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Social and Technical Interoperability, the Construction of Users, and “Arrested Closure”: A Case Study of Networked Electronic Mail Development

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Abstract: Behind email’s success lies a history of extended social interactions among ARPANET developers, programmers, and users from relatively heterogeneous backgrounds. An analysis of social identifications present in online discussions about email development found that inter-organizational computer networking allowed an increasingly wide variety of programmers and users to interact; assumptions about users to be openly stated and challenged; and the prototyping and testing of new technologies in heterogeneous social and technical contexts. Technical interoperation and its social analogue, social collaboration, became key challenges in the development of networked email and led to “arrested closure” in the form of flexible standards.

Keywords: interoperability, users, arrested closure, message systems, networked email, ARPANET, collaborative standard development, Request For Comment, RFC

Introduction

Electronic mail, developed informally by a small, elite group of computer experts to serve their own communication needs, has become a “mundane” technology, much like the pencil.¹ Email use is now common in the U.S. and developed nations. Louis Harris and Associates recently reported that sending and receiving email was the most popular online activity among online computer users in the U.S.: Sixty-three percent of online users reported using email “often.”² The number of worldwide email accounts by the end of 1999 was estimated at about 570 million (although an unknown number of people have multiple accounts), over

130 billion email messages were sent in 1999, and the most common use of the Internet continues to be email.³ In September 2001, 45.2 percent of the U.S. population reported using email.⁴

The familiarity of networked email masks the technical and social challenges that influenced its development during the early days of the ARPANET.⁵ Foremost among these challenges was that of “inter-operation,” the goal for the network technologies to smoothly operate with each other. In this paper, I argue that the expanding ARPANET research network not only became rapidly dependent on email for administrative and collaborative reasons, therefore reinforcing the need for *technical* interoperation of email, but it also provided an increasingly heterogeneous social environment in which a parallel *social* “inter-operation” was necessary in order to negotiate email standards.

The development of networked email faced a few unique challenges. Although email had not been a goal of the ARPANET’s project, it arose out of the instrumental needs of coordinating the network’s development and administration.⁶ Email was an unexpectedly popular—but technically unsophisticated—application of the innovative network. It resembled (and still resembles) the simple store-and-forward telegram, and did not require the network’s innovative path redundancy nor its real-time interactivity. Given email’s low level of sophistication and an interpretation of ARPANET resources as primarily technical rather than social, funding for the development of email programs and standards was a low priority. This meant that volunteers were especially important in programming and supporting email services across the network, and created concerns among institutional users who increasingly regarded email as an essential utility.⁷

This research examines the development of email standards and systems on the ARPANET as a process in which technical considerations, and technological closure were influenced by social identifications.⁸ The social aspects of the ARPANET have rarely been examined; most histories thus far present institutional perspectives or focus on computer hardware. As Rosenzweig notes, the varied backgrounds of social groups—“wizards, bureaucrats, warriors, and hackers” in his words—involved in the networks’ development deserve closer examination.⁹ ARPANET design was a remarkable technical feat in which participants continually reconstructed their environment; it was also a remarkable feat of social collaboration in which the design values, goals, and scenarios of different social groups were negotiated. As with the ARPANET, networked email had to operate across different technical contexts, and the organizations in which it was used—ranging from the military to the academic—were contexts with different norms for communication. Groups and individuals influencing the ARPANET included the Infor-

mation Processing Techniques Office (IPTO)¹⁰ managers, liaisons, consultants, “hackers,” various types of users, formal and ad hoc committees, and graduate students.

In studying networked email, I examine a mutual shaping context in which a communication technology was simultaneously being developed, used, and revised. This research is not intended to be a complete overview of email—this important and multifaceted history, addressed in passing in many works, remains to be comprehensively researched.¹¹ Instead this research focuses on the important period from the mid-1970s to the mid-1980s when the ARPANET, and later the Internet, was rapidly expanding in number and heterogeneity of nodes and user population. I argue that during this period, the ARPANET’s technical and social environment facilitated the development of robust email standards because of two factors. First, the technical factor, ARPANET (later Internet) technologies provided a basic yet flexible infrastructure for the development of more complex communication services.¹²

Second, and the primary focus of this study, is the socio-technical factor. Development of a software-based communication technology is a complex social as well as technological process because of the assumptions about social interactions embedded in it, particularly if the software is used to support its own development. The ARPANET was designed to link heterogeneous computing environments. Thus, interoperability was of critical importance. As network connections proliferated, the heterogeneity of both the computing environments and the social groups with access to and influence on the network increased. With this increase came broader participation which encouraged a form of software development incorporating an increased number of user and programmer perspectives, and in which discussions about software design processes themselves occurred (“meta-design”). In addition, email’s early programmers were able to discuss, critique, and troubleshoot email software as they used it, both in terms of *technical* interoperation (e.g., test messages were sent out and the results reported on) and *social* collaboration (e.g., the social contexts of email use were discussed).

Both the broader participation and the ability to shape the technology in use had important implications for the final form of email standards and the programming of email software. It is important to note that participants in the larger online group examined in this case study initially discussed the standardization of email *software*, in particular which commands and functions would adequately reproduce “real-world” administrative tasks and how they would be invoked (e.g., storing and retrieving email messages were compared to filing memos and filtering messages was compared to sorting incoming postal mail). As the

difficulty of agreeing on email characteristics appropriate for the ARPANET's diverse social/administrative contexts became apparent, this group's efforts shifted to discussing the *structure of email messages*. Agreement on minimum standards for message headers enabled the interoperation of email systems from the widest set of computing environments, while the standardization of how to extend header information enabled specialized uses and future expansion (such as the ability to add email enclosures).

Finally, the following study examines the role of inter-organizational networking on the construction of user identities and the development of email. While the larger online group examined in this research was initiated to encourage closure with regard to email functions, and a second unofficial online group emerged to handle specific technical challenges, there is little evidence for a *direct* connection between the online discussions and specific email features and standards. Rather, the online discussions had a subtler impact. The participants in both groups resisted “premature closure” in email standards—that is, stabilization before sufficient perspectives were addressed—by serving as vocal proponents for interoperation. Through online discussion and demonstration, both groups demonstrated the need for simple but flexible email standards while providing forums that attracted an overwhelming constituency of email software programmers to implement them.

The discussions of email user identities and their implications for email system design are evidence of the social nature of software development. In the following sections, I summarize the challenges programmers face in defining users, outline the historical homogeneous and heterogeneous networking contexts and their implications for email system development, introduce two inter-organizational ARPANET online discussion groups, and summarize constructions of organizational and individual email users presented in this group.

Defining identities and software users

A core challenge in designing software is understanding the context of its use, and how this context differs from that of its development. Users are constructed explicitly or negotiated implicitly as part of the design process and philosophy. Given that people with differing skills use technologies in different contexts, the notion of a singular “user”—as in “the email user”—is misleading.¹³ Who are the experts who influence the design? What are the relative influences of the programmers and the users?

