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An Electronic Secretary

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SUMMARY

This paper describes an electronic mail system which has been implemented to provide facilities for the receiver as well as the sender of electronic mail. As well as the usual mail creation, transmission and filing operations, the system allows the receiver to specify automatic redirection of mail, and provides classification facilities so that the order of mail presentation is under the receiver's control. The system also includes an automatic mechanism for acknowledging mail and for cancelling mail which is either out-of-date or which was sent in error. The model on which the system is based is a non-automated office, so analogues of waste paper baskets, etc. are provided.

KEY WORDS Electronic Mail Office automation Electronic information exchange

INTRODUCTION

In a perceptive editorial in the *Communications of the ACM*, Denning[1] remarked on some of the problems posed by the introduction of electronic mail systems. These problems arise because it is easy and cheap to send mail to many different users even when that mail is only peripherally relevant to their interests. Existing electronic mail systems, such as that described by Gardner,[2] are geared towards the creation and transmission of mail and do not usually provide facilities which allow the receiver to control the presentation of mail. As a result, users of large-scale electronic mail systems may be presented with much more mail than they actually want and cannot decide for themselves how mail should be presented to them.

We believe that these problems of electronic mail systems are a result of the evolution of these systems from very simple message-passing procedures which are an inherent feature of most time-sharing computer system. These systems are designed for transmitting short messages and the users are, generally, colleagues or friends. As a result, the majority of electronic mail systems do not take into account how non-electronic mail is actually handled in most organizations.

In designing our system, we deliberately avoided basing its facilities on existing mail systems such as the Unix MAIL[3] command. Rather, our system, which we call the Electronic Secretary, is based on a model of a human secretary and office system and simulates, to some extent, how non-electronic mail may be handled by a personal secretary.

The responsibilities of secretarial staff vary from organization to organization but, in all cases, their mail handling functions are not merely confined to mail distribution. Some of the tasks which a secretary might undertake are:

(1) *Mail redirection.* If the individual to whom mail is addressed is on holiday or on a business trip, he or she may tell the secretary that all mail is to be handled by

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some other person in the organization. Alternatively, he or she may tell the secretary to filter the mail and pass urgent mail or mail on particular topics to some other person and leave personal and non-urgent mail to be handled when the original recipient returns.

(2) *Mail classification.* A secretary can order mail so that more important items of mail come to hand before routine circulars, advertising matter, etc.

(3) *Mail acknowledgement.* A secretary may be instructed to acknowledge mail as it is delivered to the recipient.

(4) *Mail filtering.* A secretary may read mail before delivery and, depending on the contents and/or the sender of the mail, decide that that mail is best handled by someone who is not the original addressee of the mail.

These tasks have nothing to do with the sending of mail but are exclusively concerned with the receiving and presentation of mail. To execute these tasks, the secretary makes use of instructions given to him or her by mail recipients or uses implicit knowledge of the structure of the organization. However, as he or she does not need to 'understand' the mail, it is possible to automate these tasks. Our system, the Electronic Secretary system (ESS), allows the user to specify how his or her mail is to be processed. However, as it is intended as a general-purpose system, it does not include inherent organizational knowledge.

As our system provides fairly standard mail creation and transmission facilities, the remainder of this paper concentrates on a description of the more innovative features of the Electronic Secretary program. In the following section, we describe how mail may be categorized, redirected, acknowledged and cancelled. This is followed by a brief description of the implementation of the system and the paper concludes with an assessment of our system.

SYSTEM FACILITIES

In common with other electronic mail systems, the ESS offers the usual facilities of mail creation, mail transmission, mail presentation and mail filing. These are implemented via a menu-driven interface where the user selects the operation to be carried out, creates his or her input if necessary and, if the operation is mail transmission, specifies one or more addressees. As well as being able to send to single users and groups of named users, there also exists an address ALL which allows 'circulars' to be sent to all users of the mail system.

Each item of mail is tagged by the system with the names of the sender and receiver, with a creation date and with a user-supplied title. It is then entered in one or more mailboxes after which it may be accessed by addressees.

