Working Paper II

DEVELOPMENT TRENDS 1

A INTRODUCTION 2

Computer mail is not a simple phenomenon. It involves at least three major streams of development: ARPANET computer mail, computer teleconferencing, and mailbox services on time-sharing computer networks. Each stream has its own history and, until quite recently, each has proceeded almost as if other forms of computer mail did not exist. Lately, the three streams have shown signs of converging or at least cross-polinating one another. 3

Yet computer mail as a whole is not evolving in a vacuum. Several forms of electronic mail are at least potential competitors for computer mail, including advanced teletypewriter exchange systems, facsimile, and communicating word processing typewriters. To further complicate matters, it appears that all of these cousin media may be evolving toward some integrated electronic mail system. We discuss each development trend in turn, in order to explain where each appears to be heading and how all give evidence of convergence. 4

B. COMPUTER-BASED MEDIA 5

< FJOURNAL, 40270.NLS;1, >, 11-MAY-77 15:32 XXX ;;;; Title:
Author(s): Raymond R. Panko/RA3Y; Distribution: /RA3Y([ACTION]) ;
Sub-Collections: SRI-ARC; Clerk: RA3Y; Origin: < PANKO,
TWO.NLS;20, >, 24-MAR-77 10:54 RA3Y ;;;; ####;

Compared to other forms of electronic mail, there is a strong kinship between ARPANET computer mail, computer teleconferencing, and commercial mailbox services on time-sharing networks. What the three forms have in common is a single ancestor; all can trace their heritage to the "mailbox" services that have been available on even the earliest time-sharing systems. Mailbox programs allow one user to send brief messages to other users or to operators. These messages either go directly to the terminal of the recipient or are delivered the next time the receiver logs into the system. Yet actual communication between designers of different media, although growing, is still very small. ARPANET designers have been mostly artisans, who have seldom reported on their systems in the open literature. Conferencing designers have tended to be social scientists, who have prepared voluminous reports, usually dealing with impacts on people. Commerical mailbox designers have business people, who have seldom even communicated with one another. 6

Before time-sharing, users had to hand-carry programs to the computer center. While this cumbersome process had numerous drawbacks, it did bring progammers into contact with their colleagues and with computer operators. If they had questions, they could walk a few feet and ask them. But time-sharing systems separated users from one another by hundreds of yards, so getting help became difficult. Mailbox programs were installed to ease communication problems. The very first time-shared computer, CTSS at MIT's Project

MAC, offered a mailbox program (*), and few time-shared systems since then have not followed suit. 7

* Crisman, P.A., ed., The Compatible Time-Sharing System, A Programmer's Guide (2nd Ed.), The MIT Press, Cambridge, Massachusetts, 1965, Section AH.9.05, quoted in Stuart L. Mathison and Philip M. Walker, Computers and Telecommunications: Issues in Public Policy, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1970. 7a

A related facility is "linking," in which two terminals are tied together so that each user can see what the other is typing. If mailbox delivery resembles postal service or interoffice mail, linking resembles conversational interactions, such as telephone calls or face-to-face meetings. While linking and mailbox services can be quite distinct from one another on any given system, they really form a conceptual continuum of asynchronous and synchronous service. 8

1. ARPANET COMPUTER MAIL 9

During the 1960's, a substantial amount of the world's advanced computer research was funded by the Advanced Research Projects Agency (ARPA) of the U. S. Defense Department. To make ARPA-funded software more generally available, ARPA began funding the development of a national packet-switched computer network, later known as the ARPANET. The first lines and switching computers were installed in 1969, but it was not until the network's file transfer protocols (FTPs) were refined, in 1972, that the network became fully operational. In 1975, operation of the network was transferred to the Defense Communications Agency. Today, there are 182 host computers on the network. Half of these are large computers, the other half minicomputers. 10

The most common large computer on the network is Digital Equipment Corporation's PDP-10. Most of the 36 PDP-10s on the network use the TENEX operating system, developed by Bolt, Beranek and Newman, under ARPA funding, in the early 1970's. In 1972, just before the FTP was established, Ray Tomlinson of BBN developed message sending and reading programs for TENEX. The sending program was called SNDMSG, the reading program READMAIL. Originally, SNDMSG and READMAIL were written to handle mail flows within individual PDP-10s. Late in 1972, the package was rewritten to handle message distribution over the network, via the FTP. 11

The subsequent development of computer mail is difficult to characterize chronologically. There were several streams of development, in which successive programs refined earlier efforts. But each stream borrowed extensively from the others, adopting attractive innovations developed in other ARPANET systems. 12

The oldest stream grew out of refinements to READMAIL. Although SNDMSG was gradually refined, primarily by Julie Sussman, its evolution was gradual and limited. Just the opposite was true for the message reading side of the package. In 1973, Larry Roberts at ARPA wrote RD. This program was coded in TECO (a text editing program) macros. It offerred several new features, as did its successor NRD, which was written later in 1973, in the SAIL language, by Barry Wessler at Telenet. In 1974, Martin Yonke and John Vittal at U.S.C.'s Information Sciences Institute (ISI) wrote WRD in 1974. Later that year, Yonke wrote BANANARD, and, in 1975, Vittal wrote MSG. MSG is currently the most popular message-reading program on the ARPANET. 13

These programs, from READMAIL through MSG, were written for TENEX PDP-10s. Also written for TENEX machines were two other programs, developed more or less simultaneously in the middle of the decade at Bolt, Beranek and Newman. HG (the checmial symbol for mercury) was written by James Calvin in 1974. Another program, MAILSYS, was developed under Ted Myer in 1974. MAILSYS, which was also called XMAIL, was the larger project. As discussed below, it was later expanded to become HERMES (TM), for the Military Message-Handling Experiment. MAILSYS, and to some extent HG, combined both mail reading and mail composition functions. In contrast, the READMAIL-MSG stream either had no message composition tools or transferred the user to SNDMSG for composition. 14

In 1975, the Dynamic Modeling System project at MIT developed a message program called MSGDMS. This program was developed primarily by Mike Brooz, working under Al Vezza. MSGDMS's major innovation was its inverted index system, which allowed for very rapid retrival of old messages. Another major innovation was the sophisticated use of "background" processes, which periodically run housekeeping chores during unused computer cycles. In addition, MSGDMS was linked to the ARPANET Data Computer, a terrabit storage center. This allowed old messages to be archived, thus reducing online storage costs (which can be heavy for frequent computer mail users) yet still allowed reasonably fast retrieval of archived messages. MSGDMS was originally written under the ITS operating system developed at MIT. It was later modified to run under TENEX, under the name XMAIL. 15

The fourth major stream of development began in 1973, when ISI released its report "Consolidation of Telecommunications on Oahu" (COTCO). The report, based on an extensive study of naval communications on Oahu, recommended the the application of computer mail to operational military environments. ARPA then funded the Information Automation project at ISI, under Rob Stotz, to develop a terminal and computer mail software for a military environment. In 1975, ARPA expanded the effort and funded the development of competitive computer mail programs at MIT and BBN. The ISI program is called SIGMA. The BBN program, HERMES, was based on MAILSYS. The

