

Unified Messaging: A System for the Internet

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ABSTRACT

Unified Messaging is gaining prevalence with the convergence of the telecommunication and the computer technology. Unified messaging refers to the ability to allow user to receive faxes, voice-mails and emails in one personal mailbox. Individuals can then access the mailbox anytime and anywhere through the web or the PSTN. This paper provides an overview of unified messaging and documents the design and development of a unified messaging system over the Internet. The system allows registered users to send email, voice-mail and faxes to other registered users. Users can listen to their emails and get delivery reports on the faxes sent out. The system is fully extensible and is developed based on standard Internet protocols. Hence the system can be easily deployed by small and medium enterprises. The paper also examines the benefits of unified messaging system to corporate users as well as the technical consideration in deploying such system.

Keywords: Unified messaging, email, voice-mail, fax, Internet

1. INTRODUCTION

Messaging is an essential aspect of human communication. In today's world, human beings rely heavily on messaging to communicate with one another. The most important quality of messaging that makes it extremely vital is the fact that it fills the void in human communication. This void arises due to immediate unavailability of the receiving party.

Messaging in the business world exists primarily, as electronic mail, voice-mail and facsimile. As more and more people get connected, the volume of messaging goes up tremendously. Hence, it becomes imperative that the messaging needs of this ever-growing connected community are met. The messaging solutions should provide a framework that allows convenient access, reliability and efficiency.

As businesses grow, their employees need to be on the move more often. In recent years, the number of travellers has increased exponentially. This is because of better facilities in travel and travellers who are more curious. The traditional ways of messaging have to catch up with this new phenomenon of global travel.

Several people feel that they need a system that will allow them to maximise the benefits of messaging. This will enable them to do their work in a more efficient manner and also translate to saving money, thus evolving the concept of unified messaging.

Section 2 will provide an overview of unified messaging and the current status of the technology. Section 3 will examine the benefits of unified messaging to corporate users and the technical issues pertaining to the deployment of such systems. The architecture of the unified messaging solution over Internet is covered in Section 4. Section 5 describes the implementation of the system. Section 6 concludes the paper.

2. UNIFIED MESSAGING

The advances made in the telecommunications and computer technologies have brought about new paradigms in the human communication as well as the way business is conducted. Unified messaging is a result of the merging of these two technologies.

2.1 Overview

Broadly speaking, unified messaging can be defined as a system that allows users access to all of their messages, regardless of location, communication device or the type of connection used.

Unified messaging is a simple, yet extremely powerful concept. An individual's communication environment is constantly changing. The amount of information and the respective sources are constantly increasing. Users should be able to listen to voice messages, view documents or faxes on screen, send faxes, create emails and manage information in the manner most appropriate to their communications universe - be it in the office, at home or on the road. Unified messaging enables users to see, hear, send, store or retrieve all of their messages with any tool which is more conveniently available. These tools include the telephone, desktop, personal computer or laptop.

It is no surprise that unified messaging saves time and money. The fewer devices you need to access to send, retrieve and store messages, the more efficient you can be. The power of the Internet is limitless. With the Internet now at our fingertips, unified messaging takes another leap to improve communications. Imagine how much more effective your message becomes when it is heard rather than read.

An Internet-based personal communications manager allows people to manage calls and messages from their PC. Anywhere that they can set up and dial in can become their virtual office. Business communication is now empowered by the Internet with applications transforming the computer screen into a virtual communications center. With the click of a mouse, users can listen to voice mail messages, place calls, manage speed dial lists and change telephone numbers and availability.

The Internet provides rapid and easily accessible communications whether you are around the block or across the world. But best of all, using the Internet instead of the telephone can dramatically reduce your long-

distance bills. With Internet access, employees can retrieve and send messages (e-mail, voice, and fax) on the road, without making a long-distance call to the office. That means big opportunities for your enterprise network and big savings for your company.

2.2 Current Status

Information technology research firm Ovum [OVUM98, NEWS99] released a report that finds unified messaging, the technology that allows access to email, voice mail, faxes, and other information from a single tool, will grow strongly and eventually replace separate email, voice mail, and fax systems.