While realistic representations of users and uses are by no means the only challenges to successfully rolling out new software—others include the difficulty of large-scale testing and revising, building a critical mass of users, high development costs, and user resistance—it is essential to identify and analyze typical usage contexts, and compensate for these contexts’ differences from the simplified and idealized conceptualizations present during the early stages of their creation. When developing software for specialized contexts, programmers are likely to consult experts; but when the context appears commonsensical or part of quotidian experience, as communication services might easily appear to be, software, as with other technologies, can suffer from the consequences of “tunnel vision.”¹⁴

The success of some software—such as the graphical user interface—has been attributed to the variety of conceptualizations about potential users, and to “bootstrapping” (the notion that designers’ decisions should be actively informed by their own use of the technology), a concept proposed by Doug Engelbart at the Stanford Research Institute (SRI) during the 1960s with important implications for the communication software development.¹⁵ If the software being designed is used to support collaboration during its development, then the social interactions taking place during the design process are likely to influence perceptions of the technology, especially in the identification of drawbacks and desirable features.

Collaboration in computer networks

Email technology development, and inherent challenges, mirrored the development of networking technologies. The earliest computer networks served relatively homogeneous user groups that typically consisted of non-proximate business or military users. For example in 1952, the “Magnetronic Reservisor” linked American Airlines offices in New York City via telex in order to coordinate seat reservations. The more sophisticated U.S. military SAGE (Semi-Automatic Ground Environment) system, conceptualized in 1946 and put into operation in 1963, linked radar and computing centers for real-time processing for early warning of enemy bombers.¹⁶ Before the ARPANET, email systems used a single time-sharing computer attached to multiple terminals but isolated from other computers (in Figure 1a, this is represented by the host computer contained in the dotted rectangle marked “A”).

Figures 1a-c. Email systems in increasingly heterogeneous network environment. Rectangle “A” encloses a single host; “B” encloses a single network with multiple hosts (ARPANET model); “C” encloses multiple networks (internet model). Modified version of image appearing in V. G. Cerf, “Interneting and Electronic Message Systems,” paper presented at the AFIPS Workshop on Technical and Policy Issues in Electronic Mail and Message Systems, Washington, DC., 1980.

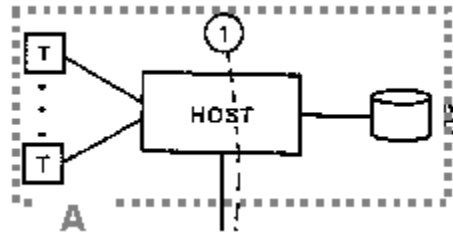


Figure 1a. Rectangle “A” encloses a single host.

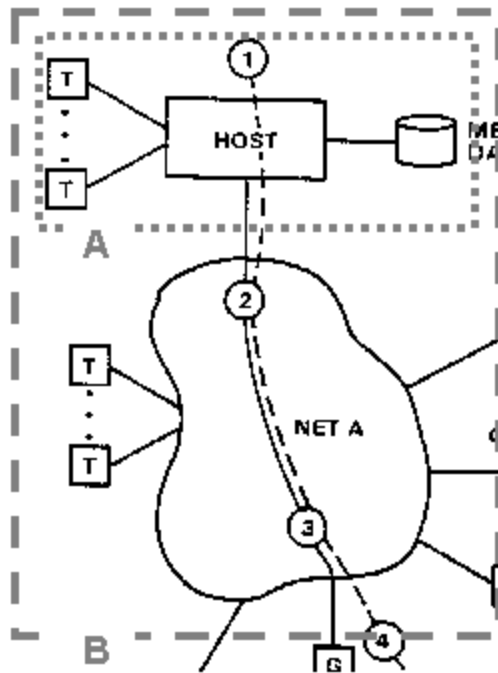


Figure 1b. Rectangle “B” encloses a single network linked to multiple hosts (only one is visible here), as in the ARPANET.

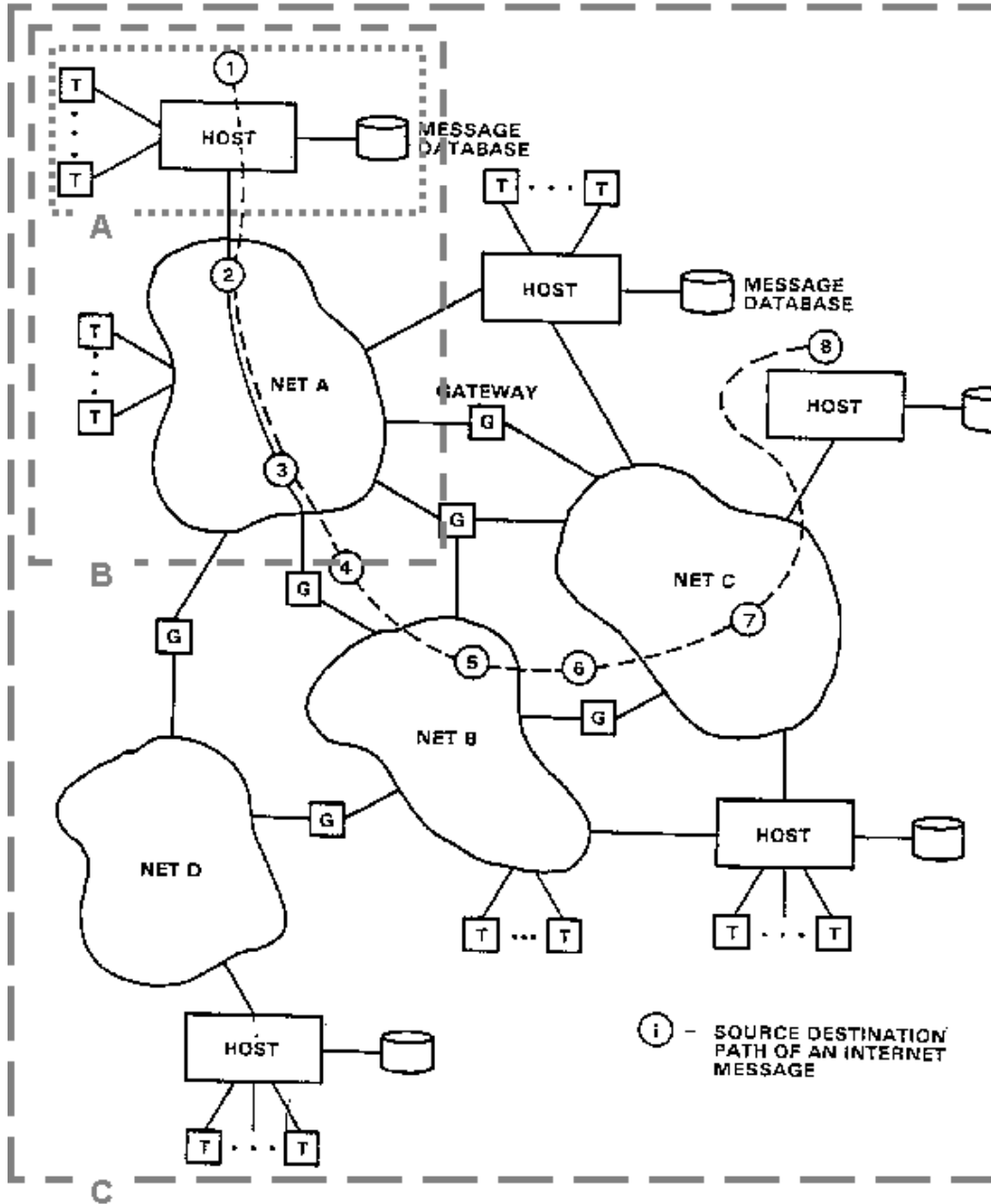


Figure 1c. Rectangle “C” encloses multiple networks, as in an internet.