As well as these standard electronic mail facilities, we have also included additional system facilities which, as far as we are aware, are not available on other electronic mail systems and which are direct analogues of functions which may be carried out by a human secretary. These facilities are:

(1) mail categorization
(2) mail redirection
(3) mail acknowledgement
(4) mail cancellation

We describe each of these facilities in more detail below.

Mail categorization

It is a truism that we do not regard all mail, electronic or otherwise, in the same way. In general, we like to deal with mail marked urgent and personal before routine reports, circulars and advertisements. We usually separate our mail into different classes and examine these classes in order. This classification may be carried out by a secretary or may simply be done by examining envelopes and, using details on the envelope, roughly classifying each item of mail. Alternatively, we may skim through the mail selecting the most interesting to read immediately and putting others aside to be dealt with later.

Unfortunately, most electronic mail systems do not permit mail classification but treat all items of mail in the same way. They present the mail in the order it was recieved with no distinction made between urgent messages, personal mail, lengthy reports and routine circulars.

The solution proposed by Denning[1] was for each user to have a number of postboxes with each reserved for a different type of mail. Rather than adopt this suggestion explicitly, we have implemented classification by allowing the sender to include 'front of envelope' information with his mail. He may mark mail as 'urgent' or 'personal' or may simply send it as 'general' mail. We also have a special class of mail which consists of messages acknowledging that mail has been read. These acknowledgements are system generated and, naturally, are not themselves automatically acknowledged.

Mail is normally classified by the sender and is presented to the user in priority order. The order of presentation is as follows:

(1) *Urgent mail.* We assume that this mail should be read as soon as possible so it is presented first when a user asks to read his mail.
(2) *Personal mail.* This is mail from friends and colleagues and we assume that the reader will want to read this before other, more general, mail.
(3) *General mail.* We classify mail which is concerned with the everyday aspects of work as general mail. Therefore reports, notices of seminars, minutes of meetings, etc. all fall into this category.
(4) *Acknowledgements.* These are simply notices that an item of mail which was previously posted by the system user has been read. These are useful but not particularly interesting so they are the last items of mail presented to the reader.

The classification of an item as an acknowledgement is carried out by the ESS. Naturally, the user may override this default presentation order and explicitly request that a particular class or item or mail be presented to him.

An item of mail may be classified by the sender as 'urgent'. Urgent mail is mail which, presumably, must be read and processed fairly quickly so it is imperative that the user gets to know that such mail is available.

Normally, the Electronic Secretary does its work quietly. The usual mode of usage is for the user to ask to read his mail once or twice a day without necessarily knowing whether mail is available or not. However, in the same way as a human secretary can interrupt with an urgent message, so too can the Electronic Secretary. When urgent mail arrives for a user who is logged on to the system, his terminal is 'beeped' and his other work is interrupted with a message that urgent mail should be read.

This urgent mail facility is potentially open to abuse in that any mail may be classified by the sender as 'urgent' and given top priority even if it is a routine circular. We hesitate to restrict the facility, to particular senders say, as urgent mail might

derive from any source. However, we place a restriction on the length of urgent messages (currently 800 characters) which means that reports, minutes of meetings, etc. cannot be classified as urgent by the sender.

We make a distinction between urgent mail, which may be impersonal, and personal mail, which need not be urgent. We define personal mail as mail from friends and colleagues which the recipient will, almost certainly, want to read.

A mail recipient may decide who may send personal mail to him by giving his own private mail system password to selected senders. When a sender wishes to classify mail as 'personal', he must provide this password as well as the recipient's identification. If he is unable to input the correct password, the system automatically classifies the mail as 'general' rather than 'personal'.

Mail which is neither urgent nor personal is termed 'general' mail and there are no restrictions placed on this type of mail. However, we have included in our system a mechanism whereby general mail may be assigned an importance in the range 1 to 8 and this mail is presented to the reader in order of importance. Therefore mail with importance 8 is presented first, followed by mail of importance 7, and so on.

