member of IEICE and a member of IEEE and IPSJ. He joined the faculty of Nagasaki University in April 2013. He was Senior Research Engineer, Supervisor, Group leader of Service Harmonization Project, NTT Service Evolution Laboratories at the time of this article was written.

Ryoji Kataoka

Senior Research Engineer, Supervisor, NTT Service Evolution Laboratories.

He received the B.E. and M.E. degrees in electronic engineering from Chiba University in 1985 and 1987, respectively. He joined NTT in 1987 and has been engaged in research on transaction processing, multimedia information systems, and information retrieval. He is a member of IPSJ.

HTML5-related Activities of NTT Group

Kenji Yasunaga, Shigeo Matsuno, and Akio Matsuda

Abstract

The NTT Group has already begun developing a variety of services that utilize HTML5 (hypertext markup language, fifth revision). This article introduces two advanced examples of such services: an e-book reader developed using HTML5 by NTT Solmare and an application of service development and engineer training using HTML5 by NTT Resonant.

1. Introduction

NTT's R&D (research and development) Laboratory Group is already developing several elemental technologies to improve the service of the content distribution infrastructure over the next-generation web platform. In parallel, some NTT Group companies are also actively engaged in their own HTML5 (hypertext markup language, fifth revision) related activities. We introduce here the activities of NTT Solmare and NTT Resonant, which began developing services that utilize HTML5 early on.

2. Activities of NTT Solmare

NTT Solmare [1] has been developing business applications centering mainly on comic and game distribution in order to realize e-book services for multiple devices. The e-book industry recently entered a highly competitive phase, as evidenced by the purchase of kobo by Rakuten and the domestic introduction of Amazon's Kindle e-book reader. At the same time, the main terminal in the mobile market is shifting from cell phones to smartphones, so there is now a full-fledged effort to provide services for multiple devices including smartphones, personal computers (PCs), and tablets.

Against this background, NTT Solmare has been using HTML5 to develop an e-book viewer for e-book services that are device-independent ahead of competitor companies in preparation for the soon-to-come multi-device era.

2.1 e-Book viewer development

HTML5 was selected as the development language for the e-book viewer in order to increase the development speed and reduce the cost of operation and maintenance. Developing dedicated applications for each device allows the utilization of the device characteristics but also requires separate development for each device, which lengthens the development period. Applications developed using HTML5, however, can be used on all devices running a web browser that supports HTML5. Thus, multiple devices are supported, which minimizes the required development effort and consequently shortens the development period. In terms of operation as well as maintenance, there is no need to manage the source code for each device when adding functions or changing screens, for example, which greatly increases efficiency.

2.2 Functional advantages of HTML5

The HTML5 functions that were particularly beneficial in the current development are *Canvas, Web Workers, Web Storage, and Cache Manifest.*

Canvas is a function to draw figures on a web browser using JavaScript. Using it as an e-book viewer function makes it possible to turn pages (images) or express animation that moves without having to use a special plug-in. However, when Canvas was used by itself for the page transition function, a problem occurred because of the extensive processing required. Using it in combination with Web Workers, which runs JavaScript processing in the background, makes page transition processing very

Fig. 1. Image of HTML5 e-book viewer.

smooth.

Web Storage is a function that enables a large amount of data to be stored in the web browser. Conventionally, data for each user can only be saved on the server side or, if the amount of data is small, on the web browser by using a cookie. Using Web Storage, however, makes it possible to save a large amount of e-book data in the terminal so that it can be viewed even when offline. Further, using Cache Manifest to efficiently manage resources that are cached locally eliminates operation delays. Efforts such as these have resulted in the completion of the first version of an HTML5 e-book viewer. (**Fig. 1**)

2.3 Development of e-book viewing application for Windows 8

At the same time the first version of the HTML5 e-book viewer was completed, Microsoft announced the launch of its online application store called *Windows Store* and revealed that HTML5 would be supported as an application development language for the next version of the Windows operating system (OS) (Windows 8). The results of various surveys showed that the HTML5 viewer that was developed could be ported to Windows 8, so we began working to develop an e-book viewing application for Windows 8 ahead of other companies.

The development did not proceed easily, however. For example, Windows 8 uses a completely new interface that assumes a touch operation such as with a tablet, so some operations are specifically defined, for example, for touch direction and screen usage. Therefore, we had to use the development guidelines that were only provided in English at the time and tune the already developed HTML5 e-book viewer for the Windows 8 interface. In addition, Windows 8 did not provide a digital rights management (DRM) module for application development. Consequently, we first had to study the scarce technical materials that were available for developers. After that, we came up with a DRM method by utilizing the characteristics of Windows 8. We also implemented our own DRM module that we developed from scratch in the e-book viewing application.

Further, we repeatedly upgraded the application's functions for each release of the Windows 8 CP (Consumer Preview), RP (Release Preview), and RTM (Release to Manufacturing) versions, as well as for the OS version upgrades. This application development was a technologically advanced effort that was done before other companies carried out similar work. We demonstrated the application during a keynote address at the Microsoft developer event Windows Developer Days, where it received a great deal of attention (**Fig. 2**).

This application is currently registered as *Chikyu Shoten* (World Bookstore) under the Windows Store book category (**Fig. 3**).

Fig. 2. Demonstration at Windows Developer Days.

Fig. 3. Windows Store top screen.

3. Activities of NTT Resonant

NTT Resonant provides various Internet services such as the portal site *goo*, which will celebrate its 16th anniversary in March 2013. The company is engaged in a variety of efforts to provide services to users that make their Internet experience more enjoyable. Some of these efforts include actively working (since 2009) on activities related to HTML5, the next-generation web standard specification.

There are two main reasons the company is working with HTML5. The first is the change in markup specifications. Some people view HTML5 as a leading-edge technology that can do anything, but it is actually just a revision of the current web standard HTML 4.01. In other words, we should adapt to the evolution of the web standard that is taking place. The second reason is the diversification of devices and platforms. Currently, various devices such as televisions, game consoles, car navigation systems, and home appliances in addition to smartphones and tablets are able to connect to the Internet. Furthermore, a variety of mobile operating systems such as iOS, Android, and Windows Phone, and web browsers such as Safari, Chrome, IE (Internet Explorer), and Firefox, have also appeared. We should therefore create new services for these multiple devices that use various OSs and browsers. In this respect, we view HTML5 as a key technology and are involved in two relevant activities: application of HTML5 in service development and engineer training.

3.1 Application in service development

We introduce several examples in which HTML5 is applied to various services provided by NTT Resonant.

(1) goo video: When *goo video* [3] underwent a site renewal in January 2012, it was implemented in HTML5. This site was designed to make searching and viewing easier for users, and the content on the site was also optimized for screen viewing on PCs, smartphones, and tablets to improve the user experience.

(2) PinQA: *PinQA* is a spot information gathering service [4]. When support for smartphones was added in August 2012, the HTML5 configuration element known as CSS3 (Cascading Style Sheets, third generation) was used to optimize the smartphone screens. In addition, the Geolocation API (application programming interface) was used to acquire information on current user position.

The advantages of applying HTML5 to services is the ability to support multiple devices with one source. This makes it possible to provide a consistent experience to users while minimizing the required development cost. However, some issues remain. For example, the HTML5 function compatibility is incomplete because of the different types of platforms that will use it, for example, OSs and browsers, as well as the differences between versions. This can cause problems in guaranteeing the operation to users and may lead to the risk that web pages containing ads will not display correctly. In addition, in the current mobile application market, the market for native applications is large and is led by iOS and Android. These mobile operating systems overshadow the Web application market in terms of user reach and potential business value. HTML5 is still evolving, and the technological issues are expected to be resolved before the official recommendation is approved in

Resonant University Workshops	- What will HTML5 change? (2011) - HTML5 will change trends of Web (2012) - Web Design Trends (2012)
Asaren Technology Acquisition Morning Workshop	- Let's Build the Web Using HTML5! (2011, 3 months) - Large-scale JavaScript Development (2011–2012, 6 months) - Seminar on HTML5 Applications Created Using Cross Platform (2012)
Tech talk Technical talk session	- HTML5 (2009) - What is HTML5? (2010) - Learn about current HTML5! (2012) - What is SPYDY? (2012)

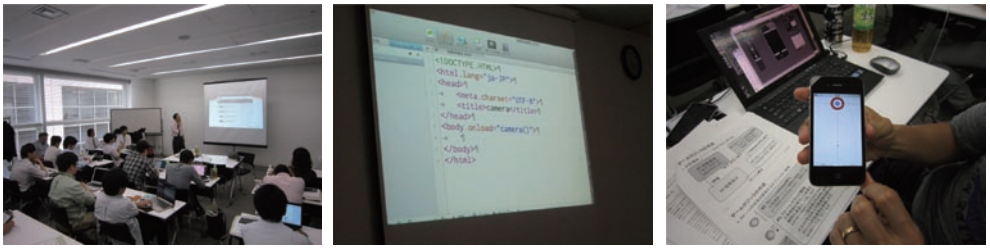


Fig. 4. In-house workshops related to HTML5.

2014. At the current stage, however, when developing services for mobile devices, it is important to take different approaches for native applications and web applications depending on the purpose and usage environment of the service (including applications).

3.2 Engineer training

NTT Resonant holds Resonant University, a series of workshops for all employees that includes *Tech Talk and Asaren*, which respectively are technical talk sessions and morning workshops for technology acquisition. These sessions introduce technical and design trends, including the latest HTML5 trends, through seminars and practical technical training provided by knowledgeable persons inside and outside the company. They are opportunities for employees to increase their knowledge of HTML5 and to improve their engineering skills. HTML5 was first addressed as a theme in February 2009, and related activities have been conducted during the four years since then (**Fig. 4**).

In addition, as a technical study, a hackathon type overnight testing session was held by 10 employees to compare HTML5 based web applications with native applications and to compare and verify the development frameworks. The results of this session confirmed that expressive ability comparable to that of native applications was possible using HTML5, but that it was inferior in terms of execution speed and terminal resource access. The knowledge gained from this test was used to determine areas of application development (**Fig. 5**).

During fiscal 2012, HTML5 was designated as one of the areas to focus on in order to strengthen the core competence of NTT Resonant. HTML5 has already been implemented in some services by some employees. We will accelerate this initiative and advance the implementation of HTML5 in services, while evaluating the areas in which to apply it. In parallel, we will create an environment for training HTML5 engineers and will prepare and implement a training plan. We will also strive to improve our skills in order to play a major role in facilitating the consumer services of the NTT Group.

4. Future NTT Group activities

This article introduced examples from NTT Solmare and NTT Resonant. The NTT Group is involved in developing various services utilizing HTML5. Further, NTT R&D is conducting research and development to improve the next-generation web distribution infrastructure services that will serve as a platform for consumer services.

