VoIP Solutions for Enterprise Communication Systems

Kazuhisa Tanaka
Shigeaki Kinoshita
Hideyuki Toki
Kouichi Kaneko

OVERVIEW: The environment surrounding enterprise communication systems is changing drastically. Enterprises are thus demanding flexible communication systems that not only minimize running costs but also keep pace with rapid environmental changes. Moreover, the strategic direction in enterprises places high value on communication systems that can support the construction of various kinds of customer channels and improve customer services by utilizing the Internet and Intranets effectively. Using the voice over Internet protocol (VoIP), which integrates voice and data networks, is a key approach to such systems for both wide area networks (WANs) and local area networks (LANs). The LAN approach combines communication systems with business applications, upgrading the systems to the level of electronic commerce, including providing a call center on the Web. Hitachi provides both LAN and WAN solutions that use VoIP to reduce communication costs.

INTRODUCTION

COMMUNICATION systems are indispensable tools for enterprises to support their activities. Improving business efficiency and reducing expenses are two undertakings needed to expand business, and both are strongly needed for enterprise communication systems. Communication expenses can be reduced by integrating voice and data, and total system running costs (including maintenance and operation) can be minimized. Also, there is a strong need for a system with enough flexibility to keep pace with new communication services because enterprises must lower their investment risks and avoid having systems become quickly obsolete.

In addition, the growth in popularity of electronic commerce on the Internet, such as advertising on the Web, providing product information, ordering, and order taking, means that enterprise communication systems must be able to support to highly network-oriented businesses.

The voice over Internet protocol (VoIP) is an attractive approach to meeting these requirements. In this paper we give an overview of integrating voice and data by using VoIP technology and describe Hitachi's solutions for IP-based enterprise communication systems for both wide area networks (WANs) and local area networks (LANs).

NEED FOR IMPROVED ENTERPRISE COMMUNICATION SYSTEMS: HITACHI'S APPROACH

Need for Improved Enterprise Communication Systems

Enterprise communication systems need two key improvements: reduction of communication expense and minimization of total system running costs, including operation and maintenance costs. By adopting frame relay and asynchronous transfer mode (ATM)-related equipment, network efficiency can be improved and voice and data can be integrated, thereby reducing communication expenses. ATM is particularly helpful because it can accurately guarantee bandwidth and integrate voice and data while maintaining secure communications.

Furthermore, as the volume of data (IP) traffic continues to increase sharply due to the prevalence of the Internet and intranets, communication systems are shifting to an IP-network-based configuration. Therefore, the challenges enterprises are facing are not merely to integrate voice and data, but to construct a strategic communication system as a tool for expanding businesses by combining systems with business applications and by using Internet services like the Web.[1)]

Expectations for VoIP

VoIP technology enables digitized voice data to be transmitted in the form of IP packets. Generally, voice compression and encoding technologies are used with VoIP technology to improve transmission efficiency. To connect voice networks with IP networks, IP gateways are used. They support such functions as (1) compressing and encoding/decoding voice signals from terminals like PBXs, (2) packetizing/de-packetizing compressed/encoded data, and (3) converting call-processing information like call-origination requests from PBXs to make them usable by VoIP. The VoIP process is illustrated in Fig. 1.

Many factors degrade voice quality, including delay, swing, and packet discarding, because an IP network is a best-efforts one. To ensure voice quality, (1) delay must be managed to maintain real-time voice transmission, (2) echoes caused by transmission delay must be cancelled, (3) jitter due to swings in the arrival times of packets must be absorbed, and (4) voice levels between terminals must be adjusted. To support this real-time communication and guarantee communication quality, the standardization and development of priority controls and bandwidth guarantees for IP packets has been progressing.[2)] These activities have enabled the integration of voice and data networks by using VoIP. The resulting change in the communication architecture is illustrated in Fig. 2.