One of the earliest examples of email on such a system was MIT’s Project MAC, which allowed the

depositing of messages from one user to another in the computer. On logging into the computer a user may be informed by the machine that there is a message in his “mail box,” and the computer will then print the message on command.¹⁷

This type of system would be technologically and socially homogeneous: users were either geographically proximate or had similar organizational ties, and systems used a single set of technical standards.

Networking heterogeneous systems

A more complex network (shown schematically within the larger dotted rectangle B in Figure 1b) linked different types of host computers, as in the ARPANET configuration.¹⁸ Specialized network computers (“Interface Network Processors”—IMPs) connected different types of host computers serving different organizations to a single network, and the “remote subscriber terminals” were connected via TIPs (Terminal IMPs), which were similar but linked inexpensive “dumb” terminals to the ARPANET. TIPs were popular because they provided access to network resources at relatively low cost.¹⁹ An organization without a mainframe could use another organization’s software remotely via TIP access.

The ARPANET was innovative not only because of its packet-switching technology but also because it linked computing systems having different technical standards and work groups having different social norms. It was originally designed to link sites to share military contractors’ computing resources and to test network technology for reliability and robustness, under the management of the Information Projects Techniques Office (IPTO). The IPTO, founded in 1962 as part of the U.S. Department of Defense’s DARPA, provided research support to partnerships between the U.S. defense and academic research communities. The office was influential in the development of computer science theory, practice, and education, although its original focus was the use of computers for command and control applications.²⁰

Before the ARPANET was operational, IPTO directors J. C. R. Licklider (1962-64, 74-75) and Robert Taylor (1966-69), described the computer as a communication device based on their experiences at the Stanford Research Institute with group “project meeting” software.²¹ Their article suggested the networked computer’s potential for communication before widespread network access: “A communications engineer thinks of communication as transferring information from one point to another in codes and signals” but

We want to emphasize something beyond its one-way transfer.... Creative, interactive communication requires a plastic or moldable medium that can be modeled, a dynamic medium in which premises will flow into consequences.... Such a medium is at hand—the programmed digital computer.²²

Inter-organizational online collaboration can be traced back to the IPTO's goal to not only share computing resources for military research, but also to create closer ties among computer science and engineering communities, in particular among the researchers and graduate students responsible for operating the new network.²³ The original ARPANET contract was given to a distributed group to encourage collaboration²⁴ because an earlier experiment with network technology had demonstrated the difficulty of encouraging researchers to collaborate. IPTO's first funding for network research (in 1964 under Licklider) went to UCLA to link three computer centers. However, it failed because of "strong local disinterest: The directors of the three centers appeared not to want to work together."²⁵

A key feature of ARPANET design collaboration was the careful documenting of design debates. The Network Working Group, which solved problems in linking computers to the ARPANET, fully documented its work starting in 1966 to help solve problems that they expected other network users would later encounter.²⁶ By 1969, when the ARPANET became operational, proposals for technical and social norms for information exchange were instituted in the Request For Comments (RFC) documents that were soon distributed online. Graduate student Steve Crocker set the tone of the RFCs when describing a Network Working Group meeting (comprised mostly of other graduate students) about communication between host computers and IMPs: "I present here some of the tentative agreements reached and some of the open questions encountered. Very little of what is here is firm and reactions are expected."²⁷ In RFC 3 of April 1969, entitled "Document Conventions," Crocker wrote:

The content of a NWG note [the early name for RFC] may be any thought, suggestion, etc. related to the HOST software or other aspect of the network. Notes are encouraged to be timely rather than polished. Philosophical positions without examples or other specifics, specific suggestions or implementation techniques without introductory or background explication, and explicit questions without any attempted answers are all acceptable. ... These standards (or lack of them) are stated explicitly for two reasons. First, there is a tendency to view a written statement as ipso facto authoritative, and we hope to promote the exchange and discussion of considerably less than authoritative ideas. Second, there is a natural hesitancy to publish something unpolished, and we hope to ease this inhibition.²⁸

These early RFCs sent a welcoming signal to others interested in contributing to and improving the ARPANET. Brian Reid, later a Carnegie Mellon graduate student and a participant in MsgGroup, told them "I did not feel excluded by a little core of protocol kings. I felt included by a friendly group of people who recognized that the *purpose of networking was to bring everybody in.*"²⁹

ARPANET access increased rapidly from four connections in 1969 to twenty-three in April 1972. ARPANET email was introduced in 1972 when Ray Tomlinson of BBN modified existing mainframe email and network file transfer software to create a tool for coordination among network developers.³⁰ He is credited with selecting the “@” symbol to designate the host to which the message should be transferred.³¹ This addition facilitated the use of email for inter-organizational purposes.

Email soon became the dominant use of the network, a surprising “smash hit” in the words of Frank Heart, manager of the ARPANET project at BBN.³² One reason was that email supported the numerous administrative tasks necessary for operating the ARPANET. It was asynchronous, allowing time for reflection and for people in different time zones and with different work schedules to participate; it was scalable, allowing a variety of people to participate either directly or via copies of messages; and it allowed people from a wide geographical region to participate. Using email automatically created machine-readable documents that could be stored, forwarded, or commented upon, and context information (date, time, sender) was generated automatically. For some people, there were disadvantages that included having to type (although sometimes done by secretaries), and the technology could be difficult to use.

Initially network documents were available both by email and by postal mail. The Network Information Center (NIC)³³ on the ARPANET did have an interface in the early 1970s to send postal mail—a clerk would print and mail messages—but this stopped because of high cost and an increase in online mailboxes.³⁴ The first RFCs to explicitly discuss ARPANET email, in 1971, describe it in terms of a “mail box” to simplify the exchange of administrative information about the ARPANET, in particular for the NIC to deliver and receive messages and documents.³⁵ This protocol also defined what would become “headers” to provide information for a person to distribute the messages:

At the head of the message or document sent to mail box number 0 [the default mailbox to be connected to a printer] there is to be an initial address string terminated by a form feed. This address string is to contain the sender’s name and address, and the receiver’s name and address formatted in some reasonable, easy-to-read form for a clerk to read and distribute.³⁶

As the importance of managing and automating email became apparent, standardizing the contents and format of these headers would become the subject of extensive debate. Much as an expanding railroad network earlier created pressure to standardize timekeeping for efficient coordination of trains, linking far-flung computers created pressure to standardize metadata such as time-stamps to allow efficient data sharing. On pre-network computers, time-stamps were based on local times and used

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Minneapolis, as adapted from ARPANET Completion Report Draft, September 9, 1977.

