IP Gateway System for Telecommunication Carriers

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OVERVIEW: With the growing importance of the Internet, the number of users who want to access the Internet by dialup connection is increasing rapidly. This increases the load on existing switches because the duration of a dialup connection is generally longer than that of a normal voice call, so that telecommunication carriers are forced to substantially increase the number of switches. As economical solutions to this situation, Hitachi provides to telecommunication carriers an IP (Internet protocol) gateway system developed based on the integrated switching system technologies that Hitachi has nurtured over the years and a rapidly evolving IP technology. The gateway system can not only accommodate dialup traffic economically but can also support an up-and-coming technology, voice over IP (VoIP), which converts voice signals into IP data.

INTRODUCTION

ONE of the factors that has transformed the telecommunication industry in recent years is the dramatic spread of Internet use. Among the methods for accessing the Internet, dialup connections have the advantage of enabling users at home to easily establish an Internet environment by connecting to an Internet access point using their existing telephone lines. However, the connection is different from that of ordinary telephone calls in that the duration is longer and the usage is concentrated at nighttime. This requires telecommunication carriers to extensively upgrade their communication facilities, especially their switching systems.

In this situation, Hitachi has developed an IP (Internet protocol) gateway system that identifies Internet calls and allows them to bypass the telephone network to directly connect to the Internet. This enables telecommunication carriers to reduce the amount of network facilities they must add.

Hitachi has delivered this system to Tokyo Telecommunication Network Co., Inc. (TTNet), and the system is now in operation. After reviewing the methods now available for accessing the Internet and discussing the challenges to dialup connections, we will describe Hitachi's IP gateway system.

ACCESS TO THE INTERNET

The Internet has grown remarkably in recent years. Users connect to the Internet, through the access point of a telecommunication carrier or Internet service provider (ISP), then connect to an Internet exchange (IX) in Japan or overseas via the carrier or ISP. The access methods available are discussed in other article "IP Network Access System"[1)] in this issue.

The access methods have the following features from the viewpoint of using existing facilities.

(1) Dialup method: Generally, users can easily connect to the Internet using a commercially available personal computer with a built-in modem.

(2) ADSL method: This method usually uses existing telephone lines. However, it requires a digital subscriber line asynchronous modem (DSLAM) in the telecommunication carrier's office and a dedicated device (ADSL modem) at each subscriber's location.

(3) CATV method: This method requires a dedicated device (cable modem) in the set-top box at each subscriber's location.

(4) Mobile method: This method requires radio base stations to be built, and dedicated radio equipment and an antenna are needed at each subscriber's location.

(5) FTTH method: This method requires installation of optical-fiber cables up to the subscribers' locations.

Of these methods, dialup access is the most useful way to quickly respond to the needs of the Internet population, from young to old, so it is the mainstream access method. However, this method increases the economic and infrastructure burdens if users remain connected for long periods of time. Nevertheless, its advantage that anyone can easily and instantaneously

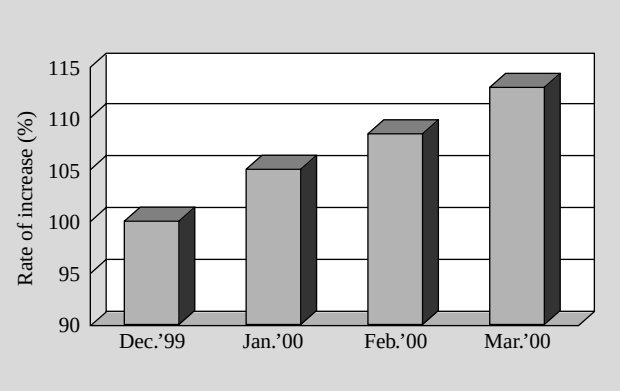

Fig. 1—Number of Dialup Users in Japan.
The number of dialup users increased continuously from December 1999 to March 2000.
Source: Ministry of Posts and Telecommunications of Japan, Number of users of Internet service connection on April 2000 Number of users (10,590 k) in December 1999 was set to 100.