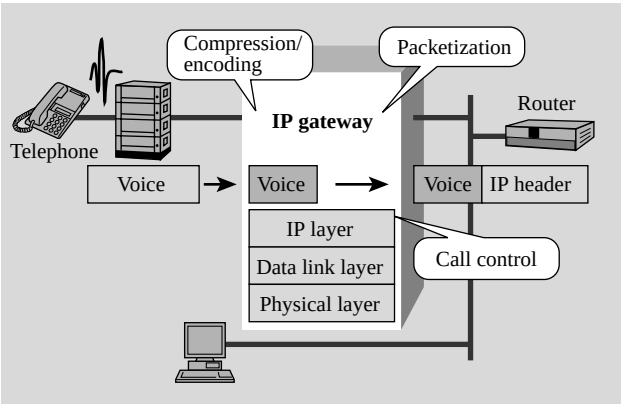

Fig. 1—Illustration of VoIP Process.
VoIP is achieved by voice compression, IP packetization, and call management.

Hitachi's Approach

Hitachi considers an IP network to be a social infrastructure and the kernel of the enterprise communication system. Hitachi provides two types of solutions as VoIP applications, WAN and LAN. The WAN solution will provide the low communication cost of an IP network and the availability of IP-related services. The LAN solution will construct platforms that combine integrated wiring and business applications.

HITACHI'S WAN SOLUTION

Objective

In enterprises with multiple offices, dedicated lines are often used to connect offices. Data networks like the intranet and host computer communication networks have been constructed independently from voice networks for inter-office extension.

However, VoIP can be used to integrate voice networks with data networks. Enterprises can thus reduce communication costs by eliminating redundant lines between offices and can make use of their carriers' low-cost IP network services.

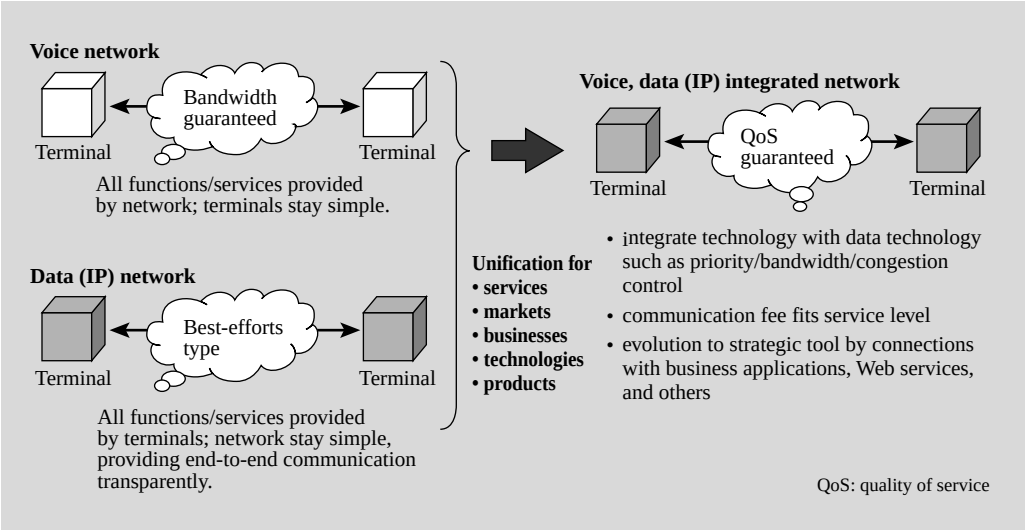

Fig. 2—Change in Communication Architecture.
Two networks with different features can be integrated by using VoIP. The unified networks evolve into a business tool that can reduce communication expenses, cope with diversified demands for services, and expand business opportunities.

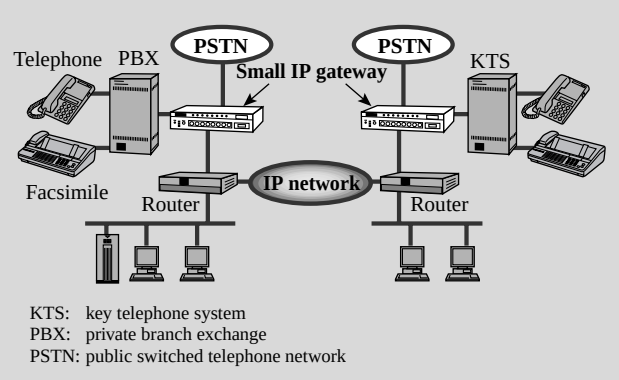

Fig. 3—VoIP Solution for Small Enterprise Networks. This solution integrates existing PBX/key telephone systems with LAN systems by using small IP gateways.

