Network Solution for Achieving Large-Scale, High-Availability VoIP Services

● Kiyofumi Shigeno ● Hisayuki Sekine ● Eiichiro Takahashi

(Manuscript received March 17, 2006)

VoIP technologies that enable Internet voice communication are spreading rapidly, with many telecommunication carriers already providing VoIP services based on these technologies. The market for this area is expected to become significantly larger as the number of subscribers continues to increase. VoIP technologies must first be enhanced, however, before VoIP services can support all the voice services of existing switching systems, including lifeline services such as for emergency calls. This paper introduces Fujitsu's server platform technologies for controlling not only highly scalable but also highly reliable VoIP services, as well as our lineup of products in this field, and then discusses future development plans. Lastly, it introduces our session control technology, which represents a key technology used for VoIP services in the development of various advanced services.

1. Introduction

IP telephony services based on VoIP technology are making the transition to a telecommunications infrastructure that supports the social infrastructure. As a result, the demand for carrier-grade systems (high-availability products designed for telecommunications carriers) in the relevant service markets is increasing and technology to produce high-level products has become essential.

To meet this type of market need, Fujitsu has developed the large-scale GeoServe VoIP server system for carriers.

In this paper, we introduce Fujitsu's VoIP server architecture and the products that have been developed based on this architecture, a platform configuration technology that meets the demand for carrier-grade products, and service diversification initiatives geared toward multimedia.

2. Server architecture and products

In this section, we describe Fujitsu's VoIP server architecture and the products that have been developed based on this architecture.

2.1 Server architecture requirements

A VoIP server is a network node system for implementing IP telephony services, and this type of server needs high availability equal to that of traditional telephone switching systems. Furthermore, there is a need to follow through with the multi-system connectivity services provided by traditional telephone switching systems and also ensure the timely provision of new services geared towards next-generation systems. To meet these needs, high service quality for rapid application development and low costs is also being sought.

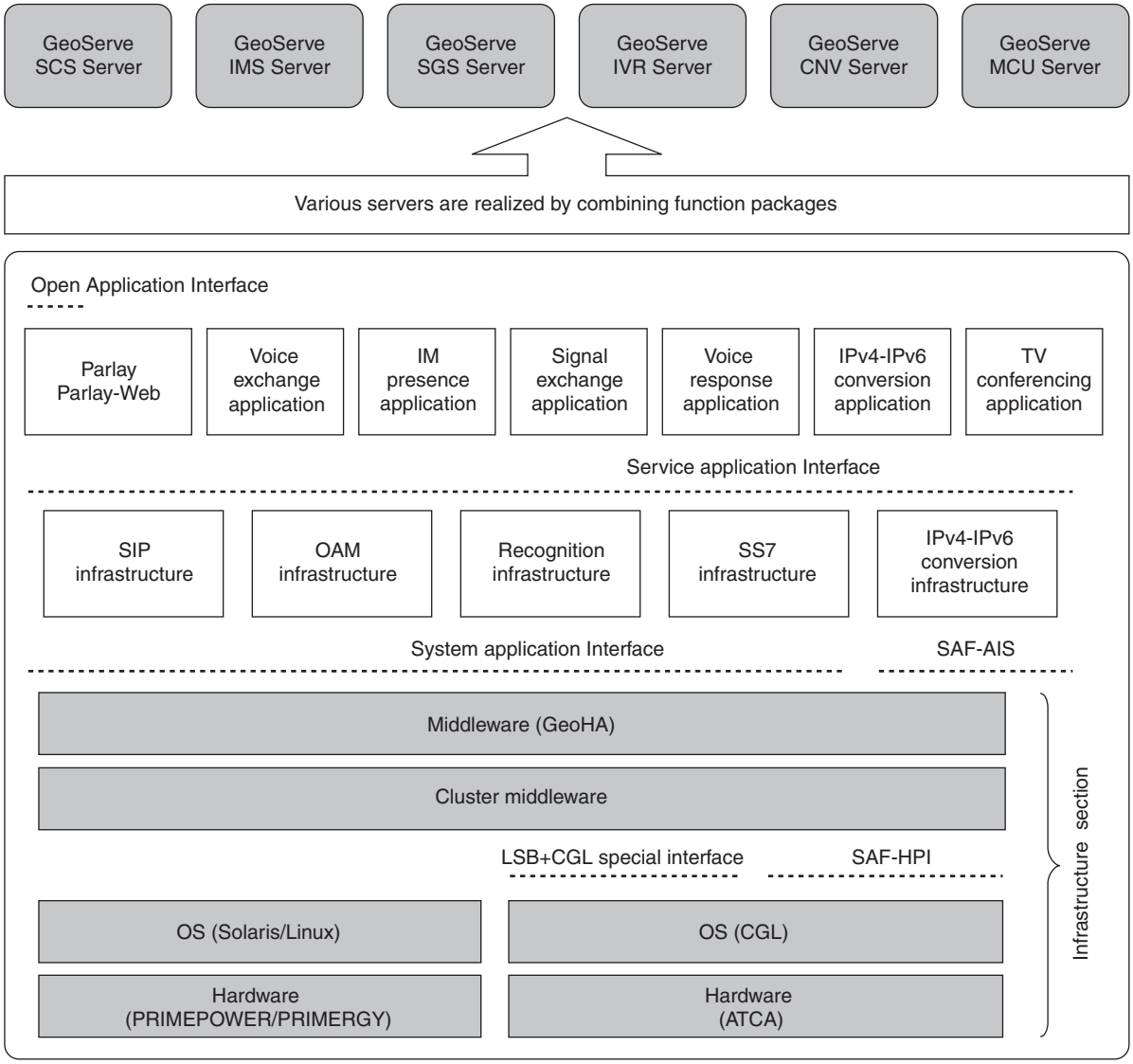
Carriers (telecommunications providers) have a strong need for a solid network configuration designed for IP telephony services, and an

