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Unified Messaging Systems: an Evolutionary Overview

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Abstract

Over the last decade, the widespread demand and use of the internet has changed the direction of the telecommunications industry as it was recognised that the internet could be used as an inexpensive way to handle not only data but also voice communications. This convergence of traditional voice and data technologies towards an IP-based open architecture has been paralleled by a convergence of the internet and mobile communications. As a result of these convergences, unified messaging has emerged as a technically viable service. Integrated messaging services that offer partial unification of different message types are already in the marketplace. This paper asks what unified messaging means and examines underlying architectural developments that are likely to shape the unified messaging applications of the future.

1 Introduction

Traditionally, circuit switched voice networks and packet-switched data networks have been kept separate in the enterprise (see Figure 1). During the 1990's, however, the widespread use of the internet changed the direction of the telecommunications industry as it slowly recognised the potential of the Internet as an inexpensive way to handle not only data but also voice communications. The ubiquitous Internet Protocol (IP), a simple and effective protocol for packet delivery, is independent of the information it carries and with its open architecture, easily inter-operates with other protocols. Although challenges remain to achieve network convergence, the promise of communications that offer the quality and reliability of traditional voice systems with the efficiencies and manageability of TCP/IP over an enterprise network infrastructure is highly attractive to the enterprise. This convergence between traditional telephony and the internet has been paralleled by the convergence of internet with mobile technologies. One of the outcomes of these convergences has been the emergence of unified messaging (UM) as a viable service offering. Although proprietary technologies and the lack of intelligence, both in the network and in access devices, have limited the development of UM to date, first generation integrated messaging services that

offer partial unification of messaging services have arrived in the marketplace. This paper investigates what is meant by a Unified Messaging System (UMS), how they are currently evolving and attempts to predict, in broad terms, what the future holds for unified messaging.

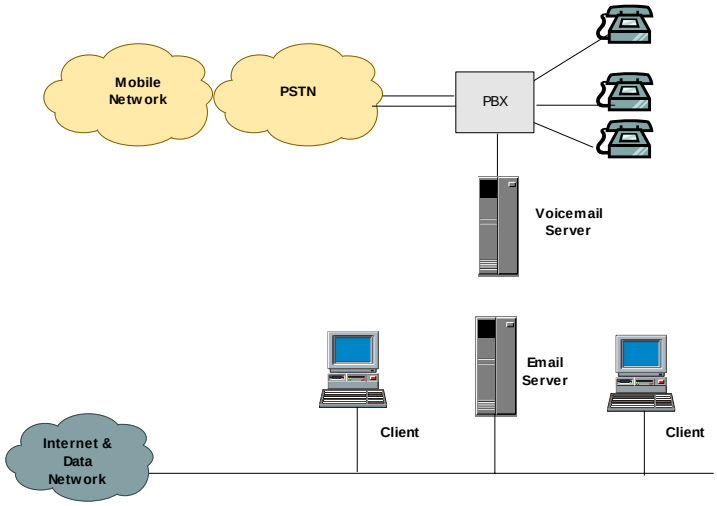

Figure 1 Typical Legacy Network Architecture in the Enterprise

2 Is there a market for Unified Messaging?

Most of the market research in Unified Messaging appears to have been focused on the US market. In recent research conducted by the Gartner Group (April 2001), it was established that nearly 50% of small businesses in the US see benefits in unified messaging and want some degree of integration among their systems. Their research is interpreted as a strong indication that " a market for unified messaging may be finally emerging". The research identified telecommuters, home offices and small businesses as the market segment most interested. Residential and private users represent less than 5% of the projected US market. The research also indicated that there is similar potential for mid-range (up to 1,000 employees) business in Canada and the US.

In a separate study, Frost & Sullivan (Press Release in June 2000) predict that the market for UM services will grow to US$5 billion by 2005. In Europe, where mobile services are well advanced and the mass market penetration is higher than in the US, it is likely that the rapidly growing number of users requiring unified messaging will increase as Mobile Service Providers add Integrated Messaging to their service bundle offerings.

