CHAPTER 11

The Softswitch Model of VoIP

Introduction

The public switched telephone network was designed primarily to handle voice. However, the network is now challenged with carrying increasing amounts of nonvoice data traffic, which is threatening to strain it. Because of this, service providers are looking for ways to cut operating costs by building the next-generation network, which is a single network that will be capable carrying voice, data, and other multimedia traffic. In this way they will avoid trying to fit data into voice networks or vice versa.

Current Class 4 and Class 5 switches cannot be used in the converged network because of the limitation of their architecture. These switches are optimized for voice without much consideration for nonvoice services. Moreover, the software and hardware are so tightly integrated that the introduction of a new service sometimes requires not only software changes but also hardware changes. The software is responsible for making call routing decisions and implementing the call processing logic for all the custom calling features that the switch supports. Currently this software runs on proprietary processors. Because of the tight integration of the software and the switch hardware, no public interfaces have been provided for new features to be added or existing features to be modified by third-party vendors.

In the early 1990s the telecommunications carriers felt the need for changes to be made in the switch architecture. This led to the concept of advanced intelligent network (AIN), which was defined by the former Bellcore (now Telcordia). The goal of the AIN is for the switch software to reside on an external platform while the switch does what it is supposed to do, namely, basic call switching. This would allow a local exchange carrier and its customers to create and modify telecommunications services for subscribers quickly and economically. Unfortunately, it has become obvious that many desirable new features require direct interaction with the call state machine, which is a capability that AIN does not provide. (Call state is the information about the progress of a call, such as stating that the call is about to begin, is on hold, or has terminated.)

The next-generation network addresses this problem encountered by AIN through the softswitch. A softswitch is a software-based switching solution that runs on standard hardware to supplement or replace central-office switching functions. Softswitches perform the same functions as traditional switches and are completely transparent to end users. Thus, they are functionally equivalent to conventional phone switches, but they are better, faster, and cheaper. They replace the current closed, proprietary switches with unbundled software components running on carrier-class servers.

The International Softswitch Consortium describes a softswitch as a device that provides at least the following functions:

- Intelligence that controls connection services for a media gateway and/or native IP endpoints
- Ability to select processes that can be applied to a call
- Routing of a call within the network, based on signaling and customer database information
- Ability to transfer control of the call to another network element
- Interfacing and supporting management functions, such as provisioning, fault management, and billing

The softswitch provides a mechanism for translating between different signaling protocols and permits PSTN calls to be terminated in any packet-switched network. Thus, it provides the mechanism by which next-generation applications, such as unified messaging, video conferencing, interactive chat, and collaborative browsing will be delivered from IP servers.

From this discussion, it is obvious that the softswitch performs functions similar to those of the MGC and the gatekeeper. However, while MGC handles call-control functions, softswitch performs additional functions besides call control. It provides a service creation environment and protocol mediation, which means that it enables different devices to use different protocols to communicate. Its service creation environment enables it to serve as a platform for third-party call control, enhanced services, and customized applications. Therefore, a softswitch can be considered the operating system of the converged network.

This chapter deals with the softswitch model of VoIP. The remainder of the chapter discusses the benefits of the software and its architecture. Because the softswitch is a relatively new technology, the discussions will be based on information that is available at the time of writing. This includes information available from the International Softswitch Consortium and the information provided by some of the companies that have softswitch products.

Benefits of the Softswitch

The softswitch provides several advantages over traditional switching alternatives. These advantages can be summarized as follows:

- The chief advantage of the softswitch is cost. It costs far less than a Class 4 or Class 5 switch that can deliver the same functionality.
- Because the softswitch is modular in nature, new value-added services and features can easily be provided. This is usually done by simply adding a new server that delivers the desired functionality.
- A Class 4 or Class 5 switch is vertically integrated in the sense that the software, hardware, and everything else come from one vendor in one box. But in the softswitch, solutions come from multiple vendors because these solutions are based on open standards. Therefore, the service provider is not locked into one vendor. Also, since open standards enable innovation and reduce cost, the service provider can choose the best products to build a network at a greatly reduced cost.
- Because it is based on open architecture, there are lower barriers to entry for both system suppliers and service providers.
- Since the softswitch is modular, it is highly scalable and service providers can build a network that grows according to how much they can afford. This is a particularly critical point in environments, such as today’s, in which telephony markets and technologies can change overnight.