Evaluation of native reproducibility of HTML5 Web application
- Becoming closer to reproducing a GUI comparable to that of native applications
- Some aspects are inferior to native applications in terms of speed and resource access
- Differentiate use by using HTML5 for simple applications and native applications for games and apps that require performance

	Native application		Web application (HTML5)	
Expressibility	◎	Capable of broad expression from games to tool system applications	○	Sufficient expression of tool system applications that do not require drawing functions
Resource access	○	Fully utilizes terminal resources, no cross domain problems	△	There are terminal resource limitations and cross domain problems.
Execution speed	◎	Can utilize maximum terminal performance	○	In the practical range for tool system applications, but not good for applications (games etc.) that require drawing performance
Productivity	△	Double development for iOS and Android	◎	Common development using HTML5
Multi-device support	△	Requires tuning for each terminal	○	HTML5 supports multiple devices

◎ Sufficient practical range
○ Practical range
△ There are several limitations

Fig. 5. Evaluation of native reproducibility of HTML5 Web application.

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[4] PinQA (in Japanese). http://pinqa.com

Kenji Yasunaga
Senior Director, Service Development, Comic Business Unit, NTT Solmare.
He joined NTT in 1997 and engaged in R&D of public devices and IC cards in NTT Human Interface Laboratories. From 2000, he was engaged in developing IP business phones (hybrid type) and terminal equipment for subscriber networks in NTT WEST. He is currently directing a development group focusing on the development of systems related to comics used in combination with new technologies such as cloud linkage and HTML5.

Shigeo Matsuno
Manager, New Business Team, Corporate Strategy Planning Department, NTT Resonant.
He graduated from the Commerce Department of Meiji University, Tokyo, in 1998 and joined NTT in the same year. He joined NTT-X (now NTT Resonant) in 2001 and engaged in corporate web integration and planning & developing of web services. He has been involved in creating new business applications since 2011.

Akio Matsuda
Manager, NTT Research and Development Planning Department.
Since joining NTT in 1997, he has been engaged mainly in service development in the field of content and new business development. In 2011, he assumed his present position and is currently engaged in producing content.

Standardization Trends in W3C Relating to Next-generation Content Distribution Services

Shinji Ishii, Tomoki Watanabe, Masayuki Ihara, and Toru Kobayashi

Abstract

The prices of liquid crystal displays and touch panels are continuing to decrease, and accordingly, the popularity of devices that use web browsers is increasing. These devices include smartphones, tablets, televisions, car navigation systems, e-book readers, and digital signage systems. There is also a growing transition towards open platforms that use web browser technology to further expand business activities and popularize services. This article introduces services designed for use with devices newly equipped with web browser functions, and reviews trends in the World Wide Web Consortium (W3C), which is the de facto standardization organization for web browser specifications.

1. Introduction

There are two main flows of standardization related to the use of networks to deliver content. One flow involves the expansion from telecommunication services into Internet-related services, and the other involves the expansion of broadcasting services. Telecommunication services began with audio only and then expanded to Internet protocol television (IPTV), which includes video, audio, and text.

Similarly, broadcasting started with radio broadcasts and then expanded to black and white TV, color TV, digital TV, and Hi-Vision TV. Recently, the two types of services have been combined in IPTV.

The principal devices for IPTV are TV displays that can handle full Hi-Vision. The market share of these TVs is expanding for products that have the same pixel count as personal computer (PC) displays. Some of the functions of TVs and PCs have begun to merge, whereas in the past, they were considered to be completely different products. As a result, volume efficiency has driven down the prices of full Hi-Vision liquid crystal panels, which are increasingly being used for purposes other than TVs or PCs.

2. Objectives and timing of standardization

As a general tendency, businesses must continuously reduce prices in order to maintain profits. Conventionally, even products that ensured a company's profits through the use of proprietary technology had to decrease in price annually for that company to retain its competitive edge. Incidentally, even products in which more generic components are combined are losing their competitive edge.

A strategy that is sometimes effective for companies that want to survive in the market is to actively participate in efforts to standardize specifications within their business field. They can generally improve productivity by adopting those specifications, which enables them to continue to secure profits. The relationship between market expansion and the lapse of time is shown as a hypothetical model of individual proprietary techniques and standard specification techniques in **Fig. 1**. Progress is not necessarily limited to this model; it depends on factors such as the market share of each business. However, this is seen to be an age in which the trend toward open sourcing is transitioning from individual proprietary techniques to standard specification techniques. Note

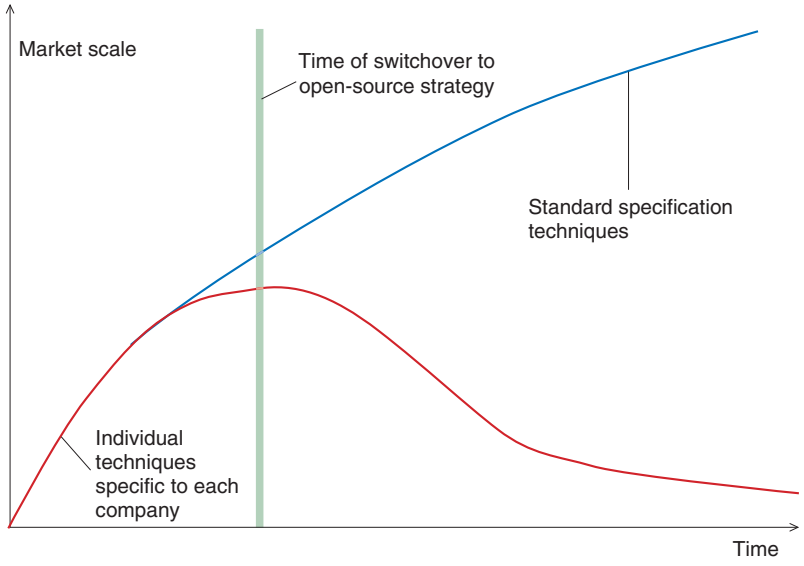

Fig. 1. Model of relationship between market expansion and time, focusing on open sourcing.

that since standardization has been necessary from the earliest days for services in which mutual connectivity between different companies' products is essential, e.g., telephones and data communications, this model does not apply to them.

Standardization can be divided into three main categories: *de jure standards* that give equality to the participating organizations of each country that contributes to standardization efforts. This category covers standards that are prescribed by international standardization organizations and requires basic compliance with recommendations. Another category consists of *de facto standards*, where organizations and businesses having the same standardization objectives have met together and generally agreed on standards, with the result that methods that have won acceptance through open competition make up a large share of the market. The third category is *alliances*, where a few companies have met together to maximize market share,

The World Wide Web Consortium (W3C) aims to draw up common specifications for web browsers [1]; it fits in the second category of a de facto standardization organization and currently has over 380 entities participating in it. NTT is actively promoting standardization relating to services for promoting content distribution and of browsers and communication functions installed in devices used for such services.

We comment below on trends in W3C based on their relevance to the content distribution market.

3. Initiative towards W3C standardization challenges related to content distribution

The prices of liquid crystal displays and touch panels have continued to drop recently as a result of the volume efficiency of digital TVs and computer displays with touch panels. Consequently, smartphones, tablets, and e-book readers that can be directly operated by touch, without keyboards or remote controllers, are rapidly becoming popular. Other examples of display devices equipped with touch sensors are car navigation systems and electronic advertising media (digital signage) systems in locations such as large shopping malls and transportation stations. The capabilities of these devices in addition to their inherent basic functions can be expected to expand when browsers are installed in them.

At the time the W3C was launched, the main target for standardization was browsers used in PC displays. However, the use of browsers is spreading to the following communication devices [2]:

- Smartphones and tablets
- TVs with web browsers
- Car navigation systems
- e-Book readers
- Digital signage (electronic advertising media)

The HTML5 (hypertext markup language, fifth

Table 1. Standardization topics related to content distribution.

Standardization Group	Main standardization details
Device APIs WG	Web Intents etc. to implement interaction between a number of devices
CSS WG	Style sheets for implementing the representation of a variety of writing styles, including vertical writing etc.
SVG WG	SVG to implement the compression and expansion of high-quality images etc.
Geolocation WG	Use of position information from GPS
Web RTC WG	Handling from web application data from sensor devices such as cameras and microphones, and use of data communications between host and other terminals
NFC WG	Communication between devices using proximity ICs

API: application programming interface
CSS: cascading style sheets
IC: integrated circuit
NFC: near-field communications
RTC: real-time communications
SVG: Scalable Vector Graphics
WG: Working Group

revision) framework is also progressing to enable users to browse web pages, even when using platforms from different browser developers. It is thought that the use of a common rendering feature in browsers will bring about changes even in business formats that provide and use content.

To cope with this trend, the W3C established a place where relevant personnel such as service providers could exchange opinions and viewpoints concerning required browser functions, including those related to the aforementioned business schemes, instead of just drawing up standardization specifications centered on specialist technicians, as was done in the past. Approximately two years ago, a study began on the implementation of TV services on TV displays that have browser functions [3].

Another study that started in April 2012 concerning the application of TV displays for electronic advertising display apparatuses is investigating the possibility of such applications from business use cases [4].

4. Standardization topics relevant to communications services

We give an overview here of the effects of W3C's browser specifications on devices having the previously described communication functions, and we explain the current investigation status in W3C.

Browser functions are new additions to devices that already had their own inherent functions (such as telecommunication functions in smartphones). No special synergistic effect will be achieved by simply having the browser functions and the functions inherent to the devices acting as independent services. It will be possible to implement expanded and novel fusion services by adding functions that enable interaction between the inherent functions and the browser functions. A number of W3C standardization topics that are relevant to content distribution are listed in **Table 1.**

Let us take smartphones as an example; applications running on the Android operating system (OS) and on iOS (Apple's mobile OS, previously known as iPhone OS) are not compatible, but certain advantages are enabled when the service providers collaborate in developing functions that run on web browsers. If it becomes possible for a browser to make use of the positional information from a GPS (global positioning system), which is a function provided in many smartphones, as a web browser function, we can expect to achieve synergistic effects that could not be obtained with the telecommunications function alone. For example, the user could acquire the current position of a shop of interest by using such positional information and could then phone that shop. The points of standardization for each type of device provided with communications functions are given below.

4.1 Smartphones and tablets

The greatest feature of smartphones and tablets is that they can be used in various locations both indoors and outdoors. For example, they can be used while the user is at home, at school or the office, or while out walking, which makes them extremely accessible communication devices. Functionally, they can handle communication in the form of video, audio, and data.

The use of smartphones has increased significantly in just the past few years, and as a result, the use of

browsers in devices other than PCs has also greatly increased. In particular, liquid crystal screens with built-in touch sensors have made it possible to specify a location on the screen and to use software keyboards. This helps to achieve an operating feel close to that of a PC, enables a flexible screen layout, and ensures that many of the input functions that can be used with a PC can also be used on a smartphone. This means that the browser functions that were originally designed primarily for PCs can be implemented in smartphones and tablets, allowing users to easily carry and use them outside. This makes it easy for users to search for information in the vicinity of their current location.

