Building Converged Networks with IMS Technology

David Geer

For several years, telecommunications providers have touted the potential of converged networks that offer a wide range of voice, data, and multimedia services, all over a single IP infrastructure.

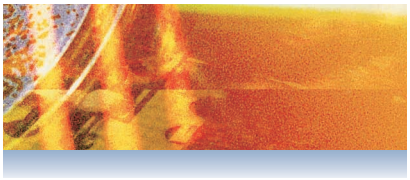
These networks—which differ from today's disparate voice, data, signaling, and control networks—would be based on open standards rather than proprietary approaches and let users work with applications or one another across wireless or wireline platforms.

However, these networks have been just a vision until recently. Now, though, a growing number of telecommunications carriers and equipment vendors—including Alcatel, British Telecommunication, Ericsson, Lucent Technologies, Motorola, and Nokia—are beginning to release devices and services based on a convergence approach called IP Multimedia Subsystem.

IMS is the culmination of technology standards by the Internet Engineering Task Force (IETF) and two Third Generation Partnership Project groups (the 3GPP and 3GPP2).

IMS supports many types of communications, including instant messaging (IM), push-to-talk cellular walkie-talkie service, videoconferencing, and video on demand. It also provides authentication and, for wireless services, roaming capabilities.

Converged networks offer carriers—which are always looking for income sources—the advantages of using a single network infrastructure to quickly implement new, revenue-producing services that customers can work with regardless of the platform they use, said Alain Moutthan, chief technical officer of SIPquest, an IMS application vendor.



In the process, customers would gain access to a variety of seamlessly accessible services.

However, proponents must overcome several key technical hurdles and convince potential users of IMS's advantages.

DRIVING FORCES

"The acceptance of new non-voice mobile offerings shows that many users want richer, multimedia communications services available wherever they are," said Greg Patterson, senior member of Bell South's architecture and technology technical staff.

Major wireless and wireline network service providers are supporting IMS to generate revenue and control expenses. Large networking-equipment vendors and smaller companies that provide applications and ancillary equipment are also adopting the technology, Patterson noted.

In the past, providers offered converged services via time-consuming, expensive integration that required them to build support for the technologies behind each service.

Proponents say IMS eliminates the need for such difficult integration because it provides a common service environment on which to make services available.

ALL ABOUT IMS

The 3GPP—a group of standards bodies, mostly from Europe, that sets third-generation telecommunications specifications—initially developed IMS for W-CDMA (wideband code-division multiple-access), the 3G version of GSM (Global System for Mobile Communications) cellular technology.

The 3GPP2—a collaborative project of North American and Asian standards organizations—subsequently adapted IMS for use with CDMA2000, the 3G version of CDMA.

In essence, IMS, using open interfaces, would serve as its own underlying network platform for routing communications based on various networking protocols.

Figure 1 shows a basic IMS architecture.

IMS protocols

IMS works with several important protocols.

SIP. IMS uses the IETF's Session Initiation Protocol for session control and signaling. Thus, any device with SIP-compatible software and an SIP address, which is a kind of uniform resource identifier, can participate in IMS sessions.

SIP establishes IP connections and specifies how to initiate, modify, or terminate an interactive user session involving multimedia.

COPS. IMS uses the IETF's Common Open Policy Service protocol to ensure quality of service, which is important for telephony and other traffic that doesn't tolerate latency. COPS enables the communication of QoS and other

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traffic policy information between a policy server and clients.

Diameter. IMS's home subscriber server (HSS) is the system's master database of information about subscribers, including their names and locations, services they have permission to access, and data to be used with the authentication and authorization processes.

IMS uses the IETF's Diameter protocol to let devices access the HSS and then provide the necessary authentication, authorization, and, for billable communications, accounting services, said Emerio Marchetti, service provider Sprint Nextel's senior director of network engineering operations.

IMS network elements

There are several major IMS network elements in addition to the HSS.

