Extending the Reach of the Internet Through Paging

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Abstract

This paper describes a technique implemented for the integration of paging networks with the Internet through electronic mail.

Pager subscribers are assigned standard Internet e-mail addresses. When a message is received for such a subscriber, he/she is immediately informed via the pager by a concise radio message. The actual e-mail message remains at the e-mail server until the subscriber retrieves it.

The growth of the Internet and that of the paging industry has been rapid and widespread, though independent of each other. Also, different communities have come to be served by each. With the technique described herein, a small, cheap pager receiver will not only be part of a global network, but it will also extend the reach of the Internet to an entirely new community.

1 Introduction

Of the multitude of services available on the Internet, electronic mail is by far the most popular. The Internet community has an e-mail infrastructure which is rich and widespread [2]. This infrastructure offers a variety of services from simple personal messaging to exotic multimedia applications. The infrastructure connects commercial, government and educational sectors in every continent of the world, with end-user equipment with vast differences.

Paging is a simple, one-way radio messaging system which allows continuous accessibility to someone away from the wired communications network [1]. The subscriber carries a palm-sized, low-cost receiver which can receive messages via the paging network. These messages may be of the forms *alert, tone, numeric* or *alphanumeric*. The introduction of more sophisticated products such as cellular phones and other multi-function communicators have spurred the paging industry to provide more value-added services and to improve pager design to remain competitive.

Some such value added services are voice mail, faxes, electronic mail and business and financial news services. Several value-added applications are described in [2], [3] and [4].

1.1 Electronic Mail Services in Sri Lanka

Technologies such as telex and fax have been popular in Sri Lanka for many years. However, computer-based communication such as e-mail has gained tremendous popularity in recent years, mainly due to its ease-of-use, efficiency and speed.

A few individuals and organizations have obtained and use accounts in several foreign e-mail services such as Compuserve, AT&T Mail and MCI mail, but this has not become popular due to the expense of having to make international phone calls to log-on to a remote host to access such services.

A dial-up Internet electronic mail system was first set-up by the academic sector in 1990 [5]. Subsequently, several commercial organizations have started offering similar store-and-forward e-mail services. Several governmental and commercial organizations are now in the process of setting up on-line connections to the Internet.

An illustration of Sri Lanka's e-mail connectivity is shown in Figure 1. There are two main types of e-mail service providers, academic institutions and commercial organizations. Many individuals, businesses of varying sizes, non-governmental organizations (NGOs) and academic institutes use e-mail extensively today to communicate with relatives, partners and colleagues in all parts of the world. It is estimated that there are about 400 organizations outside the academic sector using e-mail regularly.

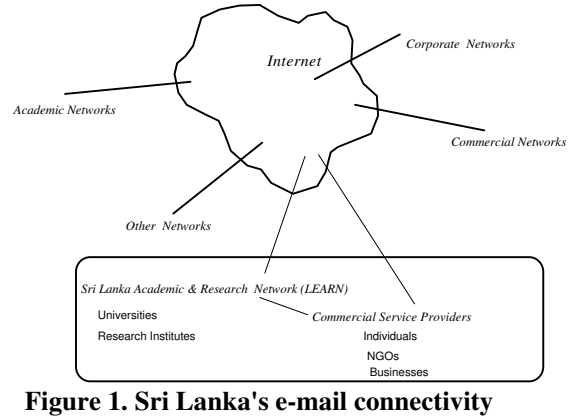

Figure 1. Sri Lanka's e-mail connectivity

However, leased telephone lines are still a costly luxury in Sri Lanka. Therefore, a majority of these users dial-up the e-mail service provider's host to send and retrieve e-mail messages. Therefore, most subscribers do not receive either local or international messages instantaneously.

1.2 Paging Services in Sri Lanka

In Sri Lanka, paging is growing as an alternative solution to daily communication needs. The many service providers are expanding their networks to cover many areas of the country. The uses of paging services range from communication between parents and children to that between hospitals and doctors. Financial information such as stock market data, sports updates and flight information are other types of information that add value to paging systems.

An automatic paging system is shown in Figure 2 below.

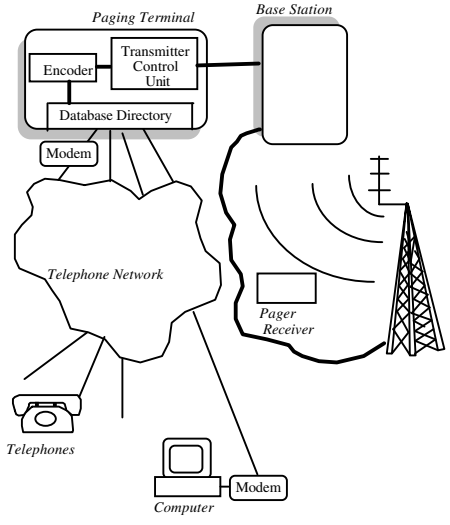

Figure 2. The operation of an automatic paging system

The paging terminal in an automatic paging system answers a telephone line and allows users to call it using the public telephone network, enter the destination pager number followed by numeric or voice messages. This can also be accessed by a computer via a modem to transmit text messages through the paging network.