Discussions in the W3C have been expanded to include non-PC browsers and are currently intensifying and becoming more specific. Other devices that are expected to interact with TVs or the like, as described later, are also becoming very important devices in this field.

4.2 TVs equipped with web browsers

TVs equipped with web browsers are designed to receive video services of TV broadcasts and IPTV services in the home. To ensure that functions that previously required hardware such as TV receivers or dedicated reception boards can be handled in a browser, it is necessary to modify the user interface. This requires an interface that differs from the traditional TV remote control. There are also other challenges to meet such as content protection and replacing functions that once used hardware with browsers or software that interacts with them, based on delivery techniques that differ from multicast protocols on the web.

4.3 Car navigation systems

The use of car navigation systems is expected to expand greatly in the future. It is becoming possible to make use of communications functions and position information notification functions related to the functions for route-searching and congestion information notification that are the main purposes of car navigation systems. These functions have the potential to provide not only guidance on traffic and retail premises in the vicinity of the current travel location, but also to display travel safety information and the results of information processing from multiple sensors. For example, these sensors might be installed in GPS devices and cameras in order to determine the state of the road surface and of other traffic; collecting their data would complement driver performance. It is thought that setting and installing a screen display layout for each of these functions and using a browser with generic display functions will be effective for implementing these functions.

In November 2012, a workshop was held to investigate methods of using in-vehicle displays in the future and was centered on major international automobile manufacturers [5]. The work of the discussion group from this workshop has started in earnest.

4.4 e-Book readers

In the field of book publishing, an expansion and shift toward the e-book reader market is predicted. Book readers that have been released up to the present have been dedicated devices from each manufacturer. However, Wi-Fi functions and browsers are now being installed as additional functions in e-book readers, and browser access functions are beginning to appear. This suggests that the barrier between e-book readers and tablet PCs will eventually cease to exist.

In addition, the vertical writing and kanji-reading text include ruby markup (called furigana in Japan) that are often seen in printed matter in Japan could not be displayed in browsers in the past. However, since it is hoped that e-book readers will be able to handle such text, they are increasingly being included in compliant browser specifications.

4.5 Digital signage (electronic advertising media)

One side effect of the drop in prices of liquid crystal TVs that can handle Hi-Vision is that digital signage using TV displays is starting to increase in outdoor advertising and guidance displays. Currently, animation and audio can be used on electronic signboards created from arrays of multiple TV displays in tile form or kiosk terminals. In the future, it will be possible to use a browser to implement functions equivalent to content that was once created for individual systems, by using functions such as those for communicating with portable devices or the like. Browser-based signage systems will also simplify the reciprocal use of content and can be expected to reduce the cost of producing content [6].

5. Future developments

As liquid crystal displays and touch panels drop in price, the trend towards implementing web browsers in devices continues to grow. These devices are not limited to PCs but include other devices and services such as smartphones, tablets, TV services, car

navigation systems, e-book readers, and digital signage systems.

It will be important in the future to plan transition timing to an open-sourcing strategy and create an accompanying standardization framework beforehand. The NTT Group is actively promoting the standardization of services that use communication functions tailored to open-source browser platforms or to browser functions used in devices.

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Shinji Ishii
Senior Research Engineer, NTT Service Evolution Laboratories.
He joined NTT in 1989. He has mainly been engaged in developmental research on copy protection systems and conditional access systems for broadband communications and digital broadcasting. He is currently a fellow of the World Wide Web Consortium at Massachusetts Institute of Technology, USA. His current research and standardization area is standardization of web-based digital signage systems.

Tomoki Watanabe
Senior Researcher, NTT Service Evolution Laboratories.
He received the B.E. degree in electrical computer engineering from Yokohama National University, Kanagawa, in 1992. He joined NTT Human Interface Laboratories in 1992, where he engaged in research on human interfaces. From 1995 to 2000, he worked on the development of a data transmission and collection system at NTT Cyber Solutions Laboratories. His research interests are user interfaces, web architecture, and consumer electronics.

Masayuki Ihara
Senior Research Engineer, Supervisor, Service Harmonization Project, NTT Service Evolution Laboratories.
He received the M.E. and Ph.D. degrees from Tokyo Institute of Technology in 1994 and 2010, respectively. He worked at the New Media Innovation Centre and at the University of British Columbia in Canada from 2002 to 2003. His research interests include value based design, cognition of human values and preferences, and human-computer interaction. He is a member of the Association for Computing Machinery, the Information Processing Society of Japan (IPSJ), and the Institute of Electronics, Information and Communication Engineers (IEICE).

Toru Kobayashi
Professor of Electrical Engineering and Computer Science Division, Graduate School of Engineering, Nagasaki University.
He joined NTT in 1987 just after graduating from the Graduate School of Mechanical Engineering, Tohoku University, Miyagi. He received the Ph.D. degree from the Graduate School of Information Systems, the University of Electro-Communications, Tokyo, in 2011. During his career at NTT, he was engaged in R&D of software engineering, network platforms, groupware, information security, ubiquitous computing, data mining, etc. He also spent almost four years in Düsseldorf, Germany, where he managed joint research projects and standardization activities related to smart card technologies in cooperation with an EU research institution. He is a senior member of IEICE and a member of IEEE and IPSJ. He joined the faculty of Nagasaki University in April 2013. He was Senior Research Engineer, Supervisor, Group leader of Service Harmonization Project, NTT Service Evolution Laboratories at the time of this article was written.

TeleManagement Forum (TM Forum) Activity Update and Report on TM Forum Management World 2012

Keiichi Sasaki and Atsushi Kitai

Abstract

NTT COMWARE is focusing on enterprise architecture (EA) as a way to optimize business and operating systems, and we are particularly interested in the work and standards of the TeleManagement Forum (TM Forum) in supporting an EA tailored for telecom operators. This article provides an overview of current TM Forum activities and reports on TM Forum Management World (TMW) 2012, TM Forum's main conference that was held in Dublin, Ireland, May 22–24, 2012.

1. Overview of TM Forum

The TeleManagement Forum (TM Forum) [1]–[3] is a global non-profit industry association that seeks to vitalize the telecommunications industry by creating services based on collaboration and standards to achieve and support telecommunication system network management.

In today's *digital world* characterized by extraordinary diversification of smartphones and other digital devices, rapid globalization of markets, and relative ease with which service providers can enter into niche areas, the TM Forum provides information and support to help its members create and deliver profitable *digital services* such as eHealth systems, smart grids, and cloud computing. The TM Forum helps telecom service providers develop and deploy revenue-assured digital services by offering them the enterprise architecture (EA) called *Frameworx*, which consists of a suite of best practices, standards (called frameworks), and interfaces that support optimized business operations and systems. The Forum also provides wide-ranging technical support—business benchmarking, system building support, next-generation fixed-mobile integration management, and more—as well as close collaboration with other industry standardization organizations.

2. TM Forum standards

2.1 Frameworx

Frameworx defines an EA framework tailored for telecom service providers and includes all reference model processes, information, and application frameworks required to build a robust EA, as well as standardized interfaces and other details needed to implement the EA (**Fig. 1**).

The central portion of Fig. 1 shows the Business Process, Information, Application, and Integration frameworks that are the core of Frameworx. For example, the Business Process Framework (eTOM = enhanced Telecom Operation Map) is employed as a reference model when analyzing business processes or considering business architectures. Similarly, the Information Framework (SID = Shared Information and Data) is used when considering information models and data architectures, and the Application Framework (TAM = Telecom Application Map) is used when considering application configurations and application architectures. Finally, the Integration Framework includes interface provisions, support for various technologies, and other elements necessary for implementation, and is used as a basis for considering the technology architecture. The Multi-Technology Network Management (MTNM) and Multi-Technology Operations System Interface (MTOSI), which is defined as the interface between the Element

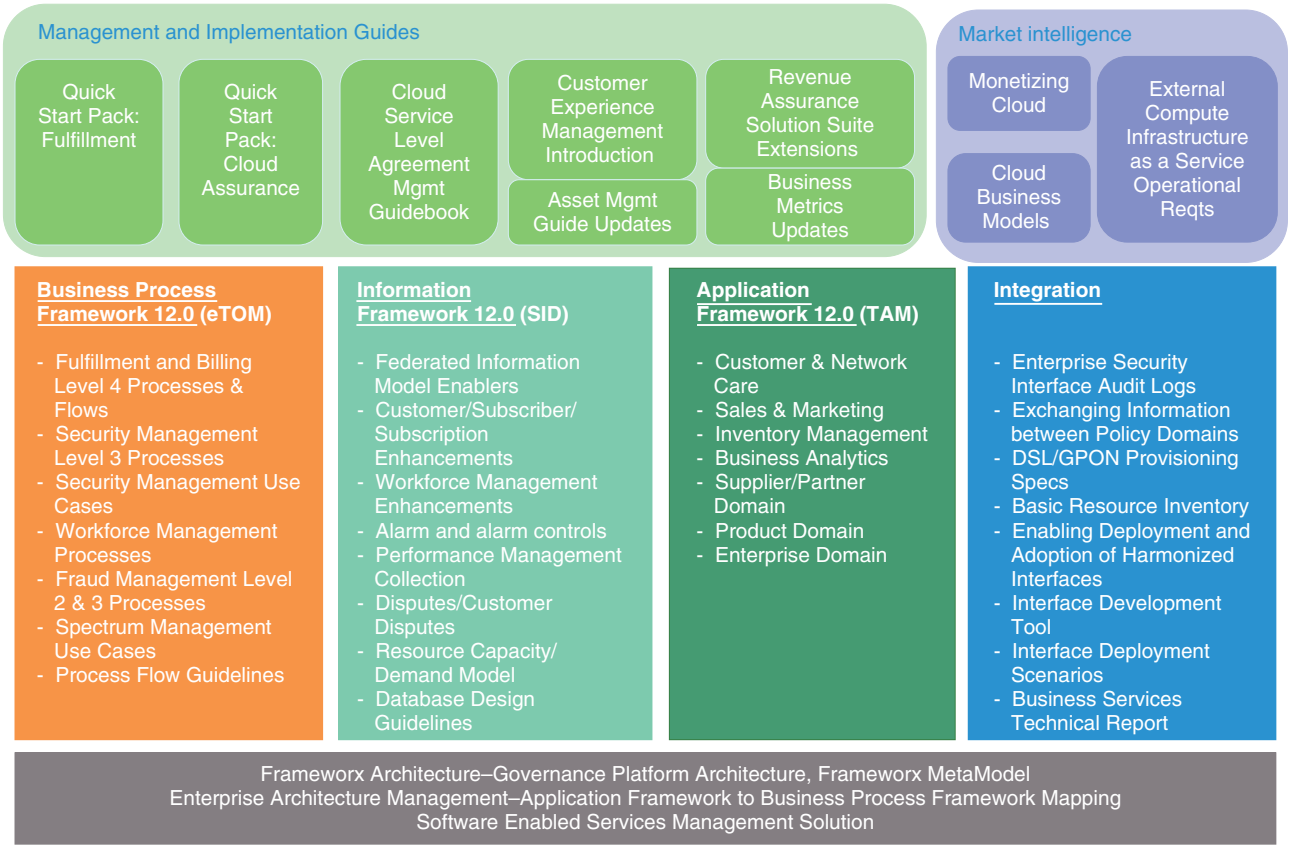


Fig. 1. Frameworx 12.0 overview.

