Gigabit Router for Supporting IPv6 Commercial Networks

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OVERVIEW: The commercial use of the Internet has rapidly spread as a communication infrastructure. But IP (Internet protocol), which is a basic technology of the Internet, cannot keep up with this rapidly expanding market. Especially, a lack of IP addresses is a serious problem. There is a prediction that the IP addresses will be exhausted within several years. To solve this problem regarding lack of IP (IPv4) addresses, a next-generation Internet protocol "IPv6 (Internet protocol version 6)," which has been standardized by the IETF (The Internet Engineering Task Force) as a succession of IPv4, has been developed. Supported by the recent trend toward broadband/ always-on connection, the movement towards commercial use of IPv6 is becoming more and more active. To respond to this trend, Hitachi has developed IPv6-supportive functions for its current gigabit router. In September 2001, it was upgraded to provide the same functions as on IPv4 but on IPv6; IPv6 packet transfer and filter/QoS (quality of service) control function. Furthermore, a new model for enterprise use was added. It provides expanded MPLS (multiprotocol label switching), IP-VPN (IP virtual private network) functions as well as an improved user interface.

INTRODUCTION

THE IP-technology-based Internet has grown up and is now playing a center role as a social communication infrastructure. However, it has been predicted that IP (IPv4) addresses will be exhausted because of the recent rapid spread of broadband/always-on connections like ADSL (asymmetric digital subscriber line). "IPv6" is the next-generation Internet protocol, standardized by IETF, to solve IPv4 problems, including scarcity of IP addresses. As IPv6 has, as a special feature, a huge address area (i.e., 2^{128} addresses), the application to such areas beyond conventional usage like home electronics is considered for the Internet. And 3GPP (third-generation partnership project) has decided to apply IPv6 for next-generation mobile networks. As an example of the movement showing the spread of IPv6 services, many ISPs (Internet service providers) have been providing IPv6 trial and commercial services since 2001.

In response to this situation, Hitachi has promptly commercialized an IPv6-supportive gigabit router which enables the construction of an IPv6 network, after many interoperability tests with other vendors[1)]. It has already been delivered to many customers and is under trial for commercial use.

This report describes functions required for IPv6, and explains how the gigabit router provides these functions by means of an example of it's application. Furthermore, we describe a new model for enterprise use (see Fig. 1), added to new line-up in April 2002, and its new functions.

FUNCTIONS REQUIRED FOR COMMERCIALIZATION OF IPv6

To promote the shift from IPv4 to IPv6, conversion technologies such as IPv4/IPv6 dual stack or tunneling are important. Furthermore, we must realize the same functionality and/or performance as in the IPv4 commercial network. In the IPv6 commercial network, the main functions required are listed as follows:

(1) Packet transfer speed as high as that of IPv4

As an IPv4 router supporting today's broadband network, a gigabit-class router is mostly used since it realizes high-speed packet transfer. Therefore, in the IPv6 commercial network, at least the same high-speed packet transfer performance is required.

(2) Routing function

In an IP-based network, routing is performed by each router on the network by exchanging information about the best route (not always the shortest route).

Fig. 1—Hitachi's Gigabit Router Product Line-up.
The line-up includes models for carrier/ISP and a newly-added model for enterprise servers. The new model provides high-speed packet transfer in a thin package size of 1 U (approximately 44 mm).

Various routing protocols are used for routing control. They can be categorized as an interior gateway protocol (IGP), which is used for routing inside an administration system, and exterior gateway protocol (EGP), which is used for routing among several administration systems. In both gateway protocols, a routing protocol that is widely operated in the IPv4 network today must be supported.

As for IS-IS (intermediate system to intermediate system), which is used widely outside Japan, the routing for both IPv4 and IPv6 will be supported as an important task for expanding Hitachi's router use in non-Japanese markets.

(3) Network management function

To operate a network after its construction, remote and centralized control by SNMP (simple network management protocol) is an essential. Network equipment, including a router, supports SNMP agent and incorporates various MIB (management information base), thus enabling network management.