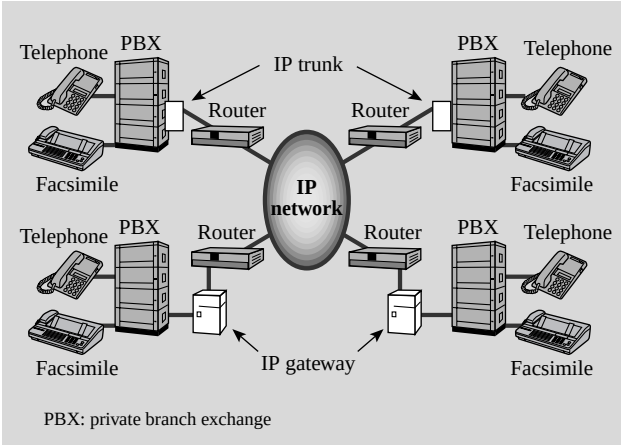

Fig. 4—VoIP Solution for Large Enterprise Networks. This solution minimizes communication expenses between offices by supporting convenient legacy PBX functions.

Solution for Small Networks

This solution is for networks with a few offices and using dedicated lines. Communication expenses are reduced by using small IP gateways with about four outgoing lines.

The gateways accommodate lines in concentrators, such as key telephone systems going to the public network or a dedicated network, and then connect the lines with the IP network. The redundant lines for both the public and dedicated network can thus be eliminated. In addition, communication costs can be reduced even more if the IP gateways are used for outgoing calls to the public network via the dedicated network. The small network configuration is illustrated in Fig. 3.

Solution for Large Network

This solution is for network with a medium to large number of PBXs and a large number of inter-office lines. The inherited PBX functions are provided by using IP trunks for the PBXs or by using IP gateways designed for large networks.

The IP trunk in each PBX gives them VoIP functions. The IP gateway is based on PBX technology, and provides functions that are combined with those of the PBX.

The PBX-based VoIP network enables large enterprises to flexibly adjust equipment quantities in conjunction with adding and removing lines. They also have available PBX applications based on the common signaling system, including call forwarding, call waiting, a common extension scheme between offices, and inter-PBX roaming for the personal handy-phone system (PHS). Furthermore, maintenance capabilities are improved by adopting common operations. The large network configuration is illustrated in Fig. 4.

HITACHI'S LAN SOLUTION

Objective

Data-oriented networks, that is, IP-based networks, play an important role in business activities. A LAN is the main part of a data network. The addition of VoIP to a LAN reduces installation costs due to the integration of wiring and unifies operation and maintenance methods. Moreover, by having a common IP base, the LAN can work well with IP-based business applications and Internet services like the Web. It is thus expected to serve as a platform for strategic communication systems for expanding businesses.

LAN Telephony Solution

In this solution, IP telephones with VoIP functions are connected directly to a LAN network and used as extensions. Telephones and facsimiles used at the same time are connected to the public network via an IP-PBX with the IP gateway function and switching capabilities. Because LAN cables can integrate the wiring used for voice and data, installation costs can be reduced and operation and maintenance methods can be unified, thereby reducing total operational costs. This solution is applicable to newly built offices or small office home offices (SOHOs).

In voice-oriented legacy networks, numbering plans must be altered or equipment must be rearranged every time the office layout is changed or seat locations are switched. However, in this LAN telephony network, IP telephones can be used at any location simply by connecting them to the LAN cable. A LAN telephony configuration is illustrated in Fig. 5.

