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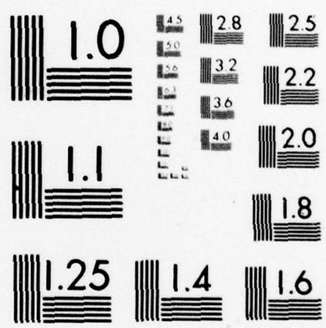

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MESSAGE SERVICES IN COMPUTER NETWORKS*

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ABSTRACT

In this paper we discuss the key issues in the generation and distribution of messages in a computer network. The principal issues are: user support, privacy and security, addressing, and standards and regulations. Examples of current message systems on the ARPANET are discussed.

1. INTRODUCTION

In this paper we discuss some key issues dealing with network message services [1], [2]. A network message is a record in a file that is transported from one file to another. The sending and receiving files can be in the same computer or in other computers in the network. When user 1 sends a message to user 2, the actual mechanism corresponds to a record in user 1's message file being sent to user 2's message file. User 2 does not have to be logged in when the message is actually sent. It is sent to his message file which is like a mailbox, and can be retrieved at any later time. Thus the sender is decoupled from the receiver. A network message service thus provides record communication in an electronic medium and can be thought of as *electronic mail*.

Computer-based message services are not new. Indeed, such services as TWX and TELEX have been in existence for a number of years. Since 1972, ARPANET users have been using message services of increasing sophistication and over the years, network messages have grown to become the largest single source of traffic

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on the ARPANET. In this paper we will discuss the features of the more commonly used network message services on ARPANET and discuss some key issues in the development of message services for a computer network.

2. FEATURES OF NETWORK MESSAGE SERVICES

A network message system is a computer program that has two principal parts: 1. A message handling program and 2. a message distribution program or *mailer*.

The message handling program has the key features of message composition, reading and filing. The mailer has the responsibility of delivering the message to the receivers' mailboxes. Many of the sophisticated message handling systems available in ARPANET today contain text processing, editing, and formatting features to assist in the composition of messages. They usually provide a flexible file management structure so that messages can be stored in a user-generated data-base and manipulated using standard data management techniques of sorting, searching, retrieving and archiving.

3. MESSAGE STRUCTURE

A message has two parts: a header and the text itself. The header has a number of fields which include such information as the sender, the primary recipient(s), the recipients for copies, the date and time the message was sent and the subject of the message. In a computer network the header and addressing format must be standardized in order for different computers, operating systems, and message handling systems to recognize and process the incoming and outgoing messages. In the ARPANET the header of a received message has a format as in the following example:

```
Mail from BBN-TENEXE rcvd at 29-Jun-78 0938-PDT
Date: 29 Jun 1978 1236-EDT
From: BINDER at BBN-TENEXE
Subject: Re: IEEE Satellite paper
To: KUO at USC-ISI
CC: BINDER
```

An outgoing message using the SNDMSG command on ARPANET/TENEX Systems has the following format:

```
SNDMSG (CR)
To: < Mailbox name > at < Computer name > (CR)
CC: < Mailbox name > at < Computer name > (CR)
Subject: Miscellaneous (CR)
```

Message (? For Help):

where (CR) means carriage return. The headers To, CC, Subject and Message are prompt symbols and are typed by the computer. The sender merely enters the requested information in the header fields followed by a (CR) to enter the next field. After he completes typing the message text he types a (control) Z and a carriage return, then the mailer indicates that the message has been delivered with a statement of the following kind:

Kuo at USC-ISI--OK
BINDER--OK

If the machine to which the message is addressed is unable to accept the message then a statement of the following kind appears:

ROTHNIE at CCA--QUEUED--TIMED-OUT

The message is then stored in a buffer until the addressee (machine) is able to accept the message. If, for the previous example, ROTHNIE does not have a mailbox at CCA then the mailer prints a statement to the sender or sends a msg to the sender to explain why it was unable to deliver the message.

Certain sites have multiple computers on ARPANET. Examples are BBN with five TENEX systems labeled BBNA, B, C, D, E. Any message addressed to any BBN machine will be correctly forwarded to a user on any other BBN machine. This forwarding capability, however, is quite rudimentary and exists only on certain sites in ARPANET. In a later section we will discuss the idea of centralized address data bases and directories.

4. HERMES, MSG, AND SIGMA

HERMES. HERMES [3] is a message processing system developed by Bolt Beranek and Newman, Inc. (BBN) as a message communication system for certain TENEX operating systems on ARPANET. HERMES is now operating at eight ARPANET TENEX sites and is also accessible on the US public packet network, TELENET.