Management System (EMS) and the Network Management System (NMS), currently forms part of the definition of the Integration Framework, and is part of the TM Forum Integration Program (TIP). The scope of the TIP project includes the following tasks:

(1) Define Shared Interface Infrastructure (SII):
- Identify protocol-neutral interface patterns including meta-model and common model definitions.
- Identify Web Service specification models (XSD/WSDL) (XML (extensible markup language) Schema Documentation/Web Services Description Language).
- Provide auto-generation and support for documentation, Reference Implementations (RIs), and Compliance Test Kits (CTKs).

(2) Expand and maintain MTNM, MTOSI, OSS/J (operations support system through Java), etc. that define TM Forum interfaces.

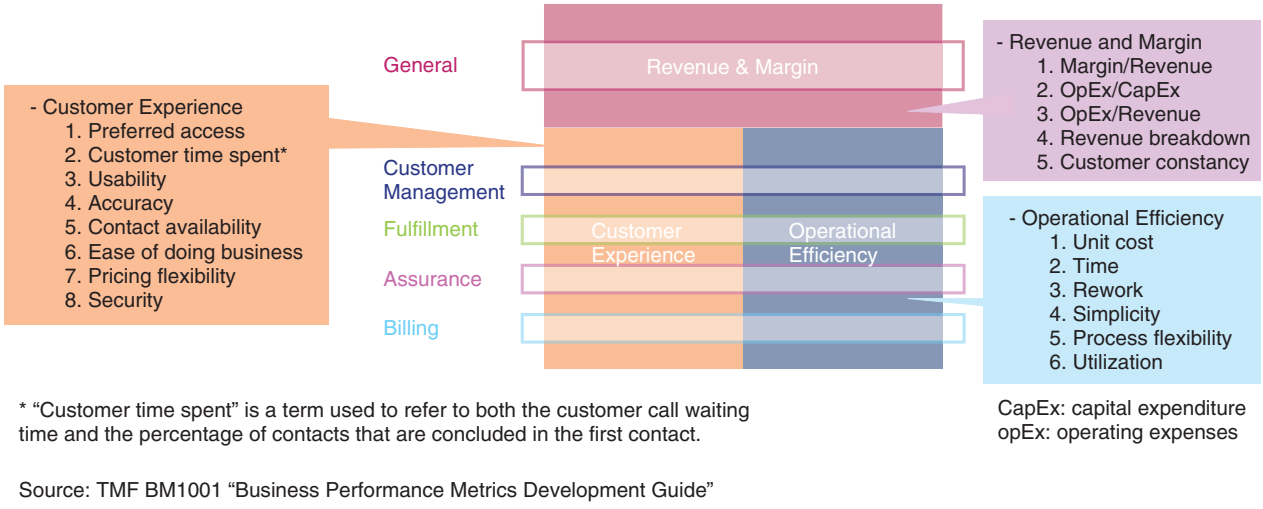
(3) Manage interface-related tasks for the entire TM Forum.

(4) Define new integration interface specifications based on the Web Service/XML-based management interface JOSIF (Joint Open Source Interface Framework), and migrate the existing interface.

(5) Other:
- Formalize interface concept, profiling.
- Align interface with eTOM, SID, TAM, and SII.

While there have been no studies of MTNM/MTOSI per se, carrier Ethernet, GPON (gigabit-capable passive optical network) management, and MPLS-TP (multi-protocol label switching transport profile) management profiles have been examined as part of the TIP project. Results have been incorporated into MTOSI, and MTOSI 3.0 is scheduled for release in May 2013.

The upper left portion of Fig. 1 shows the



* "Customer time spent" is a term used to refer to both the customer call waiting time and the percentage of contacts that are concluded in the first contact.

CapEx: capital expenditure
opEx: operating expenses

Source: TMF BM1001 "Business Performance Metrics Development Guide"

Fig. 2. Structure of Business Metrics.

Management and Implementation Guidelines that have been defined. This includes a suite of guidelines called Quick Start Packs (QSPs) tailored for discrete operations such as Fulfillment, Cloud Assurance, and Cloud Service Level Agreements. Also included are an Asset Management Guide, an Introduction to Customer Experience Management, and Revenue Assurance Guidelines. The Quick Start Packs offer a way of quickly rolling out cloud-related and other new services without having to master the entire Frameworx suite.

The upper right portion of Fig. 1 shows Cloud and New Services, which are standardized elements providing models and software-enabled services that permit cloud services to be rolled out quickly and efficiently.

Study teams have been set up to investigate each Frameworx technology, and these teams leverage telephone conferencing for user-friendly operations and services. New findings are incorporated into biannual releases of Frameworx that are numbered 1x.0 in the spring and 1x.5 in the fall or winter.

2.2 Business benchmarking

TM Forum's Business Benchmarking program provides telecom service providers with a report assessing their relative business efficiency and performance against other carriers. The assessment compares business performance across a variety of metrics spanning revenue and margin, customer experience, and operational efficiency and also measures profitability, cost-effectiveness, and customer satisfaction. It should provide a fairly clear-cut estimate of a carrier's operational efficiency. An example of a typical business matrix is shown in **Fig. 2**.

Benchmarking programs cover a wide range of metrics tailored to each carrier's needs from business expansion to operational units, and can be used to assess billing, operation costs, or specific service offerings (broadband, mobile, etc.) of the company. Because benchmarking is based on standardized business matrices that are time-tested and organized, they should lead to a marked improvement in monitoring and analyzing business operations in real time.

2.3 System building support and design tools

TM Forum holds regular events such as TM Forum Management World (TMW) conferences and training seminars, and in July 2012 conducted an Action Week event where all the project teams came together for discussions and a special tool development workshop. It was here that they introduced the development environment combining open-source Eclipse with the open-source plugin TigerStripe, which opened the path to model-driven development specifically for telecom service providers and auto-generation interface coding in WSDL format. By adopting this approach, France Telecom/Orange reported they were able to slash development time compared to using a UML (unified modeling language)/XML editor alone.

In addition to the Eclipse environment, good headway is being made in developing modeling and

mapping tools for business processes and information frameworks that will enable smooth implementation of TM Forum technology-based development. Along with standardization of guidelines such as the Quick Start Packs, this initiative will bring services and businesses closer to implementation and is thus considered very important for the TM Forum.

2.4 Next-generation fixed-mobile network integration management

TM Forum is moving forward with an efficient scheme for managing fixed-mobile networks, primarily at the request of European carriers. Discussions are currently underway in collaboration with the Third Generation Partnership Project (3GPP) on a fault management case study for fixed-mobile convergence (FMC) that addresses integrated management of fault alarms and development of a new model that would simplify fault isolation.

Integrated management of fixed-mobile networks will become increasingly important in Japan as well, and we would like to pursue an investigation of FMC that also includes collaboration with the 3GPP.

2.5 Collaboration with other standards organizations

Because TM Forum's sphere of interest encompasses management of telecom system networks, the Forum has had a liaison relationship with ITU-T SG2 (formerly SG4) and has proposed recommendations for network management. More recently, joint meetings have been held more frequently between various standards organizations across different areas such as the joint collaborative sessions with the 3GPP regarding fixed-mobile networks. In Japan, there is a move to strengthen ties between the TM Forum and the Technical Committee on Information and Communication Management (ICM) [4] as manifested in a special lecture delivered by the TM Forum at APNOMS (Asia-Pacific Network Operations and Management) 2012 that will be reciprocated at an upcoming TMW conference with a lecture given by ICM.

3. TM Forum Management World 2012

The TMW conference is a combined event held several times a year where technical reports and case studies are presented, and new products are exhibited and demonstrated. The most recent conference, the biggest ever, was TM Forum Management World 2012 held in Dublin, Ireland in May 2012. We report here some of the highlights of the Conference.

3.1 Carrier initiatives

We introduce here several TM Forum standardization initiatives instigated by Deutsche Telekom (DT), Polish Telecom, NTT Communications, and other carriers at the conference. DT has built Next Generation Service and Resource Lifecycle Management as an OSS reference architecture for its own group companies by expanding upon TM Forum technology with the idea of creating a better To-Be architecture aimed at more efficient operations. DT highlights a number of advantages of Frameworx technology:

- If you start with an existing standard as a reference, there is no need to build your standard from scratch, which greatly reduces development costs.
- Guaranteed integrity (completeness)
- Quick and easy communication
- Improved architecture sustainability
- Commercial off-the-shelf (COTS) ready-to-use OSS
- Freedom to select the vendor of choice

DT also identifies several disadvantages:

- Diminishes self-reliance in developing own solutions.
- Slower pace of standardization
- Greater ambiguity of standards descriptions
- Current standards lack UML and other descriptive languages.

Not having to develop a standard from scratch is a clear advantage for carriers, but there are also some disadvantages that must be taken into account: the slower pace of standardization and the mismatch between standards and the company's businesses. TM Forum will probably move to accommodate requests from DT and other carriers by making improvements that help implement standards that are more closely aligned to current company operations.

3.2 Frameworx 12.0

Frameworx 12.0 was released last year timed to coincide with the conference. Key changes mostly came in the form of additional language in the following sections.

(1) Detailed Business Process Framework (eTOM)

The Business Process Framework consists of levels that form a hierarchy, with each level encapsulating a group of processes at the next level of detail: Level-0 defines a very general business domain, but each successive level defines more detailed processes. Level-1 is the process group and Level-2 is the core process,

but representation of actual business processes comes with Level-3 process (task) and Level-4 process (step) granularity. The latest 2012 release includes definitions of close to 800 new (mostly Level-4) processes. Additionally, process elements have been merged into the model, thus making process flow definition much more detailed. This more detailed analysis of business processes can be attributed to the importance of having more efficient operations and rapid deployment of new services.

(2) Expansion of the Information Framework (SID)

The biggest change to the SID section was the addition of the entity *capacity*. This defines the ability of a network to provide bandwidth or some other metric as an information framework, product, service, or resource, which are all defined in terms of *capacity*. For example, if companies apply the concept of *capacity* when implementing a cloud-based service, they may find that managing integrated service *capacity* in a multi-cloud environment is very useful for supporting cloud interoperability and load distribution.

