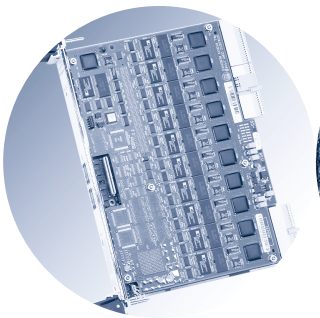
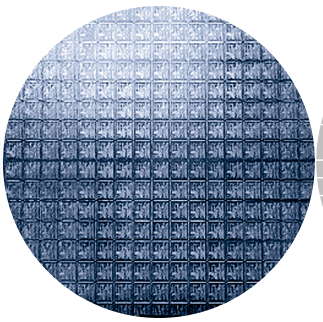
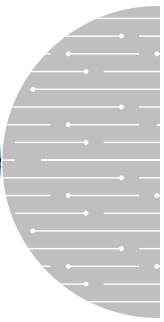
Whitepaper

Unified Messaging and Unified Communications in the Modular Network

Intel in Communications







Contents

Executive Summary

The concept of unified messaging has been discussed for years but never fully embraced by enterprises and service providers. In the past, the development and deployment of unified messaging solutions were difficult to justify because of the associated costs of equipment, management, and maintenance. However, several factors now suggest that the time for a widespread adoption of advanced messaging solutions has come. Enterprises have a growing mobile and distributed workforce that needs improved methods of communication. Messaging technology has also advanced with the introduction of unified communications, the proliferation of new messaging devices, significant strides in voice and data convergence, and the widespread adoption of a host of open standards for messaging-related technologies.

This paper will discuss the evolution of unified messaging into unified communications, the market segment and benefits of today's messaging solutions, strategies for building messaging systems today, and the role of modular network components in messaging solutions.

Why Aren't We All Using Unified Messaging?

As messaging technologies proliferated, developers realized how inconvenient and time-consuming it is to check voice mail for telephone messages, Inboxes for email messages, and the fax machine for faxes. Why not handle all types of messages through a single interface, either on a computer or over the telephone? This type of unified access would be especially helpful to the increasing number of workers at home or at customer sites, hotels, and airports.

Unified messaging is a logical extension of current technology trends, but its adoption has taken longer than expected. In large measure, this has been caused by the economic downturn in 2001, which has slowed the pace of investment in new technologies even when the benefits of that technology are compelling. In addition, other technologies, such as converged networks and Voice over Internet Protocol (VoIP), had to be put in place first to pave the way for an easy and cost-effective deployment of unified messaging applications.

Overcoming Integration Challenges

Putting voice and email messages in the same interface presented network implementation and integration challenges that were often expensive to solve. In some cases, existing voice mail and email systems could not support unified messaging, and businesses would have had to scrap their existing systems to bring unified messaging to their companies – an expense that was difficult to justify. But these formidable challenges are quickly being overcome:

- Large companies are continuing to converge their voice and data networks, and moving to benefit from new technologies. For example, in a July 2002 article **(http://www.techweb.com/tech/network/20020726_networking)**, TechWeb cites a report from the Aberdeen Group, which estimates that "more than half of Fortune 500 companies now have some IP-based phones in place, while businesses like Lehman Brothers, Merrill Lynch, Dow Jones, and Cisco have incorporated full-blown VoIP networks."
- Small and medium size companies now have access to very cost-effective technology, such as the Intel® NetStructure™ PBX-IP media gateway, that allows them to connect their legacy PBX or key system to their LAN for VoIP phone calls. They can also now connect a PC-PBX or an IP-PBX to legacy phone sets so that they do not have to rewire to use new packet-based applications.
- Speech technology has made enormous strides, and automated speech recognition (ASR) and text-to-speech (TTS) technologies make instant access to text-based information over the phone incredibly easy and natural as anyone who has used an automated system to check their bank balance or track a shipment knows.

And as systems are converging, new ways of communicating are proliferating. Instant messaging and short message services are accessible on a variety of handheld and multimodal devices, allowing new ways of entering or receiving information via mouse, keyboard, speech, pen display, and voice.