In normal operation, once the paging terminal receives a call, it prompts the caller for the destination pager number, and then verifies it with its internal subscriber database. Then, the terminal prompts the caller for the message and sends it to the encoder which encodes the message in the proper format. The transmitter control unit monitors the channels and sends the encoded messages to the transmitter at appropriate times.

In the more common manual (operator assisted) paging systems, the functions of the paging terminal are carried out by human operators. However, paging systems in general allow both operator assisted as well as automatic access. We use the automatic access facility in implementing our e-mail/pager interface.

2.0 Integration of E-mail with Paging Networks

The concept of our integrated e-mail / pager system is shown in Figure 3.

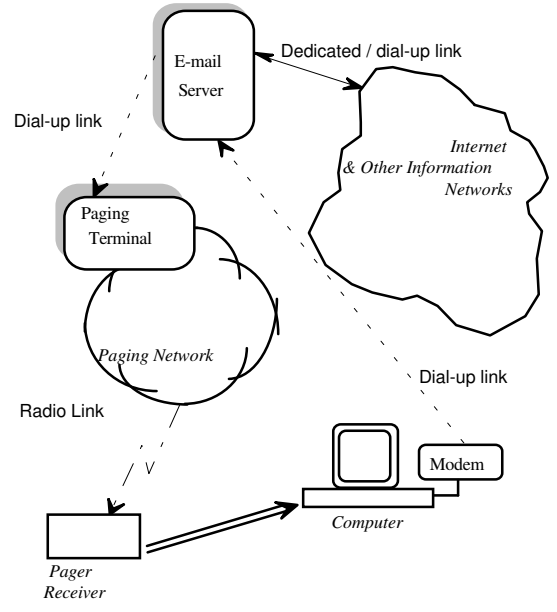

Figure 3. An overall view of the e-mail / pager interface

2.1 Message processing at the e-mail server and the paging terminal

In this implementation, each e-mail / pager subscriber is given an Internet e-mail address by the service provider. The software on the e-mail server scans every incoming e-mail message for the recipient.

If a message arrives for an e-mail / pager subscriber, a short paging message is automatically prepared including the sender's name and the subject of the e-mail message. The recipient's pager number is looked up from an internal database and the paging message is encapsulated with this and other information required to access the paging terminal. Then the e-mail server dials up the paging terminal and transfers the message. This sequence of events is illustrated in Figure 4.

The paging terminal then extracts the message and transmits it via its radio network. The destination pager will receive this message and the subscriber will know immediately that he has an e-

mail message, it's sender and the subject. He can then retrieve the message by dialing up the e-mail server in the normal manner at his convenience.

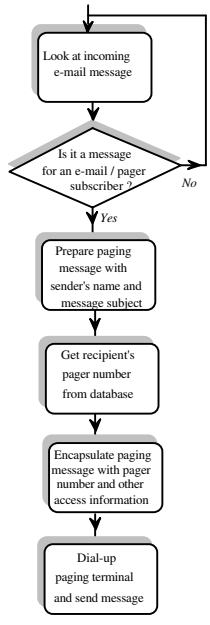

Figure 4. The sequence of operations at the e-mail server

2.2 Communication between the e-mail server and the paging terminal

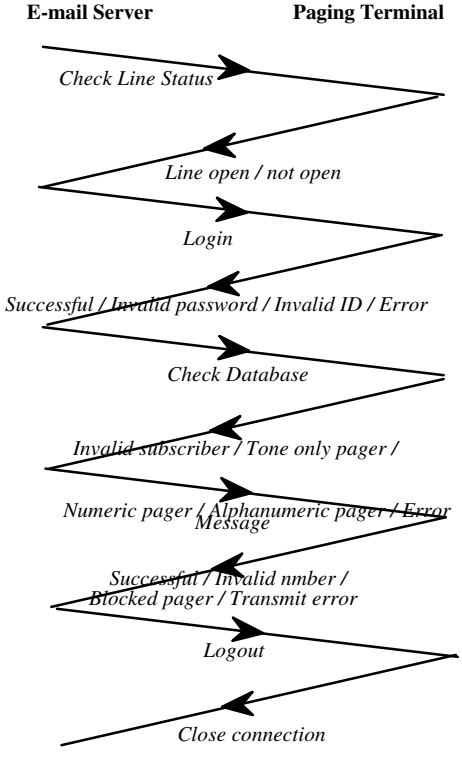

Figure 5. Communication protocol between the e-mail server and the paging terminal

The communication is carried out by asynchronous modems at either end. The communication protocol consists of several commands transmitted by the e-mail server to the paging terminal and corresponding responses from the paging terminal indicating the success or failure of each command.