In our user community, made up of research workers, it is probably unnecessary to provide as many as eight importance categories. It is difficult for a sender to be objective about the importance of his mail and the normal tendency is to use the highest category of importance. As we have no means of charging for mail, there is little we can do to control this tendency. However, the importance classification is useful even although it is not much used by senders of mail.

It provides a mechanism whereby a reader may order his or her mail in the order in which he or she wishes to deal with it. In essence, a user may reclassify mail by intercepting it as it is presented and redirecting it to himself with modified importance. Thus if he considers the real importance of an item of mail is 4 say, but the sender has assigned an importance of 7, the sender's classification may be changed. This reclassification may either be carried out automatically according to the sender's identity or mail contents or may be specified by the reader after the mail has been skimmed. We will discuss this facility in more detail in the following section.

The lowest presentation priority is assigned to acknowledgements which are automatically issued by the electronic mail system. These are presented last to the reader unless he explicitly asks to see them before other classes of mail.

Mail redirection

It is often the case that mail which we receive on some particular topic should have been sent to some other person who is better qualified to deal with that mail. There are also times when we know that we will not be available to process mail and we may wish that our mail, apart from personal mail, should be redirected to someone else for processing. The Electronic Secretary system provides mail redirection facilities which can be triggered automatically by either the mail contents or by the mail sender's identity or which can be invoked manually as a user reads his mail.

The concept of redirecting mail does not just cover the notion of sending mail to another user. It also provides a mechanism whereby the user of the Electronic Secretary system may classify his mail according to sender or content and a mechanism for discarding unwanted mail. It is thus a very general facility which contributes significantly to the power of the system.

We allow three possible destinations for redirected mail. These are:

(1) *Another system user*. Mail is redirected as specified when it is best handled by someone else.
(2) *The original recipient of the mail*. A user can specify that some classes of mail should be redirected to himself. As it is possible to modify the importance of an item of mail when it is redirected, this means that the user may assign his own importance ratings to mail on specific topics or from specific people.
(3) *The special user 'wpb'*. Redirecting mail to this destination is analogous to throwing it in a waste paper basket.

We illustrate, by examples, how the redirection facilities are used in our system. Assume that there is a user of our Electronic Secretary system called John. At some stage, John goes on a business trip which takes him away from his office terminal for an extended period. We explain below how he might redirect different classes of mail while he is away and how he might use the mail redirection facilities on his return.

Say John serves on some organizational committee with all committee mail sent to him by other committee members logged in as user COMSEC. While John is away, his place on the committee may be taken, temporarily, by his departmental colleague, Anne, and all mail from COMSEC should be sent to her rather than to John. Rather than inform all committee members that mail sent from COMSEC should be directed to Anne instead of John, John simply sets up a mail redirection specifying that all mail from COMSEC to him should be automatically redirected, with unchanged importance, to Anne. The system monitors John's incoming mail and when mail from COMSEC is detected it is redirected to Anne.

Another of John's responsibilities is to collate computer terminal fault reports and call out hardware maintenance services as required. These reports are mailed to him on a special-purpose form headed 'Terminal Fault Report'. While he is away, this duty is taken over by another user called Ron so, to redirect fault reports to him, John simply specifies that all mail containing the string 'Terminal Fault Report' should be automatically redirected to Ron. There is no need for users to know that any change in the reporting system has been made.

To minimize the volume of mail awaiting his return, John may wish to discard mail from particular senders whom he knows are guilty of sending large amounts of 'junk' mail. He may also wish to delete mail about events which he knows he will be unable to attend. Say user RD persistently uses electronic mail to send advertising matter. John may specify that any mail from that sender should be redirected to 'wpb' which means that the mail from RD is not presented to him. Similarly, as John knows he will be unable to attend meetings of his wine tasting club while he is away, he may specify that all mail containing the string 'WINE TASTING' should be redirected to 'wpb'.

After redirecting some of his mail to other users or to the waste paper basket, John may also decide to change the importance of some of the items of incoming mail. Say he receives regular system update news from user SYSMAN. These are of interest but of low priority. He may thus specify that all incoming mail from SYSMAN should be redirected to himself (John) but that the importance of the redirected mail should be changed to the lowest priority, 1.