FEATURES OF IPv6 SUPPORTIVE GIGABIT ROUTER

After the release of the IPv6 router in February 2001, Hitachi's gigabit router has supported additional functions required for the commercial use of IPv6. The three points below describe how Hitachi's gigabit router supports for the required functions mentioned in the previous chapter.

(1) Hardware routing of IPv6 packets

Since the beginning of its development, Hitachi's gigabit router has enabled IPv4 high-speed packet transfer by proper hardware mounting for packet transfer and routing search[2)]. In IPv6 too, it provides maximum performance of 26,000 packets per second by hardware IP packet processing, namely, the same as in IPv4. The gigabit router also provides the same filtering and QoS function for IPv6 as for IPv4.

TABLE 1. Routing Protocol Supported by Hitachi's Gigabit Router
By the routing protocols below, it can offer the same routing environment as in IPv4 network.

Classification	For IPv4	For IPv6
IGP	RIPv1/v2	RIPng
	OSPF	OSPFv3
EGP	BGP4	BGP4+

RIP: routing information protocol
OSPF: open shortest path first
BGP4: border gateway protocol-version 4
BGP4+: multiprotocol extensions for border gateway protocol-version 4

(2) IPv6 support of routing control protocol

Table 1 lists the features of the routing control protocols supported by Hitachi's gigabit router. IETF standardized an expanded protocol for IPv6 from the protocol used in IPv4. As Table 1 shows, in addition to RIPng (routing information protocol next generation), it has taken a world lead in supporting OSPFv3 for IGP (interior gateway protocol). It supports BGP4+ for EGP. This means that Hitachi's gigabit router offers the same routing control environment as in the IPv4 network.

(3) Support of IPv6 MIB

The SNMP agent of Hitachi's gigabit router uses IPv6-related MIB devised by IETF. By using this MIB, similar to other network equipment, it can be remotely controlled through corresponding network-management equipment. In addition, the IPv6 network can be controlled by Hitachi's network-management products for supporting IPv6 MIB.

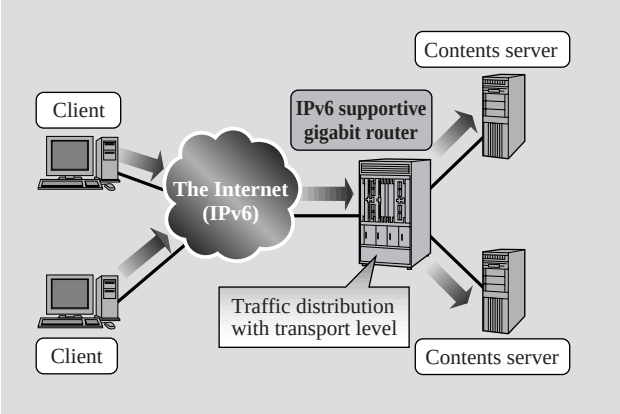

Fig. 2—Example of Application Using IPv6 Supportive Gigabit Router.
This example shows an application of IPv6 supportive gigabit router as a load-distribution device at the transport level.

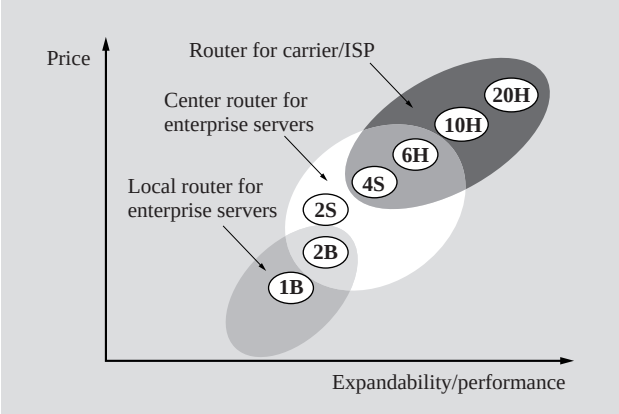

Fig. 3—Positioning of New Model.
Newly-added model is a local router for enterprise servers which are not covered by current models.