Figure 5 shows a summary of these commands and responses.

3 Advantages and constraints

3.1 Advantages

The main advantage of this technique is with respect to the paging service. It adds value to paging services by extending its accessibility both nationally and internationally. An e-mail / pager interface allows people to contact each other and exchange information, even when they are away from their normal place of work. Moreover, the involvement of a pager in the communication process is transparent to the sender of the information who simply sends an e-mail message. The increased accessibility that is achieved requires no additional investment into infrastructure.

The mobility provided by the pager is a significant advantage from the point of view of information networks and their users. A subscriber who is constantly on the move can use this technique to supplement his e-mail access without incurring the expense of a wireless modem or a radio mail system.

For e-mail users, this technique provides a way of immediate notification of the reception of important messages or information. The alternative is to have a dedicated connection to the e-mail host which may often be unavailable or prohibitively expensive. With this technique, a pager and a subscription to a paging service provides an economical supplement to the basic e-mail service.

3.2 Constraints and some solutions

The constraints of this system are mainly due to the bandwidth restrictions and the one-way nature of paging services.

Currently, paging systems transmit at 512 b/s. Transmitting a long message over a paging network may unduly overload the system and block other user traffic. Hence, only a concise summary is transmitted. Therefore, the recipient has to dial-up and actually retrieve the message from the e-mail server. However, if the entire message can be transmitted, it would be a significant advantage. One possible method of overcoming this drawback is for the e-mail server to initiate a notifying

message immediately on reception of the message in the normal manner, and the actual messages assigned various priority levels and transmitted at times when the traffic on the paging network is expected to be low.

Another constraint in transmitting entire e-mail messages to a pager is its limited display and storage capacity. A long message is difficult to read on a small pager display, and the storage capacity may not be sufficient to store long messages for later retrieval. As a method of overcoming this difficulty, a pager / PC interface has been developed. A pager receiver is attached to the PC interface, and the messages received are stored on the PC as they arrive.

A pager, not being equipped with a transmitter has no way of originating e-mail messages or even acknowledging the receipt of one. As a partial solution to this problem, the communication protocol between the e-mail server and the paging terminal includes status information after the message is sent to indicate whether the message has been transmitted successfully. The e-mail server, on receiving this information is able to send the same to the sender of the message. However, this does not guarantee that the recipient has received the message, since the paging network has no way of knowing whether the pager was activated at the time, or if the user was actually carrying it at the time.

4 Enhancements

The most common applications for this system are:

1. To provide users who have only a dial-up e-mail connection the ability to receive instant notification of incoming messages.
2. To alert mobile users of the receipt of an e-mail message.
3. To allow the delivery of short messages directly via an (alphanumeric) pager.

While all of the above are possible with the current system, the following enhancements would make them more useful.

1. Connecting a pager to a computer, together with software to initiate a call to the mail server whenever the pager notifies the receipt of an e-mail message.
2. For mobile users, the interfacing of the e-mail system to a voice mail system (which already exists in many paging systems) would allow the retrieval of messages via a normal telephone, and eliminate the need to carry a portable computer and a modem.

4.1 Mail filtering

One of the major drawbacks of using the paging system for e-mail (other than its one-way nature) is the limited bandwidth of the paging channel and the pager user-interface. The "typical" e-mail message is too long to be transmitted economically over a paging channel, and to be viewed comfortably on a pager. In addition, many people receive large numbers of e-mail messages, and would not want to be disturbed each time a message is received.

Our system has some rudimentary rules for deciding on what part of the message to transmit, based on the capability of the pager. Subscribers may also be provided with two e-mail addresses, one of which activates the pager and the other which simply places the message in the mail box, without a real-time alert. They could then instruct senders to send only urgent messages to the former address.

To provide more control over the messages transmitted, this system could be extended along the lines proposed in [6], to provide rule-based mail filtering, storage and forwarding.

5 Summary

This paper illustrated an implementation of an e-mail / pager interface. Such gateways between the two types of systems are in operation in many parts of the world. This type of an interface is especially relevant to a country like Sri Lanka where on-line access to information is still not cost effective for many users. Most e-mail users have dial-up access, whereby it is not possible to receive a message instantaneously. This technique allows immediate notification of the reception of a message through a paging network.

An overview of the operation of electronic mail and paging services in Sri Lanka was provided, and the implementation of a gateway between the two systems was described in detail.

This technique extends the reach of a part of the vast amount of resources on the Internet and other information networks through electronic mail.

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