New IPv6 Connectivity Services

—Expansion of Global IPv6 Services by NTT Communications Corporation—

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OVERVIEW: Internet Protocol Version 6 (IPv6) has been proposed as a means of addressing various shortcomings in current Internet Protocol (IPv4). It aims, in particular, to solve the exhaustion of IP addresses, to consolidate routing tables, to simplify implementation of Internet protocol security (IPsec) and quality of service (QoS), and to achieve "Peer to Peer" communications. It appears that IPv6 is about to explode on the Internet scene at long last. Against the above background, NTT Communications Corporation has become the leading company to provide IPv6 connectivity services with an eye to providing an effective environment for IPv6 developers. The company is also proceeding with its preparations for a stable backyard environment to provide for new ways of using the Internet through completely new applications not seen in the present Internet world.

INTRODUCTION

IPv6 is a new version of Internet protocol that has come about to solve a variety of problems in conventional IPv4 in addition to simply resolving the absolute exhaustion of address space. It is also anticipated to consolidate routing information, to ensure QoS, and to achieve standard IPsec implementation. In a world based on IPv6, we can envision all kinds of objects to be assigned addresses and to exchange information freely.

This report presents NTT Communications' approach to IPv6 and describes IPv6 connectivity services that the company is now providing (see Fig. 1).

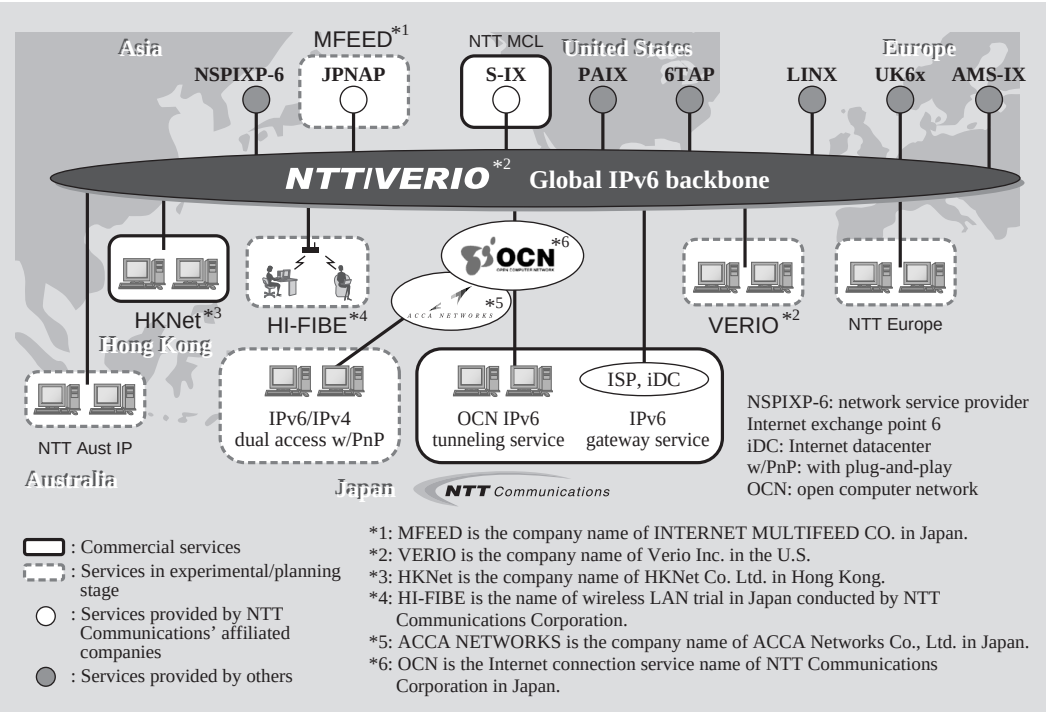


Fig. 1—Expansion of Global IPv6 Services by NTT Communications.
NTT Communications is globally expanding IPv6 connectivity services including trials and Internet exchange services in cooperation with affiliated companies.

NTT COMMUNICATIONS' APPROACH TO IPv6

Two basic scenarios can be considered for the transition from current IPv4 to next-generation IPv6. The first is called the "exhaustion scenario" in which IPv4 addresses are first used up, and the second is called the "expansion scenario" in which new IPv6-oriented applications make their appearance. If the exhaustion scenario were to be followed, one approach as an Internet service provider (ISP) would be to proceed with preparations for IPv6 in a somewhat detached manner. NTT Communications, however, envisioned the coming of new applications based on the peer-to-peer model (in contrast to the existing client-server model as typified by web access and e-mail) in a stage prior to IPv6. It felt that such applications could give rise to a genuine expansion scenario in which IPv6 diffuses in an accelerated manner. It is with this in mind that NTT Communications took the initiative in dealing with IPv6 issues with the aim of actively promoting this scenario.