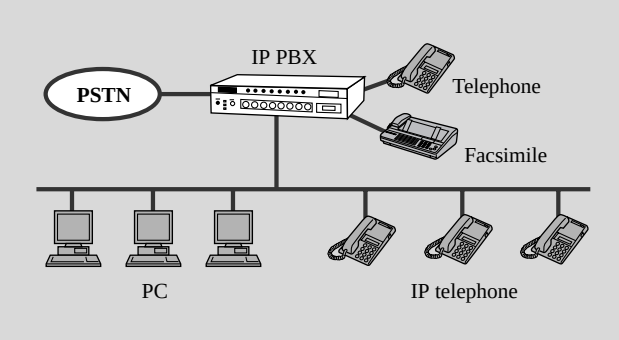

Fig. 5—LAN Telephony Solution.
Voice and data wiring is integrated by using an IP PBX.

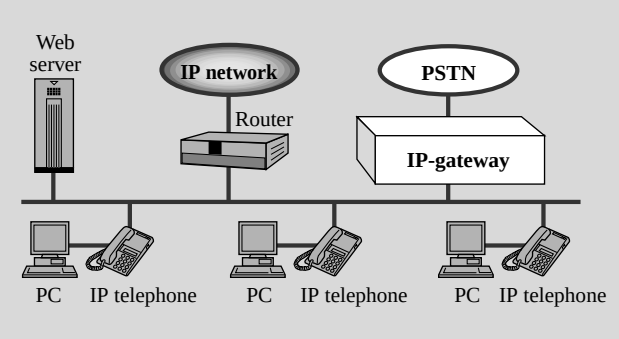

Fig. 6—Solution in Combination with CTI.
A Web-based call center is achieved by combining LAN telephony with CTI.

Solution in Combination with CTI

Computer-telephony integration (CTI) technology can provide various applications that combine telephones and computers. It is mainly used in call center systems or job-assistance office applications.

For example, customers using the Web can call a support person at a call center via the Internet without using another telephone line. The receptionist can handle the call while viewing the same Web page, thereby improving service quality. In addition, LAN telephony will make it possible to reduce system construction costs even for small reception or support centers. The network configuration of this combined approach is illustrated in Fig. 6.

CONCLUSIONS

Enterprise communication systems for the future are required and expected not only to reduce costs, but also to serve as an infrastructure providing various widely opened communication measures and services to clients such as providing product information on the Web. This report described Hitachi's solution for voice and data integration by using VoIP technology.

Hitachi will provide an overall solution, from system planing to implementation for both, operation and maintenance, using VoIP as the basis of its offered solutions.

REFERENCES

(1) T. Matsuda, "Building technique of data/voice integrated network for enterprise," *Nikkei BP* (Jan. 2000) in Japanese.
(2) I. Ichikawa et al., "Special Issue on IP Networking Technologies for Communication Infrastructure," *The Journal of the Institute of Electronics, Information and Communication Engineers* **83**, No. 4, 247-339 (Apr. 2000) in Japanese.

ABOUT THE AUTHORS

Kazuhisa Tanaka
Joined Hitachi, Ltd. in 1993, and now works at the Network System Operation at the Information Infrastructure & Network Systems Division. He is currently engaged in the development of strategies for IP-related businesses and products. Mr. Tanaka is a member of the Institute of Electronics, Information and Communication Engineers, and can be reached by e-mail at kazu@tcd.hitachi.co.jp.

Shigeaki Kinoshita
Joined Hitachi, Ltd. in 1991, and now works at the Network System Integrated Department at the Information Infrastructure & Network Systems Division. He is currently engaged in designing small ATM switches and development of strategies for IP-based products. Mr. Kinoshita is a member of the Information Processing Society of Japan, and can be reached by e-mail at sigeaki_kinoshita@cm.tcd.hitachi.co.jp.

Hideyuki Toki
Joined Hitachi, Ltd. in 1990, and now works at the Network System Integrated Department at the Information Infrastructure & Network Systems Division. He is currently engaged in designing small ATM switches and development strategies for IP-based products. Mr. Toki is a member of the Institute of Electronics, Information and Communication Engineers, and can be reached by e-mail at hideyuki_toki@cm.tcd.hitachi.co.jp.

Kouichi Kaneko
Joined Hitachi, Ltd. in 1988, and now works at the Partner Business Promotion Center at the Information Infrastructure & Network Systems Division. He is currently engaged in development of IP-related business and partner businesses. Mr. Kaneko can be reached by e-mail at kouichi_kaneko@cm.tcd.hitachi.co.jp.