HERMES has the following basic capabilities:

1. Message Composition
2. Message Reading
3. Message Filing
4. Message Searching

5. Message Deleting

It has special features of message file management. Messages can be stored in message files and the messages within a file can be organized into *permanent sequences*, which can be referred to by name. Sequences can be sorted, edited, and changed by simple commands. Other advanced features of HERMES include selecting messages by naming the characteristics desired and creating permanent, named collections of such message characteristics known as *filters*. Once created, these filters can be used to build up or narrow down selections of messages in a long message file. HERMES also allows the creation of special *templates* in order to tailor input/output message formats. In addition to these special features, HERMES has an interactive, on-line guide to special features and commands and extensive on-line reference material. HERMES is flexible and easy to use and is currently one of the most widely used message systems on ARPANET today.

<u>MSG</u>. Another extensively used message processing system supported by the TENEX systems on ARPANET is program MSG [4] developed by the Information Sciences Institute of the University of Southern California (USC/ISI). The commands in MSG are single characters and are self-completing. A complete set of MSG commands is given in Table 1. Most are self-explanatory. The message reading instructions are

H Headers (message sequence):
T Type (message sequence):

Typing H would yield a typical list as:

65	28Jun	BINDER at BBN-TENEXE	RE: IEEE Satellite Paper
66	29Jun	MURPHY at USC-ISIE	CCISW attendee list
67	29Jun	SACERDOTI at SRI	CCIS Workshop
68	30Jun	To: SACERDOTI at SRI	RE: CCIS Workshop

The Header fields are:

< MSG NO. > < DATE > < SENDER OR RECEIVER > < SUBJECT >

If the instruction I is typed, the length of the message in characters is also included in the header field.

The send message instructions are:

S SNDMSG (CONFIRM):
A Answer Message Number:
F Forward (message sequence):

The file instructions are:

M Move (message sequence):

Into File name:

R Read File name:
O Overwrite old file:

The delete instructions are:

D Delete (message sequence):
U Undelete (message sequence):

Because MSG uses extensive string searches and file manipulations, certain instructions tend to require high processor overhead. One generally finds that the more sophisticated and easy to use a system is, the more memory and greater processing time it requires.

SIGMA. US military record traffic is usually sent by AUTODIN I, a store-and-forward message switching network of the US Department of Defense. The Military Message Experiment (MME) is an experiment currently being carried out at the Headquarters of the Commander-in-Chief, Pacific in Honolulu, Hawaii for the automated distribution of AUTODIN message among military users in a command center. The message processing computer for MME is a PDP-10 TENEX time-sharing system which is connected to the AUTODIN system (not ARPANET). The MME message processing system SIGMA [5], which is being developed by the Information Sciences Institute of the University of Southern California, is constructed around a global database of AUTODIN messages. Users can create their own message files from this global database. Outgoing messages can be composed, edited, reviewed, and released using completely automated procedures. Storage, organization and retrieval of incoming messages are among a long list of SIGMA's automated features. SIGMA is an example of a centralized message processing system which acts as a distributor of messages. It was developed for a non-computer specialist military user and thus has a greater range of user-assist and prompt features than HERMES or MSG. Since it operates in a military milieu, SIGMA provides security features which are absent in other non-military message handling systems. SIGMA allows four levels of security: TOP SECRET, SECRET, CONFIDENTIAL AND UNCLASSIFIED. In addition, SIGMA contains a number of automated protection mechanisms to insure that correct security procedures are carried out.

Because of its large number of user-support and security features, SIGMA is necessarily complex. The price of complexity in this case is slow response. This is one of the key issues that must be considered in the design of an automated message handling system.

5. DESIGN ISSUES FOR NETWORK MESSAGE SERVICES

__User Support Features__. Over the past few years, the ARPANET message services have become quite sophisticated in their user-support features - prompting, editing, message composition, filing and retrieval. A message system such as HERMES or MSG requires substantially more memory than a simple system that only reads mail from a message file. In SIGMA, not only are there extensive user-support features but also security and protection features. At the time of this writing ten simultaneous SIGMA users can place a substantial load on the TENEX time-sharing system, with the result that the time required to display a single message of file on a user terminal CRT screen is on the order of a minute or more. In the case of SIGMA, there seems to be a direct relationship between the degree of user support and response time.

For a time-sharing system in which the message handling programs are not re-entrant, each on-line message system user must have his own copy of the program in memory which places a heavy demand on available on-line memory to service message users. On-line file space is another valuable resource to message users. In a system like BBN-TENEX, a user is allocated only a given number of pages of memory. He is not allowed to exceed his page allocation. This limitation of on-line memory places a practical constraint on user file space; so that, in spite of the sophisticated file manipulative mechanisms available in a system like HERMES, conservation of file space often place severe limitations on their use.

Designers of message systems must design for their intended users. If the user community consists of experienced computer users then the message processing system can be quite rudimentary since the users can use text editors and file management systems that are not an integral part of the message handling system to compose, read, and file their messages. On the other hand, if the intended user is a non-specialist, like a military user, then the message handling system must contain many more user support features, such as prompts and on-line instructions which tend to load down the sytem and make the system response time slower.