- The softswitch supports full interworking with the PSTN by providing seamless interconnection to the PSTN for both SS7 and CAS interfaces. Thus, it allows telecommunications companies to leverage their existing investment in switching and assure a smooth transition to packet-based IP technology.
- The softswitch provides translation between different signaling systems such as SS7, SIP, H.323, MGCP, Megaco, and Q.931. Thus, it provides seamless interconnection of packet-switched networks that use different signaling protocols.

Softswitch Architecture

Figure 11.1 shows the physical configuration of a softswitch-based network. In the figure, the softswitch has been functionally decomposed into the media gateway and the softswitch controller, which provides different types of functions, including controlling the media gateway.

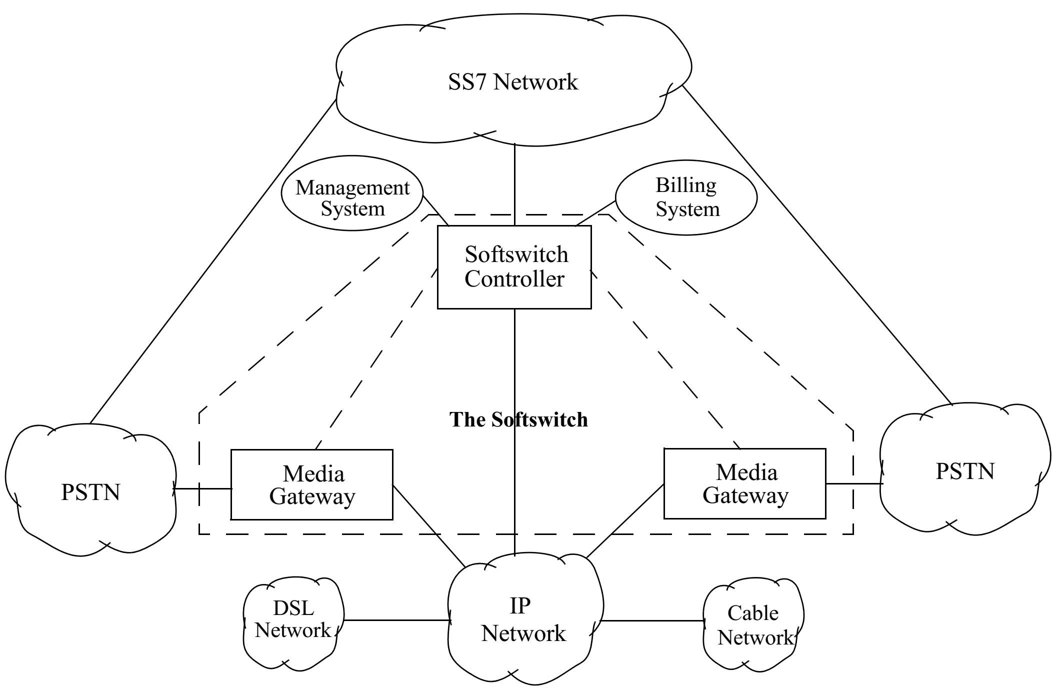

Figure 11.1 Softswitch system architecture.

The International Softswitch Consortium's softswitch functional services architecture defines the following capabilities of the softswitch:

Call control function. Provides connection control, translations and routing, gateway management, call control, bandwidth management, signaling, provisioning, security, and call-detail recording.

Media gateway function. Provides conversion of between circuit-switched resources, such as lines and trunks, and the packet-switched network, such as IP and ATM. It also handles voice compression, fax relay, echo cancelation, and digit detection.

Signaling gateway function. Provides conversion between the SS7 signaling network and the packet-switched network. Thus, it provides access to the SS7 network.

