R&D Spirits

Next-generation Gateways for Advanced Aggregation of Communication Services

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A project for implementing next-generation gateways using Open Services Gateway Initiative (OSGi) middleware is now underway at NTT Cyber Solutions Laboratories. We asked Senior Manager Ryutaro Kawamura, the head of this project and a leader in OSGi standardization, to describe the features of this gateway technology—called OSGi Service Aggregation Platform (OSAP)—and to tell us about the changes that it will bring to society.

Development of an original platform based on the OSGi framework

—Dr. Kawamura, could you outline your current R&D work for us?

We are now researching and developing software components based on middleware called Open Services Gateway Initiative (OSGi). Right now, we are working on interconnecting network devices such as cellular phones and personal computers, but we eventually want to interconnect all sorts of things including personal digital assistants (PDAs), audio-visual equipment, and automobiles so that they can communicate with each other. The age of ubiquitous computing is arriving fast, but to make effective use of a ubiquitous environment, it must be possible to add new functions, customize each user's experience, and deal with new problems on a continuous basis. It is extremely difficult, however, to respond individually to changes of all types every time they are made. One solution is to group together various kinds of communication-control functions, protocols, applications, etc. as a software component called a "bundle" and to download only those bundles that are needed when they are needed via the network (**Fig. 1**). This is the basic idea behind software components. This approach means that the latest and most optimal software is always being used and that each user's gateway can be easily customized. The downloading of only necessary bundles also means a savings in hardware memory capacity. One gateway-construction technology based on this idea is OSGi, which is now a target of international standardization [1]. NTT is participating in these activities. OSGi middleware can be incorporated in products like home gateways, broadband routers, set-top boxes, personal computers, vehicle computers, and televisions according to the application in question. In our project, we are developing an OSGi Service Aggregation Platform, or OSAP for short. This is a next-generation Internet-services platform that features service gateways having original NTT extensions for security etc. control in addition to the OSGi framework, plus a center system that manages service gateways and connects service providers with users.

—What kind of role will this technology play in society?

The spread of OSAP in society will enable Internet services to be provided in a far more advanced and efficient manner. Various types of usage can be envisioned, but an especially good example is the "ICT home," where ICT means information and communication technology (**Fig. 2**). In this scenario, each

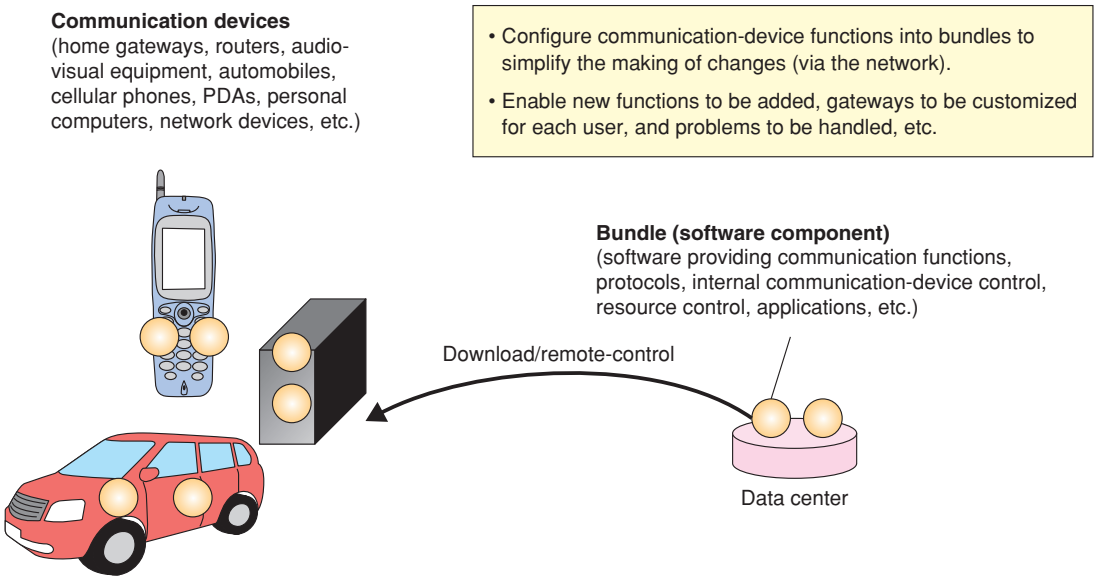

Fig. 1. Purpose of OSGi.

