IPv6 Network Construction Support Solution: Application to the IPv6 Experimental System of IPv6 Promotion Council

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OVERVIEW: To become an infrastructure to distribute digital information globally, the Internet requires Internet protocol version 6 (IPv6), a new key technology that can dramatically increase the number of connected devices. Internet protocol version 4 (IPv4) that is currently being used as the base technology for the Internet provides only about 4.3 billion addresses. This number is even smaller than the world population. With IPv4, the Internet can only be a network for computers. The upcoming IPv6 provides virtually an infinite number of addresses. This will enable home appliances, cell phones, cars, game devices, etc. that have not been connected to the Internet so far to communicate with one another via the Internet. It will not be an exaggeration to say that IPv6 is a key to developing the Internet dramatically and changing the paradigm of today's life and business. Hitachi was very quick to start working on this IPv6 technology. Using its advanced technology, Hitachi provided gigabit routers and an integrated system operation manager, Job Management Partner 1 (JP1), for a demonstration experiment of an IPv6 access network and digital home appliances of the IPv6 Promotion Council. This paper describes how Hitachi contributed to this experiment.

INTRODUCTION

RECENTLY, the number of broadband Internet users using xDSL (digital subscriber line) or cable TV lines has increased dramatically. Controlling TVs and other digital appliances and components in homes and offices through the Internet is becoming a reality. In addition, diverse Internet services are being provided in many fields such as transportation (ITS: intelligent transport systems), wireless technologies, education, and shopping. The Internet is expected to be used more widely than ever.

The key technology for these next-generation Internet services is IPv6. The IPv6-based next-generation Internet will integrate communication and broadcasting networks and provide a new infrastructure for the highly sophisticated information-based society that supports user-friendly versatile shopping sites and other services to meet daily needs. To quickly establish this new social infrastructure, an IPv6 Promotion Council[1)] was founded to promote the use of IPv6 by gathering knowledge from a variety of sources including public corporations, governmental and nongovernmental organizations, and individual users. The council decided to carry out a demonstration experiment using an IPv6 access network and digital home appliances. In this experiment, user monitors used an IPv6 broadband access network and digital appliances in their homes to gain a better understanding of IPv6. This understanding promotes the use of IPv6 and helps detect current technical problems and investigate market needs.

IPv6 PROMOTION COUNCIL AND HITACHI'S CONTRIBUTION

Overview

The IPv6 Promotion Council was established in October 2000 with the Ministry of Public Management, Home Affairs, Posts and Telecommunications (then the Ministry of Posts and Telecommunications) as an observer. Its goal is to promote the IPv6-based next-generation Internet by gathering knowledge from a variety of sources including public corporations, governmental and nongovernmental organizations, and individual users.

The council consists of 223 companies as well as individual users (as of January 24, 2002). Corporate members include ISPs (Internet service providers) (such as Internet Initiative Japan Inc. and NIFTY