EXAMPLE OF AN APPLICATION USING IPv6 SUPPORTIVE GIGABIT ROUTER

With the spread of broadband connection, the load on a web server, which plays a central role in contents delivery on the Internet, is ever more increasing.

A technology that can efficiently disperse loads on multiple web servers by IP address base in order to process many accesses to web servers simultaneously has already been commercialized. However, a system providing each type of service has not been provided yet. To disperse traffic by each type of service, it is necessary to distinguish flow on a transport layer. In IPv4, an IP packet may be divided by fragmentation. In that case, transport headers cannot be added to succeeding packets. Therefore, dispersing traffic by each type of service cannot always be executed on an IPv4 network.

On the other hand, IPv6 uses a standardized protocol to avoid fragment by knowing the maximum length of packets to be sent before sending. Hitachi's gigabit router enables flow detection at the IP layer and packet distinction at the transport layer by hardware; it thus enables high processing of traffic dispersion. A combination of Hitachi's gigabit router and IPv6 enables a contents delivery system with good cost/performance ratio to be constructed, since traffic is dispersed among servers offering different types of services (see Fig. 2).

NEW MODEL AND NEW FUNCTIONS OF HITACHI'S GIGABIT ROUTER

Hitachi's gigabit router has been improved in terms of product value by not only adding IPv6 support but also adding various other functions. In particular, three functions have recently been added: (1) addition of a new model, (2) expansion of the IPv6 function, and (3) improvement of the user interface.

Outline of New Model

The new models have been aimed so far at routers for ISP/carriers and core routers of huge intra-networks as gigabit routers that support Internet communication infrastructure.

However, owing to the recent rapid drop in the price of communication, an infrastructure that can realize the use of a broadband network at a lower price is ready. Companies that want to advance the incorporation of the Internet can easily construct a broadband network among separately located offices.

Against this background, as Fig. 3 shows, the new model — mainly targeted at core routers for enterprise use — has been added. Its main features are described as follows:

(1) High-speed packet transfer in 1 U (approximately 44 mm) sized equipment.

The new model enhances hardware processing speed of existing models. Namely, it provides 1,000,000 packets per second, which no other router can attain at the same size. Also, its high-speed packet-transfer capability means that it is compatible with a broadband network with a wide margin.

(2) IPv6 support

As for IPv6 support, the new model has the same function as existing models. This model, as an IPv4/IPv6 dual stack, supports not only the construction of an IPv4 network but also the migration to IPv6 without

extra investment.
(3) Higher performance as existing current models

The new model provides software resources including a routing-control protocol, and secures high reliability based on the operational results already achieved by current models.

MPLS IP-VPN Function

MPLS (multiprotocol label switching) is a technology for constructing backbone networks that provide an IP-VPN (virtual private network) service, and it is now drawing attention of many ISPs and carriers.

Hitachi's gigabit router, taking advantage of high-speed transportation of MPLS packet by hardware, is aimed at "high-speed VPN edge" in the MPLS IP-VPN network, and provides an original high-speed IP-VPN function, based on the industrial-standard MPLS protocol and the single label by its high-speed hardware processing.

It has expanded this function and enabled high-speed IP-VPN function to be provided in compliance with IETF standardized (RFC2547bis) two-step label switch, thus allowing the construction of a high-speed MPLS IP-VPN network that can connect to other vendors' routers.

Improvement of User Interface

As for CLI (command line interface), which provides a user interface with Hitachi's gigabit router, many functions have been added to enable easy operation by our customers who have been accustomed to operate other vendor's de facto standard routers.
(1) Operation command input system
(2) Various key operations, i.e., those used in command supplement or help output, etc.

As for CLI, we will adapt to user needs and continuously improve operability.

CONCLUSIONS

Hitachi's gigabit router, which is based on the next Internet protocol "IPv6," has been developed. It supports high-speed IPv6 transportation of 26 million packets per second, a routing-control protocol required for IPv6 network construction, and IPv6 network management; thus, it enables an IPv6 commercial network to be constructed.

Our future goals are to follow standardization in IETF, support IPv6-related functions including IPv6-migration technologies, and keep pushing the migration of the communication infrastructure towards the IPv6 network.

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