3 Existing UMS Providers

UM Services can be provided in two basic ways: by the service provider (SP) or by the enterprise. If provided by the SP, the infrastructure, including the 'Unified Inbox' belongs to the SP and is located off the customer site. This approach is suited to the mass market and to smaller enterprises who are strongly reliant on service providers for their underlying communications services (e.g. mobile telephony services), who don't wish to make a high initial investment or primarily want unified messaging for contact purposes only. It has the advantages of high and rapid scalability and low initial investment costs. Instead the customer pays incremental charges for each extra 'inbox'. Service providers with existing primary services, such as ISPs or Mobile Phone operators, have been able to add some integrated messaging services quite easily by simply adding a UM platform, thereby augmenting their existing service with enhanced offerings to the consumer. A good example is the provision of integrated SMS, email and voicemail. From a technical standpoint this is a relatively simple operation and the challenge lies principally in the provision of operational service support e.g. provisioning a single account with enhanced multiple services or billing end-users at different rates depending on which service is being used.

The alternative is for the enterprise to own and operate its own UMS infrastructure, giving far greater flexibility and the opportunity to integrate UM into collaborative or other applications. This has the important advantage of improved security as a result of complete control. Given that the critical communications systems of telephony and email (and fax still, to some extent) are typically based on-site for most medium to large enterprises, it seems likely that the UMS will reside on site. In summary, it seems that for the foreseeable future, UM services for the Mass Market and SMEs is likely to be provided by external service providers and that the larger enterprises will invest in their own systems.

4 What is a Unified Messaging System?

What do we means by a unified Messaging system? A Unified Messaging System (UMS) is primarily concerned with the unification of messaging over disparate messaging systems. It is concerned with both incoming and outgoing messages and with the management of stored messages. One broad definition for a UMS might be a system for sending, receiving and managing messages, which supports multiple media types and provides access to any message from any device.

The functionality that a UMS could potentially provide includes the following capabilities:

- to send and receive messages of various types (e.g. email and sms) from within a single application
- to manage (save, delete, forward, attach, archive) all messages within a single inbox
- to provide access from a wide range of terminals/devices
- to use a common command set for access
- to use a single message store
- to convert messages from one media type to another
- to process messages automatically
- to provide Interactive Voice Response (IVR), keyboard or graphic user interfaces
- to support real-time messaging (e.g. voice calls, video conferencing) as well as non-rela-time (e.g. voicemail, email, message board) and near real-time (paging, SMS, MMS)
- to work with messages of disparate media: text, audio, video
- to create multimedia messages
- to provide a 'one number service' for a user that finds the user wherever the user is
- to provide 'personalised assistant' services
- to provide unified directory services

From this functionality we can identify the key components of the future UMS:

- Single or Unified Inbox
- Unified Command Set for Access
- Unified Message Store
- Interface to private networks
- Interface to public telecommunications networks
- Unified Directory Services
- Unified Management of Disparate Messaging Components
- Rules-based Forwarding of Messages

5 Evolving UMS Architectures – An Overview

A number of different approaches to the unification of messaging have evolved. These meet the functionality and features identified above to a greater or lesser extent. This can be categorised as:

- Integrated Messaging Systems
- Unified Messaging Systems for non real-time messaging
- Unified Messaging Systems with real-time call capabilities
- Unified Communications

Although listed roughly in the order in which they have emerged, these different approaches have not evolved from a common origin but rather from different origins based primarily on whether development began from either a telephony or email start-point. The approaches also use a different architectural model and it is worth examining these in order to understand the degree to which any given approach can meet the features and functionality of a true UMS.

5.1 Integrated Messaging (Client Focused)

Integrated Messaging (Client Focused) is the unification of similar message-type services (usually non real-time or near real-time) for access or retrieval where the individual messaging processes are kept separate. An example is the unification of email, SMS or voicemail into a single service.