appropriate server architecture and early-stage product development based on this architecture are essential to meeting this need.

In response, Fujitsu has developed the large-scale GeoServe VoIP server system for these carriers. The GeoServe system is currently being used by various carriers for their business services, and has already shown considerable practical results. High availability and service quality in the carrier grade has been realized by using the server architecture shown in **Figure 1**.

2.2 Realization of high availability

Fujitsu's PRIMEPOWER and PRIMERGY open-source servers are used for the hardware to configure the GeoServe system, and the Solaris and Linux open-source operating systems have been incorporated. Furthermore, cluster middleware to satisfy the demand for continuity of information, including information at the application level, and high-availability middleware to ensure continuity of service have been installed independently to realize a platform that satisfies



SS7: Signaling System No.7

Figure 1
GeoServe server architecture.

the need for overall high availability.

The technology used for the high-availability platform will be explained in detail in the next section.

2.3 Realization of high service quality

High service quality has been realized by providing function packages and defining the service Application Interface (API). In the GeoServe system, we have provided Session Initiation Protocol (SIP)[1] based application services and offer five common functions as packages: SIP infrastructure, OAM infrastructure, recognition infrastructure, SS7 infrastructure, and IPv4-IPv6 conversion infrastructure. The service API is defined by these infrastructure functions, making it possible to develop VoIP system application software without requiring any knowledge of lower-layer functions.

We have produced the following GeoServe series application servers based on this architecture.

1) GeoServe SCS (session control server for SIP applications)
2) GeoServe IMS (instant messaging and presence server)
3) GeoServe SGS (connection server for connecting IP telephones to an existing telephone network)
4) GeoServe IVR (interactive voice response server)
5) GeoServe CNV (server for converting IPv4 to IPv6)
6) GeoServe MCU (videoconference server)

Furthermore, to offer new services designed for the next-generation network in a timely manner, we are offering Parlay[2] as an open API. Parlay is an international standard, and because the development environment is a general one, it plays a very important role as an API that supports the development of next-generation network applications. In addition, to promote the strengthening of integration with Web services, we have installed the Parlay-Web service interface (XML/SOAP), and we are expanding the service domain through application integration.

3. High-availability platform

In this section, we describe the technology realized in the high-availability platform.

In this section, "high availability" means the ability to communicate anytime, anywhere, and with anyone. Accordingly, uninterrupted 24/7 service is indispensable for achieving this high availability. Fujitsu's high-availability platform meets this requirement and provides a framework for enabling service continuity, system expandability, and ease of maintenance. This high-availability platform can be defined in general terms as the hardware, OS, and middleware that comprise the infrastructure part of the server architecture shown in Figure 1.

3.1 Fujitsu initiatives

We have developed the middleware (GeoHA) that was required to configure the high-availability platform. GeoHA was developed to realize a general-purpose server that incorporates the high-availability functions provided by a traditional telephone switching system. As a result, we were able to realize most of the functions that are characteristic of this type of system and by enabling the porting of existing software assets, we succeeded in releasing the GeoServe series in a short period of time.

The main functions provided by the GeoHA middleware are shown in **Figure 2**. GeoHA consists of a virtual real-time OS and a common infrastructure for using the execution environment and providing various maintenance functions equivalent to those provided by a traditional switching system.