Not only did the ARPANET link together geographically distant locations, but it also linked government, military, academic, and commercial organizations. During these early stages of the ARPANET, the conceptualization of tools for social communication was still wide open. A “messaging system” could encompass a simple email system, an automated conferencing system, a database system managing online archives, and even include real-time chat systems. Each conception had different design characteristics, appropriate for different user groups and organizational contexts, as was reflected in the terms used. In 1977, Panko and Panko noted that such systems were variously termed “computer mail, computer message services, computer teleconferencing systems, and electronic message services.”⁴¹

The data structure of the email message is divided into two parts reflecting its origins from the administrative memo and the ARPANET data packet. The header section contains a series of data fields about the message (these are typically read and generated by software), while the body contains the message itself (this is usually read and generated by the user). Most email standards discussions and RFCs focused on defining and refining the header fields and their uses. In particular, RFC 822 defined the structure of Internet email messages and remains influential today; RFC 821 defined the “simple mail transport protocol” (SMTP) that described how messages should be transferred from host to host; and RFC 1123 corrected and updated these standards.⁴²

A message on an internetwork (shown schematically within the largest dotted rectangle C in Figure 1c) could take the route shown by the dotted line, crossing multiple networks and being read on a completely different system than the one on which it was composed. Figure 1c represents multiple networks with multiple computers linked by gateways (marked by G) which “translate” the message data as it moves from network to network. As the networks grew in complexity, the interoperation challenge grew and technical standardization became more critical. A major technical challenge was properly routing messages to destinations at other organizations and through other networks and properly routing the replies back, as well as translating key header information. Another challenge was accommodating the widening range of technologies used to compose and read email. Users might read messages through a slow line printer, a rapid video terminal with monospaced character fonts, or the innovative Xerox Alto system, which used proportionally-spaced characters and whose designers conceptualized handling and formatting text in an entirely different manner.⁴³

Identity labels and technical proficiency

Time-sharing computers and heterogeneous networks not only linked together multiple technologies, but also multiple groups of users. Stereotyped social identifications existed during the time-sharing and early ARPANET development, when programmers developed a wide range of identity labels. These labels described the technically-proficient (such as implementers, hackers, and wizards), varieties of users, and “bureaucrats.”

The following identities are culled primarily from the perspective of the technically-proficient, as expressed in the *New Hacker’s Dictionary*, a resource which typifies both the playfulness of computing cultures and a desire to exert authority over the labeling of technology and those who work with it.⁴⁴ These identity labels were created and defined by many of the same people who participated in the online discussion groups examined in this paper, and these labels appeared regularly in their online discussions. The original Jargon File

was a collection of hacker jargon from technological cultures including the MIT AI Lab, the Stanford AI lab (SAIL) and others of the old ARPANET AI/LISP/PDP-10 communities including Bolt Beranek and Newman (BBN), Carnegie-Mellon University (CMU), and Worcester Polytechnic Institute (WPI).⁴⁵

Of these organizations, the MIT AI Lab, SAIL, BBN, and CMU had members who participated frequently in email development discussions.

“Hacker” is a complex identity label exhibiting the tensions of stereotyping and differing ingroup and outgroup definitions. In popular culture, “hacker” is a pejorative term that emphasizes maliciousness and the invasion of computer systems; but within the hacker lexicon, these individuals are known as “crackers.”⁴⁶ Within the social group itself, the term emphasizes technical proficiency, intellectual curiosity, and creativity. According to Raymond and Steele, a hacker “enjoys exploring the details of programmable systems and how to stretch their capabilities, as opposed to most users, who prefer to learn only the minimum necessary”, “programs enthusiastically (even obsessively) or who enjoys programming rather than just theorizing about programming,” is “good at programming quickly” or an “expert at a particular program...as in a ‘Unix hacker.’”⁴⁷ Note that this last definition indicates the contextual nature of hacker: someone can be a hacker with respect to one technology and not with respect to another.

From a hacker’s perspective:

there are two classes of people who work with a program: there are implementers (hackers) and lusers [sic—see below]. The users are looked

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down on by hackers to some extent because they don't understand the full ramifications of the system in all its glory.⁴⁸

Importantly, “user” is a relative term: a “skilled hacker may be a user with respect to some program he himself does not hack.”⁴⁹

Other types of users are less technically proficient. The “real user” is one who is paying money for computer use, is a commercial user, or is “someone using the system for an explicit purpose (a research project, a course, etc.) other than pure exploration.”⁵⁰ The “luser” is a user “who is also a loser,” a term coined in the mid-1970s at MIT as joke variation of the user label on one of its ITS systems.⁵¹ After this coinage, “[t]here ensued a great controversy, as some of the users didn't particularly want to be called losers to their faces every time they used the computer.”⁵² However, later “one of the ITS machines supported ‘luser’ as a request-for-help command.”⁵³

The “naïve user” (naïve, this is, with respect to the technology, not the context in which it is used) was represented sympathetically if the reason for the naïveté was inexperience. A naïve user “[t]ends to imply someone who is ignorant mainly owing to inexperience. When this is applied to someone who *has* experience, there is a definite implication of stupidity.”⁵⁴ The “naïve user” was taken more seriously during the 1970s in personal computer design and is reflected in, for example, Ted Nelson's call for redefining the user in his politicized guide to computing *Computer Lib/Dream Machine*: “A naïve user (no offense)” is an “ordinary person who doesn't need to know any [technical] things in order to do something useful with the computer. Creating programs to help *him* is the frontier of computing.”⁵⁵

Other identities included “manager,” “bureaucrat,” and “suit,” which were all derisive terms. Managers were famed for “their distance from actual productive work and their chronic failure to manage,” and their “social technologies” of formal committees, politicking, and voting were regarded suspiciously by hackers.⁵⁶

These identity labels become important as we examine the role of an online discussion group that not only incorporated people from multiple organizations, but also attempted to develop email standards and software for multiple types of users.

Development of an inter-organizational discussion group

Email was a critical communications link between and among IPTO administrators, developers, and users, and an underlying technology essential to the administrative operation of the ARPANET. But while

RFCs provided an important early forum for publicizing mailing standards, the development of ARPANET email standards lagged, perhaps because the RFC system was a relatively slow, contemplative process or because it was reaching and incorporating the views of the only most dedicated standards creators. Of even more concern was that email RFCs were sometimes not acted upon. Because of the decentralized nature of ARPANET administration, the need to test standards during their development, and the lack of funding for email system development, the adoption of email standards was rarely achieved through direct administrative edicts, but rather largely through a voluntary “opting-in” process on the part of host sites.⁵⁷

In an attempt to develop consensus and develop support for the emerging standards regarding email, IPTO administrator Steve Walker agreed to sponsor an open online forum among ARPANET users. The result, the main focus of this case study, was “Message Group” (or “MsgGroup” for short), an early online discussion list started on June 7, 1975, by computer scientist Dave Farber and lasting until 1986.⁵⁸ This group is worth studying because it was initiated to homogenize standards, its membership consisted of people involved in early and subsequent email technology development (see appendices B and C), and it was regarded as influential both during its existence and in retrospect.⁵⁹ The group’s demise in 1986 was attributed by its former participants to the availability of other online discussion forums, the solution of the basic messaging problems, and a focus on other technical challenges.

MsgGroup started to link together people already involved in the development of messaging systems, as well as others who might have been interested in the topic. At this time, a variety of systems were in development or recently completed: MSG had just been developed by John Vittal, BBN had started developing Hermes under contract to IPTO, and MSGDMS at MIT and RDMAIL at CMU were under development (#1157, 30 April 1979).⁶⁰

Formation of the group was prompted by the following message from the IPTO program manager:⁶¹

My reason for seeking to establish a group of people concerned with message processing was (and remains) to develop a sense of what is mandatory, what is nice and what is not desirable in message services. We have had a lot of experience with lots of services and should be able to collect our thoughts on the matter.

My goal at present was not to establish “another committee” but to see if a dialog can develop over the net. I sense that to some extent this has already happened but there are many who have not entered the discussion. There are lots of possible reasons for this and I do not wish to force anyone to participate

but I strongly urge anyone with comments (positive or negative) to toss them in (#2, 7 June 1975).