As an ISP, NTT Communications decided that it would first give priority to establishing an environment that could provide stable IPv6 connectivity and that could be used with confidence by developers of new applications. And, in parallel with this effort, it also attached importance to being the first ISP to conduct tests and trials of functions that utilize IPv6 characteristics and to demonstrate the feasibility of migrating to an IPv6 commercial operating phase.

In summer 1999, the Asia Pacific Network Information Center (APNIC) began allocating sub-TLA (top level aggregation) address blocks, and in the autumn of the year NTT Communications received its first sub-TLA address block (2001:218::/35) as a commercial Internet provider in Japan. The company then entered an experimental phase consisting of IPv6 tunneling experiments on the Open Computer Network (OCN) and the testing of other IPv6 technologies and functions, and eventually launched commercial IPv6 connectivity services in the spring of 2001. At the beginning of these experiments, NTT Communications constructed and began operating a global IPv6 network spanning Japan, United States and Europe, and has since been accumulating valuable knowhow as a Global Tier 1 ISP in IPv6 (top level ISP) that does not depend on others for its routing. During this time, it has also attempted to make an accurate assessment of customer needs through connectivity provision experiments at various bases in the above countries and areas.

The IPv6 gateway service and commercial IPv6 connectivity services on OCN described below represents the outcome of the above efforts.

IPv6 GATEWAY SERVICE

NTT/VERIO Global IPv6 Backbone Network

After acquiring an sub-TLA address block in autumn 1999, NTT Communications constructed and began operating a global IPv6 backbone spanning Japan, United States, and Europe (see Fig. 2). This backbone is operated as a joint system of NTT Communications and Verio Inc. in the United States the same as with IPv4. A Network Operation Center (NOC) has been set up at each of two bases in Japan and the United States, and thus a 24-hour, 365-day maintenance scheme is being constructed to provide commercial-level quality.

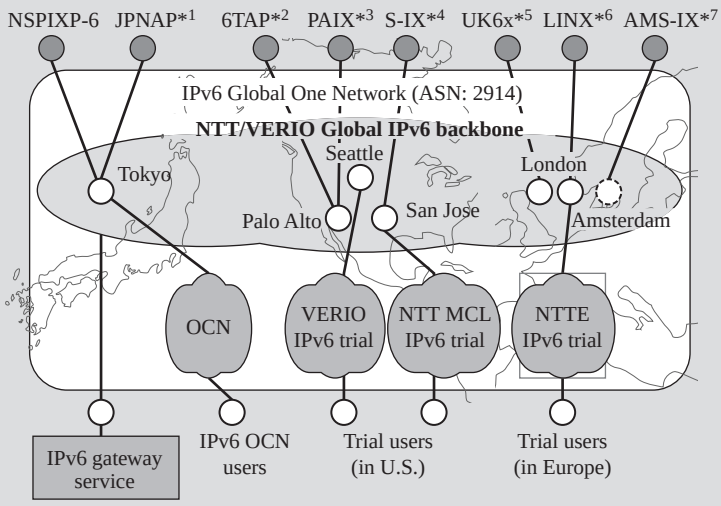
Progress is also being made in establishing connections with major IPv6 Internet exchanges (IPv6-IXs) in various countries and peering with sub-TLA address-acquisition organizations around the world is expanding steadily.

In contrast to IPv4 in which U.S. vendors took the lead in supplying routers, NTT Communications has also considered IPv6-compatible products from Japanese manufacturers for deployment in the global network and has adopted a Japan + U.S. multi-vendor system. A very cooperative relationship is being constructed with each vendor.

Commercial IPv6 Native Service

"IPv6 native service" means direct connection with the global IPv6 backbone and provision of connectivity over IPv6 native (dedicated) circuits without going through IPv4. Two connection formats are provided here: "general subscriber service" based on leased-line connection and "co-location connectivity service" that makes a LAN connection within a NTT Communications building (see Fig. 3).

It was originally thought that primary providers in Japan and IPv6-advanced enterprises would be the main customers of this service. Over the one year since service launch, however, the number of corporate customers has swelled to more than ten companies, far exceeding earlier predictions. This suggests serious interest in IPv6 on the part of domestic providers and various companies. Various ISPs are also about to begin provision of commercial IPv6 services on a gradual basis, and it appears that a genuine IPv6 diffusion period will begin in either 2002 or 2003.



ASN: autonomous system number
NTT MCL: NTT Multimedia Communications Laboratories, Inc.
NTTE: NTT Europe Ltd.