Carriers are requesting various improvements for next-generation network products, for example, a longer product cycle for general-purpose servers, disclosed OS specifications, and shorter service interruption periods for redundancy switching. Recent years have seen progress in

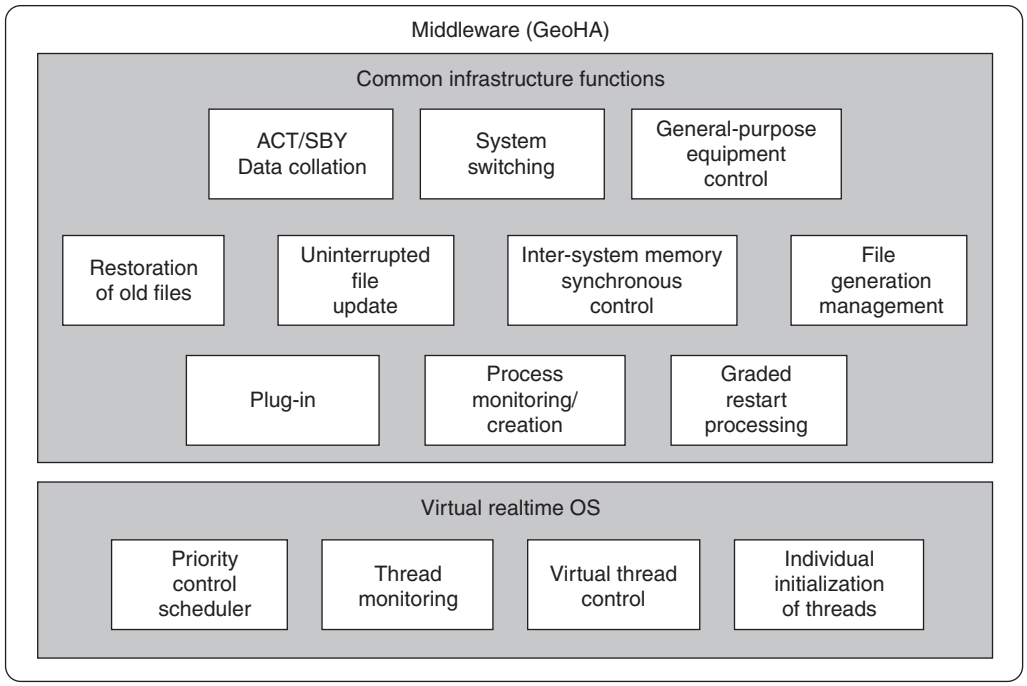


Figure 2
Functions provided by GeoHA middleware.

the standardization of specifications to provide solutions to these issues, and Fujitsu is also in the midst of incorporating these improvements in its product development.

3.2 Standardization of high-availability platform

The stable supply of devices and continuous technical cooperation and the standardization of system specifications are basic rules when supplying products to the carrier market. In addition, expectations regarding the merits of a reduction in costs through the principle of competition are also increasing. These expectations are a worldwide trend, and three specifications can be given as examples of the movement towards the standardization of system specifications: Advanced Telecom Computing Architecture (ATCA), Carrier-Grade Linux (CGL) and Service Availability Forum (SAF). The features of these specifications are described below.

The ATCA specification is for server hardware having a blade configuration. It defines the board, backplane, and shelf mechanical specifications required for system management, as well as the distribution of electric power and the power connection method. Because of this specification, installation of blade boards from multiple vendors has been enabled, and a platform configuration that makes the most of blade servers' features while providing superior ease of maintenance and expandability has been realized.

The CGL specification is an expansion specification for Linux OS carriers that is advocated by Open Source Development Labs (OSDL). Along with the openness of the Linux OS, this specification provides strengthened realtime processing, redundancy processing, and fault monitoring processing, and is closely integrated with ATCA and SAF.

The SAF specification is aimed at a unified platform for the development of service application software. The following three sets of interface specifications are defined by SAF.

1) Hardware Platform Interface (HPI)
Separate hidden hardware specifications
2) Application Interface Specification (AIS)
A consolidated middleware interface for the entire cluster (server groups that provide equivalent service)
3) System Management Service (SMS)
A consolidated framework for system processing (for maintenance application use)

As well as meeting user needs, the ATCA, CGL, and SAF specifications described in this section are also effective investments for vendors. Fujitsu is proactively helping vendors to invest in these specifications.

4. Approaches to service diversification

In this section, we describe our initiatives for service diversification.