MIT program is as yet unnamed. All three programs are written to run on the Hewlett-Packard 2645A terminal, under operating system software developed by ISI. 16

This year, one of the three programs will be tested extensively in the Military Message-Handling Experiment in Oahu. The other two programs will be tested, but on a more limited basis. MITRE is currently evaluating the three systems. During the experiment on Oahu, MITRE will conduct an evaluation of the results. 17

Our discussion has passed over many computer mail programs whose application has been more limited but which introduced many interesting and useful features. One current program that bears special mention is MS, being developed by Dave Crocker and Bill Crosby, under Bob Anderson, in RAND's Personal Computing project. MS (pronounced "Miz") runs on a RAND-UNIX PDP-11 minicomputer. The UNIX operating system, which was developed at AT&T, has sophisticated text-editing features. 18

ARPANET computer mail is almost bewildering for its diversity. Some programs were developed under intense direct funding. Others were written in programmers spare time. Despite this diversity, ARPA has been able to coordinate network mail development, albeit loosely. Minimal mail header standards for FTP have been created under ARPANET Requests for Comment 680 and 720. In addition, the ARPANET has a working committee on Computers and Human Communication (CAHCOM), which is chaired by Dave Farber at Irvine. There is also a loosely-knit Message Service Group (MSGGROUP), which has about 60 members and has been conducting an active general dialog over the network since mid-1975. Although much standardization still needs to be done, messages can already be sent among most TENEX and non-TENEX hosts on the ARPANET. 19

Perhaps the most useful service provided by the network to mail users is the ARPANET Directory, which is now funded by the Defense Communications Agency. The Directory, published by the Network Information Center (NIC) at SRI, is like a telephone book -- giving the names of ARPANET mail users, the host computers to which their mail is delivered, their postal addresses, their telephone numbers, their unique network idents (which are like telephone numbers, license plates, or TWX acronyms), and the names of network groups to which they belong. 20

A discussion of network communication would be incomplete without a discussion of "linking," in which two distant terminals are locked together. When two users link terminals, each can see what the other types. They can type messages back and forth in a completely conversational style. They can even execute a program together and discuss the results. Most large ARPANET hosts have some form of linking for two parties using the same host. In addition, through the RSEXEC system developed at BBN, a user on any TENEX computer can locate and link to any other loged-in of a TENEX machine on the ARPANET, and with users and several other types of machines as well. RSEXEC is essentially a distributed multi-host operating system with many interesting characteristics. RSEXEC linking across hosts has been available since 1972. A number of non-TENEX hosts now offer RSEXEC. 21

In NLS, a system developed under Engelbart at Stanford Research Institute, shared-screen teleconferencing allows two users to link video displays or to link a video display to a wall screen projector. Shared-screen teleconferencing in conjunction with a telephone call, has been used to train distant NLS users. Shared screen teleconferencing has also been used to augment face-to-face meetings. 22

Normally only two parties are linked at one time. Multi-party linking would require considerably more discipline than standard linking tools provide. Some progress has been made in providing multi-user, multi-host linking. The most notable example is TALK, developed by Jim Calvin at BBN. TALK allows group conferencing among users on several different hosts. 23

The ARPANET has been used on several occasions to handle true computer teleconferencing systems. Until late 1974, for example, the FORUM teleconferencing system, developed at the Institute for the Future under Vallee, Amara, Lipinski, Miller, and Helmer, used the ARPANET for its experiments. But FORUM has not played any long-term role on the NETWORK, except for some limited continuing uses at ISI. 24

Composition requires editing, and virtually all message-sending systems provide some editing tools. Editing can become quite extensive, including right-margin justification, automated spelling-correction, and customized formatting. In advanced systems, the dividing line between computer mail and word processing is becoming quite blurred. 25

We have held until the last our discussion of the most conceptually sophisticated computer mail system on the ARPANET: NLS Journal Mail. NLS, as noted above, was developed at SRI. Development began in 1963, primarily under ARPA funding. It continues today, under mixed funding. Overall, NLS is an integrated office automation system, offering extensive document composition tools, forms systems, and other office-related tools. In 1970 and 1971, SRI developed the Journal Mail subsystem, to distribute messsages, pre-prepared documents, data, line-drawn pictures, and other information. Because NLS was developed in an environment where long documents were common, it developed facilities for delivering long documents without inconveniencing users -- a facility no other ARPANET computer mail system provides. 26

Journal Mail was built as a working tool for a complex programming effort. As a result, careful thought was given, in 1969, to the problems raised by personnel turnover, limits on human recall, general communication processes on complex projects and other facts of life that require formal dialog in organizations. The Journal design embodied many correspondence control mechanisms, although most of these were not implemented fully. 27

The original design called for directory assistance-type functions and dialog recording in a multi-host environment, and many design innovations were made on this area. The original design also called for logical entities called "sets" of messages, which could be treated as personal message files, as teleconference transcript files, as successive versions of a controlled document, and so on. Potentially, sets could provide a basic logical architecture for complex communication processes. 28

Many concepts in the original journal design were not implemented, but others were. Features that were developed, such as an ability to handle long documents and on-line "directory assistance" functions make journal mail quite powerful. In addition, NLS Journal Mail has "hooks" into other media. It can accept files prepared off-line on several terminals; it can deliver mail to a non-NLS user via standard ARPANET computer mail; and, if a user is not a network user, it prints the item for postal distribution. 29

A number of ARPANET mail programs are beginning to be used by nonresearchers. NLS Journal Mail, HERMES, and MSG are being used by operational military organizations with access to the ARPANET. The U.S. Army Material Development and Readiness Command (DARCOM) for example, has over 200 computer mail users. 30

Both NLS Journal Mail and HERMES have non-ARPANET users. HERMES service is available via Telenet, a commercial computer netwwork owned in part by BBN. NLS service, including Journal Mail, is sold f.o.b. Cupertino. 31

While ARPANET computer mail is the most visible communication-oriented activity on the network, there are scattered ancillary developments that indicate new ways to augment the usefulness of computer mail. We consider just three here: calendar, bulletin board, and forms systems. 32

As discussed in Working Paper II, office workers communicate most frequently with people who are "close" in the organizational sense, i.e., the average individual has far more communication with his or her office mates than with people in other divisions in thecompany, still less with people in other companies. It may follow also be true that a person's most intense form of communication is with himself or herself in the form of notes and reminders. At least one good appointment system has been built on the ARPANET. This is CALENDAR, written at BBN by Ted Strollo. CALENDAR is not a sophisticated system, nor is it stylistically easy to use, but it is quite workable and points to new directions for development. We have no statistics on its daily use by a typical user, but we suspect it rivals or surpasses the frequency of mail system use. 33

Moving up to the level of the working group, Richard Kahler at Stanford Hospital's SUMEX-AIM project has written a bulletin board program, called BBD, that runs under TENEX. BBD is written in SAIL, and it is a well-designed, well-conceptualized system. It is very similar in its command style to ARPANET computer mail systems, especially MSG; in fact, it is tied to MSG, although rather loosely. Strictly speaking, BBD should not be listed under ARPANET computer mail, since it is not an ARPA-funded activity, but it is closely tied to the ARPANET community. 34