As with RFCs, MsgGroup contributions were assigned sequential numbers and archived for later reference by its moderator.⁶² However, MsgGroup contributions covered a broader range of issues and, because membership was open, aired the views of a wider group of people concerned about the development of email. While specific standards were not discussed in detail within the group—they continued being published as RFCs. Many of MsgGroup’s contributors credit the group with influencing the development of networked email. There were three other groups that addressed issues similar to MsgGroup, all of which shared a large overlap in membership. The Message Service Committee and the IPTO-funded CAHCOM (Computer-Aided Human Communication) committee were smaller, more exclusive groups than MsgGroup and had official mandates while the unsanctioned “Header-People” discussion group had a more technically-oriented membership, had no moderator responsible for the list (it was an early example of an “automatically rebroadcasting” listserv), and focused on specific design and implementation details of email header information.⁶³

MsgGroup’s 329 contributors (about sixty of whom could be considered core members because of the number of messages they contributed or length of their membership)⁶⁴ were distributed across the United States (and in later years Europe), at a variety of military, academic, and consulting organizations, and contributed a total of 2,578 messages to the list. According to the first distribution list posted to the group, MsgGroup messages were sent to nineteen mailboxes on six host computers (#13, 12 June 1975). In April 1979 there were 133 mailboxes, and it took about two hours to send each message to the list (#1012, 10 April 1979). The last distribution list posted to the group, version 46, had 191 mailboxes (including several group mailboxes such as the CMU mail developers mailbox RdMail@CMUA, and MsgGroup@ECL, RAND-MsgGroup@RAND-UNIX, Future-NET@SRI-KL and MsgGroup@UDEL) on forty host computers (#1583, 22 December 1980).

An early message about the appropriate technology for use in the discussion indicates that founding MsgGroup members wanted to make the list as accessible as possible. Email was considered more appropriate than teleconferencing systems because it was very convenient for most members, allowed “passive observation,” and facilitated easy deletion of messages. Using an interactive chat program, TCTALK, was regarded as a “very inefficient process” because other participants would have to watch the others type. The then recently-developed FORUM system was not recommended because it had a “long start-up curve” and required that everyone have access to the same computer host.⁶⁵

Group members clearly felt that robust email standards should be developed quickly before inferior existing technology propagated:

Make no mistake—what our ‘toy’ systems do to us today is going to happen to a hell of a lot of people tomorrow. In the computer game there is a distressing tendency for an informal set of operating procedures to become a de facto standard through rapid diffusion. And the wider the diffusion the more difficult even desirable change becomes (#908, 11 March 1979).

Categorization of email developers and users

While computer developers have been portrayed as elite and insensitive to social issues, members of MsgGroup repeatedly reflected on social aspects of their technology (email), both with regard to the group itself and to wider society. Of the 86 substantive discussion threads⁶⁶ that took place in MsgGroup, 32 involved discussions of social issues in relation to the group and 48 involved discussions of broader social issues in the design of email systems; in contrast, 57 involved technical discussions (I classified the threads into multiple categories if appropriate).⁶⁷

The primary goal of MsgGroup was interpreted by its moderator as exploring “netmail from a users point of view through discussion of issues among the message system development and application community within the ARPANET” (#1157, 30 April 1979). The group linked together the few people at each organization concerned about the topic. Early members included “some managers, some users, some customers ..., some implement[ers], and some hackers” (#1157, 30 April 1979). Of the nodes represented in Figure 2, the academic hosts participating in the development of email included MIT, Stanford, Carnegie-Mellon, and UCLA; the governmental/military hosts included ARPA, National Bureau of Standards, and various military sites including Ames; and the consulting and commercial sites included BBN (Bolt Beranek and Newman), CCA (Computer Corporation of America), RAND, and, later, Xerox PARC.

As with the ARPANET, specialized online groups such as MsgGroup and Header-People linked “resources”—people with specialized knowledge and experiences—from different computer sites. Using ARPANET email systems, both online groups enabled people who would not normally interact—people who were not “Principal Investigators” given travel reimbursement to attend face-to-face meetings—to build social networks across organizations focusing on email system design. Although pragmatic collaboration was encouraged on the ARPANET, it could be threatening to the more traditional organizational structures. The creation of Header-People, the unsanctioned technical email list, was

initially questioned by MsgGroup’s moderator and by a member of an ARPA-sponsored committee who wrote “You can’t go on forever, merrily communicating with other system hacker types...” (“What the ‘standard’ is and isn’t,” September 27, 1976).⁶⁸

Networking organizations with widely differing social norms presented challenges. Norberg and O’Neill point out that a barrier to military units accepting the ARPANET was that the “network would make it easier for subordinates to send messages to other agencies without the approval of commanding officers, possibly circumventing the military’s chain of command.”⁶⁹ This tension between structured and informal collaboration was to be expected given ARPA’s hybrid academic-military nature and its emphasis on decentralized ARPANET development. In exchange for academic research and technical expertise, early ARPANET managers tolerated off-topic online discussions, unusual work schedules, network testing, and lax network security.⁷⁰ The DoD finally resolved this dilemma in 1983 by splitting off 68 of the then-total 113 ARPANET nodes into a separate (and more secure and stable) MILNET network, and leaving the remaining ARPANET nodes for network research and development.

MsgGroup’s archived discussions reveal two self-identified subgroups: administrative-oriented professionals and technically-oriented hackers.⁷¹ Participants emphasized their social identities by highlighting their administrative and technical experiences, and some participants explicitly described themselves as having backgrounds in both areas. Of the approximately sixty core members, ten percent were predominantly administratively-oriented and about half as many were predominantly technically-oriented, with about one-quarter appearing to fit in both categories. The remaining participants did not give sufficient information to be categorized.

Organizational identities

The ARPANET connected governmental, academic, and commercial organizations, and identifications of all three types were present in MsgGroup discussions. During MsgGroup’s 1975 to 1986 duration, increased internetworking and the use of gateways connected new organizations, socially and technically, to the ARPANET and MsgGroup. In 1982 Xerox-PARC’s internal mail system was gatewayed to the ARPANET. International users began to contribute to MsgGroup using the ARPANET directly or via gateways. Messages from University College in London first appeared in 1981, and messages from University of Stockholm’s OZCOM system were gatewayed through MIT’s network in 1984.

Linking new organizations and email software presented technical and social challenges that were reflected in the online groups' discussions. Three examples of discussions representing organizations as having specific (and problematic) differences in technical standards are, chronologically, the "ARPA order," the "decent header," and the "Xerox woes" threads. The "ARPA order" thread (6 to 15 March 1979, 26 messages), was seeded by a message from an IPTO manager asking Carnegie Mellon to modify its RDMAIL software in direct contrast to the then standard, RFC 733, because BBN's Hermes software could not process RDMAIL messages. One member wrote about ignoring the RFC 733 standard to accommodate BBN (#882, 7 March 1979). An MIT hacker noted that the ARPA "bureaucrats" were interfering with "one of the most democratically adopted standards" and that the order was retrogressive (#884, 7 March 1979). A CMU member explained why they agreed to modify RDMAIL to meet this request:

CMU is the only site on the net which generates recipients with imbedded spaces. From the point of view of anyone managing time or money, it makes more sense to have one site make a change rather than many, especially if the change is as small as this one is (I expect to take a total of about 1/2 hour to make the change) (#887, 7 March 1979).

