R&D Spirits

IP-VPN Service Platform Development for the Personal Market

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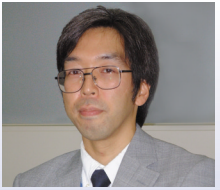


The Secure Communication Project at NTT Information Sharing Platform Laboratories is devoted to developing a next-generation IP-VPN (Internet protocol virtual private network) service platform. To find out how IP-VPN technology is evolving in the broadband era and what type of business it enables, we talked with senior research engineer Junichi Murayama, a member of the Secure Communication Project.

Achieving compatibility between expanded bandwidth and expanded number of sites with high cost performance

—Mr. Murayama, please tell us about your current research now taking place in the Secure Communication Project.

We are working on the development of a next-generation Internet protocol virtual private network (IP-VPN) service platform (**Figs. 1** and **2**). IP-VPN services provide group-oriented virtual broadband networks for corporate and other uses. Because IP addresses within a group can be allocated as desired, these services allow greater freedom in IP network design, and because access from outside the group is, in principle, prohibited, secure communications can be achieved. In addition, the provision of a physical platform shared by multiple IP-VPNs provides outstanding cost performance compared with using leased lines. However, the conventional IP-VPN architecture is inferior to the Internet architecture in terms of scalability. Our aim, therefore, is to provide IP-VPN services that can accommodate more users. I need to point out here that our research is not obsessed with specific elemental technologies. We are more concerned with combining the latest communication technologies in an optimal manner to achieve our objectives. In other words, our research concentrates on creating the “glue” to hold various technologies together.

—What are your specific objectives here?

Our two main objectives are increasing the number of service sites to accommodate more users and expanding bandwidth between service sites to enable smooth broadband communications. Currently, the maximum number of provider edge routers that connects service sites with a service provider network is about 100, but our goal is to increase this by one order of magnitude. And for bandwidth, we aim to increase the current Gbit/s-class capacity by three orders of magnitude to the Tbit/s-class capacity.

—What technologies are you focusing on?

Considering an optimal mechanism for our objectives, we are focusing on three main technologies. The first of these is called “provider-provisioned virtual private network (PPVPN),” a basic technology for forming virtual private networks. This technology is combined with generalized multiprotocol label switching (GMPLS), an optical communication technology, and Internet protocol version 6 (IPv6), the next-generation of IP technology. In short, we have “cherry picked” technologies. GMPLS excels in forming broadband communications between two

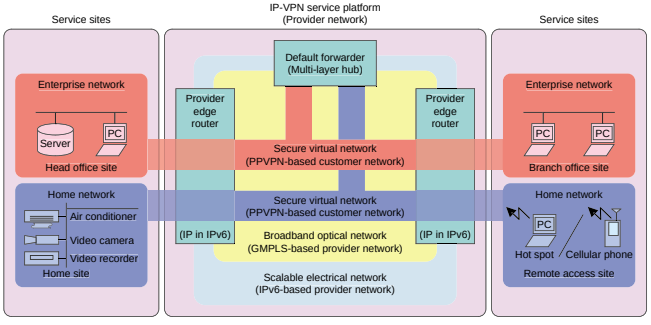
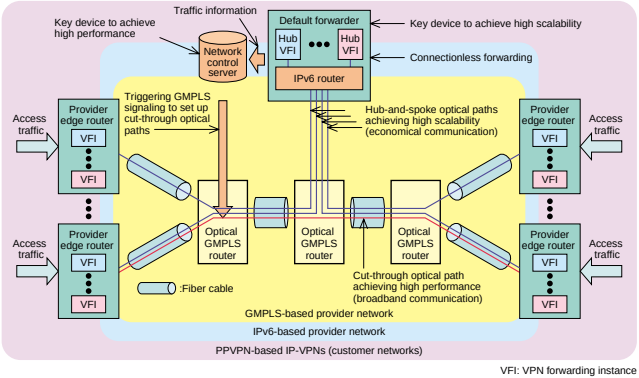


Fig. 1. Overview of the IP-VPN service platform.

Fig. 2. Prototype system.