4.1 Technologies for handling service diversification

In next-generation networks, it is anticipated that the circulation of various types of media other than voice in the mission-critical communications environment established by IP telephony will create a demand for new services.

Furthermore, it will become necessary to make the telecommunications infrastructure, which was built for access technologies such as existing telephones, mobile telephones, and IP telephones, seamless and to realize interconnectivity and media integration between services with different characteristics. To implement this type of interconnected service that targets multimedia, gateway technology is essential for our product strategy, while high-level session control with SIP at the core will be required.

In this section, we introduce our initiatives with regard to the Back-to-Back User Agent (B2BUA) technology that was installed as an infrastructure in order to realize a high-level session control system. B2BUA is a logical entity that receives requests from service users to applications and performs processing as a user agent server. It is an effective infrastructure technology for session connection to applications and for building a connection system between different service networks. Some examples of B2BUA technology used in application areas in next-generation networks are shown in **Figure 3**. The shaded boxes in the figure represent the application areas where B2BUA technology is used. For example, the Application (APL) service connection GW is a system for performing access distribution from multiple service users to multiple APL servers, as well as user solicitation (call-up) from APL servers, and has been realized by combining the B2BUA infrastructure with various types of scenario-based software that indicate the access control method.

4.2 Product initiatives

To target the application areas that were given as examples in the preceding section, Fujitsu has built a high-level session control infrastructure using B2BUA technology. Adding scenario-based software to show server behavior when session control is used on this infrastructure enables the highly effective configuration of node systems offering functions such as the following:

1) Interconnection between different protocols
2) Interconnection between different services
3) Hidden connections between different networks
4) Complex control of multiple sessions

Rapid product development can be achieved to meet requirements such as session connections that involve codec conversion from terminals with different specifications, multi-session control for TV conferencing, and session switching services linked to auto voice responses.

The software architecture for an infrastructure configuration based on B2BUA technology is shown in **Figure 4**. The section labeled “B2BUA infrastructure” in the figure is a logical entity for performing processing as a user agent server. The

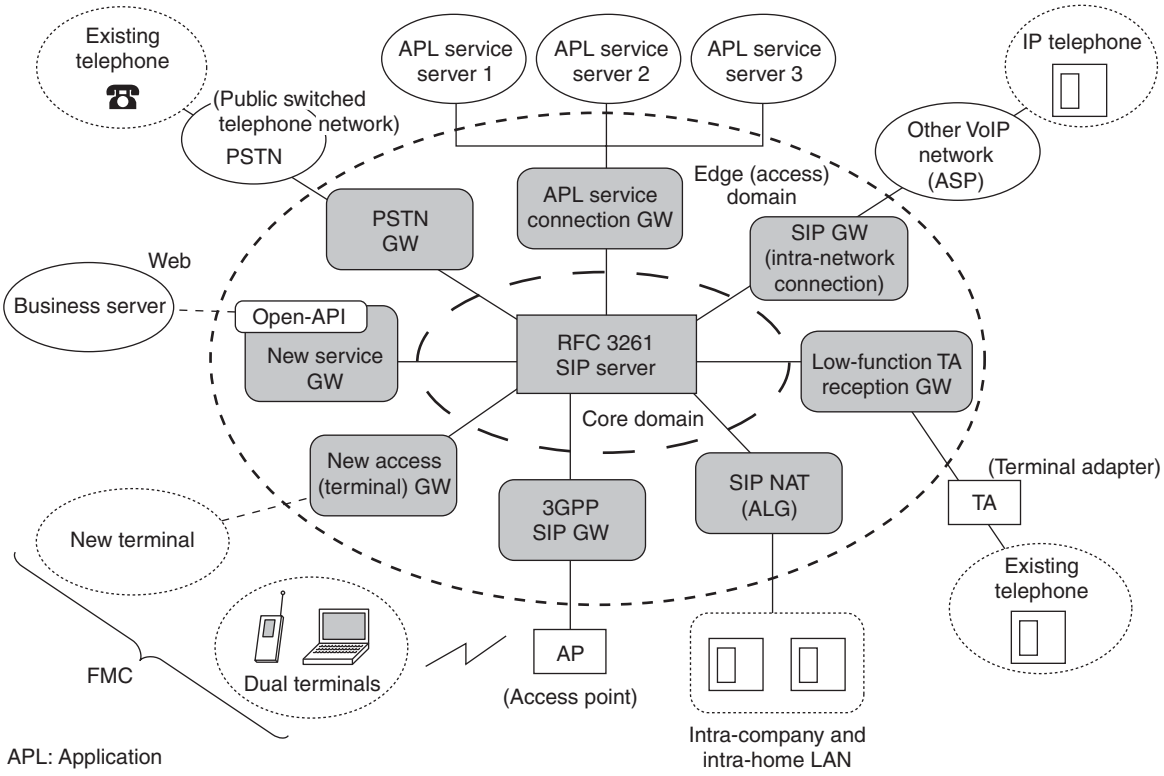


Figure 3
B2BUA technology application areas.