Conceptually, it would be possible to build calendar and bulletin board systems as integral parts of computer mail systems. Conceptually, both appointments and bulletin board entries can be viewed as messages, albeit with some special characteristics such as expiration dates and notification cycles. With careful design, it would be possible for users to read their bulletin boards with his or her normal mail reading commands, to send notices to their calendar via normal computer mail, to receive appointment reminders via computer mail, and to read through filed messages as easily as messages in the user's standard "in box" (this last feature is already common). A mail system well-tied to calendar and bulletin board systems would probably receive a much higher level of use than a stand-alone mail system. 35

There has only been sporadic development in forms systems, although there are a few examples of special-purpose systems designed to handle one or two specific types of forms. One interesting experimental system system is NEWFORMS, a subsystem of NLS. In addition, the three systtems designed for the Military Message Handling Experiment can handle form composition quite easily. The HERMES command "Compose," for example, can be extended to include the name of a form, e.g., "Compose Invoice." 36

Most existing forms systems, unfortunately, do little more than prompt the composer to input various fields of information. But a forms system should also be able to collect a good deal of background information itself, so that it can fill in various fields automatically, without requiring human assistance. The NLS forms system has some capabilities in this area, but they are limited.

Future forms systems will amost certainly search data bases and do complex data manipulations in order to fill out fields. 37

Recently, Michael D. Zisman has suggested that the challenge in forms processing is not task assistance but task recognition (*). According to Zisman, a system should not only assist the user in filling in forms, but it should automate the forms process by sensing when a form should be sent out for completion. As part of his dissertation at the Wharton School of the University of Pennsylvania, Zisman is developing a task-recognition system to automate the process of reviewing and publishing journal articles. The main activity of Zisman's system is to send out "tickler" messages when certain events occur, then checking on the status of responses to these messages as time goes on. 38

(*) Presentation at Stanford Research Institute, March 6, 1977. 38a

2. COMPUTER TELECONFERENCING 39

The idea behind computer conferencing is to let experts in various fields exchange ideas and reach agreements on important topics. The basic idea is quite old. Sinaiko at the U.S. Institute for Defense Analysis and Helmer and Baran at RAND all discussed computer conferencing in the middle and late 1960s. 40

Computer conferencing became a reality in the 1970s. At first, it was bound to DELPHI conferencing, a technique for securing opinions from a group of experts, through a series of anonymous questionnaires. The computer was viewed initially as a mere device for speeding the collection and analysis of questionnaires. In 1970, DELPHI conferencing systems were built by Turoff, Wilcox, McKendree and Renner at the U.S. Office of Emergency Preparedness and by Schuyler and Johansen at Northwestern. 41

It soon became apparent, that experts were not satisfied with anonymous questionnaires. They wanted to talk freely with one another. Turoff developed a series of programs, beginning with Party-Line in 1971, and computer teleconferencing was born. 42

In 1972 and 1973, several computer conferencing systems were built, including one by Carter and Umpleby at the University of Illinois. The most significant development, however, was the development of FORUM by Helmer, Amara, Hubert Lipinski, and Miller, at the Institute for the Future (IFTF). FORUM, developed under ARPA and NSF funding, began as a DELPHI system, but was made a flexible communication system after 1973, when Vallee took over the project. From 1973 through 1974, 28 experimental conferences were held on FORUM, using the ARPANET for transmission. Extensive user analyses were conducted by Johansen at IFTF, under NSF contracts. In late

1974, a version of FORUM was made available to qualified parties, under the name PLANET, on the commercial TYMSHARE computer network. 43

During 1974 and 1975, quitte a few teleconferencing systems were built. One of these, GENERAL CONFERENCING SYSTEM (GCS) was designed by Bert Lifman, of General Conferencing Systems, Ltd., of Toronto. In late 1974, GCS was made available on the I. P. Sharpe computer network in Canada and parts of the United States. It was used extensively by the Nonmedical Use of Drugs Directorate in 1974. In the United Kingdom, Downson built the CONCLAVE system for the National Physics Laboratory network. 44

In late 1976, Turoff built the Electtronic Information Exchange System (EIES) at the New Jersey Institute of Technology. EIES was built under NSF funding and is now being used in a series of experimental conferences which deal mainly with the subjects of conferencing in general and with communication among scientists and technologists. In early 1977, Vallee created InfoMedia, which provides PLANET and other software on a commercial basis and which supplies general assistance to conferencing users. 45

Computer conferencing has probably passed its apogee. While GCS, PLANET and EIES are available commercially or semi-commercially, conferencing shows little sign of future expansion. Probably, users are turning to computer mail instead, because of its wider applicability and its ability to handle informal conferencing. For example, only 5% of the Nonmedical Use of Drugs Directorate messages were in the conference "mode," the rest were private messages. The percentage of conferencing messages is much higher when useers form an ad hoc, temporary group. For coherent and lasting organizations, however, we suspect that the Directorate's experience will be typical. 46

There seem to be three trends in teleconferencing development. One is to develop limited but simple to use systems, exemplified by FORUM/PLANET. The other is to tie conferencing to fairly extensive editing and information retrieval systems, as exemplified by Turoff's work. The simplicity-extensiveness issue seems to be the focus of most design arguments. A third trend is for users to turn to message systems and linking tools for conferencing. The ARPANET computer mail system HG, for example, allows several users to read a common message file, each user having personal pointers showing which messages are new for him or her. It is our belief that augmented mail systems will eventually replace dedicated conferencing systems for asynchronous communication and that improved linking systems, such as the ARPANET RSEXEC linking function, will replace conferencing for conversational communications. 47

The fatal error of current conferencing systems, in the author's opinion, is their confusion of group communication for organizational communication. Current systems are based on the "small group" research tradition of psychology and may be quite appropriate in certain instances. But communication in business and government organizations has patterns, discussed in Chapter III, which conferencing is ill-equipped to handle. 48

In any society, there is far more written communication in the organizational mode than in the small group mode. Only if conferencing can cut into the face-to-face meeting market can it hope to reach a significant size. It hs yet to demonstrate this capability. Moreover, when conferencing is successful, it is often in discussions lasting for days and even months, and comuter mail can also handle extended conferences well. 49

3. IN-HOUSE MAILBOX SYSTEMS 50

Most individual time-shared computers now offer mailbox systems, even IBM computers, on which implementation is extraordinarily difficult. Consequently, most organizations can use their own computers and computer networks for message communication within the company. The U.S. Office of Telecommunications Policy in Washington, D.C., for example, communicates with the Boulder, Colorado office of the Office of Telecommunications via a government computer (an IBM 360 running the Administrative Terminal System). But use of in-house computers is believed to be fairly limited.