Call session control functions. The three CSCFs process SIP signaling packets and provide control and routing functions for sessions. The *serving CSCF* handles session control services and application invocation. The *interrogating CSCF* is the entry point for communications in the home network. The *proxy CSCF* is the entry point for an outside network and is used when roaming takes place.

SIP application server. This server hosts and executes IMS-based services.

Access gateway. This element provides an interface between the wireless or wireline network used for data transmission and the IP-based network used for processing.

PSTN gateway. The public switched telephone network gateway interfaces with the traditional circuit-switched telephone network by providing signal and coding translation between IP and phone systems.

Breakout gateway control function. The BGCF offers routing functionality based on telephone numbers and is used only in communications between an IMS network and a phone in a traditional circuit-switched system.

Policy decision function. The PDF assigns bandwidth, resources, and packet priorities for sessions based on both QoS requirements and demand on the system.

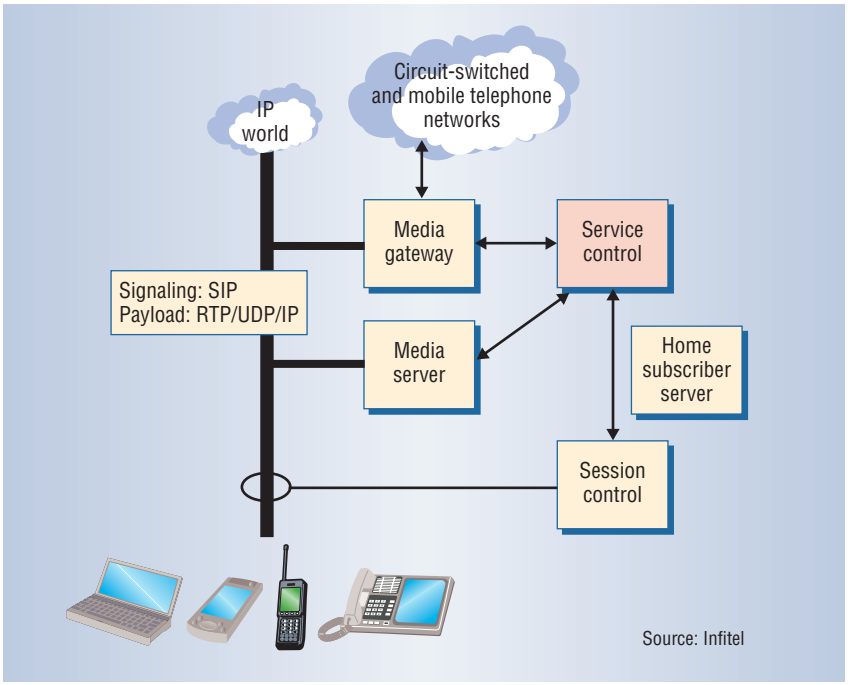

Figure 1. IMS supports many types of communications over various kinds of wireline and wireless networks. IMS integrates all services on an IP-based infrastructure—using IP, the User Datagram Protocol (UDP), or the Real-Time Transport Protocol (RTP)—and provides session control and signaling via the Session Initiation Protocol (SIP).

Foreign and home agents. For mobile users, the foreign agent is a router that serves a device being used away from its home network. For transmissions to the device, the home agent acts as a router on the home network that tunnels packets to a temporary care-of address. The foreign agent picks up the data from this address and delivers it to the device.

Interfaces

IMS uses open interfaces to let different sets of functions interact, even across platforms. SIP is the technology's primary open interface, according to Sprint Nextel's Marchetti.

The standardized IMS service control interface enables connectivity between the session manager and SIP application servers, explained Mike Morris, director of converged core solutions in Lucent Technologies' Network Solutions Group. This enables users to obtain the services they request from applications to which they have access.

Security

IMS isn't designed to prevent hacker attacks, explained Marchetti. Outside technologies, such as firewalls, must provide that capability, he explained.

IMS uses authentication for wireline-access security.