Unified Messaging Evolves into Unified Communications

Basic unified messaging systems allow users to access voice mail, fax messages, and email from a single user interface. More sophisticated versions of these systems allow users to manage their messages over the telephone with TTS technology, deliver faxes and emails to any fax machine, allow logical administration of messages, and more.

While organizations have been moving towards deploying unified messaging systems, developers have continued to enhance the basic system, which has now evolved into a technology called unified communications. This latest evolution delivers real-time access to voice mail, fax, and email along with the ability to use personal calendars, contact lists, and databases from a single interface. More information is available faster, with greater user control, and management is increasingly easy.

Standards Protect Investment in New Messaging Technologies

Since messaging technologies are changing so quickly, how can developers and service providers build and deploy systems that can incorporate new technologies? And how can an enterprise ensure that it adopts the best technology available while paying as little for that new technology as possible?

The answer is simple. Developers and service providers who build or deploy their messaging applications with open, standards-based components can address a broader market segment, create systems faster, and implement new functionality with greater ease. At the same time, enterprises that choose standards-based systems (or standards-based hosted services) ensure scalability, flexibility, and access to applications with rich feature sets and must-have technology that will bring the best return on investment while making sure those systems will have a long, useful life.

Messaging Technologies Provide Benefits

Unified messaging and communications provide obvious benefits:

- Accessing a single interface for email, voice mail, and fax messages saves time, increases productivity, and lowers costs.
- Managing all kinds of messages from a single interface allows those messages to be stored and retrieved more efficiently.
- Using either a phone or a computer to access messages allows users who are out of the office to manage their messages quickly and easily.

A growing number of workers are regularly separated from their phones, fax machines, or email systems. Missed meetings can waste an executive's time and add more stress to an already hectic day, an unreturned call can mean a lost sale, and slow response time can anger important customers. Unified messaging and communications systems are designed to prevent these problems and ensure messages reach their destinations in a timely manner with as little aggravation as possible.

Market Segment Studies Estimate ROI

In the last few years, many valuable studies have been produced by market research organizations mapping unified messaging and communications trends. A 2001 Frost & Sullivan study, *North American Unified Messaging Markets*, stated "TCO analysis shows that the full cost of ownership for a unified messaging solution is lower than for distinct voice mail, e-mail and fax systems. The UM approach yields cost savings, especially in the form of reduced annual expenditures in areas such as communication, installation, maintenance, administration and training, among others."

In March 2000, the PELORUS Group produced a comprehensive study entitled *Unified Messaging CPE: Moving to Unified*

Communications, Business Strategies and Opportunities through 2004. One of the most interesting sections of this report discusses several "hard dollar" projections for unified messaging from the research of others.

- A Radicati analysis showed a 66 percent reduction in support costs for an annual savings of over $500 per user when unified messaging technology was in place.
- An AVT Corporation study reported a 53 percent time savings when users checked messages through a unified messaging interface instead of checking for different types of messages separately: voice mail over the phone, fax messages at the fax machine, and emails at a desktop PC.
- Nokia/Telekol found that several customers of unified messaging systems estimated a savings of 20-30 minutes per day per user. Using an average salary of $30 per hour, Nokia/Telekol projected an average savings of $15 per person per day and about $4,875 per person per year. When multiplied by hundreds or thousands of employees in an organization, the savings could be very significant.

In yet another study, a January 2000 piece called *Unified Messaging Time Saving Study*, the Comm Group and Captaris estimated that a company with 200 seats of CallXpress* from Captaris could gain back the cost of implementation in an average of only 68 days.

Service Provider Opportunities

Several studies, including *Unified Messaging Market Trends, 2000-2004* by the Radicati Group, discuss why unified messaging and communications solutions are an excellent opportunity for service providers.

- Enterprises often prefer to outsource unified services because of high initial startup costs and because they often lack the type of converged network needed for easy implementation of unified messaging and communications.
- Service providers can make themselves more competitive by offering such attractive new services at a low cost.
- Messages in multiple media are increasing, and service providers can provide a timely solution to managing them.

After service providers win a basic contract for unified messaging and communications, they can up sell additional messaging functionality to existing single-service subscribers. Once a standards-based unified solution is in place, the provisioning costs of upgrading and implementing additional services generally goes down significantly. Thus service providers can continue to offer their customers lower-cost, higher-quality services, often in combination with other services, to promote the kind of loyalty that keep customers coming back for the latest new or enhanced services.