The report predicts that unified messaging mailboxes will grow from around 200,000 worldwide at the end 1997 to more than 110 million by 2003. Worldwide product revenue will also increase rapidly from a negligible market to a whopping \$9 billion in 2003.

Existing unified-messaging products are all struggling to achieve the full set of capabilities that we would expect of unified messaging, regardless of the product architecture employed.

Unified messaging systems have hardly become universal. The United States of America has an estimated 50 million Email users and 150 million voice-mail users, but less than 100,000 users of unified message systems that combine E-mail, voice mail, and fax, according to industry analysts.

The reason can be traced to complex technology, a lack of standards, questionable performance, and doubts about whether the pricey systems can be cost-justified.

There are two basic implementations of unified messaging, a mailbox that can include mail from various media sources and a network-based bridge between different networks that translates information into a compatible format. Since voice mail and email systems are very different beasts, it can be hard to choose a uniform set-up that works for both. The technology is also expensive. According to some analysts, the cost to deploy unified messaging applications is about US\$200 per user.

Additionally, there has been the issue of channel conflict. Usually, companies that sell computer or fax systems are different from those that sell telephone systems. As a result, most previous attempts to build integrated message boxes, especially those involving phone systems, have required complex proprietary hardware and software.

3. BENEFITS & CONSIDERATIONS

Unified messaging is a relatively new concept. It has only been brought to light recently. The reasons for this phenomenon have been partly highlighted earlier. In this section, the business benefits and technical aspects pertaining to the deployment of unified messaging will be discussed.

3.1 Benefits

Messaging is vital to any business that wants to compete for the consumer dollar in this wired world. The progress in computer-related fields and the Internet has led to the elimination of boundaries between countries and economies.

Therefore, for businesses, it is absolutely imperative that their employees receive crucial information in time. This

information can enable the employees to make that important presentation or to clinch that lucrative contract. The issue that arises here is how the employees stay in touch with the information sources. Moreover, the link between the employees and information resources has to be maintained in an effective and cheap way.

Unified messaging provides an effective and cheap solution for businesses that want to stay ahead of their competition. Even though the initial investment costs might be high and the field not much developed at this point of time, managers might want to take note of this phenomenon and plan how to incorporate it into their organisations.

There are several reasons why unified messaging is where the future of messaging lies:

a. Faster dissemination of information

Under traditional messaging, users have to check several mailboxes for their messages. Unified messaging enables the users to check all their messages through one mailbox. This eliminates the chore of checking several messages and ensures that the users can prioritise their tasks.

b. Cheaper to maintain

The costs involved per user to maintain several mailboxes for different kinds of messages are relatively high. This is particularly true for small companies that do not have the money to invest in a high-end system that will prove cost-effective in the end. Using unified messaging solutions, the cost of maintaining the messaging solution goes down considerably. This arises from the fact that all messages arrive to the same mailbox and maintenance can be carried out more easily and swiftly.

c. Reduced end user costs

At present, if a user checks all the messages from different mailboxes, he accumulates costs for each operation. Moreover, he also has to pay for checking messages even if all of them are of low priority. On the other hand, using a unified messaging mailbox, he can check all his messages at the same time. Also, he can ignore messages that are of lower priority.

d. Notification of new messages

Under traditional messaging systems, usually there is no way of finding out whether there are any messages except actually logging into the mailbox. Under unified messaging, logging into one mailbox allows the user to check for any new message – email, voice mail or fax.

e. Sender's ease of composing a message

The business world has not yet found a way to replace a signature by electronic means. Therefore, the facsimile remains pivotal in business communications. Hence, usually a sender of a message needs to send messages in different forms to make sure that the message is clear. In doing so, the sender requires information about the receiver regarding the various mailbox addresses. Also, to make the message complete, the receiver needs to receive all the messages together. In traditional messaging, there is no way to compose a single message with different components and make sure that the receiver gets the intended information in totality. In unified messaging, the sender can choose what components he wants to include in the message and send it to a single mailbox. The receiver gets the message as a single message with different components. The receiver can access all these components simultaneously and get a more appropriate

picture of the message the sender intended to send.

f. Security

Facsimile is an inherently insecure way of business communications. This is because the facsimile is sent to a machine that is usually allowed access to several users. Unlike email and voice mail that require passwords access, obtaining a facsimile not intended for one, is easier. However, in unified messaging, all components of the message are protected by passwords or some other security mechanisms like encryption.

g. Ease of use and flexibility

In today's world, numbers or addresses increasingly define our identity. Should a person need to communicate with another, he needs several identification parameters depending on the form of communication. In unified messaging, having a unique identification parameter that allows people to communicate in different forms is made possible. This makes communications easier. Also, for users, not having to bother with checking several mailboxes and remembering different methods to access them is a benefit provided by unified messaging.