(3) Other additions, extension, and future plans

Some additional or more detailed provisions were made to the Application Framework of Frameworx 2012, especially relating to the bill calculation process, payment management, and other aspects of billing operations. In addition, the Integration Framework was also slightly revised: the description of the integration interface was made more explicit to harmonize and integrate more smoothly with overall interface specifications. *Fulfillment and resolution of cloud service problems* provisions were added to the service deployment Quick Start Pack guidelines mentioned earlier, and Frameworx as a whole was substantially updated from the aspects of analysis of upper process business processes to implementation.

We can anticipate additional changes with the next release that will accommodate analysis and fine-tuning of new requirements associated with providing and operating smart grids, eHealth, M2M (machine-to-machine and machine-to-management), and other digital services.

3.3 Significantly greater Asian presence

Asian participation was far more conspicuous at TMW 2012 than at previous conferences, with representatives from Malaysia Telecom and Vietnam Telecom introducing their recent initiatives. Huawei in particular was well represented; the Chinese telecommunications company exhibited its products and services, sponsored one of the presentations, and provided one of the Chairs of the conference. Even the sponsors of the conference showed a marked shift away from the past dominance of the U.S., Europe, and Japan toward more inclusive participation of China, India, and other Asian powers, and we can expect to see more conferences held in Asia in the years ahead.

3.4 Executive Committee Meeting

Separate and distinct from the various technology study teams, the Executive Committee Meeting is a forum to consider the future direction of TM Forum policies and initiatives. In addition to a face-to-face meeting, which is held at the same time as the TMW conference, regular monthly videoconferences are held to discuss the overall business direction, technology trends and investigation policies, the roadmap ahead, and other matters.

The NTT Group is represented on the Forum by Atsushi Kitai, Executive Manager, Head of the Research and Development Department, Core Technology, Quality Management and Engineering Division, NTT COMWARE and he is well positioned to keep track of TM Forum policies and also to keep the Forum updated on the status and direction of NTT Group research.

4. Future development

In addition to providing rapid roll out and efficient management of new services in continuously evolving markets, the TM Forum seeks to stimulate the telecom industry by studying and developing wide-ranging industry standards that assure revenues and improve business opportunities. We will continue to focus attention on TM Forum initiatives, keep tabs on the state of technology and industry trends, and continue to share knowledge with the NTT Group as a whole.

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Keiichi Sasaki
Engineer, Head of the Research and Development Department, Core Technology, Quality Management and Engineering Division, NTT COMWARE.

He received the B.E. and M.E. degrees in information engineering from Tohoku University, Miyagi, in 1991 and 1993, respectively. He joined NTT Network Information Systems Laboratories in 1993 and engaged in research and inspections of projects related to network operations. He moved to NTT COMWARE in 1997 and worked on a Java development method and the selection of in-house-recommended development tools/software, etc. Later, his work included SS7 control technologies from the Java interface, research and applicability evaluation of biometric authentication techniques, and research on NGN standardization and monitoring of NGN network control standardization trends. He has held his present position since 2008.

Atsushi Kitai
Executive Manager, Head of the Research and Development Department, Core Technology, Quality Management and Engineering Division, NTT COMWARE.

He received the B.E. and M.E. degrees from Osaka University in 1982 and 1984, respectively. He has held various management positions in his 28 years with the NTT Group and has studied technologies including operations systems architectures and infrastructure software for ICT systems such as transaction processing monitors and core open source software suites. He is an Executive Committee member and a Technical Strategy Subcommittee member of TeleManagement Forum (TMForum).

Failure Cases in Optical Access Facilities (Fiber Breakage in Optical Cabinets) and Countermeasures

Abstract

The Technical Assistance and Support Center undertakes detailed analyses of actual failures and proposes countermeasures to failures that occur in optical distribution facilities. This article reports two actual failure cases involving optical fiber breakage that occurred in an optical cabinet installed in multi-dwelling unit buildings and proposes countermeasures to prevent such failures in the future. This is the sixteenth in a bimonthly series on the theme of practical field information on telecommunication technologies. This month's contribution is from the Access Engineering Group, Technical Assistance and Support Center, Maintenance and Service Operations Department, Network Business Headquarters, NTT EAST.

1. Introduction

The NTT Group is constructing optical distribution facilities for providing broadband communication services to customers in Japan. Among them, the NTT Group pays a great deal of attention to customers living in multi-dwelling unit (MDU) buildings such as apartment buildings and condominiums. There is a real need to construct optical distribution facilities with optical fiber cables and optical cabinets in MDU buildings. The optical cabinets are used for terminating and connecting these optical cables.

There are two kinds of optical cabinets installed in MDU buildings. The optical distribution structure in an MDU building is shown in **Fig. 1**. One type of cabinet is used for terminating purposes; its role is to terminate a drop cable and connect it to optical distribution facilities on the premises. The other type is used for connecting purposes; its role is to connect premise cable to floor cables.

We have already reported actual failure cases and proposed countermeasures for optical access facilities [1]–[3]. Here, we report two examples of actual failure cases that have occurred with optical cabinets installed in MDU buildings, and we propose countermeasures to prevent such failures.

2. Optical cabinets

The optical distribution configuration in an MDU building is shown in **Fig. 2**. The optical cabinets have a number of roles. One primary role is to serve as a premise terminal cabinet (PT cabinet). Another is to serve as a premise distribution cabinet (PD cabinet). The details of these cabinets are described in the following subsections.

2.1 PT cabinet

A PT cabinet is shown in **Fig. 3**. The PT cabinet has important functions, which are to terminate drop cables and to serve as a connection point for premise cables and floor cables. In addition, the PT cabinet has a demarcation-point function with SC-connectors.

2.2 PD cabinet

A PD cabinet is shown in **Fig. 4**. The PD cabinet also has an important function, which is to serve as a connection point for premise cables and floor cables. PD cabinets have no demarcation-point function.

3. Cable installation

3.1 Installation of a drop cable

A drop cable holder used in a PT cabinet is shown

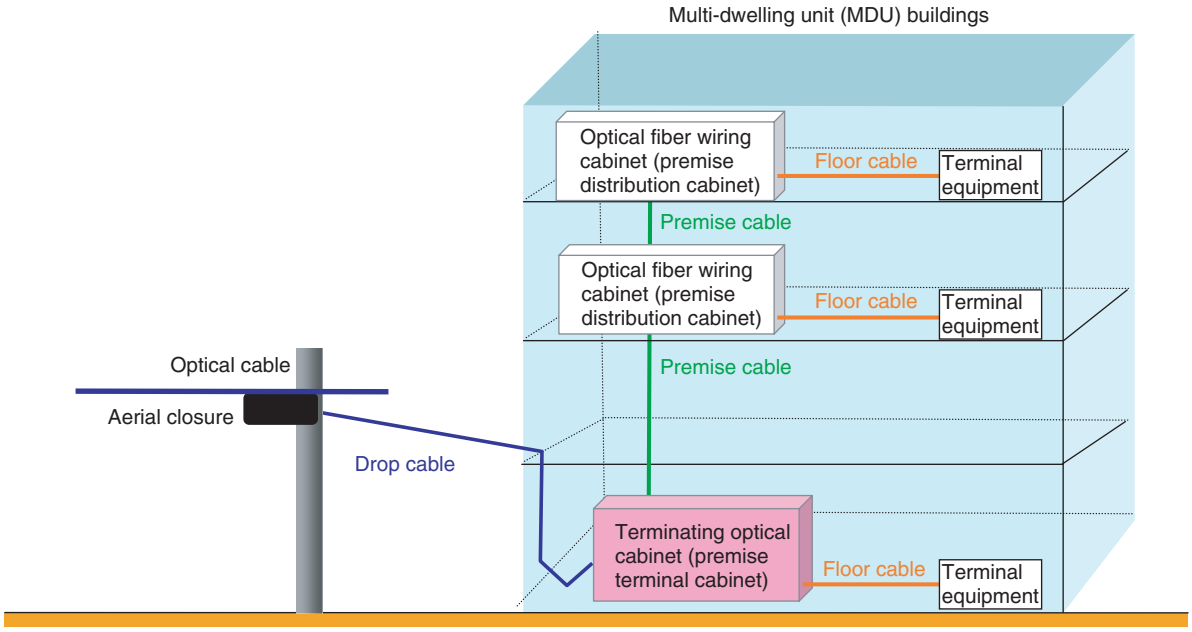


Fig. 1. Optical distribution structure in an MDU building.