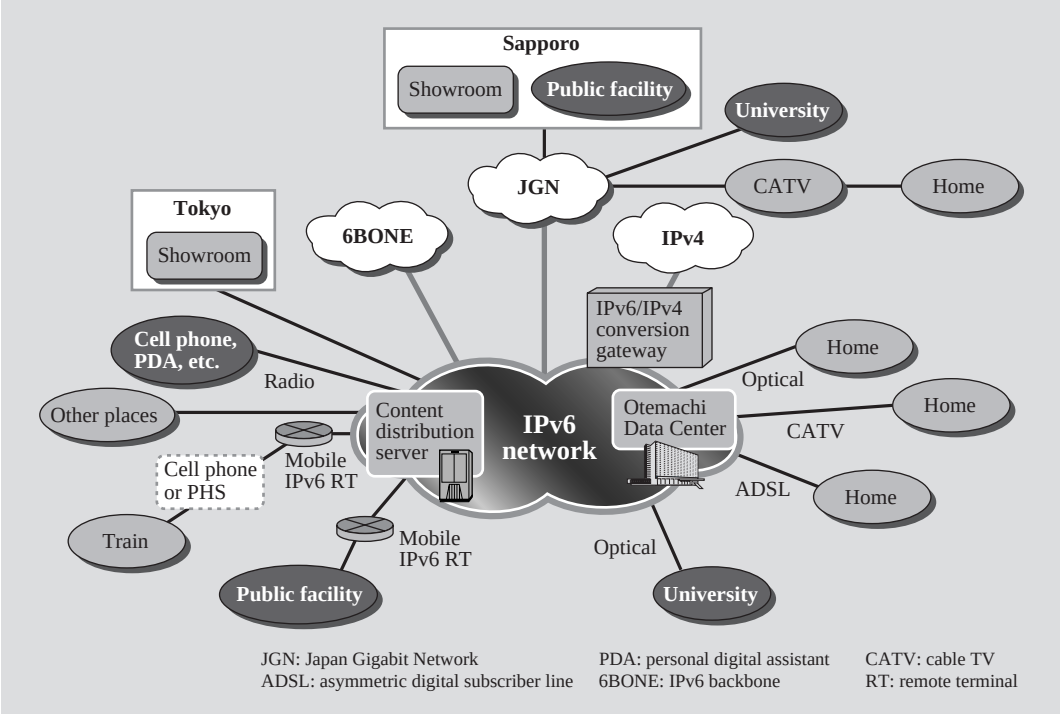

Fig. 1—IPv6 Experiment by IPv6 Promotion Council. The IPv6 Promotion Council had a group of people recruited as monitors through advertisements use an IPv6 access network and digital IPv6 home appliances to determine potential technical problems and market needs.

Corp.), carriers (such as NTT: NIPPON TELEGRAPH AND TELEPHONE CORPORATION and KDDI CORPORATION), broadcasting media (such as Asahi Broadcasting Corporation and NIPPON TELEVISION NETWORK CORPORATION), and manufacturers (such as Hitachi, Ltd., Sharp Corporation, and Sony Corporation).

The "e-Japan Priority Policy Program" was formulated in March 2001 to create an IPv6-based Internet environment by 2005 so that all the people in Japan can receive, process, and transmit information securely, quickly, and easily from anywhere. To carry out this national policy, the council together with broadcasting media and the Ministry of Public Management, Home Affairs, Posts and Telecommunications has been promoting demonstration experiments on using IPv6 in digital home appliances. It also studies how to manage address assignment during the changeover period to IPv6, investigates the problem of IPv4 address depletion and the need for IPv6 addresses, and promotes IPv6 in a variety of events and showrooms.

Details of the Experiment and Hitachi's IPv6 Solution

The IPv6 Promotion Council recruited monitors through advertisements and carried out a demonstration experiment of an IPv6 access network and digital home appliances (see Fig. 1). This experiment was aimed at promoting the use of IPv6, finding out technical problems, and investigating the market needs by having the monitors actually use the IPv6-based broadband access network and IPv6-based digital appliances.

Hitachi helped usen Corp., Tokyo Metallic Communications Corp., and IP REVOLUTION, INC. establish an experimental IPv6 access system. For this experiment, Hitachi established a network tailored to the goal of the experiment for each carrier and ISP and provided solutions for the IPv6 operation plan.

For the three carriers whom Hitachi helped establish their systems, Hitachi established an IPv6 network system using Hitachi's gigabit routers as the core equipment.

The gigabit routers were adopted for the following advanced features:

(1) Their hardware processes IPv6 addresses at a high speed (which is an indispensable prerequisite for backbone routers).

(2) They support variety of IPv6 functions such as BGP4+ (border gateway protocol version 4+), OSPFv3 (open shortest path first version 3), and RIPng (routing information protocol next generation).

(3) They have a track record of being introduced at a variety of carriers, iDCs (Internet datacenters), and ISPs that work on IPv6.

One of the purposes of the experiment was to prepare for the shift to IPv6 services by gaining the knowhow on network management. For this reason, the introduction of a network management system was a must. Hitachi's integrated system operation manager JP1 was used for network management.

Integrated system operation manager JP1 was adopted because of the following features:
(1) JP1's functioning with Hitachi's gigabit routers was already verified and the software worked very stably.
(2) JP1 provides GUI-based IPv6 network management.

This experiment required a "total solution" technology to integrate not only Hitachi's products but also products from other vendors into the system. Hitachi made the best use of its total solution technology in order to provide the optimum system.