VFI: VPN forwarding instance

Fig. 3. Architecture of the IP-VPN service platform.

service sites but is not as structurally or economically effective as IPv6 in network expansion, while IPv6 excels at increasing the number of service sites but is not as adept as optical systems in achieving broadband connections. The main point here, however, is combining the technologies that we have picked in the best way. In brief, we do this by first configuring an effective network for increasing the number of service sites based on IPv6, and using provider edge routers to convert to IPv6 and transfer packets regardless of what protocol users are using. This approach can be scaled up in the same manner as today's Internet. Next, using a process that automatically identifies inter-site links with heavy traffic based on addresses of IPv6 packets passing through relay routers, we set up optical paths by GMPLS to expand bandwidth. Here, by having IPv6 ensure reachability among all service sites and by deploying optical path only when and where needed, we can satisfy the required performance in terms of both capacity and cost (**Fig. 3**).

By the way, for readers interested in these technologies, they will be described in more detail in the March 2004 issue of this periodical.

Promoting leading research in home networks

—What can this platform technology be used for?

First, it can be used to enhance current business applications. As I mentioned earlier, IP-VPN is extremely secure, which means that it can be used like leased lines but with lower fees. We therefore envision IP-VPN spreading beyond major corporate users like financial institutions to medium and small enterprises. We are also aiming to apply this technology to personal applications such as home networks by improving network scalability. Since the business market is essentially limited, our group would love to take up the challenge of the personal market.

—What do you think this research will bring forth three and five years from now?

At present, network functions are incorporated in home electronic products, but in about three years from now, we expect to see the initial use of genuine home networks that allow network functions to be controlled automatically and remotely. This should make many things possible. For example, a user

should be able to use a personal computer or cellular phone as a terminal to monitor rooms in the family's house from a remote location by means of video images, or turn on the air conditioner before returning home and set rooms to a comfortable temperature, or even prepare a hot bath. Of course, some of these are already possible over the Internet, but security issues must also be considered in addition to what is technically possible. If a third-party can eavesdrop on video images taken by a home security camera, there is not much sense in installing such a system. Using IP-VPN technology to create a personal network can provide secure and worry-free network use. In about five years time, we foresee the spread of home networks accelerating.

—Could you tell us something about domestic and international trends in research of this kind?

First of all, standardization of the three main technologies that I described earlier is progressing through the Internet Engineering Task Force (IETF). Although I myself am not directly involved in the research of these technologies or associated standardization activities, many of my colleagues at NTT are making contributions. Because we are more concerned with optimizing the combination of these technologies than with the technologies themselves, our research is not being pursued much elsewhere. In fact, I think we are the only research project working to link IP-VPN to home networks with a focus on security. Why are there so few competing researchers? One reason might be that research efforts around the world are still concentrating on elemental technologies like GMPLS making it difficult at this stage to envision how they might be combined. In other words, our research aims to stay one or two steps ahead of current world research in this area. NTT, by the way, is also conducting research on elemental technologies that can provide the researcher with useful tools. Our group is working in an environment that makes it easy to determine the nature and direction of technology development and that provides support for cutting-edge research.

Creating ideal conditions for developing "technology that makes a difference" —an industry-wide issue

—How did research of IP-VPN for the personal market begin at NTT?

Well, despite the fact that NTT was the first to commercialize IP-VPN services, the market has since become extremely competitive among telecom providers, so we felt the need to expand the market in new directions. We thought that developing "technology that makes a difference" to improve scalability and create personal applications like home networks would be an effective strategy for coming out a winner in this market.

—What research have you been personally involved with up to now?

In my university days, I was interested in semiconductor devices as the foundation for electronics technologies, and seeing that the nanotechnology era was coming, I became involved in research dealing with the shrinking of LSI feature dimensions. Then, after entering NTT and finding myself in the research laboratories of a leading carrier, my interests shifted to searching out untapped capabilities in the application of LSIs, and the target of my research became networks. At this time, network research was heavily focused on ATM technology with the aim of achieving broadband communications. Its underlying mechanism, however, was surprisingly complex, and for a newcomer like me, it did not appear very practical. I consequently had the idea that ATM technology could be used for providing diversified services as opposed to broadband connections.

The platform that we initially developed had functions for providing a variety of services. These included IP-VPN services as well as Internet services, extranet services, quality guarantee services, and multicast services. The technology that we employed here was geared to achieving NTT's vision at the time of "global mega-media networks," or GMN, and was therefore called GMN-connectionless technology, or GMN-CL. Of the services provided by GMN-CL, IP-VPN received high praise in particular, but to tell the truth, it was not very popular at first. IP-VPN began to attract attention a bit later, especially when overseas vendors began to independently develop routers for providing IP-VPN services. Our technology, which preceded theirs, was actually superior, and because it was particularly applicable to corporate networks, it came to be deployed at four companies in the NTT Group where it continues to be used. This was a milestone in IP-VPN service provision. The goal of our current research, meanwhile, is to take IP-VPN into the optical era through the use of GMPLS technology. For me, it's been a real pleasure

to expand upon a single research theme since coming to NTT.