3.2 Technical Considerations

With the advent of the Internet, messaging has become much more powerful and useful. With facilities like electronic mail and bulletin boards, users can stay updated with the latest information that is crucial to the company.

Messaging in the form of voice mail is provided using computer-telephony. Using the powerful features of today's computers, a richer set of functionality is provided to the

user. In big corporations, computer-telephony systems have been used for a long time.

Facsimile, as mentioned before, is currently the only widely accepted means of communication involving signatures. Usually, facsimile solutions consist of a facsimile machine that connects to a telephone line. This machine can send and receive messages. However, this machine does not have any store facilities and usually the message received is printed on paper. The responsibility of ensuring that the message does not fall into the wrong hands lies with the receiver.

In developing unified messaging solutions, the following technical issues must be considered:

a. Speed of retrieval

The user should be able to retrieve all the messages (email, voice, and facsimile) fast and in real time. That translates to the architecture being capable of accommodating different message formats. Also, the architecture should be able to handle inter-conversion between different message formats. This will allow the user to get all the messages in a fast and efficient way.

b. Inter-conversion between different formats

Traditional PABX systems communicate in a different format than the Internet. The hardware that integrates these two systems is the ubiquitous modem. Using a modem and an enabled computer, the user can send and receive electronic mail and facsimile. Also, the computer can act as a call centre and allow callers to leave messages for the user. The challenge lies in the integration of this standalone computer,

the Internet and the PABX.

c. Database design

Both voice and facsimile data differ from standard email in a very important aspect. While standard email uses text for message, both voice mail and facsimile usually use a non-textual format. Hence, to provide a single mailbox, as per the requirements of unified messaging, the database that is used to store the data must be able to handle different formats. There are several ways in which this problem can be solved. Object-oriented databases provide one of the best solutions. Of course, standard databases can also store these messages by just storing the location of the non-standard message contents. The database has to be easily maintainable and therefore should be simple enough to allow further expansion. Also, to minimise overheads in message retrievals, the database schema should be kept as small and tight as possible.

d. Security

Electronic mail security is usually provided using passwords. Voice mail is made secure by allowing the user to choose a numeric password that can be entered over the phone. Facsimile is inherently insecure and there are no password schemes that can protect a message. The only way to make a facsimile message secure is to restrict access to the machine itself. Unified messaging solutions need to address the different security methods for each message format. The users should be able to adapt to a new system with minimal changes. Therefore, an overall security scheme is required on top of the individual security schemes of each message format.

e. Use of new technologies

Unified messaging is a relatively new

concept. Therefore, this field is constantly evolving. Solution providers like Microsoft have already integrated the basic application interfaces like TAPI, MAPI and SAPI, in their servers. Also, Java programming language promises several new enhancements in its upcoming version. This will make unified messaging a very important and realisable concept in the near future. It is imperative for anyone who wants to develop unified messaging solutions to follow the market trend. This will enable the developer to develop a product that is accepted and viable.

f. Standardisation versus Exclusiveness

At present, most unified messaging solutions available in the market require purchase of proprietary equipment. Also, most solutions require the installation of special software if the user wants to access the mailbox over an open standard like the Internet. As unified messaging grows in popularity, it is likely that most vendors will port their solutions to a standard like the Internet. Therefore, for new vendors it makes good business and technical sense to explore the standardisation of protocols so that the transition from existing messaging systems to the unified messaging system is painless.

4. ARCHITECTURE

The architecture is designed to support unified messaging with primary access over Internet. In addition, provision is made to allow limited access via the telephone. In the latter case, certain functions such as composing email messages and listening to fax messages sent via fax machines rather than the Internet will not be supported.