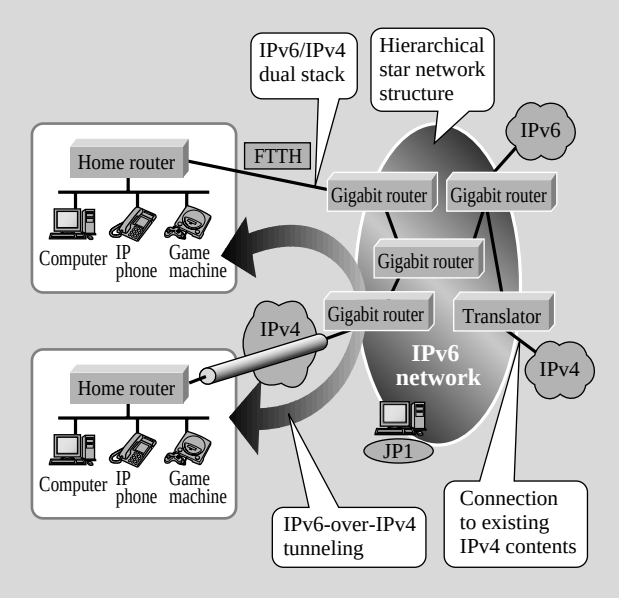

Fig. 2—Experimental IPv6 Network for usen Corp. FTTH to the subscribers' premises enables high-speed, large-capacity IPv6 Internet connection.

THE IPv6 EXPERIMENT

Experimental IPv6 Network for usen Corp.

(1) Overview

The goal of this experiment was to provide an "always-on" broadband IPv6 network to the monitors, discover potential technical problems, and gain the knowhow for the IPv6-based Internet connection. The monitors could engage in bi-directional peer-to-peer communication when using IPv6 game devices and IPv6 terminals such as voice over IP (VoIP) telephones.

usen Corp. planned to use FTTH (fiber to the home) as an access method to connect subscribers to the experimental network through 100-Mbit/s optical fiber for an "always-on" broadband IPv6 access network. It had a scalable network structure in mind to accommodate approximately 50 subscribers at the beginning of the experiment, increasing this number as the IPv6 network expanded in the future.

(2) Hitachi's solution

To meet this need, Hitachi provided a total system solution. The core network used Hitachi's gigabit routers for the hardware-based routing of IPv6 packets to handle large amounts of data of multiuser games and voice data at a high speed with minimal delays. To enable future IPv6 network expansion, the entire network had a hierarchical star structure. Hitachi implemented an economical and broadband IPv6 access network by preparing 100-Mbit/s optical Ethernet* lines going to the subscribers' premises via a LAN switch for efficient subscriber accommodation (see Fig. 2).

Experimental IPv6 Network for Tokyo Metallic Communications Corp.

(1) Overview

Tokyo Metallic Communications Corp. used this experiment to gain the knowhow on the IPv6 service using xDSL. For this purpose, the experiment used the same system configuration for accommodating xDSL as the current IPv4 service does to provide the monitors with IPv6 service (see Fig. 3).

(2) Hitachi's solution

For the experiment for Tokyo Metallic Communications Corp., the network needed to support the IPv6-over-IPv4 tunneling function to test the shift from IPv4 to IPv6. Hitachi's gigabit routers supported this tunneling function to sufficiently cover the number of tunnels accommodated in this experiment. This provided a good environment for a problem-free experiment.

Experimental IPv6 Network for IP REVOLUTION, INC.

(1) Overview

This experimental network had a goal of verifying the use of the latest technologies and applications with the IPv6-based gigabit service. Specifically, to verify the use of IPv6 applications, IP REVOLUTION, INC. wanted to test image transmission using DVTS (digital

*: Ethernet is a trademark of Xerox Corporation, USA.