—Is there anything that particularly stands out among your research experiences?

Yes. When researching GMN-CL, I found that providers and vendors took different approaches to the development of new functions for routers. This difference was most visible with vendors having brand recognition. For example, while a provider would like to add original functions to differentiate their services from those of other providers, a vendor would like to sell mass-produced routers with the same functions to many providers to save on development and maintenance costs. Also, when adding functions to a router, providers do not particularly like to disclose their specifications while vendors favor standardization to generate good public relations and improve brand recognition. In short, providers and vendors do not necessarily have the same expectations. In addition, while the provider side consists of many operators each trying to carve out a niche in the business, the vendor side consists of name-brand enterprises having huge shares of the market. Under these circumstances, it's inevitable that leadership resides on the vendor side. Researchers on the provider side are consequently concerned that this will make it difficult for providers to differentiate their services and lead to unreasonable price competition. To prevent this from happening and to develop greater cooperation between providers and vendors, one solution, I think, would be programmable routers that providers could customize as desired.

—How would you like to see this research develop in the coming years?

As part of our goal of creating home networks, I would like to see our research evolve to a point where it can help enrich our personal lifestyles. For example, I love to travel for taking pictures, and during travels, I would like to monitor my home by means of video images in order to check security. On the other hand, even when I am in home, I think it would be great to be able to direct a real-time view of a desired location through my home television as a sort of interior design. A network that can make such things possible is something that I would love to be a part of. Honestly speaking, however, I don't know if our current research will make that happen. Such a network will probably be the result of other research fields such as elemental technologies. But that's fine—I'm sure that we will be able to contribute to its development in some form. We also would not mind taking on new issues or challenges that may appear.

Meeting outside expectations as part of NTT Laboratories' mission

—How do you think NTT Laboratories appears to the world though its research activities to date?

Two things come to mind. First, as a carrier's research center, I think people would like to see ongoing creation and development of new service markets. For us researchers, it is important that we provide research results that can meet this need. Second, there are some people who would like to see disclosure of the vast amount of network know-how that NTT has accumulated, especially for collaborative purposes. To this end, it might be necessary to collect our technology in textbook form as done by name-brand vendors and to provide genuine disclosure on our Web pages or elsewhere.

—Could you please tell us your personal aspirations for the future?

In the short term, I would like to pursue research directly related to business as an extension of my current work. In the long term, however, I would like to shift from research for developing competitive technology to original research for developing new service markets. Furthermore, as a researcher, I would love to see technology that I myself have created find use in the real world. Research results that come to be used widely in society will no doubt become standardized technology. For example, I am very interested in researching the programmable routers that I mentioned earlier. Whatever the future holds, I feel that it will be a change in direction for me.

—What is it like working at NTT Laboratories?

In my research life up to now, I have been supported by many people, and I think it is because of them that I have achieved more than would have been possible with my own abilities alone. In this sense, NTT Laboratories is an "amplifier" of one's abilities. Working here has been a golden opportunity!

Interviewee profile

■ Career highlights

Junichi Murayama received the B.E. and M.E. degrees in electronics and communication engineering from Waseda University, Tokyo in 1989 and 1991, respectively. Since joining NTT in 1991, he has been engaged in research and development of large-scale IP networks and IP-VPN service platforms. He is now a senior research engineer in the Secure Communication Project of NTT Information Sharing Platform Laboratories. He is a member of the Institute of Electronics, Information and Communication Engineers (IEICE).

■ Major awards

The award of the technical group of information networks, IEICE, 1998, "IN97-39: Design of a global networking service platform".

The award of the technical group of information networks, IEICE, 2000, "IN98-133: Designing an intra-networking architecture for a global networking service platform".

NTT President's Award, 2000, "Development of next-generation IP networking technologies (GMN-CL)".

■ Publications

"The Latest Broadband Textbook Vol. 2 (in Japanese)", coauthor, ISBN 4-87280-489-9, IDG Japan, October, 2003.