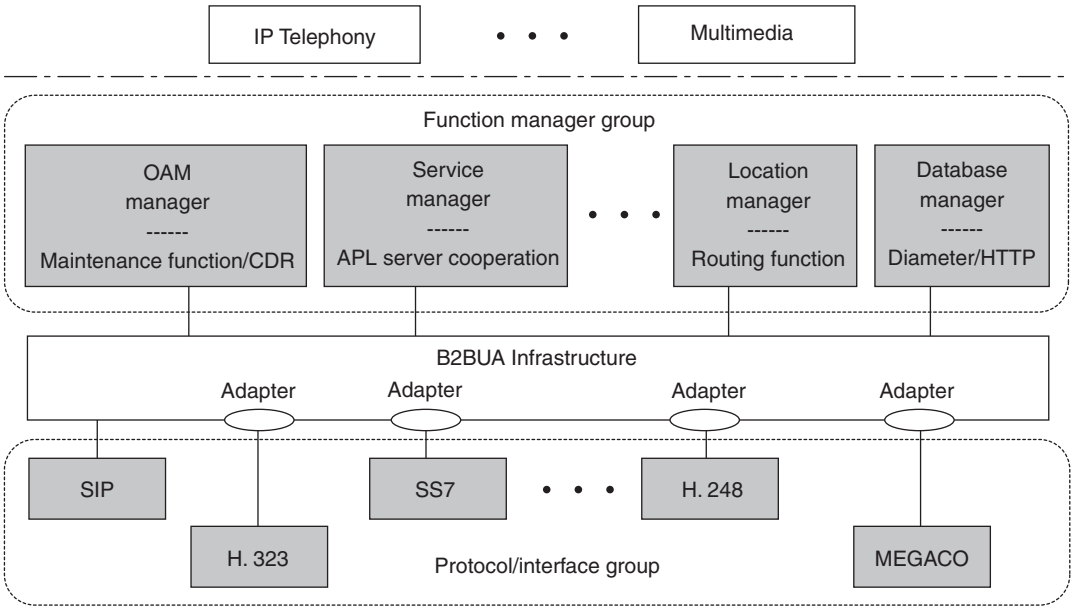


Figure 4
B2BUA software architecture.

configuration integrates session control that uses multiple protocols with APL service scenario-based software that depends on the various types of manager software. The high-level session control infrastructure using the B2BUA technology described in this section has been realized on the high-availability platform described in the preceding section and is a carrier-grade product infrastructure that provides a total solution.

5. Conclusion

In this paper, we described Fujitsu's VoIP server architecture and the realization of products based on this architecture, a platform configuration technology that responds to demands for carrier-grade systems, and service diversification initiatives that are geared toward multimedia.

The next-generation networks are in the process of evolving into lifelines to replace existing circuit switching telephone networks. Telecommunications carriers need carrier-grade products to expand their networks at an early stage and are looking for products that satisfy these requirements. The platform technology described in this paper is indispensable for meeting this type of strict product requirement.

In the next development stage, we will move forward proactively with the structural implementation of large-scale, high-availability IP telephony services based on server systems that use this platform technology, as well as with development geared toward multimedia services.

References

1) IETF RFC 3261 "SIP: Session Initiation Protocol".
2) The Parlay Group. *http://www.parlay.org/*

Kiyofumi Shigeno, *Fujitsu Ltd.*
Mr. Shigeno received the B.S. and M.S. degrees in Management Engineering from the University of Electro-Communications, Tokyo, Japan in 1978 and 1980, respectively. He joined Fujitsu Ltd., Japan in 1980, where he has been engaged in software development of telecommunication systems.

Hisayuki Sekine, *Fujitsu Ltd.*
Mr. Sekine received the B.S. degree in Electronics and Communication Engineering from Meiji University, Tokyo, Japan in 1989. He joined Fujitsu Ltd., Japan in 1989, where he has been engaged in software development of telecommunication systems.

Eiichiro Takahashi, *Fujitsu Ltd.*
Mr. Takahashi received the B.S. degree in Mathematical Science from Tokai University, Kanagawa, Japan in 1982. He joined Fujitsu Ltd., Japan in 1982, where he has been engaged in software development of telecommunication systems.