Application server function. Provides for the execution and management of enhanced services and handles the signaling interface to a call-control function. It also provides APIs for creating and deploying services. It interfaces the call-control function, media server function, and the signaling gateway function.

Media server function. Provides access to specialized media resources (such as interactive voice response (IVR), conferencing, facsimile, announcements, text-to-speech, and speech recognition) and handles the bearer interface to the media gateway function. It is not a gateway, but operates only on IP-based media. It is controlled by services executed in the application server function, and it receives and transmits media to the media gateway function.

This classification illustrates that the softswitch performs not only the function of the MGC but also service-creation environment. With the exception of the media gateway function, all the other functions can be implemented in one system or in separate systems. When they are implemented in different systems, the appropriate protocols must be supported in the different interfaces. For example, the interface between the application server and the call controller needs to support SIP while the interface between the application server and the media server supports MGCP/Megaco. Similarly, the interface between the media server and the media gateway supports RTP. SIP is also the communication mechanism between softswitches. Figure 11.2 shows the interrelationships of the different components. The figure also shows some of the protocols across the different interfaces.

There is agreement on the issue of whether to implement the different functions in one equipment or separate equipment for each. There are pros and cons of going either way. To understand the issue properly, it can be seen

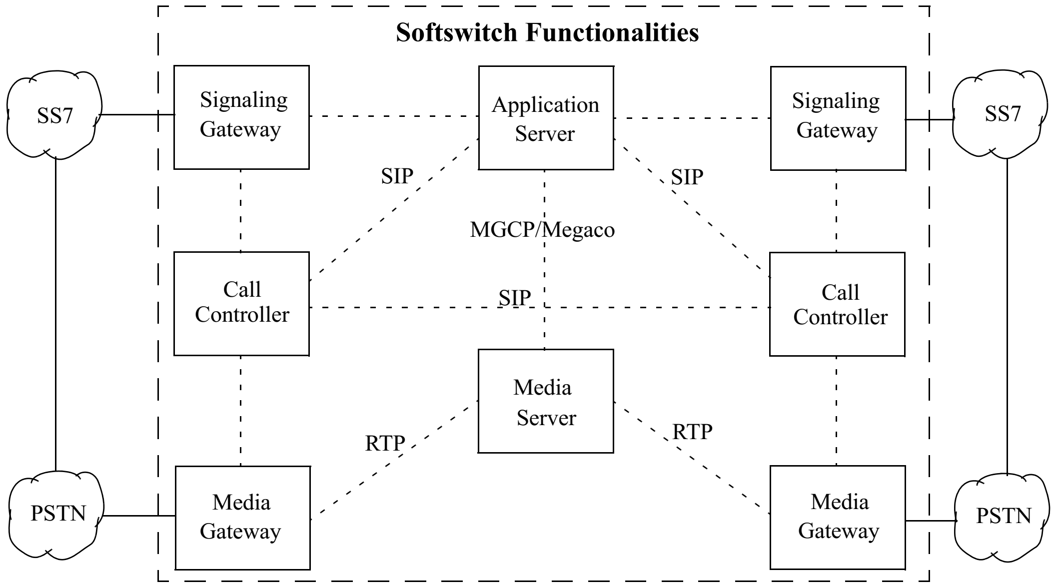

Figure 11.2 Softswitch functional services architecture.

that all the five function servers of the softswitch can be divided into three categories:

Media gateway. Provides the basic media transport services over circuit-switched and packet-switched networks.

Media controller. Consists of the call controller and the signaling gateway and handles basic call control.

Feature server. Consists of the application server and the media server. It handles advanced features and supports service-creation environment.

This classification provides an indication to the types of functions that can possibly be implemented in the same equipment. One advantage of implementing in separate equipment is that it permits a service provider to pick and choose what is needed for the network rather than buy bundled service functions that are not needed immediately. It creates freedom of choice, which enables the service provider to buy the best product from different vendors. Also, it prevents the system in which the services are implemented from being a single point of failure.