__Privacy and Security__. ARPANET messages are records or files which are addressed as mailboxes. It is important to safeguard the privacy of the message files. Since time-sharing system users all have passwords to access their files, protection of the messages is afforded to the degree in which the password system is secure. It would be quite difficult but not impossible for a user to send a message under an assumed name in the current ARPANET message systems. There is no protection currently if a number of users share one account and password. True security is obtainable only when a provably secure operating system can be developed. Until that time, standard protection methods for accounts and files can be used to protect message files.

Another security-related issue is that the mailer must be sufficiently reliable to ensure that messages are delivered only to intended recipients and not misdelivered. Within the ARPANET the ARPA file transfer protocol (FTP), which has heretofore been highly reliable, is used for the delivery of mail. However, on rare occasions messages have been misdelivered or lost. In such cases, it would be desirable to have trace mechanisms to establish some degree of accountability. Such trace mechanisms are hard to develop, but are desirable, if not necessary.

<u>Addressing</u>. When users of a central time-sharing system send messages to each other, their messages require only a one-level address - their mailbox names. Network messages must have a two-level address in the form: < mailbox name > at < host computer >. If a sender knows both the intended recipient's mailbox and the host at which the mailbox resides, then the message can be delivered by the mailer. If either piece of information is missing, then an <u>address directory</u> must be consulted to obtain this information. The ARPANET community currently has a published directory for this purpose. Known as the ARPANET DIRECTORY [6], it is issued once a year by the Network Information Center of SRI International. There is no on-line data base anywhere on the ARPANET that contains the information in the ARPANET DIRECTORY. Such an on-line data base is desirable, but the projected cost and effort of maintaining such a central data base was deemed unnecessarily high and thus the task was not supported. Since ARPANET is not a public network, rudimentary address directories are perhaps adequate for most users. However a public network message service must provide better directory information services. With recent advances in distributed data base techniques [7], it is now possible to have a distributed network information directory, in which each host maintains its directory of mailbox addresses and makes this information available to other host users. When internet messages become feasible they place an ever greater demand on directory information services.

An orthogonal requirement to providing better directory information services is that of protecting the privacy of the users of the network. If a user does not wish to send or receive messages, his account should not be listed in the directory. Standards must be agreed upon in providing inter-network directory information services.

<u>Standards and Regulations</u>. In order for messages to be passed from one computer to another, message formats must be standardized in terms of header fields and text fields. If there is to be internetwork communications then message formats must be stan-

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dardized between networks. Such standards are already established in the international TELEX networks. Standards for inter-packet switching network messages are presently not available and are dependent upon standards for internet protocols such as X-25. Different countries have varying regulations concerning network messages. In most countries network messages are so new as to have escaped scrutiny by postal and telecommunications authorities. Thus far, computer network messages in the US are regarded as a computer service, and not a telecommunications service and thus has not come under FCC (Federal Communications Commission) jurisdiction. How many other countries view computer network message services in this way is unknown. The author believes that in the next five or ten years many countries will face up to the issue of electronic mail services. In that context, computer network message services will be examined carefully. Detailed regulations and standards will then be established for internetwork and international computer message services.

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Cmnd. Char.	Meaning
A	Answer message number: <Message-number> Reply to whom the message is: F -- From <Return> -- Same as F T -- To list plus original sender C -- Cc list plus to: List plus original sender
B	Backing up -- previous message is:
^	Same as backing up
^H	Same as backing up
C	Current message is NN of MM messages in file: <FILE-NAME>
D	Delete (Message sequence) <MSG-SEQUENCE>
^E	Exec [confirm]
E	Exit and update old file <FILE-NAME> [confirm]
F	Forward (Message sequence) <MSG-SEQUENCE>
G	Go to message number: <MESSAGE-NUMBER>
H	Headers (Message sequence) <MSG-SEQUENCE>
I	Inclusion of length in header
J	Jump into lower fork running file: <Program Name> [confirm]
K	Koncise -- Provides shorter prompting
L	List (Message sequence) <MSG-SEQUENCE> On file name: <FILE-NAME>
M	Move (Message sequence) <MSG-SEQUENCE> into file name: <FILE-NAME>
N	Next message is:
<LF>	(Line feed) same as next message is:
O	Overwrite old file <FILE-NAME> [confirm]
P	Put (Message sequence) <MSG-SEQUENCE> into file name: <FILE-NAME>
Q	Quit [confirm]
R	Read file name: <FILE-NAME>
S	SNDMSG [confirm]
T	Type (Message sequence) <MSG-SEQUENCE>
U	Undelete (message sequence) <MSG-SEQUENCE>
V	Verbose -- Provides more prompting
W	Write file <FILE-NAME> sorted by message arrival time [confirm]
X	Xed [confirm]
Z	Zap profile [confirm]
´	´ Mark messages as ´Examined´ (Message sequence) <MSG-SEQUENCE>
-	- Unmark messages to be NOT ´Examined´ (Message sequence) <MSG-SEQUENCE>
:	: (The time and date is then printed)
?	? Type command character for its description, ? for summary
;	; Comment -- <Return> or ^Z returns you to command level

Table 1: A listing of MSG commands