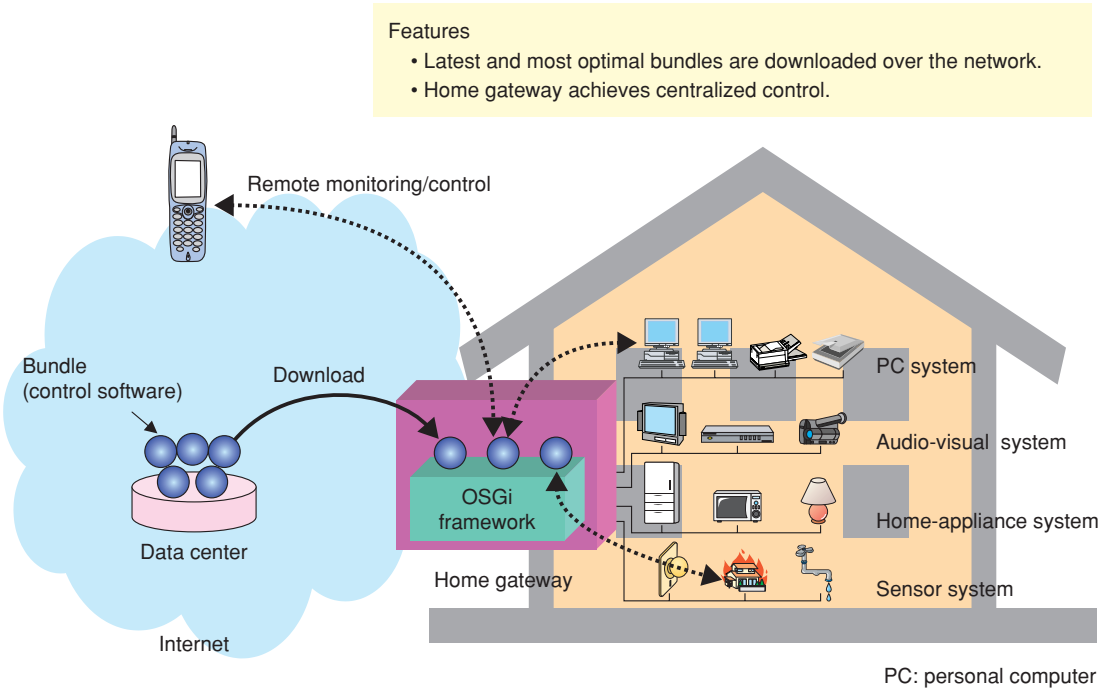

Fig. 2. OSGi control model (using a home gateway as an example).

household is given a service (or home) gateway through which bundles can be downloaded over the network. These bundles can be used to set up a security system or a home automation system, for example, that is always up to date with the latest functions. The home gateway can also be connected to the local government to enable the household to receive weather, earthquake, and other kinds of important information as well as a wide variety of services including remote care for the elderly and disaster support. This could be done by simply downloading bundles without having to install additional boxes (gateways).