A client-server architecture is adopted for the design. The architecture deals with

the three components in unified messaging, namely, electronic mail, facsimile and voice mails. The architecture comprises the following main entities:

- Client Browser
- Web Server
- Database System

- Message Management Modules (Email, facsimile, voice mail modules, registration module)

Figure 1 shows the architecture of the unified messaging system over the Internet.

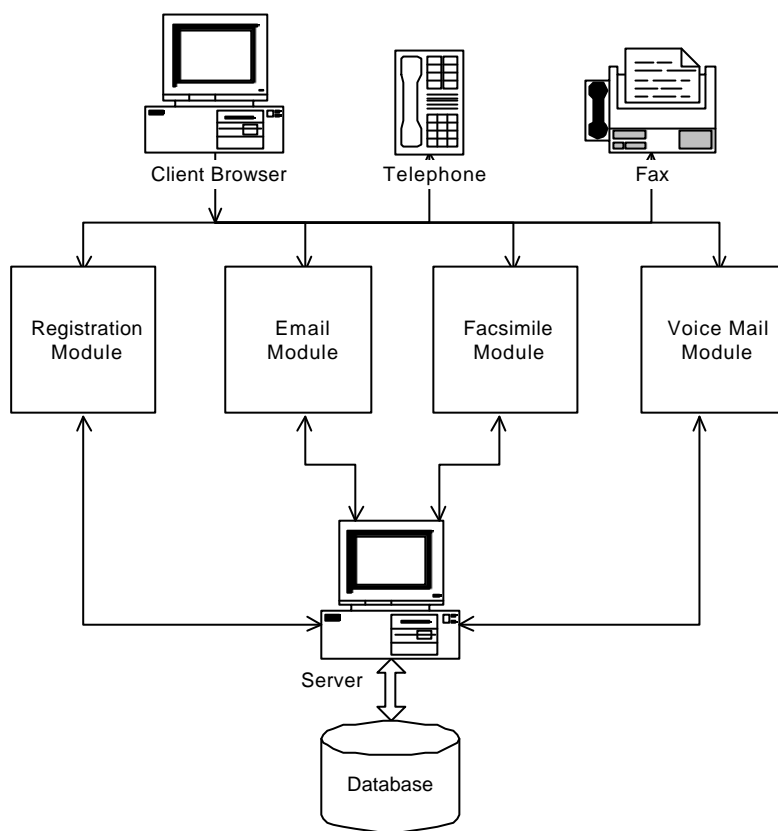


Figure 1. Architecture of the Unified Messaging System

4.1 Client

The client is basically a web browser as it is used as the primary means for the client to access the unified messaging mailbox. The use of the web browser has the advantage that no special software or hardware needs to be installed in the client machine. The only requirements are a web browser and Internet connectivity.

4.2 Server

The server comprises the web server, the database and the message management modules.

Web server is used to provide an interface to the client browser. It is also responsible for transferring the information entered by the user to the system database and allowing user to retrieve the messages over the Internet.

System database stores the information about the user and information needed for routing of messages. This information is the various identification addresses of the user: email, phone and facsimile numbers. Mail messages are also stored in this database.

Message management modules manage the receipt and retrieval of the three different types of mail messages. Messages can be received from either the Internet or the PABX. Received messages are stored in the database and retrieved according to the mode of retrieval selected by the user. User registration is also handled here.

5. IMPLEMENTATION

Figure 2 shows the block diagram of the implementation. The unified messaging

solution is hosted on a Windows NT [WINNT] server that allows the full benefits of the architecture to be realized. Internet Information Server 4.0 [IIS4] was used as the web and SMTP [SMTP] server. Active Server Pages [ASP] and Active Data Objects [ADO] were utilized for providing the necessary programming logic for the entire application. SQL Server 6.5 [SQL65] hosted the message database and Visual Basic 5.0 [VB5] was used to develop the text-to-speech application and the fax server application. Perl [PERL, PERL2] was used to provide file upload utility. The design of the web pages was done using Microsoft FrontPage 98.