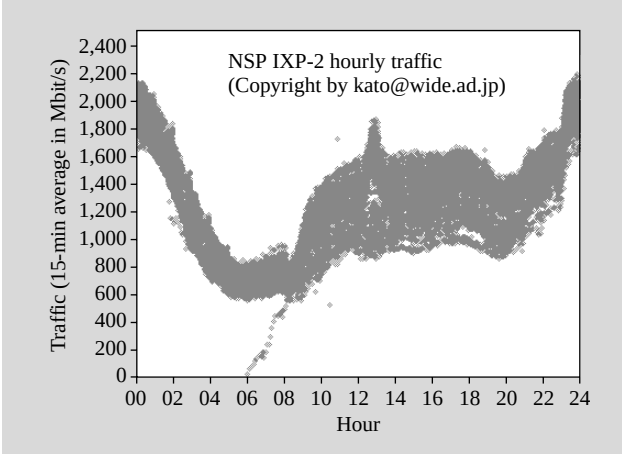

Fig. 2—Traffic Variations by Time of Day in Japan.
Traffic volume tends to increase after 11:00 p.m.
Source: Traffic status (Akira Kato of Tokyo Univ.) found on the WIDE Project Website (August 23, 2000)

have an Internet connection has brought it to a dominant position. As shown in Fig. 1, the number of dialup users in Japan increased in the first three months of 2000.

CHALLENGES TO DIALUP CONNECTIONS

Telecommunication carriers in Japan face two challenges with respect to dialup connections.
(1) The duration (holding time) of an Internet connection is generally longer than that of a normal voice call. There will thus be shortages of lines because the current switching systems were designed based on the shorter holding time of voice calls.
(2) Communication traffic in Japan increases sharply at around midnight (especially after 11:00 p.m.) due to reduced charges late at night and the late-night life style that has spread widely among young people.

Users connect to an access point of the Internet through a local telephone network. The local switch on the calling side or the provider side of the access point reaches its capacity as the number of Internet connections and their duration increase. Then the telephone network becomes unable to accept any more calls; this is referred to as congestion. One way to avoid this congestion is to add additional switching systems. However, congestion occurs only during certain time periods, so adding switching systems may be unproductive for other time periods.

Fig. 2 shows the variation in traffic load passing through a typical Japanese Internet access point with the time of day. It shows that the Internet traffic load peaks during the lunch break and at night when people are at home. The load increases sharply just after 11:00 p.m., when the lower phone charges take effect.

IP GATEWAY SYSTEM

System Configuration

Hitachi's IP gateway system provides solutions that meet these challenges. The current telephone network uses speech paths for voice signals and control paths for control signals in separate systems. Generally, common channel signaling system No. 7 is used for controlling the control signals. The gateway system uses this signaling to distinguish voice signals from Internet data. For access, an ISP provides a dedicated telephone number for users. Normal telephone calls are directed to the destinations via the telephone network. For Internet calls, the IP gateway system identifies the telephone number for dialup connection and allows the calls to bypass the telephone network and directly connect to the Internet through an access server.

This separation of calls has three benefits.
(1) Internet calls (with a connection equivalent to that of voice calls) bypass the switches, reducing the loads on the local switches. This eliminates the need for telecommunication carriers to add additional switching systems even though the number of Internet users is increasing.
(2) When determining the capacity of a switching system for communication traffic, there is no need to consider the uncertainties about Internet traffic.
(3) Investment costs are reduced because a large amount of IP-based data can be handled economically