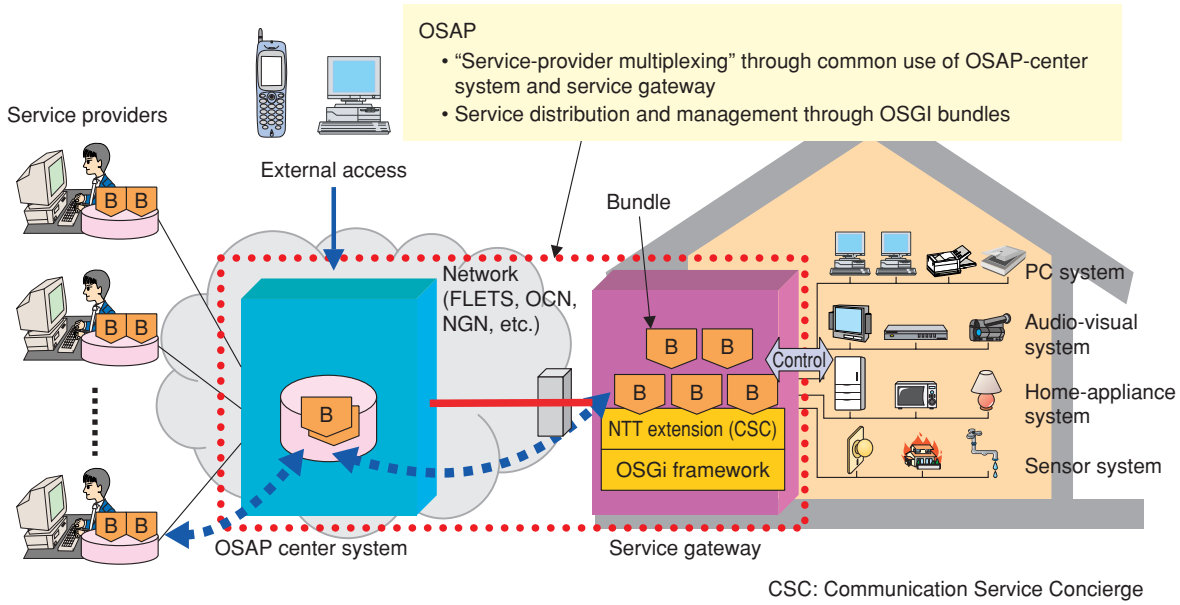

Fig. 3. Outline of OSGi Service Aggregation Platform (OSAP) (using home services as an example).

—What are some key features of OSAP?

From an R&D viewpoint, one key feature is the grouping of software in the form of a bundle through the use of Java. This enables software to be accessed and used as needed. The idea behind OSAP was first suggested to us as "mobile agents in an active network," which are software entities that can move about the network as needed. But mobile agents themselves provide more functionality than is needed on OSAP, and since they can sometimes be complicated to work with and difficult to implement, I wanted to create something that could achieve a service gateway in a simpler and feasible way. Later, with the appearance of Java, which provides software component elements, we had everything we needed to make OSAP a reality (**Fig. 3**).

Another key feature in terms of practical use is that OSAP can make the network very simple. Up to now, a gateway for each kind of service had to be set up in a house: a need for security functions meant using a security company's gateway, a need for electricity control meant using a power company's gateway, and so on. Our OSAP technology, in contrast, can aggregate other service providers' applications all together, meaning that a single gateway can control a home-appliance system, a sensor system, an audio-visual system and so on. This makes the system all the more user friendly while at the same time eliminating the development cost of gateways and center systems for service providers.

—How do you think this technology will develop three and five years into the future?

In the near future, I can see it being used for crime- and disaster-prevention systems by local governments as a platform for making society safer and more secure. Further into the future, I can imagine homes, companies, cellular phones, automobiles, and all kinds of things interconnected on this platform, leading to entirely new ways of using the network. I believe that OSAP has the potential to become the technical foundation for making the network a true social infrastructure.

A driving force behind OSGi standardization activities as a leader

—What is the worldwide trend in OSGi?

OSGi is based on middleware called JES created by Sun Microsystems in 1998 as a platform for incorporating modules in embedded equipment. Although similar technologies had been proposed by various vendors and carriers, OSGi is open middleware, which may be one reason why it has become a de facto standard for all practical purposes. A standards

body called the OSGi Alliance was established in 1999 and formal international standardization activities have been expanding since then.

—In what way is NTT involved in these standardization activities?