On his return, John's mail has been automatically filtered, to some extent, by the Electronic Secretary system but he may still have a large volume of mail to deal with. On accessing his mail, he may ask for a summary of what is available, which is simply a list of mail titles and senders ordered according to importance. At this stage, he may specify that specific items of mail should be directed to other users or to 'wpb'.

Alternatively, he can redirect items of mail to himself with modified importance thus ordering his mail as he wants to read it rather than according to the sender's priority classification.

John may alternatively ask to read his mail and, after reading or skipping through the mail, he may then invoke any of the redirection options as specified above.

In the above description of the facilities of the Electronic Secretary, we have referred to a special user called 'wpb'. This user is not a real mail system user but is an electronic analogue of an office wastebin. A characteristic of office wastebins is that documents placed in them are not immediately destroyed but may be retrieved if, subsequently, it is discovered that they were discarded by mistake. However, eventually wastebins are emptied so at some stage the documents are irretrievably discarded.

Each system user has his own 'wpb' which is implemented as an unstructured file of characters. Directing documents to 'wpb' causes them to be removed from the user's mailbox and appended to this file. This means that documents sent to 'wpb' are not irrecoverably lost as would be the case if they were deleted from the computer's filing system. As with an office wastebin, the user may go through 'wpb' to retrieve a document which has been discarded in error. However, documents do not remain indefinitely in 'wpb' as the file is cleared at periodic intervals. This clearance corresponds to the emptying of a wastebin after which documents may no longer be recovered.

Mail cancellation

Sometimes, a sender of mail wishes to cancel mail after it has been posted into the system but before it has been presented to the recipient. For example, say a notice of a meeting has been issued and the meeting is subsequently cancelled. Rather than send out another mail item which is simply a notice of cancellation, the ESS user may specify that the original notice should not be presented to the recipient. In other cases, the information in the mail may be useless after a particular date so there is no point in delivering that mail if the current date is later than the expiry date.

The Electronic Secretary system provides a cancellation capability by allowing the sender to associate a cancellation key with a message input to the system. The message may later be cancelled by issuing a cancel command with that key or, alternatively, by specifying the receiver and title of the message. The key cancellation facility is useful when a message which has been sent to a number of recipients is to be cancelled. Instead of cancelling each message individually, the sender of the mail may cancel everything by issuing a 'cancel with key' command. When a sender issues a cancel command, all mailboxes are searched and any item of mail with the given key is cancelled. The cancel command also has an interactive mode so that some but not all messages issued with a particular key may be cancelled.

Cancellation may also be automatically triggered by date. When creating mail, a sender may associate an expiry date with that mail after which the information in the mail is valueless. When a user initiates the Electronic Secretary, the system examines all mail in mailboxes which has previously been issued by that sender. If the expiry date of any item of mail precedes the current date, that item is automatically cancelled. In all cases, cancellation does not mean that the mail is irrecoverably lost. It is actually redirected to the appropriate 'wpb'.

Mail acknowledgement

It is generally true that electronic mail systems are reliable and that mail posted to a particular destination will arrive in the recipient's mailbox. There is thus no need to acknowledge the fact that mail has arrived in a mailbox but it is useful for a sender to know if mail has actually been read. We are all guilty of acknowledging that we have received mail but never actually get down to reading and acting on that mail. The Electronic Secretary therefore takes no action on the delivery of mail but when an item of mail from a sender is presented to a reader, an acknowledgement is automatically issued to that sender.

Acknowledgements have the lowest presentation priority and, naturally, are not themselves acknowledged.

SYSTEM IMPLEMENTATION

The Electronic Secretary program is implemented as a menu-driven system on a computer which serves a community of about 25 research workers. The program is implemented in the programming language S-algol[4] under the Unix[5] operating system.