One of the limitations of distributing the functions over different equipment is that it requires fixed APIs, which make it impossible to exploit new kinds of interaction between the features and the call-state machine. Implementing the media controller and the feature server in the same system permits the call-state machine to be fully accessible to the service creation environment, making it easy to create new services that may require interaction with the call-state machine.

Service Creation Environment

Service creation environment is used to create and test prototype intelligent network (IN) applications before they are deployed in real networks. It permits carriers and third-party developers to quickly customize and create enhanced services, and add or enhance interfaces to IN elements themselves. The service creation is based on reusable IN components called service independent building blocks (SIBBs), which provide rapid development of the new services or the enhancement of existing services. These new services are designed in such a manner as to allow nontechnical personnel to define, create, and test new network services in a drag-and-drop manner. More importantly, once a service has been defined, the user can simulate it in a virtual network environment, enabling the service to be tested and debugged prior to its deployment.

SIBBs are defined in the ITU-T Recommendation Q.1213 for IN Capability Set 1, and the following set of SIBBs have been identified:

Algorithm. Apply mathematical algorithm to data to produce data result.

Charge. Determine special charging treatment for the call.

Compare. Compare a value against a specified reference value.

Distribution. Distribute calls to different logical ends based on parameters.

Limit. Limit the number of calls related to IN-provided service features.

Log call information. Log detailed information for each call into a file.

Queue. Provide sequencing of IN calls to be completed to a called party.

Screen. Compare a value against a list to see whether it can be found in the list.

Service data management. Replace, retrieve, and modify user-specific data.

Status notification. Inquire about the status and/or status changes of network resources.

Translate. Determine output information from input information.

User interaction. Exchange information between the network and a calling/called party.

Verify. Compare collected information with expected format and values.

Unfortunately, as stated earlier, IN fell short of expectation with respect to service creation environment because current switches do not offer facilities for service creation. All the features of the switch are implemented in embedded software that provides no public interface from where new features can be added or existing features modified. The softswitch architecture is designed to overcome the service creation environment limitation by providing interfaces that permit new services to be created, and existing features to be modified.

Summary

This chapter has presented the softswitch model of VoIP. The softswitch is the key component of the next-generation network. It has many advantages over the current Classes 4 and 5 switches. These include the fact that it costs far less than a Class 4 or Class 5 switch that can deliver the same functionality. Also, in the softswitch, solutions come from multiple vendors because these solutions are based on open standards. Therefore, the service provider is not locked into one vendor. Furthermore, the softswitch is modular, which makes it highly scalable. Therefore, service providers can build networks that grow according to how much they can afford. The softswitch supports full interworking with the PSTN by providing seamless interconnection to the PSTN for both SS7 and CAS interfaces. Thus, it allows telecommunications companies to leverage their existing investment in switching and assure a smooth transition to packet-based IP technology. Finally, the softswitch provides translation between different signaling systems such as SS7, SIP, H.323, MGCP, Megaco, and Q.931. Thus, it provides seamless interconnection of packet-switched networks that use different signaling protocols.

The softswitch is a new telecommunications technology. Therefore, it will take time to mature. However, it provides a good model of VoIP. Because it is a new approach to the intelligent network, it is designed to overcome the limitations of the advanced intelligent network, particularly those associated with the service creation environment.

References

CopperCom, Inc. June 2000. Convergence in Local Telephone Networks: Softswitch and Packet Voice. White Paper. (Available at www.coppercom.com/pdf/wp-convergence.pdf.)

International Softswitch Consortium. Enhanced Services Framework. Applications Working Group document available from www.softswitch.org/attachments/ISCAWGFrameworkv5.pdf.

ITU-T Recommendation Q.1213. October 1995. Global Functional Plane for Intelligent Network CS-1.

R.A. Lakshmi-Rathan. April–June 1999. The lucent technologies softswitch—Realizing the promise of convergence. *Bell Labs Technical Journal*. 174–95.

Sun Microsystems. July 2000. Softswitch: Next-Generation Telecommunication Switching Platform. White Paper. (Available at www.sun.com/embedded/databook/pdf/whitepapers/FE-1340-0.pdf).