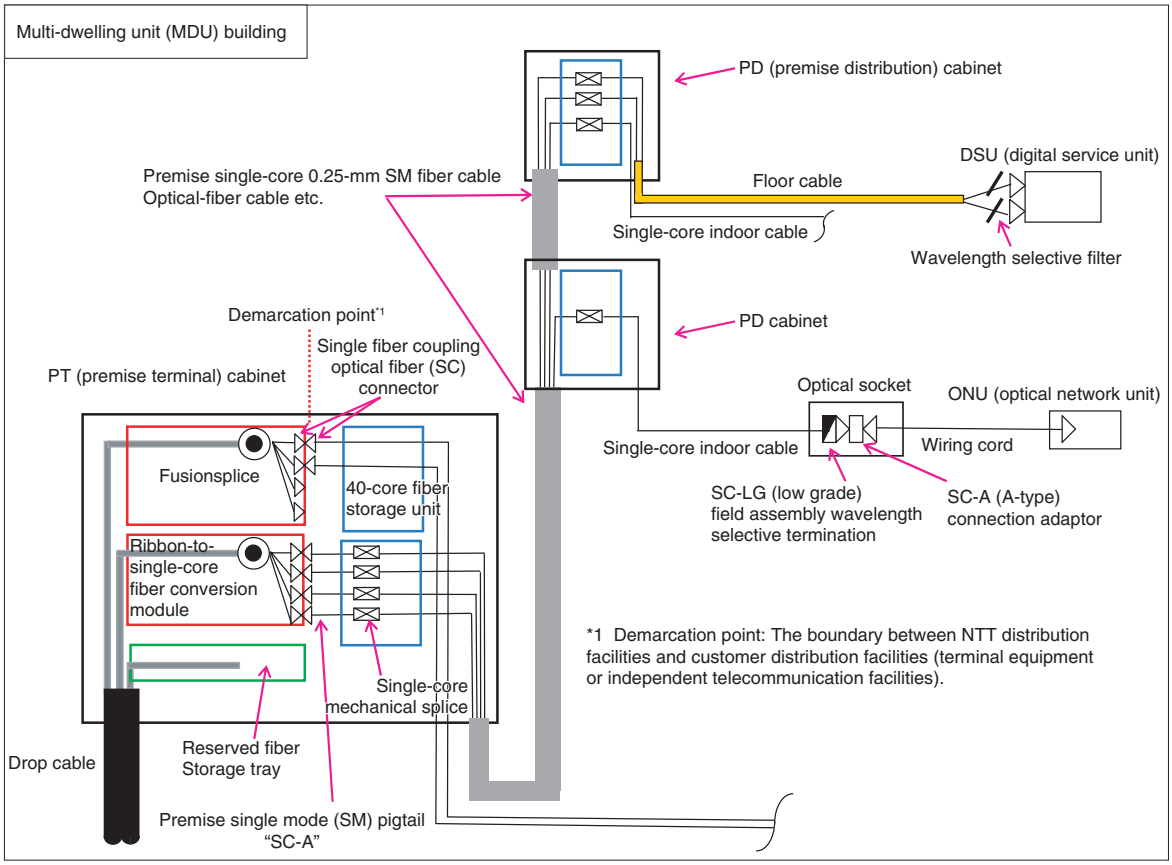
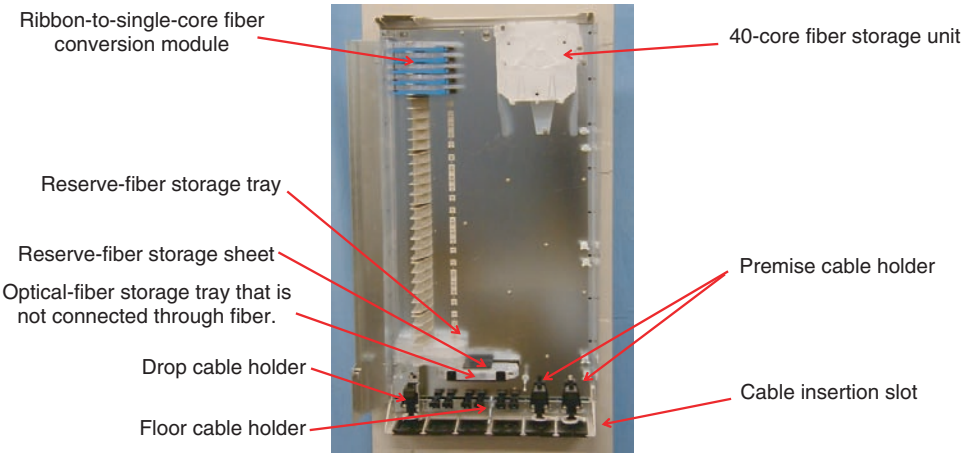


Fig. 2. Optical distribution configuration in an MDU building.



*2 PT cabinet M (Middle) type is applied in which a total number of cores is less than 120-cores.

Fig. 3. PT cabinet (M type)*2.

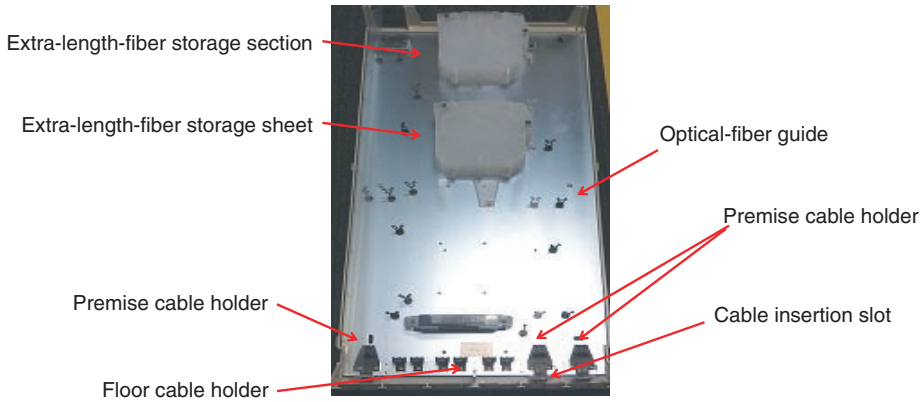


Fig. 4. PD cabinet.

in **Fig. 5**. When a drop cable with a slot structure is installed in a PT cabinet, a cable tension member is held by the cable holder.

3.2 Installation of a premise cable

A premise optical cable holder used in PT and PD cabinets is shown in **Fig. 6**. The premise cable with a cable jacket is held by the premise cable holder.

3.3 Installation of floor cables

A floor cable holder used in PT and PD cabinets is shown in **Fig. 7**. The floor cable holder with metallic clamps is used to install single-core indoor cables in PT and PD cabinets. An example of how ultraviolet (UV)-coated fiber is wired is shown in **Fig. 8**. The UV-coated fiber is passed through optical-fiber guides.

Only the UV-coated fibers in the floor cables are passed through optical-fiber guides from the floor-cable holder. This is to reduce the failure of fiber breakage, which could occur if both the optical cords and the UV-coated fibers were fastened by optical-fiber guides.

However, failures can still occur. In the next section, we report two examples of actual failure cases that have occurred in optical cabinets installed in MDU buildings. We also explain the countermeasures that were applied.

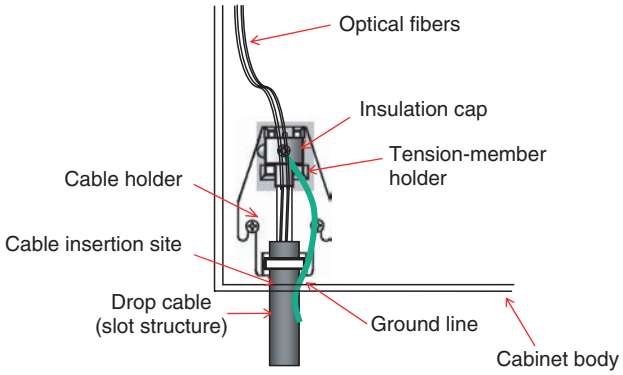


Fig. 5. Drop cable holder inside a PT cabinet.

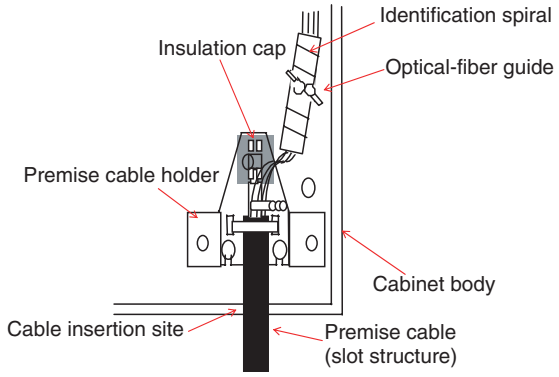


Fig. 6. Premise optical cable holder used in PT and PD cabinets.

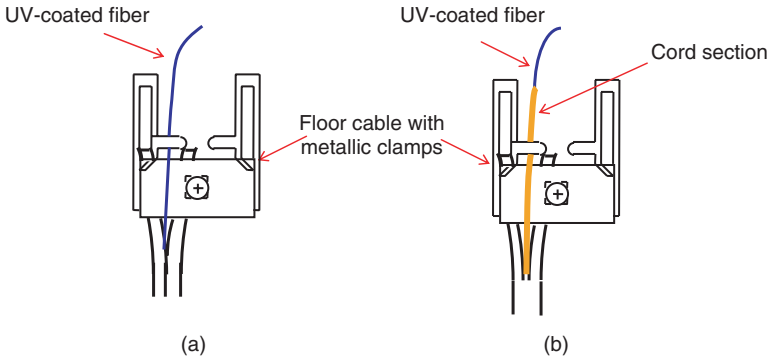


Fig. 7. Floor cable holders used inside PT and PD cabinets with (a) non-cord structure and (b) with cord structure.

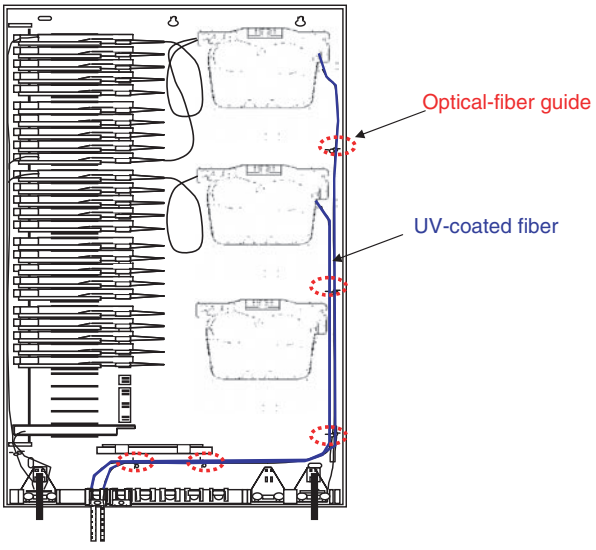


Fig. 8. Example of the wiring of UV-coated fibers in a PT (M type) cabinet.

4. Failure case and countermeasure I

4.1 Background

A fiber breakage of an optical fiber occurred near a floor cable holder in a PT cabinet, as shown in **Fig. 9.**

The fiber breakage occurred 18 cm away from the end of the cable jacket holding a single-core floor cable. We also found many scratches on the fiber that extended about 10 cm from the fiber breakage. The length of the UV-coated fiber measured from the edge of the cable jacket is generally required to be more than 160 cm. In this case, the length was less than 85 cm. Therefore, the UV-coated fiber could not be stored inside the 40-core fiber storage unit because it was too short.

4.2 Reproduction experiment

We inferred the cause for the fiber breakage and carried out experiments to reproduce the failure

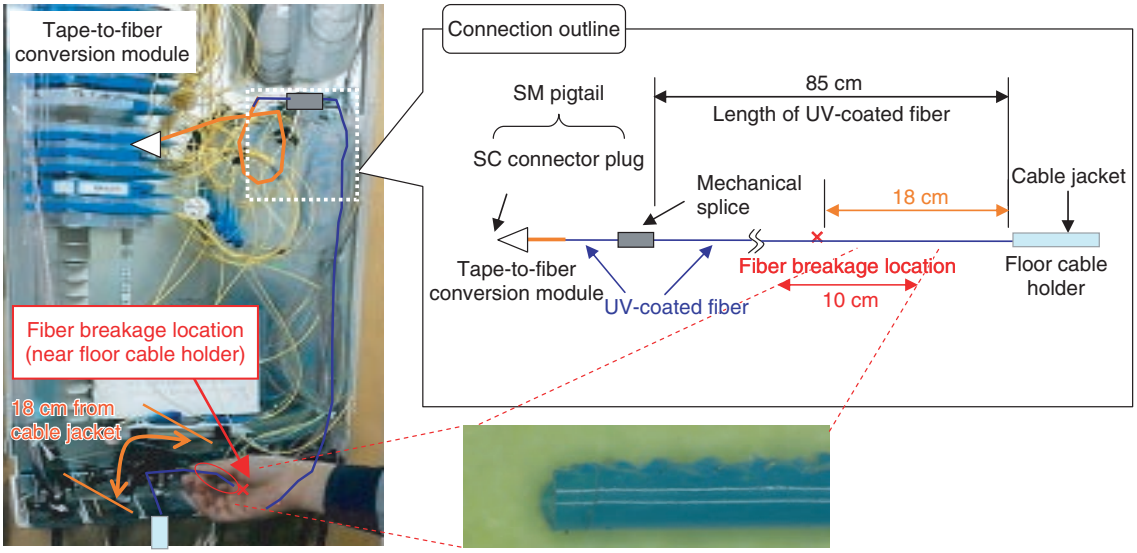


Fig. 9. Fiber breakage location in a PT cabinet (M type) and optical cabinet configuration.