NTT plays a very important role in OSGi standardization. It began participating in the OSGi Alliance in 2001 based on the idea that the prime mission of standardization is to make the next-generation Internet-services environment far better than anything that has come before. That is to say, OSGi should not be treated as simply a tool for creating services. I myself have been serving since October 2003 on the OSGi Alliance Board of Directors and since 2005 also as a vice-president for the Asia-Pacific region. I am deeply involved in the process of management of the alliance while also working to establish groups in Japan and in the Asia-Pacific region. These responsibilities require that I make about six or seven overseas trips a year, and since I am also working on the commercial aspects of OSGi for NTT, I've become quite busy to say the least.

—How has NTT come to be viewed through these standardization activities?

At the OSGi Alliance, there are a total of ten people on the Board of Directors, each with a vote. As Japan's only representative, selected from candidates of major electronic-equipment and computer makers, I can understand that much is expected of me and NTT as well. Since Japanese industry has been very influential in the world for some time, Japanese companies were strongly expected to join the OSGi Alliance and produce OSGi-based products. To meet these expectations, we have been active in educational and promotional activities within Japan. For example, OSGi Users' Forum Japan was launched in September 2004. This regularly held forum consists of workshops, interconnectivity trials, and other activities to exchange information on OSGi technology and business and to explore new services through the cooperation of diverse industries. Currently, 62 companies belong to OSGi Users' Forum Japan. We are working to increase membership with the aim of setting up an OSGi system within Japan in two or three years time.

—Are you collaborating with any companies or universities in Japan or overseas?

We have had various inquiries from outside the NTT Group. For example, we are working with a gas company in the Nagoya region of Japan to develop a comprehensive living-support system that includes security, energy saving, and remote elderly care.

Developing a business-oriented mind based on a vigorous R&D environment

—Dr. Kawamura, how did you get started in your current R&D theme?

In 2000, a project called "flexible network architecture for competitive environment," or FACE, was established with a number of young researchers at NTT Laboratories. The objective was to predict technologies that would become necessary in the future amidst an ever diversifying telecommunication environment. The project members began by identifying five themes. One result of this work was the birth of Communication Service Concierge (CSC), an early form of OSAP. This was where my research began, so I cannot say that OSAP was only my idea—it was also thought of by all of the young members of this project.

—Where did your technical foundation come from?

I researched factory automation in the engineering department while in graduate school, with a focus on control technology for machine tools and measurement robots. I guess you could say that my field of study as an engineer was to figure out what could be made to move by computer.

—What motivated you to enter NTT?

To tell you the truth, my target on entering NTT was not NTT Laboratories but rather the business division since its job was to commercialize and market new systems developed in the laboratories. You can imagine my disappointment when I was instead assigned to NTT Transmission Systems Laboratories, a section of NTT that I didn't even know existed. But much to my surprise, I soon found out that I had been assigned to a very interesting area. This was because the researchers at these laboratories all had a business-oriented mindset! Many of my senior researchers were keen on submitting their technologies to the out-

side world, an attitude that had a great influence on me. Looking back to that time, it was good that things didn't work out as I had originally hoped. Very soon after being assigned to NTT Transmission Systems Laboratories, I was able to get several products to market, which had the effect of keeping me very motivated.

—What research themes have you worked on over the course of your career?

My initial work involved a self-healing system for ATM (asynchronous transfer mode) networks. This system used technology that could automatically reroute and restore communications in about one second in the event of a fiber being cut by some sort of disaster. I worked on this system by myself for a period of about five years starting in 1989, doing everything from basic research to programming, and the system that I completed was deployed in NTT's ATM leased line service. I also researched an uninterruptible transmission system in parallel with my work on this self-healing system. An uninterruptible transmission system can be thought of as technology that goes beyond the self-healing system, which reroutes and restores communications after a circuit cutoff. What it does is to send the same information through two strands of fiber in parallel so that the signal cannot, for all practical purposes, be cut off. This system was eventually implemented by some of my colleagues and has come to be used in digital terrestrial broadcasting and other communication applications that require high levels of quality and reliability.