The Non-Traditional Workforce and Consumer Market Segments

Service providers can show freelancers, independent contractors, and small office/home office (SOHO) workers a strong value proposition for unifying both business-related voice, fax, and email with personal voice and email messages, because a single system can be less expensive and more convenient than maintaining two separate systems.

The consumer market segment presents both challenges and opportunities. Traditionally consumers are reluctant to pay for anything except essential services. However, the Internet continues to drive an interest in more, better, and faster technology in the home. The easy availability of broadband and cable modems, the ubiquity of email and mobile phones, and a varied suite of tempting phone-service offerings is encouraging consumers to consider accessing their voice and email (and occasionally fax) messages through a single interface with a single bill. The results of a survey conducted by the Yankee Group and reported in *Consumer Demand for Unified Messaging: Refining the Service Provider Opportunity* indicate that roughly 55 percent of the over 10 million households subscribing to broadband services would be interested in combining their messages into a single system.

Latest Market Segment Research Optimistic

The latest market segment research is optimistic that the time has come for widespread adoption of unified messaging and communications. Developers continue to overcome technology and cost barriers, and various alliances, partnerships, and acquisitions within the industry are also encouraging. Jay Lassman, Research Director at Gartner, says, "With the backdrop of an improving economy, the market for unified messaging should be poised to finally establish a footing."

Building Messaging Solutions Today

Sending and receiving messages has become increasingly fast and convenient, and consequently the customers for messaging services have become very demanding. They expect the latest technology, instant high-availability, and low-cost service. How can developers and service providers reduce costs and maximize profits in such a volatile environment?

Using standards-based modular components has become the strategy of choice for developers and service providers because these "building block" components can significantly reduce the cost of developing messaging solutions, upgrading legacy systems, and enhancing system scalability. Moving towards a single converged network also reduces the cost of managing disparate messaging systems.

Modular technologies can help extend the life of existing circuit-switched telecom infrastructures by allowing a gradual move to packet-based switching. Packet-based communications hold the promise of delivering low cost voice and data connectivity, but pure packet networking is still some years away. Adding modular components to the circuit-switched environment provides developers and service providers with a phased approach to a packet-based network with the added benefit of preserving legacy PBX investments. Modular components can build a solid bridge to IP telephony, enabling enhanced capabilities like unified messaging and communications right now.

Standards Are Critical

In order to ensure that modular components work together seamlessly, many organizations are working on standards, specifications, recommendations, and protocols. Because of the enormous success of standards in the recent past, most notably in the emergence of the personal computer and the Internet, standards in telecommunications are seen to be critical to future growth and progress.

Numerous associations, forums, consortiums, and working groups help to shape standards for the telecommunications industry.

- **ITU** – The pre-eminent telecommunications standards body is the International Telecommunication Union (ITU), formed in 1865. The ITU's role has evolved over the years, but its primary goal of standardizing emerging telecommunications systems and driving common global policies has remained constant.
- **SCSA** – Computer telephony (CT) standards bodies began to organize in the early 1990s, and one of the first standards was the Signal Computing System Architecture (SCSA), which defined a standard way for communications building blocks to transmit voice media streams.
- **ECTF** – The goal of the Enterprise Computer Telephony Forum (ECTF) is to ensure the interoperability of CT systems. The ECTF is an "umbrella" group, which fosters and unites smaller, more focused standards groups. In 1996, the Intelligent Network Forum joined with the ECTF to facilitate modular application interoperability in the public network.
- **IMTC, IETF, and WC3** – As IP technologies have proliferated, several organizations were organized to develop a common interface. The Voice over IP (VoIP) Protocol Forum, now part of the International Multimedia Teleconferencing Consortium (IMTC), and the Internet Engineering Task Force (IETF) were among the early IP-related standards bodies. The World Wide Web Consortium (WC3) was chartered in 1994 to enhance the potential of the World Wide Web by ensuring interoperability.

- **VoiceXML Forum and SALT Forum** – These recently formed organizations are defining standards for speech-enabled technologies. They are working to accelerate the use of speech technologies for the converging voice and data marketplace.