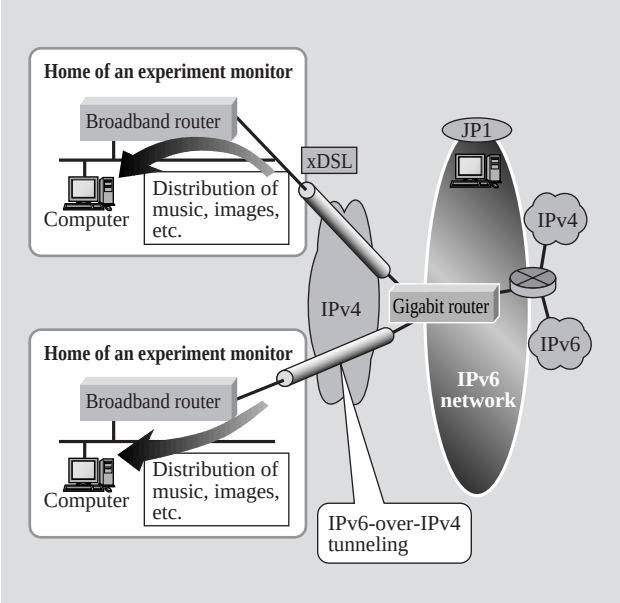

Fig. 3—Experimental IPv6 Network for Tokyo Metallic Communications Corp.
Implements an economical broadband IPv6 environment by using IPv6-over-IPv4 tunneling to a broadband router at the xDSL subscriber's premises.

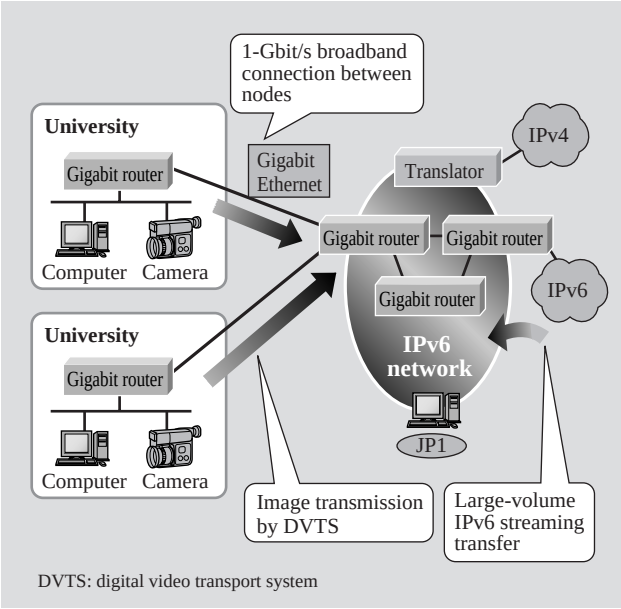

Fig. 4—Experimental IPv6 Network for IP REVOLUTION, INC. Enables image transmission by using DVTS by connecting 1-Gbit/s broadband lines between nodes.

video transport system) to view video images sent from universities via the experimental network on a TV. They also aimed at establishing an environment that would make it possible to acquire technologies for network setup, and operation and management in the future development of IPv6.

(2) Hitachi's solution

To support the transmission of large amounts of IPv6 streaming data, Hitachi used its own gigabit router for all the routers in the network because it supports IPv6 hardware-based transfer. The core network had a ring structure, which enabled verifying system operations such as the switchover operation if a network failure occurred.

Hitachi also provided a DNS (domain name system) server that supports IPv6, as well as JP1, an integrated system operation manager. This enabled using DNS design for the IPv6 addresses and operation management of the IPv6 network. The network also had a translator to allow access to the IPv4-based Internet environment to efficiently use existing resources (see Fig. 4).

FUTURE DEVELOPMENTS

These experiments allowed carriers and ISPs to investigate problems associated with the provision of IPv6 service and to gain operational knowhow needed for the IPv6 service to go in commercial operation. The results obtained in the experiments will be used to commercialize the IPv6 service.

Hitachi plans to fully cooperate with carriers and ISPs for the provision of commercial IPv6 service and to use the knowhow obtained in this experiment to promote IPv6.

CONCLUSIONS

The Internet is spreading dramatically, and services using the Internet that have not even been considered in the past are emerging one after another. For the future development of the Internet, IPv6 is an essential technology.

We would like to thank the staff of the IPv6 Promotion Council, usen Corp., Tokyo Metallic Communications Corp., and IP REVOLUTION INC. for their helpful advice and cooperation during the introduction of Hitachi's gigabit router and JP1 in this experiment.

REFERENCE

(1) http://www.v6pc.jp/index_e.html

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