However, I have also researched themes that never reached a practical level. In 1994, I collaborated with a certain company in the development of technology for securing bandwidth in an IP (Internet protocol) network. We even developed a product based on this technology, but unfortunately, it never left the laboratory. One reason given for this is that the technology itself was ahead of its time, but I cannot deny that we could have made more effort with regards to standardization. But I learned much from this failure, and in my work on OSAP, I am placing a lot of importance on standardization.

Next, I left Japan in 1998 to spend a year at Columbia University in the USA as a guest researcher. It was there that I encountered mobile-agent and active-network technology based on Java, which are areas related to OSAP. On returning to Japan, I was given the opportunity to start the FACE project, a theme that was closely related to my studies at Columbia, and the timing could not have been better.

—What is it that you strive for in your R&D life?

I want to make things and develop mechanisms that will make it easier for people to enjoy the convenience of the networked society. And I want this to apply not just to people that represent heavy users of personal computers and cellular phones, but also to people that represent the digital divide in society. However, an always-on network connection does not necessarily mean absolute bliss for everyone. So I want to explore this issue not only from the viewpoint of convenience and usefulness but also in terms of the disadvantages that such network features may bring.

Giving top priority to devising technologies useful to society

—What do you think is your future R&D direction including your current line of research?

Well, I've been working on OSGi/OSAP for about six years now, and much of that time has been spent in research and development. From here on, I feel that I should exert my efforts in making sure that OSGi/OSAP becomes a truly useful technology to society. To this end, it will not suffice to concentrate only on standardization or commercialization. Rather, I must achieve a good balance between the two. That is exactly what my role should be.

—What do you think is most important for a researcher?

"Create technology that can be used!" Of course, in research, a certain technology may be important even if only from an academic viewpoint, but I myself put priority on usability as much as I can. My prime R&D objective is to give form to my ideas and submit them to the outside world in the hope that they will be truly useful, even if they may not be academically valuable. In this endeavor, I am quite happy.

—What has it been like for you personally working at NTT Laboratories?

In short, NTT Laboratories is a group of researchers that have inherited an unbroken tradition of thinking in a "can do" manner. It's exactly this very strong passion for practical application that I find of great value and that I believe is NTT Laboratories' greatest asset.

With an attitude like this, a researcher will always research what the times demand regardless of how the times change so that he or she can give society what it needs. If we were to break with this tradition, I think that NTT Laboratories' reason for existing would become a bit shaky. This, I believe, says a lot about NTT Laboratories.

—Dr. Kawamura, what would you say to young researchers?

I would like to say something to all university students that are serious about getting into research. Please give more serious thought in selecting where you want to conduct your research. These days, many students depend only on images or even TV commercials in determining whether a certain company is good or bad for them. I was also guilty of that at one time. However, such impressions are not necessarily true representations of a company, and the difference between the image that one has created in one's mind and what is real is bound to be disappointing. To prevent this from happening, focus instead on the mindset of a company or research institution. NTT Laboratories, for example, is very application-oriented with a "can-do" mindset, as I have mentioned. It's a place where making contributions to society in various forms is considered to be an important mission. To budding researchers who are knocking at our gate with the hope of giving their ideas form and contributing to society, we extend a hearty welcome!

Reference

[1] R. Kawamura and H. Maeomichi, "Standardization Activity of OSGi (Open Services Gateway Initiative)," NTT Technical Review, Vol. 2, No. 1, pp. 94-97, 2004.

Interviewee profile

■ Career highlights

Ryutaro Kawamura received the B.S. and M.S. degrees in precision engineering and the Ph.D. degree in electronics and information engineering from Hokkaido University, Hokkaido, in 1987, 1989, and 1996, respectively. In 1989, he joined NTT Transmission Systems Laboratories. From 1998 to 1999, he was a visiting researcher at CTR in Columbia University, USA. He has been engaged in research on network reliability techniques, network control and management, high-speed computer networks, active networks, network middleware, and next-generation Internet architecture. Since 2003, he has been a member of the Board of Directors of the OSGi Alliance and since 2005 its Vice President for the Asia-Pacific region. He is a member of the IEEE Communications Society and the Institute of Electronics, Information and Communication Engineers of Japan.