All of the standards produced by the organizations mentioned here are helping to create both the modular network and an environment for advanced messaging solutions. They also allow developers, service providers, and end users a wider array of choices when implementing unified messaging and communications systems.

For a list of standards that are important for messaging, see Appendix A.

Benefits of Standards-Based Modular Components

Hardware and software building blocks make development easier and allow solutions to go to market faster. A careful analysis of this strategy reveals other advantages of a standards-based modular approach.

- Developers can concentrate on application development without worrying about underlying telephony functions.
- Applications can be tailored to a specific communications environment and yet be portable at the same time.
- Building block providers use their resources to support new technology, ensuring conformance to evolving standards.

Using modular building blocks allows solution providers to add components as they need them but at a lower cost than if they developed the components themselves. Also building block components protect investment by allowing applications to stay in market longer because building block components are designed to be both flexible and scalable.

Commercial Off-the-Shelf Components Lower Costs

Commercial off-the-shelf (COTS) components (or building blocks) have the ability to drive total system costs down due to economies of scale and increased interoperability.

COTS component developers concentrate on developing the expertise to build horizontal, cost-optimized building blocks that can be used in a variety of vertical solutions. For example, a well-designed COTS component might be used for telecom switching, voice mail, interactive voice response (IVR), unified messaging and communications, and many other applications. This allows telecom equipment manufacturers (TEMs), original equipment manufacturers (OEMs), and other solution providers to concentrate on combining multiple components and adding specialized vertical services, resulting in shorter solution development time and reduced cost. The COTS approach also results in reduced risk as it builds on currently available, broadly used, mature components.

Because COTS components are easily interoperable with other elements in a solution, they can substantially decrease development costs and time to market. With building blocks available from multiple sources, TEMs, OEMs, and solution providers can also avoid being forced to use a single vendor while benefiting from the kind of competition among suppliers that drives down prices and encourages rapid component improvement.

Of course, service providers and end-user customers ultimately benefit when component costs are lower.

IP-Based Technology and Messaging Solutions

Unified messaging solutions are realizing a greater acceptance in the home and enterprise today because of significant advancements in standards-based IP and speech technologies.

IP-based communications solutions promise voice and data connectivity that is low cost, flexible, and scalable. Using IP, packet-based voice mail systems can be integrated with traditional voice mail systems, allowing recipients to check all voice mail messages by phone, regardless of their type or origin. A caller can dictate a voice message offline, save it in WAV file or another supported PC audio file format, and then transmit it as email before trying to reach one or more recipients by

phone. The recipients can listen to the voice mail message by double-clicking on it in their email Inboxes. In this way, all voice mail messages can be accessed through a single interface, an extremely useful and powerful functionality for enabling open messaging solutions. In addition, people receiving email on cell phones and other small handheld devices without keyboards can reply to messages by sending voice mail messages as email.

In a similar way, IP-based fax solutions that use Fax over IP (FoIP) technology allow users to send faxes over the Internet, saving on toll charges and stand-alone hardware costs.

Speech-Based Technologies and Messaging Solutions

Speech-based technologies offer the most natural user interface for messaging — the human voice. Dramatic advances in ASR and TTS enable capabilities such as voice-activated dialing and barge-in (using the voice to navigate during a call) are delivering a more natural user experience and driving the adoption of voice-enabled messaging solutions.

Voice-enabled messaging lets users sort through multiple media messages quickly and easily. Such a system frees users from entering touchtone commands to access their messages and helps them comply with the laws of a growing number of states that mandate hands-free cell phone operation while driving.

Automatic Speech Recognition (ASR)

Automatic speech recognition is rapidly entering the mainstream. Its algorithms provide a speech-enabled messaging system to hear and understand human speech.

Early speech applications recognized only a small vocabulary of 20 to 30 words, but the accuracy and vocabulary size of ASR engines has dramatically improved, fueled by refined algorithms, dramatic increases in processing power, and lower costs. Today's speech systems support naturally spoken phrases and do not require prior training. Support for multiple languages is also becoming a standard feature of many systems.

Text-To-Speech (TTS)

Text-to-speech technology is a computer system's ability to translate text into synthesized speech, and allows email, fax messages, and Web-based text content to be "read" to human listeners, usually over the phone, in unified messaging and communications systems. Because it uses synthesized rather than digitized speech, TTS eliminates the need for scripting and the studio recording of human subjects, making it very inexpensive. It can also be updated quickly and sounds uniform.