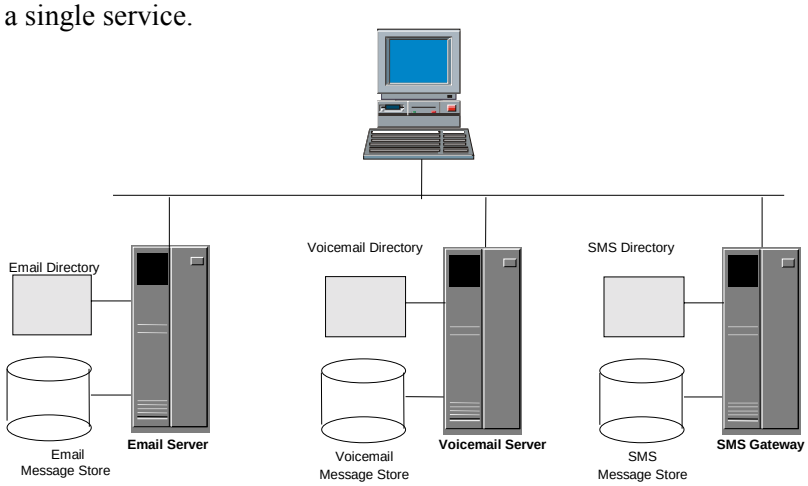

Figure 2 A Client-based Architecture for Integrated Messaging

In integrated messaging, each message service maintains its own message store, directory and administration interface. In order to unify messaging, integration software is needed to manage message traffic between multiple systems. This type of architecture pushes the core of the unification process out to the edge of the network, ultimately to the end user station. For this reason, integrated messagsing systems can be considered to be 'client focused'. Some synchronisation may also be needed between the distinct message services/servers.

5.2 Unified Messaging

5.2.1 Unified Messaging (Server Focused)

Unified Messaging (Server Focused) is also a client/server architecture and remains focussed on non-real time messaging. The main difference is that it consolidates different message type services to a single mailbox. All messages can then be accessed from within a single environment (most commonly like an email environment) and uses a single message store, a single corporate directory and a single interface for user administration. This approach typically leverages the existing email paradigm and infrastructure.

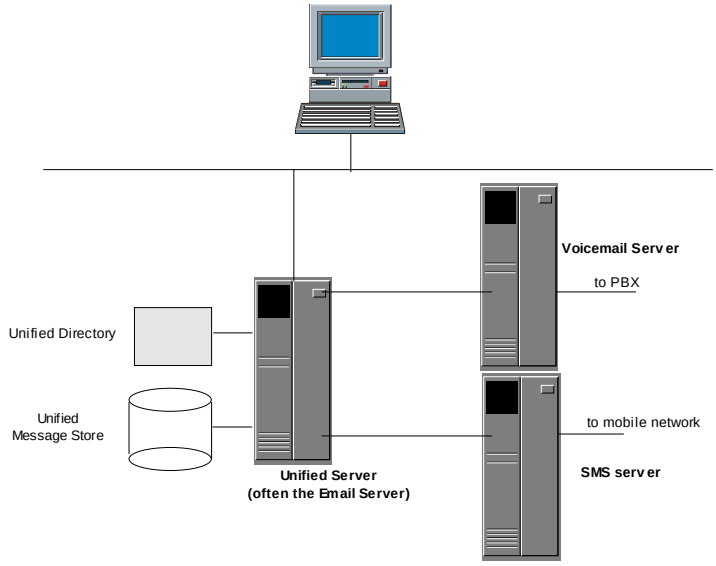

Figure 3. A Centralised Server Architecture for Integrated Messaging

It places the core of the unification process more firmly on the private network server than on the end station. Although it has the disadvantages of a single point of failure for all messaging and the need to stream traffic twice across the LAN, the server-based approach offers improved efficiencies in network administration and ease of use and is generally considered a more elegant approach than integrated messaging.

5.2.2 Unified Messaging (PBX / Switched focused) with Computer Telephony Integration

Whereas the Unified Messaging approach tends to be focused on integrating voice into an email or similar type of environment, there have also been efforts to integrate email into the PBX and switch environments.

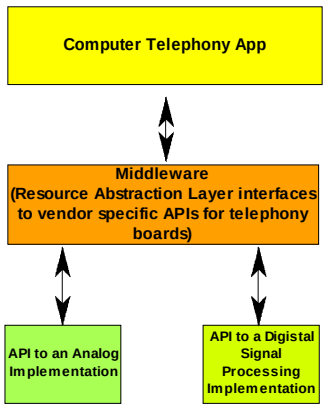

Figure 4 Computer Telephony Integration Architecture

This benefits from using the richer feature set of digital protocols that are native to the PBX rather than the integration of rudimentary analog media between the PBX and the unified 'email-type' erver. Such implementations can not only integrate text messaging services and use text-to-speech to convert emails to audio but also can integrate Computer Telephony applications into the unified messaging, thereby supporting both real-time as well as non real-time messaging. The UM applications depend on the PBX to perform switching, call routing and the transfer of message-related information. The disadvantage is that although voice systems are largely standards based, their implementations are often proprietary in nature and lack the benefits of a truly open architecture.