Hackers questioned the role of ARPA funding Hermes software development, and questioned whether BBN or the Federal government (which contracted with BBN) owned the software (#904, 8 March 1979). Hermes was perceived by hackers as being flawed not only because it was inefficient, but because they could not access and modify its proprietary source code. An SRI programmer wrote:

HERMES is a hungus [humungus?] monster of a program that should never have been given birth. Any mail program that brings the system to a screeching standstill whenever it is started and any program whose core image is almost as big as INTERLISP's is a crime against nature. It is the most inelegant program I have ever seen (#1026, 13 April 1979).

The "decent headers" thread (4 April to 28 August 1979 in several bursts, 59 messages) demonstrates differences between MIT's older messaging systems and other messaging systems on the ARPANET. The thread started when a message from a user of the ITS operating system on an MIT computer contained information not compatible with other messaging systems, which resulted in protests from MsgGroup members. Members complained that ITS users often forgot to include "subject" information in their messages. One ITS user noted that the "ITS header" problem was well-known but would take too much effort to fix. MsgGroup's moderator had to manually correct the ITS headers and compared the technical problem of ITS headers to a social problem: they were "bad breath out here in the rest of the net" (#958, 6 April 1979).

The “Xerox Woes” thread (26 August to 12 September 1982, 52 messages) demonstrates the challenges of communicating with innovative messaging systems. It started when group members from Xerox sent email with formatting that resulted in very long text lines. Xerox’s attitude, too, was deemed “anti-social” (#1820, 26 August 1982). MsgGroup members then discussed whether there should be a standardized line length, given that devices on the ARPANET used different line lengths, and whether the sending or receiving software should be responsible for message format. Finally, a member from Xerox stated the organization’s official position, and complained about attacks on Xerox (#1859, 31 August 1982). A similar, earlier thread was “Please, no 80-column texts!” (8 to 18 September 1979; 42 messages) in which a BBN member asked that others send their messages in the 72-column format because it was compatible with a wider range of output devices.

These three examples demonstrate that in this networked environment, organizations were associated with their software’s characteristics: MIT’s and Xerox’s software (and their users) were considered rude for being incompatible with other systems. In addition, ARPA attempted to control the standardization of the technology to the point of negotiating between BBN and CMU, and effectively neutralizing an existing standard, RFC 733.

User identities

User identities were often discussed by MsgGroup participants in the form of actual and potential users of messaging systems. Many MsgGroup members described themselves as email users, and clearly they were users in the sense that to participate in—or just observe—the group they had to be familiar enough with messaging systems to access and send messages. The extent to which group members used the technology, and the manner in which they thought it should ideally function resulted in the varied user conceptualizations, or varieties of “constructed users.”⁷² The early ARPANET’s research focus limited the heterogeneity of its online groups. Access limitations excluded most developers of commercial systems, actual “naïve users,” and academic organizations other than those with elite computer science departments. But the transition to the Internet in 1983, which simplified connections with other computer networks, expanded the influence and heterogeneity of MsgGroup (and other ARPANET groups).

Constructions of users within this group fit into three general categories: Administrative users, naïve (or future or novice) users, and hackers (or implementers or programmers) as users. The first type of user was an administrator operating within an organizational context. MsgGroup members with administrative backgrounds compared messaging tech-

nology to secretaries, and such a system had to easily handle typical administrative functions such as sorting and filing mail, allowing managers and secretaries to function as a single entity. This user represented the administratively-oriented members of the group during this period when access to messaging system accounts were restricted because of expense.

The second type of user was the generalized naïve user, which included clerical staff (when messaging systems were discussed in the context of large organizations) and the potential wide group of future users (when messaging systems were compared with the ubiquitous Postal Service). The naïve user was often discussed in gendered terms, particularly when secretaries were described. The naïve user appeared to be used as an idealized identity when discussing the importance of simple systems. The administratively-oriented members viewed catering to naïve users as a prerequisite for marketing messaging systems to large organizations, while technically-oriented group members regarding assisting naïve users as an evangelical duty, and described the liberating effects of computer technology for such users.

The third type of messaging system user, and ultimately the most influential type, represented the technically-proficient ARPANET members of the group itself. Although not without controversy—the members repeatedly debated their representativeness as messaging system users—group members critiqued the systems with regard to their own experiences, and in particular demonstrated problems they encountered using the technology. Online debates about “bootstrapping” indicated that MsgGroup members had differing notions of the opportunities to generalize their experiences with email systems.

The next three sections describe in detail the group’s discussions about administrative and naïve email users, and the relevance of technically-proficient users’ perspectives on email.

Constructing the administrative user

Near the beginning of MsgGroup, its moderator suggested that plans for messaging systems be evaluated by group members (#131, 15 August 1975). At this early stage, however, members were primarily either managers or closely associated with people in managerial positions; the more technically-oriented (and independently-minded) systems administrators and hackers joined later. For example, managers wrote introductions such as:

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... a ‘user’ and a ‘critic’ without portfolio (#526, 26 April 1977).

I am not a Computer Scientist. I am however one of those rare birds, a USER, and also an interested onlooker (#993, 8 April 1977).

I am a customer and a user. ... I am not the expert that most of you are, but I am a good listener and willing to give feedback from a user standpoint when specifically requested (#453, 8 February 1977).

In the early days of MsgGroup, the predominately administratively-oriented members evaluated plans submitted by developers of messaging systems. The “Nomenclature: Comparison of Mailsys, MSG and HG” thread (14 October to 29 December 1975, 20 messages) is a good example of contrasting such developer and administratively-oriented user perspectives. The user-liaison for BBN’s messaging system project asked for feedback from the group on a report comparing terminology from three messaging systems: BBN’s MAILSYS, John Vittal’s MSG (written in 1975 and at the time the “most popular message-reading program on the ARPANET” (#474, 18 March 1977)), and James Calvin’s HG (written in 1974, and which combined mail reading and mail composition features (#474, 18 March 1977)).

One member questioned whose perspective should be used in developing terms. In his view, the “manager’s perspective” was not sufficient and software should adapt to many users and groups:

[Much] of the msggroup correspondence seems to propose that message systems should be viewed from the point of view of the office manager. I also feel ... that message systems such as those we are speaking of are useful for interactions between non-managers. A circuit designer using a “computer-mediated-interaction” system ... will not want to view his interactions from the same viewpoint or in the same language as an office manager or for that matter a university professor who is using the system to do research with colleagues at other remote sites. So the basic problem with evaluating the terms used in the message system is whose point of view should we take. Of course another point of view on the problem is to say that we will never have real agreement and thus why not provide a mechanism for each different group or for that matter individuals to provide their own environment (the personal terminal attitude) (#180, 14 October 1975).

Another member noted that terminology for simple operations should work whether “whether you’re a major, or office manager or a research engineer” (#183, 15 October 1975). MsgGroup’s moderator thought that the BBN report represented a programmer’s perspective, rather than a “normal person’s”:

First some general comments about the difference between normal people and programmers. Programmers are a little like mathematicians. ... [The] FILTER

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[command:] I don't like at all because it is backwards from the way us non-programmers think about searching for things. We don't think in terms of building a filter and then passing the file through it. We think of "going through the file looking for a match." Thus we need a SEARCH MASK, or a MATCH [command] (#186, 20 October 1975).