Computer centers seldom sell their ability to handle communication to management. In addition, networking is just beginning to become widespread. 51

It is more common for companies to add correspondence features to computer systems installed for data base communication (for example, management information systems) or for routine forms transmission (for example, computer-based order taking). Montgomery Ward, for example, is now installing an in-house order-taking system and may, if traffic can be controlled, send correspondence-like messages over the system. The U.S. and Canadian steel industries, in turn, have a computer ordering system, COMPORD, developed jointly by 23 steel vendors for customer use. It could be expanded to allow correspondence. 52

There are many other systems, such as the Hewlett-Packard COMSYS system discussed below, that blur the traditional line between traditional in-house message-switching systems and computer-based media that handle many aspects of message preparation and disposal. 53

Data, forms, and correspondence seem, at first glance, to be rather independent. But, as discussed in Chapter III, they form a continuum of routineness in organizational communication and most usefully are provided together. As discussed above, a number of conferencing and ARPANET systems are already tied to data base systems and forms-processing systems. 54

4. COMMERCIAL MAILBOX NETWORK SERVICES 55

In the mid-1960s, a number of companies built time sharing networks to deliver computer power to remote sites. In contrast to transmission network operations, such as ARPANET, TYMNET and Telenet, time-sharing networks sell computer processing. All computers on the network are controlled by the network operator. 56

Most networks initially had crude mailbox tools, that allowed very brief messages to be sent. Users frequently by-passed this problem, by writing messages on a file to which sender and recipient both have access. Either both parties would read the file at frequent intervals to see if the other had written on it, or the send would send a mailbox message to notify the recipient. In the IBM Administrative TerminaOperating System (ATS), the sender could direct the recipient's attention to any file, sending the access protection codework for the file in which the actual message is kept. 57

Over time, of course, several time-sharing networks developed more pleasant communication programs. One example is Mailbox, on the Scientific Time Sharing Corporation network (STSC). Mailbox is actually an interim system, written in APL, an interpretive language. Because Mailbox is written in APL, it is not very machine-efficient, but is is quite usable as a communication medium. One STSC computer on which Mailbox is available is attached not only to the STSC transmission network, but also to the Telenet and TYMNET computer transmission networks. A version of Mailbox is also available on the I. P. Sharpe computer network in Canada. 58

Another approach is being taken to service by TYMNET. TYMNET is tariffed to offer a computer mail system, and the TYMNEET mail system, ONTYM, has just become operational. The current version of ONTYM is implemented on Burroughs minicomputers. ONTYM users may obtain service either through one of the network computers or through an on-customer-premises computer leased from TYMNET. On-premises computers are linked to the network servers, so that messages can be sent not only to other locations on the premises, but also with distant sites. 59

Commercial systems in general offer only bare-bones support to users. In terms of features, they are much closer to teletypewriter message-switching networks (discussed after page xx) than to ARPANET computer mail or computer conferencing. Their message composition tools are minimal. They normally forget messages immediately after delivery or at best keep them a day or two. Overall, they do little to automate composition or filing. 60

As a business strategy, the offering of sparse service makes some sense. As discussed in Chapter III, cost in ARPANET computer mail is dominated by composition, reading and file retrieval. By restricting these operations, chargeable cost to the user is reduced, although the user labor cost might rise. In fact, the simple process of reducing the size of the message file--say by deleting messages afte three days--greatly reduces message retrieval costs, which are often proportional to the square of the number of messages in the file. In addition, it may be easier for teletypewriter message-switching users to grasp the advantages of a "super TWX" service than to appreciate the advantages of full computer mail service. 61

With the entry of at least one ARPANET mail service, HERMES, into the commercial marketplace, the next few years should sort out the nature of consumer demand. 62

One problem should mar the interpretability of market response, however. HERMES will be three to ten times as expensive as ONTYM when both are initially offered. Yet around 1980, when Bell Canada would probably introduce its own system, the cost burden between high-performance and simple systems should be much smaller. 63

5. CONVERGENCES 64

In the last three years, commercial mailbox systems have been improving in quality, while a handful of ARPANET computer mail and conferencing systems have been offered on commercial networks. On the surface, it would appear that competition between research-generated and commercially-generated software already exists, but several factors suggest that this competition has been more apparent than real. 65

First, commercial mailbox services have generally been poorly designed, expensive, and not advertised. While they may have been used extensively already (nobody knows how much they are used), they have been used by highly tolerant users, and this market may already be saturated. 66

Second, only PLANET and HERMES have been significant commercial offerings of research-generated systems. HERMES is very expensive (see page xx), and PLANET, being a teleconferencing system, may not be satisfactory for mainstream one-to-few message traffic. In addition, no attempt has been made to market either of these two systems at a serious level. 67

The future is impossible to predict. There are some significant signs of motion, especially TYMNET's offering of ONTYM, but also the recent offering of HERMES on TELENET and the starting of Vallee's InfoMedia. But as yet the buying public has not been heard from, so the potential for current entrants is unknown; and it is quite possible that some company will pick up existing ARPANET software and enter the marketplace quickly. 68

C TELETYPEWRITER NETWORKS 69

1. GENERAL BACKGROUND 70

In 1844, Samuel F. B. Morse invented the telegraph. Two years later, Morse and his financial backers persuaded the U. S. Congress to grant $300,000 to build an experimental line between the Capitol and Baltimore, Maryland. In 1848, the line was completed, and Morse sent his famous message, "What had God wrought." While this was a pretty good sale gimmick in itself, it was neither Morse's best nor was it the first telegraph message. During 1848, when the line stretched only part way from Baltimore to Washington, the Democratic Party was holding its convention. When Harrison, a dark horse, won the presidential nomination, a Morse associate flashed word to the end of the line, anf a rider carried the news the rest of the way to Washinggton. At first, the rider was disbelieved, but when conffirrmation came later, the telegraph's fame was assured. 71

The telegraph's spread was hastened by the growth of the railroads and the U.S. Civil War. During the war, telegraphy was used so extensively that bundles of wires often lay tangled on the ground, looking like some long grapevine. Electrical inductance between wires often garbled signals, and the term "grapevine" became synonymous with tangled and inexact communications networks. 72

By the 1870's, Western Union was the largest corporation in the United States, and telegraph carriers were the largest companies in many other countries. But in 1876, Bell invented the telephone, and telegraphy gradually fell into decline. At first, high telephone rates kept the telegraph competitive. But falling rates and eas of use inevitably put the telephone in ascendency and the telegraph in decline. 73

One problem with the public telegraph service is its reliance on human operators located on telegraph company premises. It would be much more attractive for businesses if terminals could be placed on customer premises, so that company operators could handle transmission and so that deliverry time could be cut. In the 1920's, teletypewriter exchange services were created to do this. Telex was created as an international standard, TWX as an AT&T, and later Bell Canada, service. In addition, many companies have built in-house teletypewriter exchange services or have leased a private wire service from a telecommunications carrier. 74

While teletypewriter exchange sevices have been growing rapidly, their revenue is several orders of magnitude below voice revenues. Only in the international arena, where language differences cause problems for voice communications do roughtly 20% of revenues come from telegraphy and teletypewriter exchange services (Canada's international carrier, Teleglobe). 75