5.3 Partially Converged Services

With the addition of voice capabilities to an existing IP network using voice over IP technology, it becomes possible to combine real-time calls and conferencing with asynchronous messaging over an IP infrastructure. Instead of relying on a central PBX, VoIP uses the corporate LAN to switch and route calls. Applications can then be added using Application servers that use the corporate LAN. This change in the configuration greatly impacts the foundation of the technology needed to build true UM applications that supports real-time as well as non-real-time messaging – the emphasis now shifts from integration with the PBX to integration with an existing open set of LAN protocols.

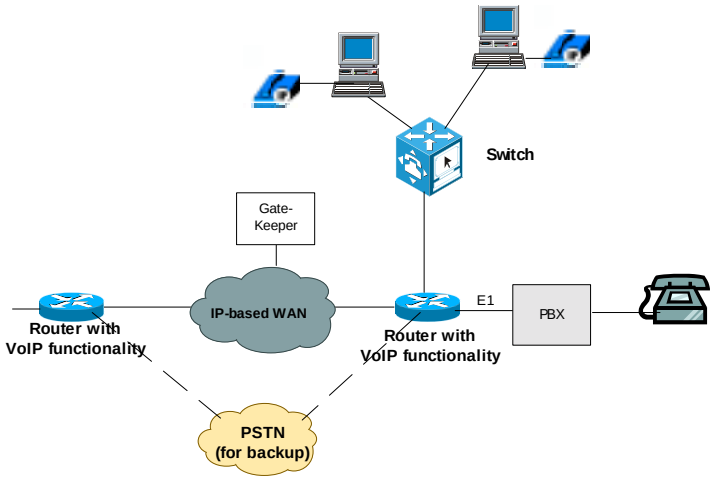

Figure 5: A Partially Converged Services Architecture for Integrated Messaging

Migration to the IP converged technology requires the use of VoIP gateways (internal or external to the PBX) in the architecture to interface existing capabilities to a VoIP infrastructure. One possible architecture is to a centralised gateway to break out onto the IP network over, say, an E1 interface. An alternative model is to use to replace the E1 interface card with a VoIP interface in the host and also use a host-based call control protocol stack (H.323, SIP, Megaco, etc.) for call establishment and tear down. DSP is still required for playback, etc. This is generally preferable as it allows a single protocol stack to control multiple gateway cards and easily facilitates protocol changes. Both approaches, however, suffer from scalability problems.

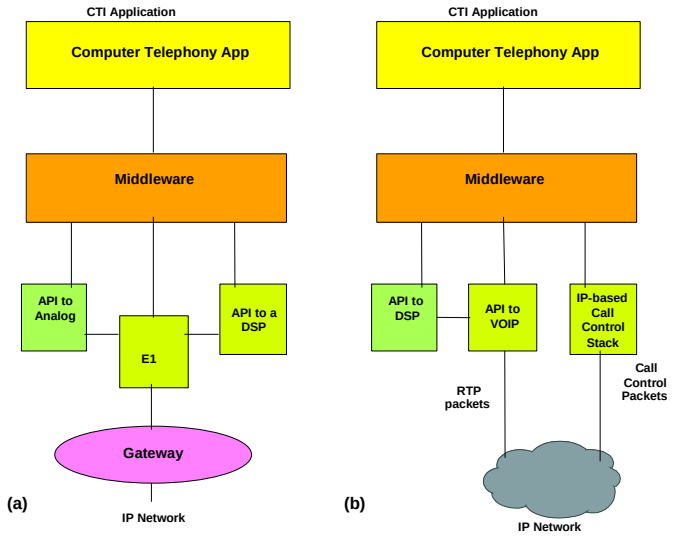

Figure 6: Migration to VoIP Technologies using (a) Centralised gateway or (b) VoIP with separate IP-based call management

An improved approach is to replace *both* the E1 and the Digital interface with an IP-based media processing board that both provides the DSP capability to record, playback, conference, etc. and also provides an IP interface.interfaces with separate IP-based call control. Although more cost-effective, it requires added complexity in the middleware and this does not improve the basic scalability problem.

5.4 Next Generation - Unified Communications

This is a converged IP network that offers voice, data, video and multimedia applications in an integrated enterprise infrastructure which uses both circuit switched and TCP/IP technology and protocols. Unified Communications are likely to operate within the enterprise over an entirely IP network because IP provides better control of bandwidth than traditional circuit-switched networks for voice and video. An application platform is still needed. It has a directory to manage personal profile information and that acts as a bridge between the circuit switched and packet switched infrastructure. Other convergent service applications can then be easily added to this basic structure. With the directory in place, advanced functions such as the use of a 'single number/find-me' are possible.