The primary mode of access for this unified messaging system is via the Internet. Users simply log into the URL of the server to leave and retrieve messages. The implementation of the unified messaging architecture shown in Figure 1 is essentially broken down into three areas, namely, the message and web server, the database and the message management portion.

5.1 Message and Web Server

The message server doubles up as a web server to provide an interface to the client browser as well as being responsible for transferring the information entered by the user to the system database.

5.2 Database

The database is the centre of all transactions that are associated with the unified messaging system. It contains the user data as well as the message store. User data and information needed for the routing of messages such as the various identification addresses of the user, namely, the email, phone and facsimile numbers are

maintained. The message store contains the voice, fax and email messages. The database is designed based on the combined message approach in which all the messages (old and new), irrespective of the user, are stored in a

uniform database. This approach has the advantages of a straightforward database administration and concurrent accesses to the user's mailbox. The latter is achieved using connection pooling.

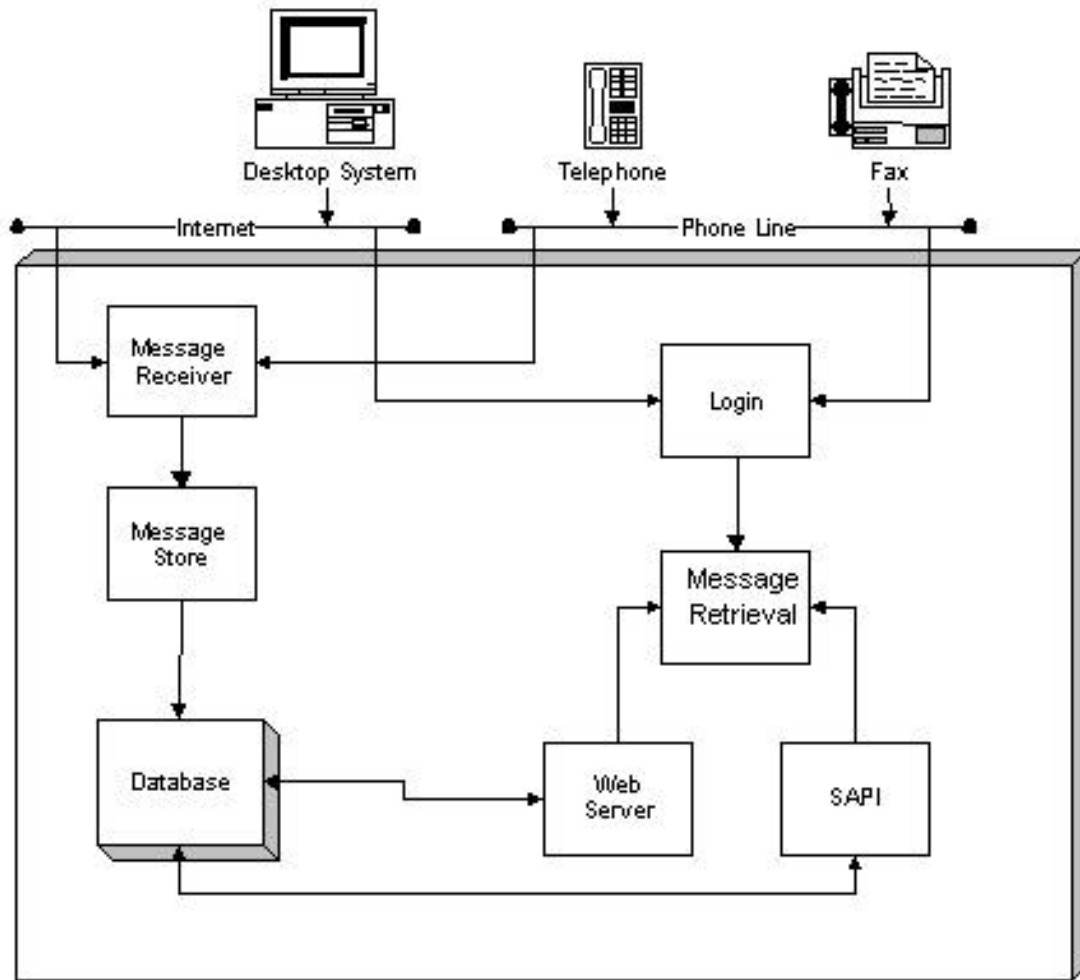


Figure 2. Block Diagram of Implementation

5.3 Message Management

Message management comprises the following:

- *Login module* allows the user to login to the mailbox using either the Internet or the phone. This module has to be able to communicate with

different systems (Internet and PABX). Therefore, it should be able

to use both the protocols in order to set a connection between the mailbox and the user.