IMS uses the IETF's HTTP Digest Authentication protocol for mobile network-access security, explained Greg Carter, IMS solutions manager for mobile-telecommunications vendor Ericsson.

Using HTTP Basic Authentication, IMS transmissions between client and server would be unencrypted and could be intercepted. HTTP Digest Authentication lets a client prove to a server that it knows the password without having to send the password in the clear. The client performs a com-

putation based on the password and a random value supplied by the server. The result is transmitted to the server, which performs the same computation and, if it obtains the identical answer, authenticates the client.

IMS also provides access security by using authentication via information in GSM-based mobile devices' subscriber identification modules.

IMS also uses authentication for wireline-communications security.

ADVANTAGES

IMS offers numerous advantages.

For example, IMS makes management easier because an administrator has just one IP network to handle, not separate networks for each service, said Dick Martens, director of product marketing and strategy for Infitel, a telecommunications application vendor.

Versatility

IMS supports IP-based services such as video, Internet telephony, and conferencing over wireline, cellular, Wi-Fi, WiMax, Ethernet, optical, DSL, cable, and other types of networks.

Among other advantages, this lets users choose the type of network that gives them the best price, bandwidth, or availability at a particular time and location.

Easy service integration

IMS would let users easily integrate multiple services on a single IP-based network.

Without IMS, companies would have to reengineer many functions each time they add a new application. For example, companies would need separate voice-mail infrastructures for wireline and wireless telephone systems.

Not having to build new network infrastructures for each service saves equipment. IMS would thus let users more easily adopt a wide range of applications to create a customized suite of communications capabilities.

In addition, companies using IMS could mix products from various vendors in their systems. This reduces dependency on a single vendor and lets companies look for the best-of-breed and/or best-priced products.

New services and applications

IMS is important to telecommunications carriers because it lets them sell new revenue-generating services that would otherwise be too expensive or complex to provide, according to Sprint Nextel's Marchetti.

IMS would let users easily integrate multiple services on a single IP-based network.

Service providers could introduce new applications more quickly than before, simply by writing them to the single set of IMS standards, rather than to the standards for the multiple networks on which they might be used. This capability would let providers meet changing customer demands and yield profits more quickly.

Carriers could also more easily customize services and applications for sale to customers.

Based on potential customer demand, the most popular new IMS services will probably be push-to-talk, already available on General Packet Radio Services networks; presence, which provides information on other users' availability on a network; video sharing during voice sessions; the sharing of other types of content such as photos; and IM, explained Marchetti.

CHALLENGES

Because IMS is an enabling platform, rather than an application, potential users may not clearly understand its potential benefits and savings, and this could slow adoption, explained Ericsson's Carter.

Also, while wireline service providers are beginning to move to IP, which is necessary for IMS adoption, mobile carriers are still focused on their cellular networks and will be slower to support the new technology, said senior analyst Keith Nissen with In-Stat, a market research firm.

Eventually, though, mobile service providers will increasingly adopt IP and IMS as a way to offer different types of multimedia services over a single 3G network, explained Henry Goldberg, In-Stat senior analyst for networking.

Carter said that while IMS provides open network interfaces, the technology will still have to work with interfaces to specific cellular phones. "There needs to be a standard IMS client interface on the phone," he explained. "Otherwise, for each IMS application, there will be a different implementation in the handset and a different user interface, defeating the purpose of IMS."

Also, noted 3GPP project manager Alain Sultan, "IMS is a brand new technology. It still needs lots of testing."

Goldberg said, "Wider adoption of 3G cellular technology will provide additional bandwidth to support IMS networks, which will enable new applications such as video sharing."

Wireline and wireless IMS systems will also gain user-location capabilities, which will particularly help emergency services, observed Sultan.

According to Bell South's Patterson, as companies increasingly adopt IMS, they may add proprietary extensions, which would reduce or eliminate some of the technology's benefits.

Added Goldberg, "Providers must overcome a list of challenges to fully migrate to a converged-networks architecture for their wireline and wireless businesses." ■

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