*1: JPNAP is the name of an IX service provided by INTERNET MULTIFEED CO. (http://www.multifeed.net/)
*2: 6TAP is the name of a joint project operating IX. (http://www.6tap.net/)
*3: PAIX is the company name of PAIX.net, Inc. and the name of an IX service provided by the company. (http://www.paix.net/index2.btm)
*4: S-IX is the name of an IX service provided by NTT MCL. (http://www.nttmcl.com/html.ComIPv6.html)
*5: UK6x is the name of an IX service provided by BTexact Technologies. (http://www.uk6x.com/)
*6: LINX is the abbreviated name of The London Internet Exchange Ltd. (http://www.linx.net/index.thtml)
*7: AMS-IX is the abbreviated name of The Amsterdam Internet Exchange. (http://www.amsix.net/)

Fig. 2—NTT/VERIO Global IPv6 Backbone Network.
The NTT/VERIO IPv6 backbone has been operating for almost three years in a configuration that spans Japan, the United States, and Europe. It connects to various Internet exchanges around the world, is actively pursuing peering with sub-TLA holders that have been allocated address blocks from RIR (Regional Internet Registry), and is performing relay connections at various locations.

NTT Communications plans to continue providing IPv6 connectivity services in Japan over the NTT/VERIO IPv6 backbone network and to expand these services to the United States and Europe from here on.

OCN SERVICES

OCN Tunneling Services

After receiving its allocation of a sub-TLA address block, NTT Communications began tunneling connection experiments on OCN in the winter of 1999. These experiments lasted about a year and a half, and during this time, the company was able to recruit about 200 trial participants that related many expectations and desires with respect to IPv6. On the basis of results obtained, a commercial tunneling service was launched in spring 2001. This service uses IPv6 over IPv4 tunneling technology to provide IPv6 connectivity through a customer's IPv4 network without modification, and is provided nationwide as a supplementary service to OCN dedicated access services ranging from OCN ADSL Access IP1 service to OCN Economy and Super OCN DSL Access services. In the service, IPv6 packets are encapsulated in IPv4 packets at a customer-provided IPv6 terminal router with tunneling function and at an IPv6 terminal router on OCN, and IPv4 packets are exchanged between these routers. Here, traffic processing between these IPv6 terminal routers is performed on the basis of IPv4 packets, which means that no IPv6 packet processing is conducted at intermediate nodes. In other words, it becomes possible to introduce an IPv6

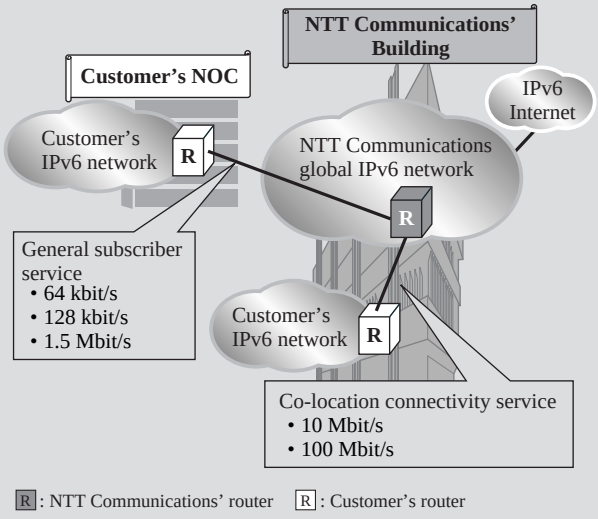


Fig. 3—Basic Configuration of IPv6 Gateway Service.
The IPv6 gateway service accommodates customers in two formats: co-location connectivity service for housing users and general subscriber service via a leased line or similar.

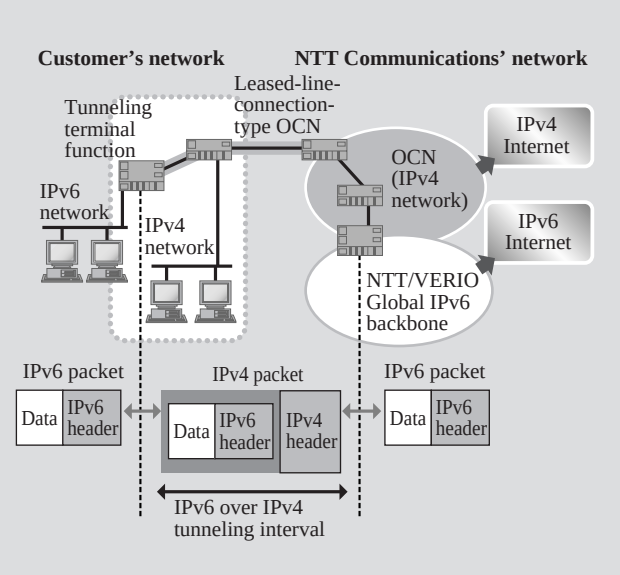


Fig. 4—Outline of OCN Tunneling Service.
OCN tunneling service uses IPv6 over IPv4 tunneling technology to provide IPv6 connectivity through customers' existing IPv4 network.