An important component of the UMS in a fully converged environment will be the insertion of intelligence into the call or message path using agent technology. This will be a key identifying characteristic of the UMS of the future. We can identify two types of agent, a Personal Agent and a Network Agent, which will be used to provide end-station and network intelligence respectively. A personal agent will operate on a unified inbox and manage all incoming and outgoing calls calls, messages and other data. It will know about the user's profile, manage the user's interface to the network, provide the user with access to network services and content through different terminal types and perform other useful functions on the user's behalf. Network agents will perform specific functions on behalf of a network provider, acting as a management agent to monitor network resources, collect useage data for billing, provide troubleshooting functions, interface to new services from other providers may be used to maintain knowledge about available net services and content, manage access to and provide access to and control of network resources.

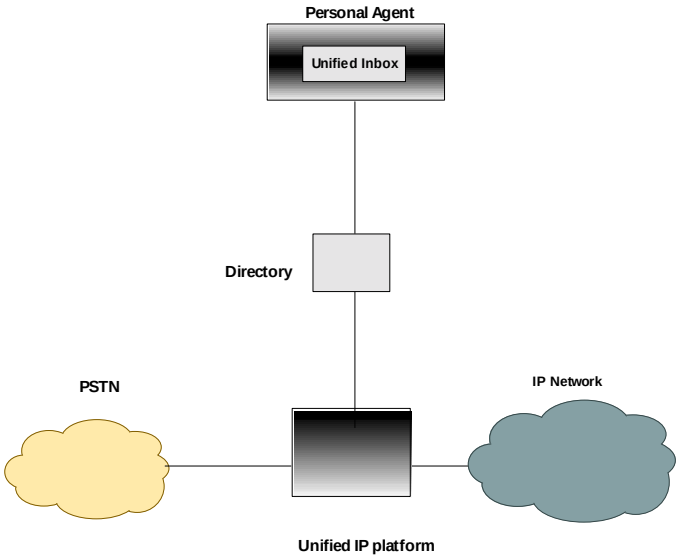

Figure 7 A Unified Communications Architecture for Integrated Messaging

Unified Communications is likely to make use of a Distributed Architecture approach which separates the media processing requirements of the application out into an external media server. The application server will retain all the logic required to execute the application and one or more media servers will be responsible for prompt intensive processing functions such as playback. The Application Server will use an advanced call and media control protocol like SIP or Megaco to control the media server. The placement of the intensive processing away from the application server will mean that far fewer CPU resources are required on the application server for each session. This architecture is highly scalable – media servers can be racked and stacked. Once again, this architecture will require a considerable effort in reworking the middleware required.

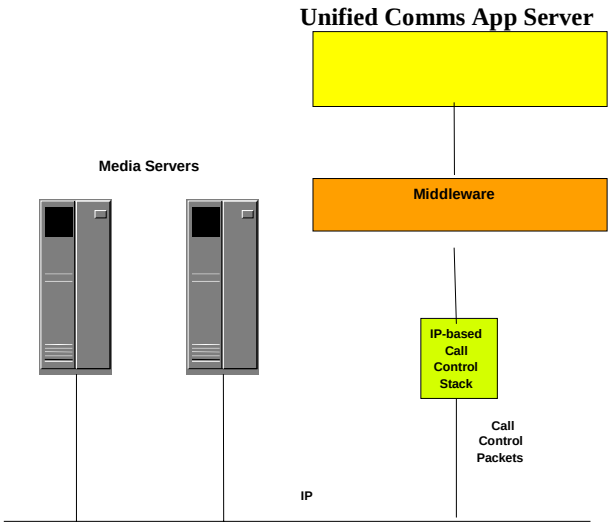

Figure 8 Telephony in a converged Unified Communications Architecture

6 Emerging Technologies that will accelerate UM

Emerging interfaces and technologies are rapidly evolving which will accelerate to UM development. Some of these are:

VoIP

Voice over Internet Protocol (VoIP) provides the capability to make a telephone call, route a call and transfer the call content over the Internet, thus providing an alternative to a traditional telephone call to anywahere in the world, but at a local toll rate. With mobile technologies such as EDGE, VoIP will also be available over mobile phones in 3G and even advanced 2.5G mobile networks.