VoiceXML and SALT

Just as the growth of the Web was catalyzed by the development of the HTML scripting standard, the acceptance of standard markup languages for voice-based services is propelling the growth of voice-enabled messaging services.

Two emerging standards are transforming the development of speech applications. Voice eXtensible Markup Language (VoiceXML) and Speech Application Language Tags (SALT) are both markup languages that enable developers to do all of the following:

- Write platform-independent applications that handle synthesized speech.
- Recognize spoken input and dual-tone multi-frequency (DTMF).
- Record spoken input.
- Allow telephony control.

VoiceXML markup tags are specifically intended for defining speech user interfaces while SALT markup tags can define "multimodal" user interfaces involving both speech and a range of devices such as a graphic display, mouse, keyboard, or pen.

VoiceXML is a complete standalone language with markup elements for defining a speech interface along with data and control flow. The language specification includes a standard Form Interpretation Algorithm (FIA), which

provides a predictable sequence of markup execution. The FIA can be combined with conditional and procedural programming elements to create complex dialogues with non-standard dialogue flow.

SALT is a small set of incremental markup tags for creating a speech interface within various markup environments such as HTML, Wireless Markup Language, Synchronized Multimedia Integrated Language (SMIL), and others.

VoiceXML and SALT represent two different approaches to a speech markup language. Together, they represent an important step in making speech applications more accessible to the mainstream computing community. Each provides the computing community with open specifications that meet the needs of unique applications, and supports the industry's preference for known tools and programming models.

The acceptance of these standards is already accelerating the use of speech by the wider computing community, and will continue to simplify the ability to incorporate speech into messaging solutions.

Emerging Technologies

Compelling new communications technologies are emerging, while existing solutions and ideas are being refined. The advent of multimedia messaging will allow the transmission of graphics, video, music, and images to any phone, personal computer, or personal digital assistant, adding a new dimension to current messaging technologies. Multimodal technology in unified communications will support the seamless transition between different modes of communications – from visual to voice to touch – without a break in a conversation or online session.

Modular Network Convergence

The modular network allows the convergence of multiple separate networks including the public switched telephone network (PSTN), the wireless network, and the Internet. By using a standards-based, intelligent, highly efficient packet infrastructure to enable convergence, the modular network can deliver universal access and a host of new technologies, applications, and service opportunities for messaging systems.

The primary elements of the modular network include:

- **Access media gateway** — Connects traditional analog or digital devices to a packet-switched voice network.
- **Feature server** — Implements signaling control point (SCP) services from the legacy circuit-switched network as well as the advanced services provided by the local exchange and access tandem central office switches.
- **Media server** — Provides announcement, messaging, conferencing, speech recognition, and TTS capabilities.
- **Packet (IP) media gateway** — Connects two packet-switched voice networks.
- **Service node/intelligent peripheral** — Provides announcements, conferencing, fax, TTS, speech recognition, and other services independent of the SCP.
- **Signaling gateway** — Converts and/or relays network call signaling at inter-network points.
- **Signaling transfer point (STP)** — SS7 router of the circuit-switched network functions as both a border router at inter-network points and as an edge router in central office switches.
- **Signaling control point (SCP)** — Intelligent network (IN) database and service element enables innovative and ubiquitous services.
- **Softswitch** — Supplies call routing, AAA functions (authorization, authentication, and accounting), and control over the switching capabilities within media gateways.