Telegraphy and teletypewriter exchange services are often called record services, because unlike voice service, they leave a paper record of the transaction. They are also called message switching services, because they switch messages between two or more points, perhaps storing them in the process. To reduce ambiguity, we use the term "record service" only for public services offered by telecommunications companies; examples are telegraphy, telex and TWX. We use the terms "message switching" or "private wire service" for intracompany services, whether installed by the company itself or leased from a telecommunications company. 76

2. RECORD COMMUNICATIONS SERVICES OFFERED BY CARRIERS 77

While most carriers still offer public telegraph service, they earn most of their record revenues from telex or TWX. In the United States, for which unified statistics on both services are available from Western Union Telegraph (*), roughly 100 million telex and TWX messages are sent each year, as opposed to roughly 300 billion telephone conversations. The ratio of voice to record revenues is approximately (*). 78

(*) Canadian Statistics here. 79

In the United States and Canada, telex/TWX traffic is growing at a healthy 15% per year. In addition, carriers in both countries are or are preparing to offer advanced systems. In the United States, mailgram accepts messages through live operators, telex, TWX and other services, then routes them to recipients through the postal service. Last year in the United States (*), mailgrams were sent. Telepost, in turn, allows people to initiate mailgrams and other postal delivery services through an on-site terminal. 80

One problem with Telex and TWX is that both are unpleasant to use. An operator must first punch the message onto paper tape, then feed the tape into the system. The message comes off at the other end of dingy scraps of paer that are hard to reproduce and to file. This inherent clumsiness gives rise to a teletypewriter priesthood, and units are often locatted far from users. The idiom "out of sight, out of mind" tends to characterize user attitudes. 81

The one nice thing about Telex and TWX is that both turn on the recipient's terminal and print incoming messages as soon as they arrive. This practice can be emulated in ARPANET computer mail. Some systems print a brief "header" as soon as incoming mail arrives. The header gives the sender's name and a brief title if the sender has provided one. But in practice it is usually too expensive to keep terminals connected to the computer all the time, so virtually all ARPANET mail users receive messages only as often as they "log on" to the system. No computer mail system has the ability to dial up and turn on a distant terminal. 82

3. PRIVATE-LINE NETWORKS 83

If a company can purchase or rent a switch and terminals, it can build its own private wire teletypewriter network. If the company has special needs, or if it already has leased telephone lines for voice transmission, private line service can be extremely attractive. 84

Some private wire networks are very large. The SITA network for airlines, for example, handles about a quarter billion "messsages" each year. While many messages are computer-to-person communications, the bulk are person-to-person administrative messages. SITA is actually not a private wire service in the strict sense, because it is operated by a consortium of airlines. 85

SITA's mixture of data, standard routine messages, and person-to-person correspondence is typical of the traffice of most private line systems. In fact, routine messages such as orders and invoices usually dominate traffic, with data forming a growing second traffic element, and personal messages trailing a distant third.

where telephone service is difficult, of course, many more interpersonal messages are sent. 86

Most large corporations have private wire networks. One Western Union official estimates that the U. S. market for private line service is around $90 million each year. Thiis is a rough estimate, since no official data are kept, and Western Union handles only about 5% of the market. At average costs per message of $0.05 and $0.20 per message (this is a "normal" range), there are probably between 450 million and 1.8 billion private wire messages sent in the United States each year. Thus, while private wire revenues are slightly smaller than Telex and TWX revenues, many more private wire messages are sent. 87

As corporations make increasing use of leased lines and WATS (Wide Area Telephone Service), and as switching and terminal hardware becomes more widely available, the use of private wire networks appears to be expanding. REcently the Wiltek Corporation attempted to produce sophisticated turn-key private wire networks. But Wiltek Corporation fell into financial difficulties associated with growth, and this interesting experimenta was aborted. 88

There is a new and growing trend toward the merger of private wire networks with corporate computer networks. Originally, the idea was simply to share leased lines between the private wire and computer services. But it soon became obvious that many computer uses had sttrong elements of communictions. For example, 23 U.S. and Canadian steel producers have recently built the COMPORD system to take orders directly from customers. 89

Another example is Hewlett-Packard's COMSSYS, which is used to switch orders, and other routine communication and interpersonal messages among Hewlett-Packard's (HP) major field offices. At each major site there is a minicomputer, to which several intelligent terminals are attached. (The computers and terminals are HP designs.) Messages are collected at each minicomputer. A main computer periodically polls ech minicomputer, to transfer messages. COMSYS uses the normal telephone network, instead of dedicated lines. It is an international network. 90

Because data, routine "forms" traffic and correspondence are inherently related, several companies are beginning to imbed admistrative message traffic within the computer system. Montgomery Ward of Chicago is now installing such a system. Like several other companies, however, Montgomery Ward is discouraging correspondence uses, fearing that costs will skyrocket. 91

Even when messages can be sent over computer-based corporate systems, the servide is much more like Telex and TWX than ARPANET computer mail. Normally, message composition is all handled before the system is involved, and the filing of correspondence after delivery, to assit in later retrieval, is almost unheard of. 92

4. IMPLICATIONS 93

In comparison with computer mail, message-switching systems are a mature industry, handling several hundred million messages a year. This suggest two possibilities that are almost diametrically opposed. 94

First, it suggests that corporations already understand the advantages of message-switching and may be quick to adopt computer mail. It may even be tthat current message-switchhing systems are too difficult to use and that computer mail will bring explosive growth to the corporate message communication arena. 95

On the other hand, the maturity of corporate message-switching and in particular the growing merger between communications and data processing may mean that comuter mail software will simply be added to the corporate time shared computer. Even assuming that an independent message computer will be rewwuired for purposes of efficiency, operation of the computer might be managed by the existing communications/computer infrastructure. 96

In practice, these alternatives are unlikely to be mutually exclusive. While the corporate infrastructure may indeed operate the bulk of all intracompany mail transmission, outside vendors should find a good market in terminals, message software for corporate computers, message-switching computers, and complete turn-key systems. TYMNET's ONTYM approach illustrates some of these possibilities. 97

Moreover, simply by creating a national interconnection network and performing ancillay services such as automated directory assistance, an aggresssive vendor could make money from long-distance communication and from sites with traffic volumes too low to justify a message computer. In addition, the maintainer of a national message network would give the dominant company a good "in" to the turn key and components markets mentioned in the previous paragraphs. 98

D COMMUNICATING WORD PROCESSING TYPEWRITERS 99

In 1964, IBM introduced the MTST Selective(c) typewriter, which could store and edit letters and longer documents. Since then, IBM has dominated the market for "word processing" systems. As the market for these systems has grown, however, IBM has felt some strong and growing challenges. Some other companies have introduced competing text-editing typewriters, while others have produced minicomputer systems with CRT screens. A few time-sharing networks have even introduced on-line editors. Recently, IBM has moved to counter the CRT mini systems with its own System 6 and System 32 lines, while keeping its text editing typewriters in production. 100