Administrative users differed from other users, such as hackers, in that they—or their organizations—were paying customers (#1066, 15 April 1979). Military users were a specialized example of such an administrative user:

The military user currently is used to a prompting message creation system (the message creation form DD173) and would probably feel more comfortable (at least initially) with some prompting. ... I am extremely gratified and excited to see the [message] group interacting and that those interactions appear to be converging around real capabilities that I think can be sold to the operational military guy (#49, 23 June 1975).

A common complaint from administrative users and the group's moderator, who had to manage large amounts of mail in this role, was that the tricks that they had to learn to use message systems—or to actually make them function—were unreasonable (#1335, 20 October 1979), especially for potential future users. MsgGroup's moderator noted this twice. In the first posting, he expressed concern that while powerful text editors such as EMACS could be used for composing, reading, and printing email messages, they were too complex and limited in terms of other features needed for email processing, such as filing messages:

I am also looking at things beyond the level of hacker/users. My work involves the transfer of these technologies into organizations and businesses that will not tolerate a need to think in editor terms to get the work done (#973, 6 April 1979).

In the second posting, the moderator responded to complaints about his sending a personal message to the list ("CC'ing") rather than only to the intended recipient:

It should be clear that we cannot expect future multitudes of computer mail system users will accept responsibility for dealing with system designs that provide trap doors to fall through and goblins that jump out to grab the unwary (#1336, 28 October 1979).

This was a common problem at the time and remains so today; the "trap doors" and "goblins," while identified, were not resolved. The "organizations and businesses" and "future multitudes of...users" represented a very different type of user than that represented within this group.

In sum, administratively-oriented MsgGroup members placed messaging technologies within familiar organizational contexts and roles; this suggested that technology design should adapt to existing organizational

structures and mimic existing tasks. The administrative perspective was exemplified by this unfavorable comparison of early messaging systems to one contributor's efficient secretary, “[who] is knowledgeable enough to make an almost perfect assessment of the ‘rightness’ of giving out clearly private information DEPENDING upon the circumstances of the request. ... I wait for our efforts to get much more sophisticated than they are” (#809, 24 February 1979).

Constructing the naïve user

Although MsgGroup members expressed concern about developing messaging systems for “naïve,” “novice,” and “future” users, representative ones were rarely—and in the last case, not yet—available. The naïve or novice user was commonly cited but was represented differently by administratively- and technically-experienced members. The former regarded them within bureaucracies while the latter appeared to see them, perhaps in light of the activism of the era, from a more personal sympathetic perspective.

The concept of “naïve user” was present in MsgGroup discussions from 1975 to 1979 (with one mention in 1982), but these concerns decreased as more technical issues were addressed in the group. In addition, the variability of user needs was largely relegated to the user-interface portion of messaging technology rather than the underlying transport standards. With the division between user interface and underlying standards, the underlying mail transport could be standardized—although still expandable—while the user interfaces could be specialized for different organizations and types of users.

Given the stated importance of designing for naïve users, it is surprising that MsgGroup members reported only two cases of directly contacting such users to examine their views of message processing. In the first instance, a member conducted an “experiment to determine command vocabulary selection” (#280, 29 January 1976), in which he “interviewed three secretaries, asking them what they do, after initially receiving a stack of mail for their boss, to determine... the next step for processing the mail” and an appropriate command for examining incoming messages. (He found that secretaries “scanned” incoming mail.) The other instance took place during a discussion about the appropriate uses of the “carbon copy” command, when another member “did a quick survey in our company, and asked several non-computer friends to do the same” (#1370, 30 October 1979). Based on his survey, he concluded that typical organizational uses of carbon copying had not been portrayed accurately in the discussion.

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The administratively-oriented members viewed defining and catering to naïve users as a prerequisite for marketing messaging systems to large organizations:

...the future goal is for this to be used by anyone and everyone who works in offices. That means that the use should be designed to fit their needs, not ours. The systems are meant to improve the productivity of currently-existing offices, and must facilitate their existing operational patterns. ... Business communications are structured, not only in government, but in any large corporation. There really is a chain of command; it must be recognized and considered in preparing a marketable product for our customers (#1360, 30 October 1979).

One concern was how to simultaneously meet the needs of a variety of users, and how to handle naïve users as they became more sophisticated through their own experiences or as computer systems became more common. The following excerpts demonstrate concerns about developing systems for changing users (“exhibit growing sophistication”) and multiple groups of users (“novice as well as experienced”):

[I] would like to suggest that tailorable systems should have a graded set of sophistication levels available as default options to facilitate new users who will exhibit growing sophistication and hence need a growing set of capabilities (#212, 18 November 1975).

...one of the really important issues in the controversy is “How do we make it easy for all users - novice as well as experienced - to find out what features are available, and how they can best utilize them” (#809, 24 February 1979).

In contrast to the above administratively-oriented views of users, the technically-oriented members of the group reported working with naïve users in their roles as liaisons and computer support staff, and for the most part expressed sympathy with these users’ perspectives. For example:

It is unacceptable to have the attitude that because a user is naïve s/he is “stupid.” There are a lot of bright people who do not know every in and out of a computer system and don’t intend to learn, but at the same time must use it. A computer system typically makes strange demands at odd times to a user, and all too often the “consultant” simply says “do this” or “type that” without any explanation; perhaps because the user did not want an explanation (#932, 4 April 1979).

Differing constructions of users were particularly clear in the administratively- and technically-oriented views of gender in relation to technical competence in naïve users. This may have been due to differing organizational experiences, ages, or social views between these two groups. Several early male administrators had secretaries type their messages and send them using the secretary’s mailbox accounts.⁷³ This led to a series of threads discussing how to handle multiple people involved in the creation of a message and the difficulty of designing

technology for secretaries, including a thread entitled “Helping Secretaries Answer Boss’ Mail.” This discussed how two people (“Boss” and “Secretary”) can collaborate in sending messages and about tools for delegating email management, and members ended up discussing standardizing header fields such as “SENDER:”, “FROM:”, and “REPLY-TO:”, as well as how software should handle these fields (for example, whether to send replies to the FROM or the SENDER address).

In several cases when features were discussed for a variety of users, naïve users were envisioned as secretaries (#280, 29 January 1976) or “housewives” (#577, 9 June 1977). The activities of messaging systems were compared to those of secretarial staff. The moderator, for example, repeatedly evaluated new features by applying his “time-honored” secretarial test: “If your secretary reformatted your incoming mail without asking, would you fire him?” (#1246, 10 September 1979); “If my secretary, without my directive, told anonymous inquirers ‘when I last read my mail, I would fire him’” (#805, 23 February 1979). The use of the masculine pronoun for secretary in the above quotations was not unusual in this group. Other members describe secretarial functions in earlier messages as follows:

The secretary then tells MSG to Answer each piece of mail, allowing him/her to also send a copy [to the] Boss’ directory (#54, 24 June 1975).

And:

Call our operative, a secretary, X. When X comes in, in the morning, he (traditionally a neutral pronoun) begins mail processing by seeing what’s been placed on the mail stack (or mail box, or “in box”) on his desk. How does he do this? By ... (#277, 25 January 1976).