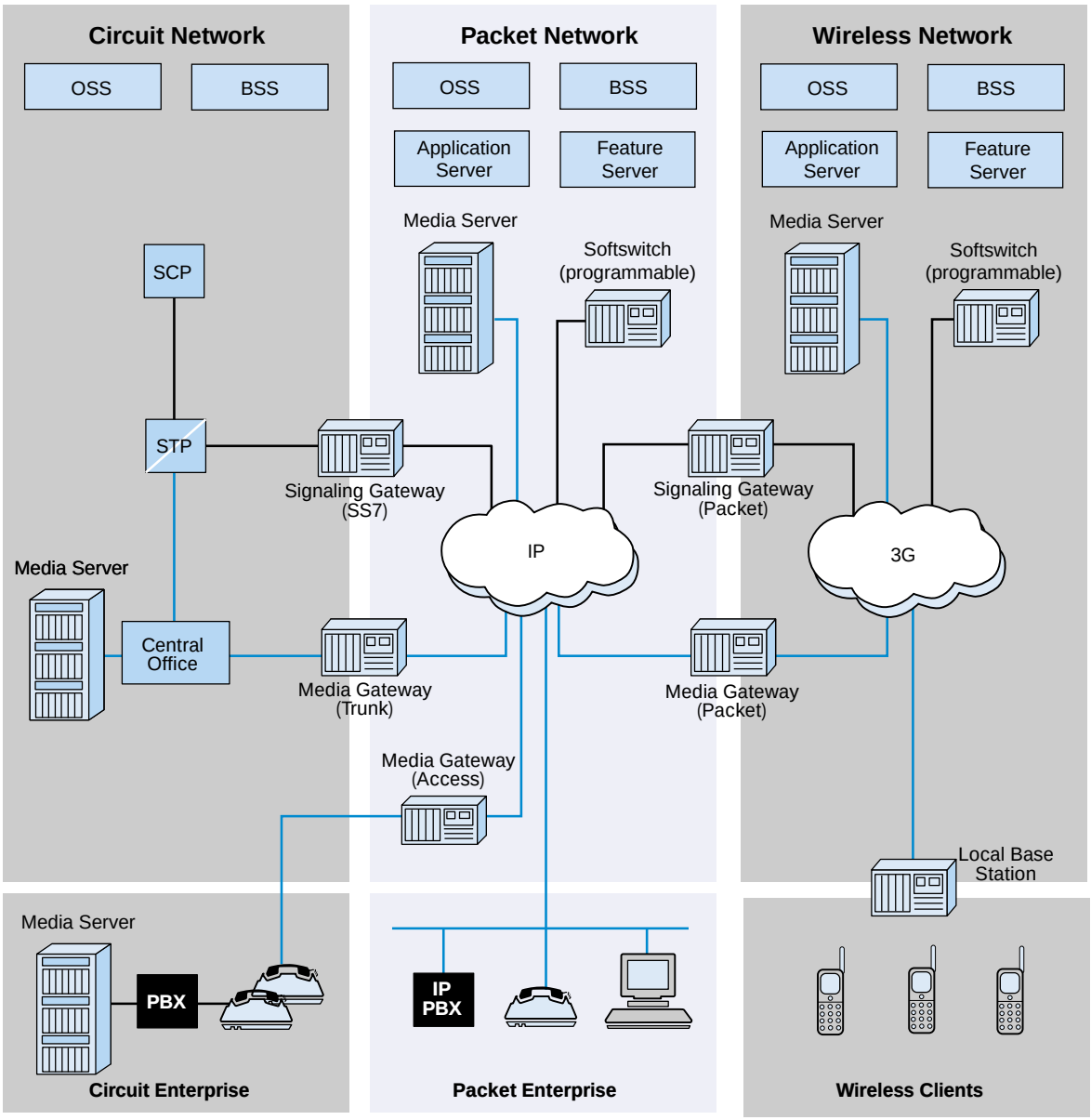


Figure 1. Modular Network System View

- **Trunk media gateway** — Provides the media stream interface between circuit-switched networks (such as the PSTN) and packet-switched (IP and ATM) voice networks.

See Figure 1 for a system view of the modular network.

The most important modular network elements that provide functionality for unified messaging and communications systems are media servers, media gateways, signaling gateways, and softswitch technology. These allow the delivery of services traditionally hosted on the PSTN, IP, and wireless networks to be combined, thus permitting users to choose either a telephone user interface (TUI), mobile user interface (MUI), or graphical user interface (GUI) for retrieving messages.

Because of these modular network elements, unified messaging and communications services are more flexible, scalable, and cost-efficient than ever before. These elements also speed the time needed to bring new messaging services to market.