(*) MARKET SIZE 101

Beginning in 1974 and 1975, several word processing companies began to realize that simply producing documents was not enough, and they began to develop and introduce communicating word processing systems. In general these systems are rather crude, requiring intervention and cooperation from operators at both ends. 102

Nevertheless, several organizations, including SONOCO and the U.S. Army Recruiting Command, have tied communicating typewriters to message-switching networks, to produce very workable message services. 103

Because text-editing typewriters handle the composition task in a "stand alone" mode, before connecting to the central computer, they can slash message service costs. Of course several ARPANET and commercial time-sharing mailbox systems support off-line message preparation. Examples are NLS in the ARPANET community and STSC's Mailbox. But there are only about a million computer terminals in North America; few have offline preparation ability, and many are dedicated to nonmail applications. 104

In contrast, all of the million-odd (*) word processing units have, by definition, offline preparation capabilities, and the number with communication capabilities is growing rapidly. Even more importantly, virtually all word processors are located in administrative offices and so are much more accessable than most computer terminals. 105

To date, we know of no application in which a word processor has been tied to a sophisticated computer mail network. It can only be a matter of time, however, until this is done, and all future computer mail systems, in our opinion, must provide word processor interfaces if they are to be competitively viable. 106

E FACSIMILE AND COMMUNICATING COPIERS 107

Sometime this year, there will be more facsimile terminals than Telex and TWX terminals in the United States (CN Dec74). This fact is all the more remarkable because, until very recently, facsimile was an oddity, used primarily in specialized applications such as the transmission of weather maps and newspaper pictures. Facsimile's growth in Canada has been much slower, because Canadian long distance telephone rates are much higher than U.S. rates. But the continuing development of high-speed facsimile, which trades off transmission time against equipment cost, should bring the facsimile revolution to Canada as well. 108

Facsimile is actually a very old medium. The first facsimile device was built in 1842, by the Scottish inventor Alexander Bain (Costigan). This makes facsimile older than the telegraph. But before facsimile could be perfected by Bain, the telegraph had developed sufficiently to grab the market, and facsimile languished. This instance of promise followed by eclipse marked facsimile throughout most of its history. In the 1920's and 1930's, facsimile had something of a Renaissance, with several large companies developing projects and at least two experiments in home-delivery of newspaper (Costigan). But the war interrupted development, and after the war television's popularity as a video medium stifled the development of home newspapers. 109

Until the late 1960's, facsimile was used almost exclusively in specialty applications, such as telephotography among newspapers and weather map distribution. But sometime in that decade there started a growth trend that has endured and gain momentum ever since. There is no agreement about what happened, but several factors that could have spurred this growth have been identified. The factor most often discussed is the ever-greater leniency of AT&T toward desk-top units. Only in 1963 did AT&T offer decent interface devices to connect facsimile units to the direct distance dialing (DDD) network, and it was not until the late 1960's that the FCC forced easy foreign attachment connection on AT&T. Even so, it was not until 1976 that really easy and inexpensive attachment to the telephone system became available in the United States (although facsimile manufacturers had already anticipated this change by the early 1970's. 110

Second was a series of technical advances, which greatly reduced message costs. For long-distance transmission, telephone charges have always dominated message costs. The only ways to reduce telephone charges were to speed up the facsimile transmission or to get lower telephone rates. Fortunately, both were possible. High speed modems (modulator-demodulators) operating at 1200 baud have greatly reduced transmission times, while the use of WATS lines and leased lines have dramatically reduced telephone rates. Besides reductions in telephone costs, facsimile users have benefited greatly from the introduction of solid-state technology. Before 1965, facsimile manufactuers lagged in the use solid-state technology, but they have since become the leaders (Costigan, p. 38). For these and other reasons, users have been enjoying considerably improved service at much lower cost, and rapid cost changes have probably been the main reason behind recent demand increases. 111

Once economics and connection to the telephone system had become attractive, manufacturers worked at building a marketplace for their products. Xerox took the lead, promoting its products heavily, and as a result Xerox now controls about 85% of the market (Business Week, OOFO. Heavy promotion and better publicity have broadened the base of facsimile users. 112

There is no standard estimate for the facsimile market, beyond a universal belief that growth is very rapid. According to the Yankee Group (CN, Dec76), there will be 140,000 units in place by the end of 1977, 212,000 by the end of 1980, and 386,000 by the end of 1984. Intternational Resource Development places the number of installed units at 150,000 in 1979 and 220,000 in 1984 (CN, Dec74). 113

One factor that will undoubtedly spur further growth is the development of improved data-compression techniques. Last year, the first of a new class of machines was introduced, capable of transmitting a full page of text in under 30 seconds. Because most facsimile material is extremely redundant, it is possible to use microprocessors to compress output before transmission and restore it at the other end. Today, this is quite expensive, but falling minicomputer costs will make facsimile ever more attractive in the 1980's. 114

Facsimile manufacturers are beginning to interface their products with digital data transmission. There are beginning to be machines that can accept a stream of ASCII text and print it on the facsimile output device. Bell Canada, moreover, is now working on the opposite approach: inputting a page and letting the facsimile unit send characters it recognizes as text but sending signatures, drawings, unclear text, and so on as normal facsimile blocks. The integration of facsimile with text could remove the greatest current impediment to the development of text systems: the inability of most text systems to integrate nontextual materials in transmissions. Although a few text-oriented systmes can already handle graphics (for example, NLS, at SRI), text/facsimile systems seem quite attractive. 115

A great spur to facsimile could come through networking. Already, the United States has a facsimile network called Graphnet, which will switch facsimile transmissions from machine to machine, even if the machines themselves are incompatible. Graphnet also performs data compression at the local office, so that customers can purchase a "dumb" terminal but still obtain most of the advantages of high-speed long distance transmission. So far, store-and-forward systems have been slow to emerge, because of the large storage capacity needed to hold a single page of facsimile information. But memory costs are declining rapidly, and it is only a matter of time before store-and-forward operation is economically atttractive. 116

One interesting and potentially crucial trend is the potential merging of facsimile and office copying. As yet there are only a few signs that office copiers will soon develop transmission capabilities, but the implications of evolutions in the copier market are so great that the possibility must be explored. 117

It is normal practice to divide the copier market into two classes. The smaller but better known market is office copiers, characterized primarily by Xerox's machines. Roughly 100 billion copies are made each year on convenience copiers in Canada and the United States (Ford, Lavery). In terms of copies produced, the duplicator market is much larger; over 200 billion duplicator copies are made each year (Lavery). The total market for reproduction equipment and supplies is roughly $3 billion. 118

In contrast to facsimile and duplicator systems, the office copier is a very recent invention, whose emergence has been totally dominated by the Xerographic reproduction process. Xerography was created in the 1930's by Chester Carlson. He got Battelle Memorial Institute to study and promote the process in 1944, and the following year Batelle interested the Haloid corporation in developing the process (Kelley). Later, Haloid became the Xerox Corporation. It was not until 1959 that Xerox products entered the market, but since then Xerox has almost completely dominated the office copier market. Only during the last two years have other companies, including IBM and Kodak begun to attack this market. 119