Mail is held in a central directory of mailboxes which is accessed by activating the Electronic Secretary program. Each user has his own mailbox which is implemented as a file of records holding information about the mail. The text of the mail is not stored directly in this file. Rather, when text is input, the Electronic Secretary program saves this text under a system-generated name and this name is used in the mailbox record to reference the text of the mail. Thus, when the same item of mail is sent to many different users only a single copy of the mail text is held by the system.

Each item of mail is represented by a data structure holding the following information:

(1) sender
(2) receiver
(3) creation date
(4) expiry date
(5) importance
(6) title
(7) cancellation keys
(8) text of mail

The information in the mail item record is generated when the mail is created by the sender. To create an item of mail, a user selects the 'create mail' command from a command menu. The system then prompts for the mail recipient or recipients, the importance, the expiry date, the title, the cancellation keys and the text of the mail which may be input directly or from some file. The ESS then completes the mail record by filling in the mail creation date and the name of the receiver and enters that record in the receiver's mailbox. Urgent and personal mail and acknowledgements are all indicated by setting the importance level to a reserved value which is inaccessible to the system user.

As well as a mailbox, each user also has a 'system instruction' file which is used by the automatic redirection facilities of the Electronic Secretary. This file contains records which specify redirections either by sender's identity or by content. In the examples of these records below, a ' : ' at the beginning of a line introduces a comment,

an '→' means redirect and a number following a ';' indicates the new importance of redirected mail.

```
: Redirect by content to waste paper bin
: Any incoming mail containing the string 'special free offer'
: is not presented to the reader
'special free offer' → wpb
: Redirect by content to another user
: Any mail containing the string 'Terminal Fault Report'
: is redirected to SYSMAN
'Terminal Fault Report' → SYSMAN
: Redirect by sender to another user
: All mail from COMSEC is redirected to J Soap
COMSEC → J Soap
: Modify importance of mail from user DJA
:All mail from DJA is assigned importance 4
DJA → SELF;4
```

The user constructs the 'system instructions' file using ESS commands initiated through the normal command menu.

When a user asks to read his mail, the ESS uses the instructions file to decide which mail to present to the reader. It is at this stage that redirections are initiated and mail destined for other system users is transferred to their mailbox. After any necessary redirections have been executed, the system then orders mail so that urgent mail is presented first followed by personal mail and then general mail in order of decreasing importance. The user may ask for a mail summary which is simply a list of titles and senders or may read the mail in full. After reading the mail, he or she may then re-enter it into the system sending it either to another user or back to himself with a modified importance for later reading.

CONCLUSIONS

Although our model of a system was based on the work done by a human secretary, the system is obviously deficient in a number of respects. The most important of these is that there is no mechanism for including a model of the organization in which the system is used. This important information is often used to decide who is the most appropriate recipient of mail and is one which is implicitly built by a human secretary as he or she works in that organization. As the encoding of such knowledge is currently an important research topic, we see no practical way of including it in our system.

A second deficiency is the lack of flexibility built into the system instructions. Although strings such as 'Terminal Fault Report' may be specified there is no mechanisms for including pattern specifications to provide more flexibility in redirection specifiers. As well as this, a human secretary can deal with logical conjunctives. For example, he or she can be instructed if a letter is from X and covers topic P it should be handled by T. Alternatively, if the letter is from X but is on topic Q, R is the best person to deal with it. Such facilities may be provided by integrating the ESS with a pattern matching system such as that described by Sommerville.[6] We have not yet explored this possibility.

Because of the environment in which we work, we have not investigated any charging mechanisms for electronic mail. In a more general system, however, the

charge for sending mail could be computed from the mail importance. Thus, the sender would be encouraged to attach an accurate priority to his mail as high importance mail would cost more to send that the same mail with a lower importance level. As Denning[1] suggested, this could be combined with a receiver's facility to automatically discard mail below a particular importance if he has a low tolerance of 'junk mail'.

In spite of some deficiencies, it is our opinion that the system which we have developed is a significant improvement over other existing electronic mail systems with which we are familiar. It meets many of Denning's criteria for a mail system which is tailored to the receiver rather than the sender of the mail and we believe that it provides a useful basis for further developments in electronic information exchange.

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