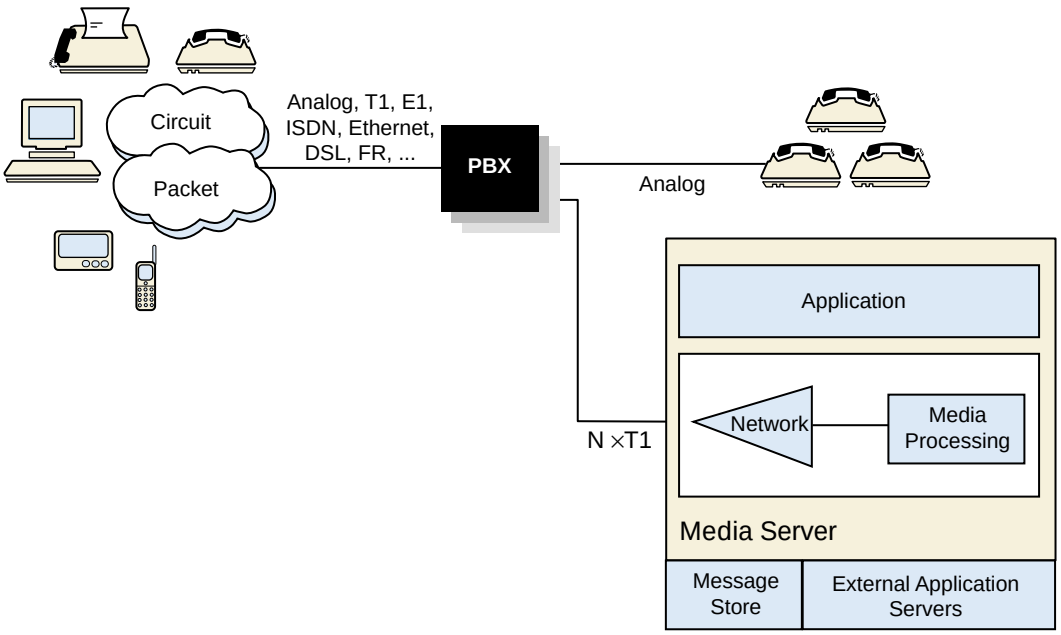


Figure 2. Unified Messaging Topology

Media Server

Media servers are service endpoints in the communications infrastructure that can support both circuit-switched and packed-switched networks. These platforms are sources of media (voice, data, video) and support applications such as voice mail, IVR, messaging, conferencing, and voice portal systems. Both enterprises and service providers can provision media servers.

Figure 2 illustrates a typical premise-based unified messaging topology. The media server in this example manages the storage and retrieval of messages, which can include voice, fax, data, or video. It has access to storage for the various media files as well as the control rules necessary to implement media services. Storage can reside either locally on the media server or remotely in a centralized storage system. In such cases, unified messaging systems that support voice and fax resources are normally integrated with an email system such as Microsoft Exchange* or IBM Lotus Notes* and have ASR and TTS capabilities.

The unified messaging topology shown above might also have an auto attendant application packaged within the solution to direct incoming calls to appropriate extensions. An auto attendant is not required if the telephony system associated with the unified messaging solution supports direct inward dial (DID), which allows individual extensions to be dialed directly with a three- or four-digit extension.

Media Gateway

Media gateways act as translation units in unified messaging and communications systems, enabling messages to move between voice and data networks, or between two different types of packet networks. A media gateway can connect the PSTN to an ATM network, an ATM network to an IP network, a PSTN to an IP network, or an IP network to an IP network when different protocols or coders are in use.

Media gateways provide the flexibility and scalability enterprises and service providers need to add more messaging functionality as their business requirements grow.

Signaling Gateway

Signaling gateways provide real-time relay or protocol conversion for call signaling and are typically deployed in one of two network types: SS7 or IP. SS7/IP signaling gateways can be used in a wide variety of applications for call control, wireless, and intelligent networking. In each case the signaling gateway forms part of a larger IP-based system.

Call control applications include IP telephony gateways, softswitch-based backbone networks, and service platforms such as large voice portal or voice mail systems. Signaling gateways can also be used to build components for mobile networks, including home location registers or short messaging service centers. The introduction of 2.5G and 3G mobile services also requires SS7/IP interworking and, therefore, signaling gateways. Intelligent networking service nodes providing services, such as toll-free or follow-me, can be upgraded or replaced by a lower-cost IP infrastructure using signaling gateways.