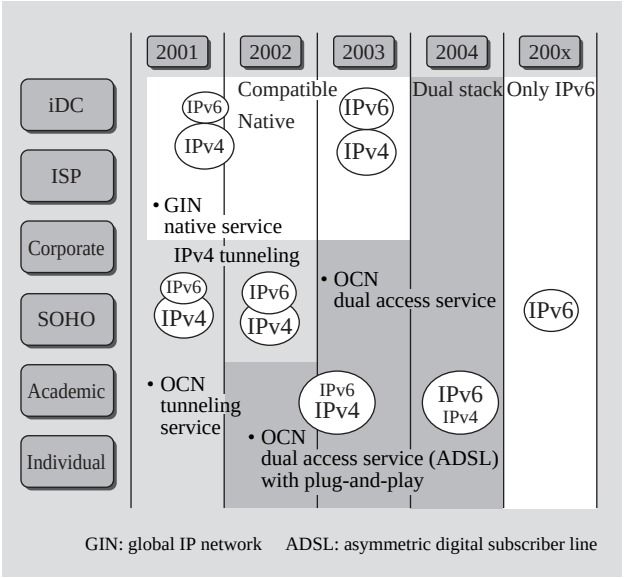


Fig. 5—NTT Communications Service Roadmap.
NTT Communications plans to expand native services, IPv6 tunneling services, and dual access services in a step-by-step fashion for all types of users from ISPs to mass users.

environment using an IPv4 environment in its unmodified form (see Fig. 4). This tunneling technology is therefore expected to play a major role in the IPv6 deployment phase.

Dual Access Service with Plug-and-play Function

NTT Communications is planning to provide an IPv6/IPv4 dual access service in the first quarter of fiscal year 2002. This service will allow both IPv6 and IPv4 to exist simultaneously on the same network [IPv6-only or IPv4-only communications (native communications) will also be allowed].

With this service, the aim is to provide totally new next-generation broadband access services that provide genuine IPv6 benefits such as plug-and-play, security, and QoS in addition to abundant IPv6 addresses. For example, it will be possible to connect routers and information appliances to the Internet at households, "Small Office, Home Office" (SOHO) sites, and sales offices of large corporations without having to make complicated settings, and it will be easy to ensure basic security and communication quality.

First, at the time of service launch, a plug-and-play function will be implemented so that necessary settings for Internet connection can be made automatically from the network side. This will enable users to enjoy an IPv6/IPv4 continuously connected Internet environment without having to make complicated settings. Next, in terms of security functions, studies will be made on having the network side provide the necessary mechanisms to block unauthorized communication packets and to construct VPNs (virtual private networks) with specific parties. This will allow users to use a safe IPv6/IPv4 continuously connected Internet environment without having to implement special software or make complicated settings. Then, to enable users to transmit and receive video and audio at even stabler levels of quality, the plan is to provide a sequence of QoS functions to maintain quality suitable for each type of communication by securing a transmission bandwidth appropriate to the purpose of that communication.

Finally, with the aim of spreading and promoting an even more convenient and inexpensive next-generation Internet, NTT Communications intends to publicize this system model and to interface with various communities both inside and outside Japan in an attempt to form a consensus for a worldwide system model.

FUTURE EXPANSION

With the aim of spreading and promoting the next-generation global Internet all the more, NTT Communications plans to provide a sequence of services to satisfy transition needs from IPv4 to IPv6 for all user levels. It aims to provide dual access services that will make it easy for users at all levels to

migrate from their present network by 2004 (see Fig. 5).

In its capacity as a leading ISP in the world to construct and operate a global IPv6 network and to lay the groundwork for new examples of IPv6 usage, NTT Communications will study new methods of utilizing the Internet in cooperation with IPv6-related partners. At the same time, it will work to spread IPv6 through educational activities targeting a variety of groups.

CONCLUSIONS

This report has presented NTT Communications' approach to commercial IPv6 connectivity services and has described several of these services.

The trials described in the section "OCN SERVICES" above are coming to bear fruit, and in two or three years time, we should see the construction of a new network society excelling in user convenience and used in a manner totally different from that of the present Internet. As an ISP, NTT Communications intends to make every effort to provide a solid backyard environment for that network.

ABOUT THE AUTHORS

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