- *Message receiver module* receives the message from either the Internet or the PABX. This module determines whether the address associated with the message is valid. It passes this message to the message store.
- *Message store module* stores the message in the system database. It first separates the message into the different components and stores each message differently for retrieval.
- *Message retrieval module* retrieves the messages for the user. Depending on whether the user has logged on from the Internet or the phone, it provides the user with options in retrieving the message.
- *SAPI* supports user login from the PABX and allows user to retrieve the messages over the phone.

5.3.1 Login Module

This module allows the user to login to the mailbox using either the Internet or the phone. The user is required to enter the username and password to access the mailbox. Access via Internet is through the login page while access via the phone is through the DTMF tones. Users enter information according to the voice prompts from the system. Login interface for the former is achieved through the web browser while the latter is accomplished using TAPI [TAPI].

The module determines whether the user is a registered user and verifies that the password supplied is valid. The result of this operation could be that the user is granted access to his mailbox or if the user enters an incorrect username / password combination, an error message results and asks the user to re-login. The concept of state prevents the user from accessing any area of the mailbox without logging in successfully to the system.

The login module also handles the registration which is the first step in realizing a unified messaging solution. It is to be noted that the registration process is designed to be carried out over the Internet. This is because:

- Validity checks on information provided by the user can be performed earlier
- Users typically prefer a visual interface
- The system is well established and the users have a gradual learning curve
- More robustness and reliability can be provided in the system

5.3.2 Message Receiver Module

This module manages the receipt of the three different messages, namely, email, fax and voice messages.

- Email

Delivering electronic mail over the Internet is relatively straightforward and widely established. The email receiver receives email messages from the Internet and passes them to the Message Store module. At present, it is to be noted that only

Internet mail is considered feasible. Email composed directly from the phone or the facsimile machine is not feasible due to lack of an interface that will allow the user to see the message entered.

- **Fax**

Sending a fax involves using a fax machine to scan a document and then transmitting the scanned image via PSTN lines to another fax machine. A unified messaging system should provide for faxing by allowing users to send faxes on the Internet and using a fax machine.

The fax receiver module interfaces to a fax machine via a TAPI interface and through the web browser in the case of Internet faxing. Sending faxes from fax machines requires the issue of identifying the destination fax number [LEO] to be addressed. In this system, optical character recognition (OCR) technology that recognises the recipient's fax number is used as well as using interactive voice response to prompt sender for destination fax number entered via Dual Tone Multi-Frequency (DTMF) tones from the telephone keypad. Moreover, the user is also able to fax over the Internet using a web browser and upload scanned images of the documents to be faxed.

- **Voice**

Traditionally voice mail is delivered over phone systems. However, with the high costs of overseas phone calls, the possibilities of retrieving the voice mail over a relatively free system like the Internet is attractive. Hence the system can receive voice mail from the phone as well as the Internet by allowing users to compose voice message on their computers. This module receives the message and passes them to the message store module. For voice mail, the

SAPI [SAPI, SAPI4] module shown in Figure 2 is not required.

5.3.3 Message Store Module

The message store module handles the storage of email, fax and voice messages and stores them in the message database. It first separates the message into the different components and stores each message differently for retrieval. It also ensures that multiple copies of the same message, which has been sent to multiple recipients, are not being stored to optimise storage space.

Email message is stored inside the message database. Voice files are binary files and the voice messages are stored on the server's file system and the respective links are updated in the message database. Fax messages are stored in two ways, namely, as text files if the user enters the message using a web browser or as binary image files if the fax message is acquired using the fax machine.