Some signaling gateways can also be used for SS7 long haul or offload applications to increase signaling bandwidth and relieve the pressure on other network resources.

Cost-Effective Messaging Begins with Modular Components

Messaging has long been a critical component in the business infrastructure, and the result is one of the most dynamic and complex market segments today. One result of all this activity is the struggle that many people face in gaining control of the large number of messages they receive each day as voice mail, email, and fax. Increasingly, this need to stay in touch – especially when mobile – has generated significant interest in unified messaging, a way of accessing all types of messages through a single interface. Such a solution works best when the messages can be accessed in a variety of ways: via the Internet, with voice commands, or through a touchtone keypad. Such versatility has led to the development of unified communications, which allows a user to stay in touch from any computer, wireless or wireline phone, or wireless device in real-time and to also access calendar and directory functions and database information through a single messaging interface.

The evolution of communications technologies now allows developers to create highly desirable messaging solutions that free users to decide when, how, and where they wish to communicate. They can receive all the important information they need, regardless of their location. The flexibility of such messaging solutions allows service providers to promote customer loyalty, and encourages customers to stay with a single service provider. A high level of customer retention allows service providers to further enhance their offerings and introduce new, revenue-generating services to their existing customer base.

New open, standards-based building blocks from Intel make the development of messaging solutions easier and faster, and flexible, scalable deployment more cost-effective. Modular Intel components allow developers and service providers to add components and new technologies as needed and at a lower cost than if they developed the components themselves. Detailed information about how Intel can help enable messaging solutions with individual board components, software, platforms, and services is available online at http://www.intel.com/network/csp/solutions/messaging/index.htm.

Appendix A. Important Standards for Messaging

Standards are agreed principles of protocol, and a protocol is a set of rules governing the format of messages that are exchanged between computers and people. Standards are sometimes called recommendations, specifications, or APIs, and some examples of standards that are important for messaging are listed in this appendix.

- **AMIS** – Audio Messaging Interchange Specification typically supports analog networking between dissimilar voice mail systems.
- **H.100** – Hardware specification for CT Bus connection compatibility.
- **H.110** – Hardware specification that defines H.100 on the CompactPCI* bus.
- **H.248/Megaco** – ITU-T recommendation for MGCP.
- **H.323** – An early standard for real-time multi-media (voice, data, video) communications over packet-based networks.
- **IMAP** – Internet Messaging Access Protocol allows user access to Internet mail servers over a WAN.
- **LDAP** – Lightweight Directory Access Protocol enables client software interaction with a directory service over a TCP connection.
- **MAPI** – Messaging Application Programming Interface allows messaging clients to interact with messaging servers.
- **MIME** – Multipurpose Internet Mail Extension protocol enables the transmission of mixed-media data files across TCP/IP networks.
- **POP3** – Post Office Protocol is used by email servers on the Internet to access email for downloading.
- **MGCP** – Media Gateway Control Protocol lets a controller establish and tear down media connections between circuit and packet ports on a media gateway.
- **S.100** – ECTF's C language API that specifies a set of interfaces for multi-vendor application interoperability on S.100-compliant systems.
- **S.410** – Java*-based API that provides considerable media control capabilities and interoperability between S.410 applications and between S.100 and S.410 applications.
- **SIGTRAN** – IETF-proposed signaling transport protocol that aims to enable the same reliability of signaling and control on IP-based networks that exists on the PSTN.
- **SIP** – Session Initiation Protocol is a text-based protocol, similar to HTTP and SMTP, for the seamless transmission of voice, fax, and data across IP and traditional telephone networks.
- **SMTP** – Simple Mail Transport Protocol is an application-level protocol that operates over TCP/IP for text email exchange.
- **SNMP** – Simple Network Management Protocol allows network management applications to query a management agent using a supported Management Information Base (MIB).
- **TAPI** – Telephone Application Programming Interface was developed by Microsoft to converge the PSTN and IP telephony on the Windows NT* operating systems.
- **TCP/IP** – Transmission Control Protocol/Internet Protocol is used for communications across interconnected networks.
- **VPIM** – Voice Profile for Internet Messaging lets different voice mail systems automatically exchange messages over the Internet.

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