VoiceXML

Voice Extensible Markup Language (VoiceXML) is an open standard for voice recognition and allows a user to access web based information through a voice interface. This Interactive Voice capability enables a user to navigate and retrieve non-voice related material through a voice-oriented end station, such as a phone or while on the move. It will therefore be a key access enabler.

SIP

The Session Initiation Protocol (SIP) is designed for an environment that is completely IP-based. It provides a framework for developing an enriched user experience by managing applications across a network e.g. SIP can be deployed over the internet to provide the advanced management of voice calls between any IP-compatible terminals (mobile, PDA, telephone, Workstation, etc.).

Multimedia Calls

Protocols are continuously being developed that will improve the capability to conduct real-time streaming of audio and video across the internet connection. This is particularly challenging over the limited access bandwidths of the mobile network. Multimedia Service (MMS) is providing the capability to combine multimedia in a single message.

7 Applications of UMS

The fundamental function of a UMS is clearly to manage communication using messaging from disparate systems using a single inbox. The most obvious applications arising from this might be classified as 'Contact' applications and could include the following:

Contact Applications

- Unified Contact Applications
- Telemetry Applications with Monitoring and Intelligent Alerts
- Intelligent Call Centre Applications
- Emergency/System Response Applications
- Message Filtering Applications

An implicit byproduct of UM is the use of a common directory service for all communications i.e. a unified directory service. The type of applications arising from these are:

Unified Directory Applications

- Enterprise Directory Applications
- World-wide Directory Applications

Whereas these two types of application are useful in their own rights, it is more likely that UMS will gain wider acceptance as a service that enhances other group-oriented applications which require the sharing of information and coordination of activities. Typical unified groupware applications might include:

Unified Groupware Applications

- Intelligent Information/Database Sharing applications
- Dynamic Group Diary/Scheduling applications
- Distributed Groupware Applications
- Distributed Decision-Making Applications
- Remote Learning Applications
- Virtual Office, Learning and Social Environments

8 Conclusions - The Future of UM

Evolution of Communications towards IP

The telecommunications world is making a shift away from traditional circuit-switched technologies towards a more open packet-switched infrastructure based on IP. IP based communications provide better control of bandwidth than traditional circuit-switched networks for voice and video. The traditional weaknesses of IP for real-time communication are being overcome with the emergence of advanced protocols such as MPLS which will support multimedia traffic with the varying classes of service required for mixed traffic over routed networks. This does not mean that the Internet will replace the telephone network in the foreseeable future, if ever. Nor will mobile networks become simply a way to transport IP traffic. Rather, the convergence of these technologies will be increasingly leveraged to provide enhanced services over IP.

Emergence of UM

The development of UM services has been limited by the proprietary nature of legacy voice systems, reliance on circuit witching and the lack of intelligence in both end devices and in the network. As a result of convergence towards open standards and APIs, UM is now gaining momentum. UM is not a new product but rather a set of resultant capabilities that seeks to leverage the individual benefits of the different networks in order to deliver new services which operate across all of them. Whereas the problem of integrating legacy networks based on traditional circuit-switching will remain with us for some time , the move towards VoIP in the enterprise will serve as a major catalyst in the adoption of UM.

Placement of services

Most companies provide voice calls, voicemail and email through on-site equipment. These are the critical components of unified messaging and indicate that UM services are most likely to be provided within the enterprise. The likely integration of UM with collaborative and workflow applications reinforces this view. For the mass market, the UM service will be provided through a service provider. Market forecasts indicate that the demand for unified messaging will grow significantly in the short term.

Open Platform with Components

For enterprises interested in Unified Messaging, it is becoming more important to take cognisance of convergence when making architectural choices. The convergence towards standard interfaces and open APIs is leading to the decoupling of established proprietary system hardware and software components. Core functionality previously associated with proprietary systems can now be developed as components for open platforms. Functionally optimised components can now be provided by vendors with different specialisations. This component-based strategy and the requirement for open API compatibility makes Java an appropriate choice for the development of UM services.

Approaches and Architectures

Current approaches to UM implementations tend to be based on either the Email or Voicemail paradigm. This limits the UMS to non-real-time messaging. Emerging UMS will leverage partial convergence, and in the future possibly Unified Communications, in order to provide a truly unified messaging experience for the user - an experience that includes comprehensive real and non real-time communication. Architectures are likely to be based on a set of distributed components, developed around open standard interfaces and APIs.

Applications

UM services will provide contact and directory applications and become integral to groupware and workflow applications. It will use intelligent messaging agents to help organise and route messages based on user-defined rules.

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