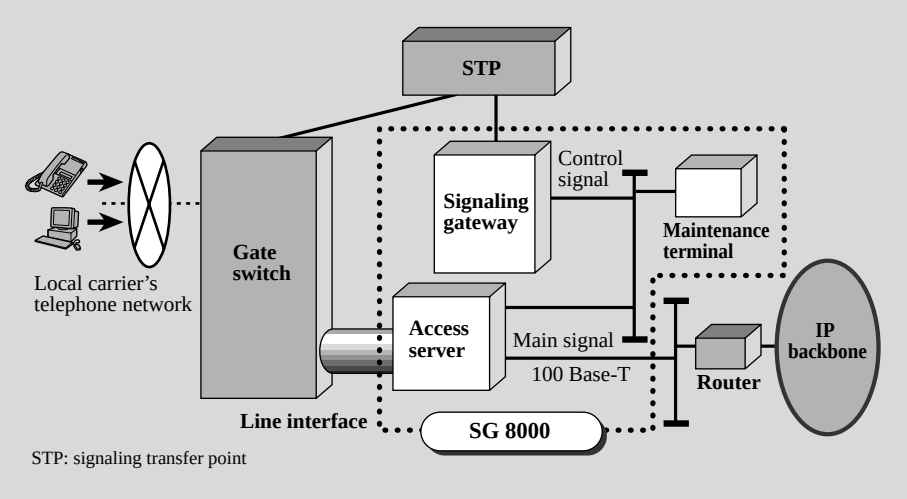

Fig. 3—Model of SG 8000 IP Gateway System.
Signaling gateway connects to an STP to receive common channel signals, including telephone number, and then controls the access server.

on the access server side.

As a result, the IP gateway system eliminates the need for expanding local switches and provides an economical solution for telecommunication carriers. Fig. 3 shows a model of the IP gateway system. The signaling gateway (SG) connects to the common channel-signaling network and then connects to an access server by using a LAN-based protocol. For Internet traffic, the main signal flows to the IP backbone via an access server (AS).

Signaling Gateway (SG)

The SG connects to a signaling transfer point (STP) of the No. 7 common channel signaling system to receive common channel signaling information. The common channel signal controls the switches, so the SG requires reliability as high as that of the switches.

Hitachi's SG is based on the switching technology that Hitachi has nurtured over decades and is thus highly reliable. Its features are as follows.

(1) High reliability due to redundant configuration
(2) In-service upgrading that allows file updates during service
(3) No. 7 common channel signaling of up to 16 channels that enables a large amount of data to be processed
(4) Support for No. 7 common channel signaling

Access Server (AS)

The access server should support various types of interfaces for dialup connections to improve general versatility. From this point of view, Hitachi's solutions use access servers having the following features.
(1) Variety of analog interfaces: V.90, V.34, V.32bis, etc.
(2) ISDN connection: synchronous 64 kbit/s, asynchronous V.110, etc.
(3) Support for stable power supply of -48 VDC generally used among telecommunication carriers
(4) General-purpose management system can be

TABLE 1. Major Specifications of Signaling Gateway and Access Server

Signaling gateway

Capacity	Up to 16 signaling links × 2 planes
CPU capability	200,000 BHCA
Protocol	No.7 common channel signaling system
Expandability	Allows partial software updates or file updates without interrupting services.
Common channel interface (signaling speed)	4.8 kbit/s 48 kbit/s
Common channel interface (line termination type)	64 kbit/s CII 2 Mbit/s CMI (in-channel method)
Mouting condition	General-purpose 483 mm (19-inch) rack
Power supply requirement	-48 VDC
Physical dimensions (mm)	1,100 (H) × 430 (W) × 500 (D) approximately

Access server

Capacity	312 lines/chassis
Dialup related protocols	PPP, Multilink PPP, IPCP, PAP, RIP, RIPV2
Line interfaces	V.90, V.34, V.32bis, V42/V.42bis ISDN: Synchronous 64 K Asynchronous V.110 PHS: PIAFS
LAN interface	10/100 Base-T
Mounting condition	General-purpose 483 mm (19-inch) rack
Power supply requirement	-48 VDC
Physical dimensions (mm)	222 (H) × 436 (W) × 472 (D) approximately

PPP: point-to-point protocol
IPCP: Internet protocol control protocol
PAP: password authentication protocol
RIP: routing information protocol

created using standard SNMP (simple network management protocol) functions

Table 1 lists the major specifications of the signaling gateway and access server.

Hitachi is working to improve the functions and commercial potential of voice over IP (VoIP), which converts voice signals into IP data, so that this system can expand to meet the needs of telecommunication carriers.

CONCLUSIONS

We have described Hitachi's SG 8000 IP gateway system, a leading-edge technology for integrating telephone and IP networks.

TTNet placed the SG 8000 system into use in May 2000, and it is now in operation. We would like to acknowledge the contributions of all the people at TTNet who helped with this project.

Hitachi always solicits the opinions of telecommunication carriers so that we can continue providing the best solutions for building speed-oriented reliability-minded systems.

REFERENCE

(1) S. Tanabe et al., "IP Network Access System," *Hitachi Review* **49**, 172-175 (Dec. 2000) (this issue).

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