We know of no estimate for the number of reproduction machines already installed in the United States and Canada, but it must dwarf the numbber of facsimile, word processing typewriters, and teletypewriter exchange terminals by several orders of magnitude. If there is even a modest shift toward communicating copiers in the future, the resultant purchases could easily outstrip revenues from other forms of electronic mail. Unfortunately, we have almost no understanding of the demand for communicating copiers. The market has not had the opportunity to study them, and there are no close analogies to the functions they perform. Their eventual market will probably depend heavily on the incremental cost of communicating features; this will determine whether communicating copiers fail to gain a market, are used mostly for high-speed printing, or form the normal output device for electronic mail. 120

While the traditional office copier is not thought of as a communications medium, it definitely is one. Even when only one or two copies are made per original, there is normally some distribution of copies to people for whom the information is new. More importantly, the convenience copier seems to have already become the first intraoffice communications medium. In large offices, there seems to be a strong tendency to "broadcast" information by creating a large number of copies per original, then distributing these to individual desks. In 22% of all copier sessions in a large office, more than 100 copies are made per original, and in 37% of all sessions, 26 or more copies are made per original (Lavery). 121

We note (see pages) that computer mail has traditionally been a medium for intraoffice communication, and that in at least one system, NLS Journal mail, broadcasting of messages dominates message volume, just as it does in the case of copiers. So if intraoffice computer mail alone is attached to copier output, much of the copier's current volume could be accounted for. We know of two organizations--ARPA and the Xerox Palo Alto Research Center--in which computer mail systems are attached to communicating copiers. In both cases, copier output has proven far more satisfactory than line printer output, at least from the viewpoint of users. 122

F. Military Record Communications 123

Military record communications could be discussed under the heading of private-line systems, but we feel it is useful to discuss them separately, not only because they use encryption, but because of several other aspects of their development: 124

- They are used in highly structured communication environments like those used to process forms and data in ordinary organizations. Working Paper II emphasizes the importance of such processing. 124a

- Military record services have evolved somewhat in a vacuum, and as a result, they offer some evolutionary features of interest. 124b

- They have pioneered the use of advanced equipment, such as optical character recognition (OCR) readers. 124c we confine our attention to U.S. military systems and more specifically to communication within the Pacific Basin under the responsibility of CINCPAC (Commander-in-Chief, Pacific), because recent studies have revealed a fair amount of information about the use of record communication within CINCPAC. 125

1. AUTODIN 126

The mainline record communication service for the U.S. armed forces is AUTODIN (Automatic Digital Network). Currently, AUTODIN uses 18 large switching computers, through which it links roughly 1,400 terminals. Over 350 million messages are handled each year. The current system is called AUTODIN I. It is due to be replaced over the next few years with a new system, AUTODIN II. 127

2. Communication Within CINCPAC 128

Military record communication is extremely formal, since it is imperative to assign responsibility for every incoming message and to secure proper release for all outgoing messages (which often have the status of military orders). Furthermore, there are elaborate and standardized procedures for handling crises situations that would normally overload normal information handling procedures. 129

Incoming messages are often addressed simply to CINPAC, although suborganizations are often listed. CINCPAC has an elaborate message handling procedure, which occupies the attention of a fair number of the staff. Incoming messages are sorted by security and precedence, routed into groups further by keywords on incoming messages (keywords are used extensively) and by manual inspection of contents and references. The messages are then delivered to top levels of each subcommand, where they filter down through regular channels. There are also channels through which messages sent directly to obvious recipients, so that some messages arrive at the level of the action officer (the one responsible for response) twice or even three times. If the message is marked "Information," responsibility is not important. If it is marked "Action" or "Cognition" (Cog), then it must either be acted upon or its contents must be memorized. CINCPAC keeps a Daily Digest to keep tabs on the outcome of action messages. Sometimes a message comes to an inappropriate command. In that case, the responsible party negotiates with another action officer to assume responsibility. This is called "selling (giving away) and buying (accepting) action." 130

Outgoing messages are usually transmitted over the signature of some relatively senior officer, but they are almost always prepared by clerical personnel or junior officers. There is a detailed but straightforward coordination ("chop" in military jargon) process, by which messages are released. The message is first coordinated with the preparer's boss, then in parallel with officers of the same level, then serially with officers of higher levels, until there is consensus. Then a responsible officer signs off on the message. 131

All this may seem needlessly complex outside of military environments, but even in corporations there is generally a need to assign esponsibilities for an incoming message, to see that proper action is taken, and to insure that proper sign-offs are made, at least for messages flowing outside large blocks of work. Moreover, while correspondence protocols are generally fairly loose in industry, the same is not rue of business forms protocols associated with orders, invoices, inventory changes, and a host of other communications that, as noted in Working Paper III, are far more prevalent than correspondence flows in companies. Techniques used to implement and automate military message flows may be quite useful in organizational settings. 132

Perhaps the most interesting aspect of military message processing in CINCPAC is the Command's esponse to risis situations and crisis exercises. There is a small team of officers (the Command Center Watch Team) whose principal task is to ecommend crisis esponse whenever the volume of messages on a given topic rises sufficiently to suggest crisis action, or when an alert comes in from a proper source. The Directorate Duty Officer, who heads the CCWT, notifies the Commander, and a standard operating procedure for response initiated if the Commander concurs. Three groups of staff, each in separate rooms, are assembled to handle messages, make decisions, and handle necessary administrative support tasks. One group consists of the base's senior officers. Standardized status-of-action files are used to maintain messages and related materials during the crisis. This approach of changing standard operating pocedures when there is unusual activity and changing these practices in a way that can be implemented quickly and without confusion is an interesting organizational process in itself, and it suggests some interesting approaches to message automation for unusual situations. 133

OUr discussion of message communications at CINCPAC has been based heavily upon an analysis performed by the MITRE corporation, by Goodwin, Mitchell, and Tasker (*). It is also based on discussions with other people knowledgeable with message handling routines at CINCPAC. 134

*Goodwin, N.C., J. Mitchell, and P.S. Tasker, Concept of Operations for Message Handling at CINCPAC, The Mitre Corporation, Bedford, Massachusetts, October 1976. 134a

3. Advanced Systems 135

Because the Pacific Basin is so large and message communication there is so vital, it has served as an advanced test bed for military message approaches. One interesting system used in the basin is the Air Force's ICATS system. ICATS accepts a typed message as input, interprets it through OCR, and displays it on a video screen for error correction by a clerical officer. The OCR-plus-human-verification approach is an attractive mating of OCR's ability to automate most aspects of message input with the human's ability to recognize and make complex contextually-determined corrections. 136

G. Postal Service 137

Canadian Postmaster-General Bryce Mackasey recently responded to a parliamentary complaint about slow mail delivery by admitting that "our first Canadians had a better service in smoke signals than we have at some times." 138

Tavernier, p. 22. 139

California Congressman Charles Wilson has discovered that the U.S. Post Office (sic) maintains a heavily guarded "secret depot" surrounded by a 12-foot fence..."It contained thousands of parcels so badly defaced that they were a horror and an embarrassment to the Post Office." 140