5.3.4 Message Retrieval Module

This module controls how the 3 types of messages are being retrieved from the system database. The different types of mail messages can be retrieved in two ways. They are retrieved over the Internet using a web browser or over the phone. If the user logs on from the Internet, then this module allows the delivery of email, fax files and audio files over the Internet. The voice message, in this case, is heard over the speakers of the client's native audio system. If the user logs on from the phone, then the user will listen to the voice messages using a combination of TAPI and SAPI. Email messages and fax messages sent via the web browser can be accessed via the phone in similar manner. Non-texture messages such as fax mails sent via fax machines cannot be retrieved using

the telephone. This is due to the fact that the text-to-speech engine in SAPI does not have the optical character reading capability to recognise and read out the faxed images.

5.3.5 SAPI Module

If the user is logged on from the PABX, the SAPI module allows the user to retrieve the messages over the phone. Email and fax messages sent via web browser are read out to the user. This is accomplished through the use of a text-to-speech engine in SAPI.

5.4 Snapshots of the Unified Messaging System

Figure 3 shows the unified mailbox of a user. This screen snapshot provides a summary of each of the different types of messages the user has. The user can click on any link to view that category of messages. Figures 4, 5 and 6 show the screen snapshots of sending voice mail, fax mail and retrieving a voice mail respectively.



Figure 3. Snapshot of a Unified Mailbox

UniMail - Unified Messaging System Login as [paul@uni@mail.com](#) [Send](#) [VoiceMail](#) [Fax](#)

[Check Mail](#) [Send Email](#) [Send VoiceMail](#) [Send Fax](#) [Options](#) [Logout](#)

New Message

Send to

Subscriber:

Subject:

*Record your message here by launching the sound recorder.
If you cannot launch the sound recorder, please follow the following procedure:*

1. Click on Start menu
2. Choose Programs -> Accessories -> Multimedia -> Sound Recorder
3. Record your voice message and save the file in a convenient location
4. Upload that file by clicking on "Browse" button below and selecting the file from its location

File Name:

Figure 4. Screen Snapshot of Send Voice Mail

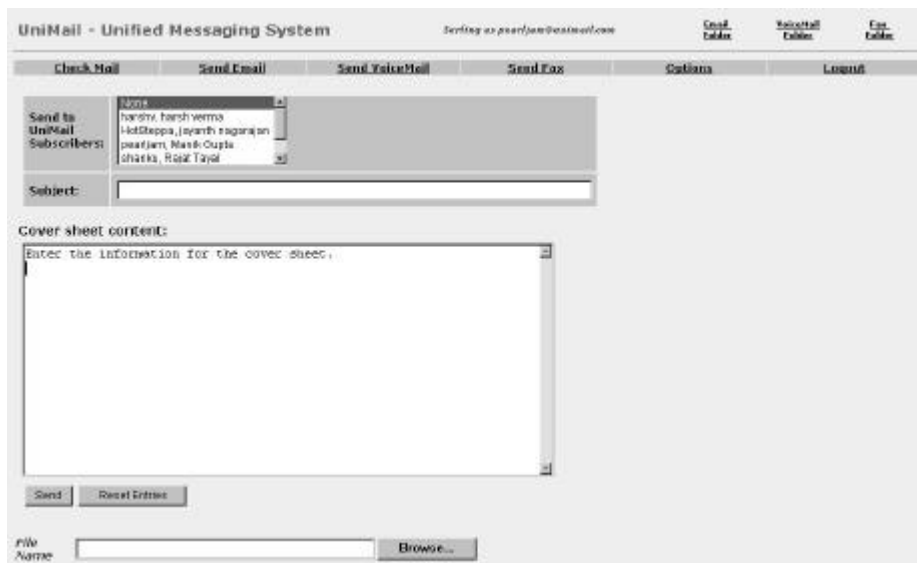


Figure 5. Screen Snapshot of Send Fax Mail



Figure 6. Screen Snapshot of Voice Mail Playout

6. CONCLUSION

This paper provides an overview of unified messaging system and examines the business benefits and the technical issues of deploying such a system in an enterprise. It also proposes a unified messaging solution which utilises current Internet and networking technologies which are readily

available in today's corporation. As such, the proposed unified messaging system is suitable for deployment in small to medium-sized corporations with minimum overhead and investment in equipment and resources. Employers on the move can still access his unified mailbox so long as there is Internet connectivity and a web browser on his notebook.

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