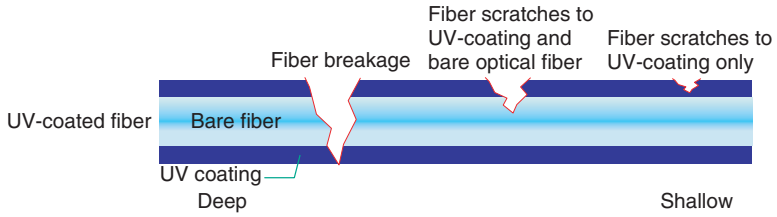


Fig. 10. Appearance of fiber scratches on optical fiber.

(**Fig. 10**). We measured the extent of the damage of the fiber scratches on a three-level basis (1: fiber breakage, 2: fiber scratches affecting both the UV-coating and bare optical fiber, 3: fiber scratches on the UV coating only). The results of the experiment are listed in **Table 1**.

(a) Fiber scratches caused by dragging the optical fiber over a floor cable with metallic clamps

The UV-coated fiber was pushed strongly against a floor cable with metallic clamps. Then, the UV-coated fiber was dragged over the floor cable with metallic clamps so that the UV-coated fiber moved about 10 cm in the axial direction of the fiber. The result of this action was that a fiber breakage (fault 1) occurred 0 out of 10 times, fiber scratches to both the UV-coated fiber and the bare fiber (fault 2) occurred 2 out of 10 times, and fiber scratches to only the UV coating (fault 3) occurred 6 out of 10 times.

(b) Fiber scratching caused by dragging the optical fiber on something other than floor cable with metallic clamps

We found that none of the faults occurred in this reproduction experiment.

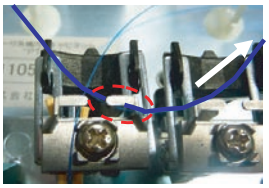
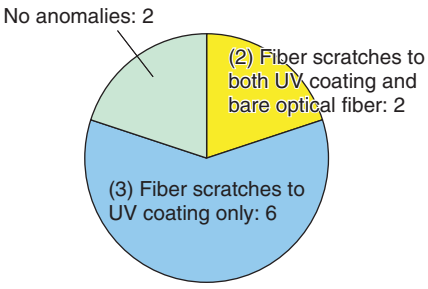
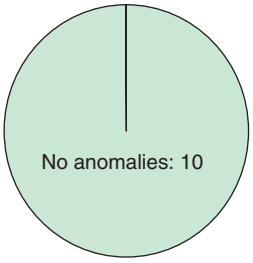
4.3 Cause of failure and countermeasure

We considered the reason for the fiber breakage. The optical fiber guides failed to hold the UV-coated fiber. In addition, the UV-coated fiber was scratched when it was dragged over the floor cable with the metallic clamp.

We also considered that the scratches on the fiber would become larger over time. This would eventually lead to fiber breakage.

A countermeasure to this problem is to ensure that the UV-coated fiber is passed appropriately through

Table 1. Outline and results of reproduction experiments.

Test item	(a) Fiber scratches were made by dragging the optical fiber over the floor cable with metallic clamps.	(b) Fiber scratches were made by dragging the optical fiber over something other than the floor cable with metallic clamps.
Test outline	 The UV-coated fiber was dragged strongly over the metallic clamps in order to move the fiber about 10 cm in the axial direction of the fiber.	 The UV-coated fiber was dragged on something other than the metallic clamps (e.g., optical-fiber guide, cable ties) to move the fiber about 10 cm in the axial direction of the fiber.
Test results (N=10)		

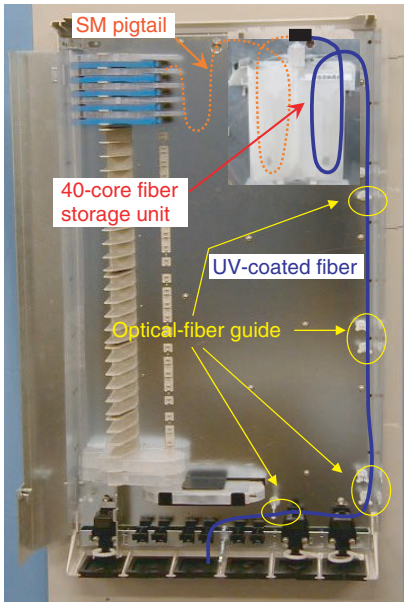


Fig. 11. Ensuring proper wiring of UV-coated fiber.

the optical-fiber guides. It is also essential to have a sufficient length of the UV-coated fiber wires and to use the correct placement methods in the optical cabinets.

For these reasons, the length of fiber that is needed should be roughly estimated before the actual wiring of the UV-coated fiber is done. In addition, it is recommended that the extra length of the UV-coated fiber be adjusted in order to prevent sagging of the optical fiber in the 40-core fiber storage unit (**Fig. 11**).

5. Failure case and countermeasure II

5.1 Background

The fiber breakage occurred after carrying out work to install the wiring in a PD cabinet. The wiring conditions and fiber breakage location in the PD cabinet are shown in **Fig. 12**.

The fiber breakage occurred near an optical-fiber guide. As mentioned previously, only UV-coated fiber should be held by the optical-fiber guides. In this case, both the UV-coated fibers and optical cords were being held by the optical-fiber guides.

5.2 Reproduction experiment

Considering the fiber breakage location, we inferred

the fiber breakage causes (a) and (b). Therefore, we carried out an experiment to reproduce the three levels of fiber scratches shown in Fig. 10. The results of the experiment are listed in **Table 2**.

(a) Optical fiber gets compressed when closing the optical cabinet

We considered the possibility that a fiber breakage could occur if the UV-coated fiber was compressed when a cabinet cover was opened or closed. We carried out an experiment to open and close the cabinet cover when the UV-coated fiber was protruding about 15 cm from the edge of the cabinet.

The results indicated that a fiber breakage (fault 1) occurred 5 out of 10 times, fiber scratches to both the UV coating and bare fiber (fault 2) occurred 1 out of 10 times, and fiber scratches to only the UV coating (fault 3) occurred 4 out of 10 times.

(b) Optical fiber gets compressed during fastening of optical-fiber guide

We also considered the possibility that if both optical cords and UV-coated fibers were fastened by the optical-fiber guides, a fiber breakage could occur in the UV-coated fiber.

Therefore, we tried strongly pushing the UV-coated fiber into place in order to fasten it with the optical-fiber guide. The results revealed that a fiber breakage

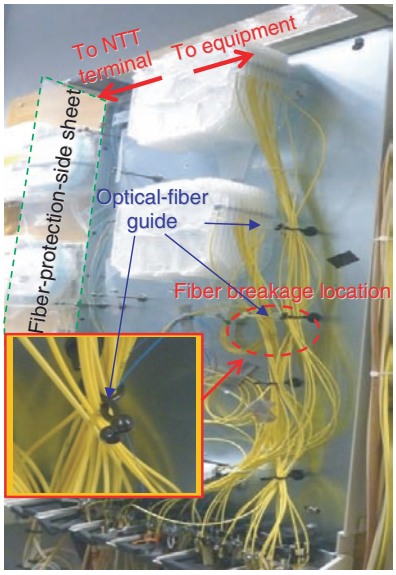
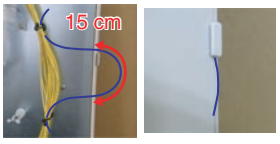
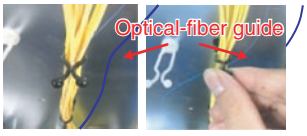
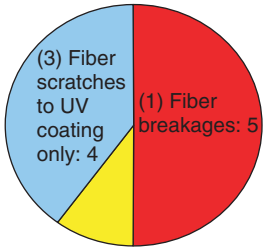
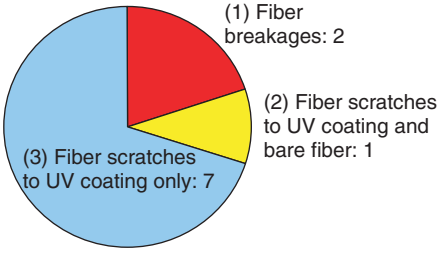


Fig. 12. Location of fiber breakage in a PD cabinet (M type).

Table 2. Outline and results of reproduction experiment.

Test item	(a) Optical fiber is compressed when the optical cabinet cover opens or closes.	(b) Optical fiber is compressed by the optical-fiber guide.
Test outline	 Cover is closed with the optical fiber protruding about 15 cm from the edge of the optical cabinet.	 The UV-coated fiber is strongly pushed into place in the section where the optical-fiber guide is fastened.
Test results (N=10)	 (2) Fiber scratches to UV coating and bare fiber: 1	

(fault 1) occurred 2 out of 10 times, fiber scratches to both the UV coating and bare fiber (fault 2) occurred 1 out of 10 times, and fiber scratches to only the UV coating (fault 3) occurred 7 out of 10 times.

5.3 Cause of failure and countermeasures

The results of the reproductive experiments reinforced our view that there were two key reasons for fiber breakages occurring in optical cabinets. One was that a fiber breakage could occur if the UV-coated fiber was compressed when the cabinet cover was opened or closed. The second was that a fiber breakage could occur if both optical cords and the UV-coated fiber were fastened by the optical-fiber guide. Consequently, strongly bending a fiber at a sharp angle, as has been done in the past, could lead to fiber breakage in optical cabinets.

A countermeasure to this problem is to take special care when opening and closing the cabinet. In addition, it is also essential that only the UV-coated fiber, and not the optical cords, be fastened by the optical-fiber guides.

6. Conclusion

This article reported two actual failure cases and proposed countermeasures for failures that occurred in optical cabinets installed in MDU buildings. The key points are as follows.

(1) It is recommended that the necessary length of fiber be roughly estimated before actually wiring the UV-coated fiber. In addition, any extra length of the UV-coated fiber should be adjusted to prevent sagging of the optical fiber inside the optical cabinets.

(2) It is important to take care when opening and closing the cabinet cover. It is also essential to fasten only UV-coated fiber with the optical-fiber guides, and not to fasten the optical cords.