Moneysworth, p. 1. 141

In late 1974 Italian newspapers reported that the situation had become so bad that post office employees were loading mail onto trains and sending it...from one station to another simply to get it off their hands. 142

Tavernier, p. 22. 143

The reason kids don't play post office any more is that it is too slow. 144

Letter to the editor in a Los Angeles newspaper, quoted in Industry Week, April 16, 1973, p. 58. 145

The post office has always been the butt of jokes and the subject of horror stories in every country, but attacks on postal service have recently taken on strong economic substance throughout the world. The basic problem is that postal delivery is strongly labor intensive. Labor accounts for 75% to 85% of all expenses in most countries. (Tavernier, Business Week, 29 May 1976) Partly because postal workers comprise one percent or more of any country's electorate, they have been abble to secure apid wage increases, especially since 1970. The service seems to be declining, too. Reduced deliveries, which are the easiest aspect of service to study, definitely show this trend. In 1939, the average city resident in the U.K. had seven deliveries on week days (T). This fell to twice daily in 1965, where it remains, tentatively, today (T). In the United States, the USPS recently announced that service in New York would fall from thrice aily to twice daily, and nine other Eastern cities would have deliveries cut from twice daily to once (Forbes, 1976). There is also a widespread feeling that postal delivery is rowing slower. Consequences have been rising stamp costs, large deficits, and poorer service. 146

In many countries, mail problems have reached a crisis stage. The British postal operation had almost a $100 million profit in 1969 (The Economist, 1974). In 1975, it lost $600 million (Tavernier). The British Post Office was not alone in its problems. The United States Postal Service lost $900 million in 1975, whhile the German post office lost $1 billion (T). Between 1973 and 1975 stamp prices rose 89%, postage rose 300% in Italy during this period, 32% in Sweden, and 26% in the U.S. (T). In 1980 the price of a tamp in the U.S. is xpected to be $0.23 (Keller). According to the USPS, service has fallen only modestly. The USPS claims, for example, that the delivery of a first class letter has risen only from 1.3 days in 1969 to 1.6 days in 1976 (Lange). Yet these averages may hide increasingly erratic delivery. 147

Things promise to get worse in the future. Only transaction mail--bills, checks, and so on--have been holding up postal volumes. Transaction mail already made up 60% of all first class mail and 40%

of all mail in the U.S. in 1968 (Toward Postal). The situation is about the same today in the U.S. and roughly the same in other countries, too. As electrnoic funds transfer (EFT) grows, first on a piecemeal basis, and later through national EFT networks, a large portion of postal revenues and an even larger portion of postal profits will disappear. Even the telephone promises to hurt postal service. A six minute telephone call in the U.S. costs about $3, including the caller's time. In comparison, the cost to send a letter is between $3 and $6 when labor is counted. As telephone rates fall, the business letter should grow even less attractive. As U.S. Postmaster General Bailar has noted (Business Week, March 29, 1976), mail probably means less today than it did a generation ago, and it will probably mean less still to the next generation. 148

A decaying post office may be viewed as an encouraging sign for computer mail, yet the spector of a decaying institution with one percent of the electorate tied to its payroll is a potentially explosive situation. In the U.S., the last two hundred years have seen ecurrent cycles in which declining service encouraged competition, which was soon destroyed when the Federal Private Express Statutes were extended to cover new competitors (Haldi, 1974). And in fact, the U.S. National Association of Letter Carriers has already requested a Congressional subsidy to get the U.S. into electronic mail (Mills, January 4, 1976). Similar threats to computer mail can be expected in other countries. 149

Until very recently, the Canadian and U.S. Post Offices had little to do with electronic mail, despite a few halting xperiments that indicated little intense interest and even less capability. In other countries, where the telephone, telegraph, and postal authorities are generally unified (at least in theory), the post offices have had little leverage in estricting development. 150

Nevertheless, it is unquestionably true that post offices and related authorities are beginning to take harder looks at electronic mail. The Canadian Post Office, and to a lesser extent the U.S. Postal Service, are both very concerned with the potential erosion of their business because of electronic funds transfer and, to some extent, electronic mail. Both post offices are beginning to hire knowledgeable staffs. It remains to be seen whether either postal authority will make a serious stab at electronic mail, beyond simple interface services, such as Telepost and Mailgram, which aid both the post office and the electronic mail operator. Outside North America, the British Post Office seems knowledgeable enough to offer electronic mail through its telecommunications section, although the BPO is striving hard to maintain its inflated Telex rates. In West Germany, the Commission for the Development of the Telecommunication System has recently advocated the offering of communicating typewriter and facsimile services as high-priority tasks, but the fruit of this recommendation seems far off. 151

H. CONCLUSIONS 152

If computer mail did not exist, the future of written corporate communications would still be hazardous to predict. The quietness of the 1960's, when corporate message communication was virtually synonymous with Telex, TWX and private-wire teletypewriter networks, has definitely vanished. There may already be more facsimile terminals than teletypewriter terminals, despite the fact that facsimile is still in its early growwth. Furthermore, there is a roiling flux of change within the intercompany market, where advanced computer-based message switching systems are emerging, and where various data-oriented services (such as MIS and order-invoice systems) are beginning to sprout message facilities. Finally, communicating typewriters and communicating copiers are just barely emerging, but both show signs of huge potential growth. 153

The main reason for the current turmoil in corporate communications is simply that corporations have never had decent service options before. Telex, TWX and even private-wire networks have been so clumsy and expensive that their combined revenues have always fallen orders of magnitude below telephone revenues. So while facsimile's passing of teletypewriter networks is impressible in terms of business record communications, there are still fewer than 300,000 facsimile units in all of Canada and the United States. The business communications market as a whole is still in an embryonic stage. 154

Computer mail service, probably in the ARPANET genre, has a great potential for growth, but is is far from certain whether computer mail will exist long as an independent offering. Facsimile networks, corporate private-line networks, and communicating typewriter networks all use computers for switching, and it is possible that switching software will evolve to handle the message-handling functions pioneered by computer mail. Similarly, the growing body of data base systems can be expanded easily to handle computer mail functions. 155

We suspect, based on historical development, that we should broaden the traditional definition of computer mail to embrace all computer-augmented media. If Bell Canada does offer a commercial service, it may well begin as a straight computer mail or a Super TWX offering, but it would have to expand immediately to handle input from communicating typewriters, and it would probably have to expand a few years later to handle facsimile and communicating copiers. Computer mail, as it now exists, may be an attractive short-term product by itself, but for the future it probably represents a direction for change, not a distinct offering. 156

In addition, future computer mail systems must be conceived as integral parts of any office automation systems Bell Canada may choose to market. Computer mail may eventually be most important not for its own revenues, but for its ability to be the glue that binds Bell Canada's future office automation systems together. The very first computer mail system should be able to network both word processing equipment and forms-processing systems. The next generation will almost certainly have to handle the networking required by broader office automation processes. 157