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[1] NTT EAST, “Simple Tool for Inspecting Cleaved Optical Fiber Ends and Optical Fiber Connector End Surfaces,” NTT Technical Review, Vol. 10, No. 8, 2012.
https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201208pf1.html

[2] NTT EAST, “Case Studies of Faults and Countermeasures in a Passive Optical Network System,” NTT Technical Review, Vol. 10, No. 7, 2012.
https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201207fa2.html

[3] NTT EAST, “Fault Cases and Countermeasures for Field Assembly Connectors in Optical Access Facilities,” NTT Technical Review, Vol. 9, No. 7, 2011.
https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201107fa2.html

Dr. Yoshihisa Okumura, a former leader of the mobile radio laboratory of Nippon Telegraph and Telephone Public Corporation, receives the Charles Stark Draper Prize from the National Academy of Engineering

Dr. Yoshihisa Okumura (a former leader of the mobile radio laboratory of Nippon Telegraph and Telephone Public Corporation (now NTT) and presently Professor Emeritus at Kanazawa Institute of Technology), received the 2013 Charles Stark Draper Prize [1] from the National Academy of Engineering, a private, nonprofit research institution in the United States, on February 19, 2013 (U.S. time), for "pioneering contributions to the world's first automobile (cellular) telephone networks, systems and standards." He is the first Japanese researcher to win this award.

The Charles Stark Draper Prize is awarded by the National Academy of Engineering to individuals who have made outstanding contributions to the advancement of engineering. It is sometimes called the Nobel Prize of engineering.

During his time at the Electrical Communications Laboratory of Nippon Telegraph and Telephone Public Corporation, Dr. Okumura made significant contributions to explaining radio propagation characteristics in mobile communications and conceived of a new system that would lead to genuine automobile telephone services in the 800-MHz band (urban mobile communications system). This work laid the foundation for future automobile cellular telephone networks and systems.

To help explain radio propagation characteristics, Dr. Okumura performed extensive outdoor transmission and reception experiments in diverse environments over a wide range of frequency bands from VHF (very high frequency) to UHF (ultrahigh frequency), and used the data obtained from these field experiments to establish in 1968 a technique for estimating received-field-strength curves in the range of 1–100 km and determining service areas. These field-strength curves received much praise for their usefulness and came to be adopted as a recommendation of Comité Consultatif Internationale des Radiocommunications (CCIR) of the International Telecommunication Union (ITU). Called the "Okumura Curves," they are still used today in the construction of various types of mobile radio systems throughout the world. For example, a propagation estimation formula based on the Okumura Curves is used in the link budget

Photo Dr. Yoshihisa Okumura (second from left), a former leader of the mobile radio laboratory of Nippon Telegraph and Telephone Public Corporation, receives the Charles Stark Draper Prize. (Photograph by Event Digital Photography, Inc.)

The “Okumura Curves”

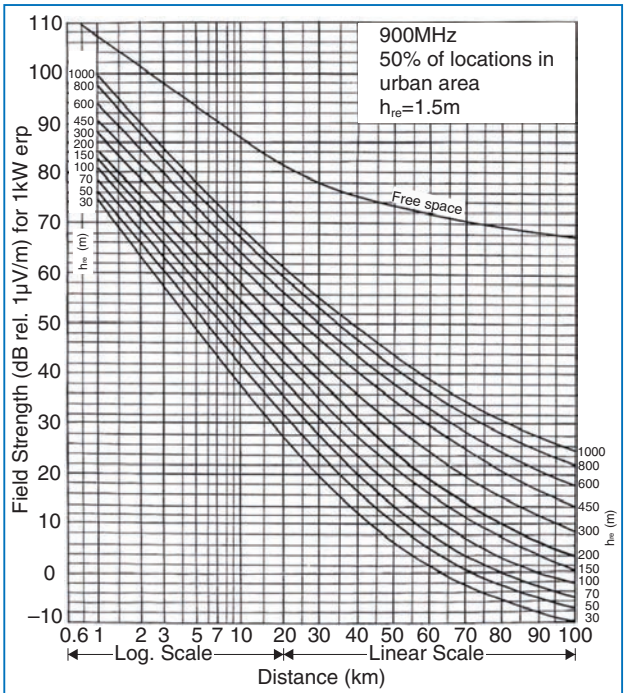

Fig. 41(c) 900MHz Band

“Field Strength and Its Variability in VHF and UHF Land-Mobile Radio Service,” Review of the Electrical Communication Laboratory, Vol. 16, No. 9-10, p. 865, 1968.

analysis of modern mobile telephone systems, and techniques introduced by Dr. Okumura for analyzing data from field experiments are used on a daily basis for inspecting and optimizing QoS (quality of service).

Reference

[1] http://www.nae.edu/Projects/Awards/DraperPrize/67245.aspx

External Awards

Young Engineer Award

Winner: Hiroyuki Takahashi, NTT Microsystem Integration Laboratories
Date: November 29, 2012
Organization: IEEE Microwave Theory and Techniques Society Japan Chapter

For "10-Gbit/s BPSK Modulator and Demodulator for a 120-GHz-Band Wireless Link".

This paper presents 10-Gbit/s binary phase-shift keying modulator and demodulator modules for a 120-GHz-band millimeter-wave wireless link. To reduce system complexity, we selected differentially coherent detection for the demodulator and designed the modulator and demodulator without IF circuits. The direct-conversion modulator consists of a 180° hybrid coupler, gain-control amplifiers, and a Wilkinson combiner. The demodulator has a 100-ps delay line made with coplanar waveguides and a variable phase shifter. The modulator and demodulator were fabricated with 0.1-μm-gate HEMTs (high-electron-mobility transistors) lattice-matched to an InP (indium phosphide) substrate. A test element of the modulator exhibited a static vector error magnitude of 5%. We also mounted the modulator and demodulator in WR-8 waveguide modules and evaluated the characteristics of 10-Gbit/s data transmission. The bit-error rate for 10-Gbit/s pseudorandom binary sequence 27-1 data is 10-12 at a received power of -39 dBm.
Published as: H. Takahashi, T. Kosugi, A. Hirata, K. Murata, and N. Kukutsu, "10-Gbit/s BPSK Modulator and Demodulator for a 120-GHz-Band Wireless Link," IEEE Trans. on Microwave Theory and Techniques, Vol. 59, No. 5, pp. 1361–1368, 2011.

APMC 2012 Prize

Winners: Jun Takeuchi, Akihiko Hirata, Hiroyuki Takahashi, and Naoya Kukutsu, NTT Microsystem Integration Laboratories
Date: December 6, 2012
Organization: Asia-Pacific Microwave Conference

For "20-Gbit/s Unidirectional Wireless System Using Polarization Multiplexing for 12-ch HDTV Signal Transmission".

This paper presents a 20-Gbit/s unidirectional wireless data transmission system with a 120-GHz-band wireless link using orthomode transducers (OMTs). The OMTs are used for polarization multiplexing unidirectional transmission of 120-GHz-band wireless link. We designed and fabricated a new finline OMT whose group delay is improved by adjusting the waveguide length. The measured group delay is 43 ps. Using the finline OMT, we developed new unidirectional wireless equipment that can transmit two channels of 10-Gbit/s data using cross polarization multiplexing. With this wireless equipment, we succeeded in transmitting 20-Gbit/s wireless data and12-ch high definition television (HDTV) signals.
Published as: J. Takeuchi, A. Hirata, H. Takahashi, and N. Kukutsu, "20-Gbit/s Unidirectional Wireless System Using Polarization Multiplexing for 12-ch HDTV Signal Transmission," Proc. of 2012 Asia-Pacific Microwave Conference (APMC), pp. 142–144, Kaohsiung, Taiwan, 2012.

Best Presentation Award

Winners: Yusuke Ichikawa[†1], Yasunari Kishimoto[†2], and Toru Kobayashi[†1]
†1 NTT Service Evolution Laboratories
†2 NTT Software Innovation Center
Date: January 17, 2012
Organization: SIG-CDS, Information Processing Society of Japan

For "A Proposal of Extracting Innovative Users with Web Access Log of an E-Commerce Site".

We studied a way of extracting user groups having specific psychographic profiles. In particular, we define innovative users as the segment interested in buying new items. Identifying such users will allow more firms to develop and market new products more efficiently. This paper assumes that innovative users are interested in specific information found on particular web pages on an e-commerce website. Once those web pages have been identified, new users can be categorized as innovative based on the pages they access. We propose a method of analyzing web access logs to classify users as innovative or not and report its effectiveness.
Published as: Y. Ichikawa, Y. Kishimoto, and T. Kobayashi, "A Proposal of Extracting Innovative Users with Web Access Log of an E-Commerce Site," SIG Technical Reports, Vol. 2013-GN-86, No. 28, pp. 1–8 (in Japanese).

Best Presentation Award

Winners: Shunichi Seko, Ryosuke Aoki, and Masayuki Ihara, NTT Service Evolution Laboratories
Date: January 17, 2013.
Organization: SIG-CDS, Information Processing Society of Japan

For "InfoSkin: User Interface for Information Selection".

In this paper, we propose "InfoSkin", a user interface that allows users to simply and easily collect information on the web. To achieve such information retrieval, we focused on the behavior in a shoe store. We designed and implemented the user interface for information selection based on the metaphor of the shoe store and then validated its effectiveness. Evaluations showed that our proposed interface allows users to take a broad view of information and improves their willingness to view and input operations.
Published as: S. Seko, R. Aoki, M. Ihara, and T. Kobayashi, "InfoSkin: User Interface for Information Selection," SIG Technical Reports, Vol. 2013-GN-86, No. 15, pp. 1–8 (in Japanese).

Best Presentation Award

Winners: Misa Hirao, Yoko Ishii, and Yasuhiko Miyazaki, NTT Service Evolution Laboratories
Date: January 17, 2013.
Organization: SIG-CDS, Information Processing Society of Japan

For "Proposal of TV Communication Support System for the Hearing Impaired and their Families".

The TV watching style has been diversified thanks to the innovation of video viewing services such as integrated services digital broadcasting and IPTV (Internet protocol television). On the other hand, the TV accessibility of hearing-impaired people still has problems. We aim to construct a communication support system for families with hearing-impaired members for use when watching TV. Hearing-impaired people have some unique limitations when watch-

ing TV because they rely mostly on visual information. Therefore, we propose a "TV interface which combines TV programs and watching people's faces". This new interface allows us to watch a TV program and to see people's sign language or expression simultaneously. We show the results of an experiment when users watched TV when using our proposed interface prototype system. The results indicate that the communication frequency increased compared to the case when the prototype system was not being used.

Published as: M. Hirao, Y. Ishii, Y. Miyazaki, N. Matsushima, and T. Kobayashi, "Proposal of TV Communication Support System for the Hearing Impaired and their Families," SIG Technical Reports, Vol. 2013-GN-86, No. 14, pp. 1–7 (in Japanese).