One thread about secretaries as current and potential future users of messaging systems is worth exploring in detail because of the reactions of members to the characterizations of secretaries. During a discussion about efficiencies of various email and operating systems that resulted in a debate about whether message systems should be simple or powerful, the topic changed briefly to “systems even a fool can use.” A male hacker distinguished between the experiences of “intellectual” programmers and those of clerical workers and their implications for user interface design, and a subsequent response linked clerical workers to women:

One must also remember that most clerical workers are women and have been taught they shouldn’t be too bright or aggressive or know a lots about computers cause computers are ‘definitely a masculine thing’. This in addition is why suggestions that clerical workers (and it applies to clerical workers of either sex) are happy being dumb (I am exaggerating and characterizing here) are so obnoxious; however in the case of female clerical workers such a suggestion is extremely obnoxious (#1085, 19 April 1979).

In general, hackers seemed especially sensitive to gender concerns in MsgGroup discussions. This observation is supported by events in the Header-People discussion group, which consisted primarily of hackers. RFC 724 addressed how to handle messages sent by secretaries as follows:

George Jones logs in as Jones on his Host. His secretary, who logs in as Secy on her Host (SHost) sends mail for him. Replies to the mail should go to George, of course.⁷⁴

An MIT hacker in Header-People not only critiqued the RFC's technical aspects, but also criticized the assumption that secretaries were women:

In the RFC, secretaries are always referred to with feminine pronouns, while other people are always male. While this reflects an almost true state of affairs, it is a shameful state, and we ought not to go about writing documents that implicitly assume that it is so. Such implicit allusions tend to lull people into an unthinking acceptance of the situation. Why can't we have a mail standard which isn't a male standard? ("RFC724", 12 May 1977).

When a revised version of RFC 724 was finally released, it incorporated—in addition to many technical modifications—revisions to the secretarial references (which were irrelevant to the technical characteristics of the standard). They were rewritten to disguise the sex of the secretary (but not that of the boss):

George Jones logs in as Jones on his host. His secretary, who logs in as Secy sends mail for him. Replies to the mail should go to George.⁷⁵

In short, the naïve user was viewed differently by administratively- and technically-oriented members of MsgGroup. The former tended to view the technology as supporting naïve users in their existing roles in organizational structures, while the latter tended to question assumptions about the technical capabilities and the sex of such users, and express hope that such users would find computing technology intellectually stimulating.

Questioning the technical user's relevance

The challenge of bootstrapping (designers using what they design) occurs when developers identify themselves as typical users and design based primarily on their own needs. Many MsgGroup members stated that they approached computer systems from both developer and user perspectives:

I am responsible for the implementation of BBN's mail system Also I am a fairly extensive user of mail systems ... (#250, 5 January 1976).

I am mostly a user and infrequently an implementer of message systems. ... I have been involved in protocol development for the ARPANET and more recently for other networks too (#532, 27 April 1977).

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[I am a] user and critic, with a strong interest in future network systems for use by the general public [and] an implementer, in the sense that I am part of designing/writing multiple interactive applications (#491, 12 April 1977).

It is clear that technically-oriented people had a great deal of influence on message systems from their perspective as users of the technology. For example, the introduction to the manual for Carnegie Mellon's own email program "RDMAIL" thanks members of the school's computer science department for their user comments.

The extent to which technical-oriented participants could represent broader categories of email system users was repeatedly discussed within this group. A representative thread about this topic began with a self-described hacker writing: "I claim that essentially all of us have almost exactly the wrong set of experiences and backgrounds to do the job properly. Our tendency is to judge a feature based on our personal preference for it" (#1075, 16 April 1979). In response, another member wrote:

Yes, we indeed may have the wrong set of experiences and backgrounds to standardize message systems PROPERLY. But it appears to me that we still have a professional responsibility to translate our experience and knowledge from the current environment into meaningful guidance to the multitude who will be using electronic mail systems in the future (#1077, 17 April 1979).

Similarly, an administrator distinguished between designer and user perspectives:

Designers must ... use the systems they design to test their designs and in so doing often become super users, but they are a different breed of cat from users who only wish to use the system and are not deeply concerned with the mechanism of how it runs. It is important to keep these distinctions in mind (#1088, 18 April 1979).

Email's technically-proficient users were able to influence the technology's development based on their own experiences. When MsgGroup's or Header-People's members identified a technical problem with email systems, they could demonstrate the problem publicly and discuss possible solutions. Technical problems with the lists themselves led to troubleshooting discussions. The MsgGroup list served as an interoperability "test site" as its members deliberately tested the limits of their email systems by sending a long message or a message that followed or disregarded a standard. In these cases, others would report how well their systems responded.

While most discussions in MsgGroup, particularly during its later years when there was a reduced presence of administrators, focused on concerns from technically-oriented users about messaging system features, there were concerns expressed about the ability to generalize

from these experiences by group members. For example, in response to a call for more complex message systems, another member wrote that complex systems did not accurately reflect the needs of most users:

I don't doubt that a vote among the message community would strongly support the proposed "progress" toward more advanced but more complex systems. What concerns me is the knowledge that there is a group of very unsophisticated message system users out there, and the strong suspicion that they better characterize future message system users (and the future for message systems) than the present user population does (#267, 15 January 1976).

Despite these concerns, hackers only twice reported collecting data from actual users.

“Arrested” social and technical closure

Full closure (or social consensus) rarely occurred in MsgGroup—in the sense that group members rarely agreed on topics after discussion, or made firm technical decisions. This is particularly apparent because some discussion topics were frequently repeated, including internetworking challenges, defining and using header fields, and adherence to standards.

Rather, it appears that the nature of closure in this group was twofold: the group served to prevent premature closure by discussing and organizing responses to deficient standards, and it provided members with social and technical “lessons learned.” By “premature closure” I mean that the decision to stabilize the technology—in this case email software—was forced before the perspectives of most relevant social groups were taken into account. This is the technological equivalent of groupthink.⁷⁶

This common challenge in creating standards is described by Vannevar Bush, who managed the development of U.S. military technology during World War II, in his introduction for an official history of the United States National Bureau of Standards, as the problem of choosing the point at which to “fix” standards, since “ambiguity or inaccuracy can slow down accomplishment... [y]et too much speed [to fix standards] can sometimes pin matters down in ways that are later found to be clumsy or expensive.”⁷⁷

How did messaging system and ARPANET standards achieve closure, given the apparent choice between having an exclusive standards committee make uninformed and unpopular decisions, and a large, heterogeneous group such as MsgGroup which was not able to reach consensus? In the early days of email, this lack of closure was an advantage. As the experience with the isolated Message Committee group demonstrated, decisions made without a wide variety of opinions

and without the support of multiple parties would fail for reasons that were technical (because they did not work in all of the contexts present in the increasingly heterogeneous network) and social (because the exclusionary process by which they were developed was not respected by the technically-oriented implementers).

The MsgGroup and Header-People online groups deliberately developed flexible standards, what I term “arrested closure.” The key solution was to settle on simple, extendable, and flexible standards. The most basic elements of email technology became standardized and were rapidly adopted because consensus could be reached about these elements and because their simplicity and flexibility allowed them to be rapidly (and inexpensively) implemented in a wide variety of contexts. This flexibility took two forms. Email technology was conceptually divided into “user agents” (which mediate the interactions between the computer and the user and can be adapted for various types of users) and “mail transfer agents” (which handle the transmission of messages from computer to computer; their standards are strictly-defined);⁷⁸ and email header standards allowed an extendable series of data fields (primarily computer-read and generated), quite separate from the actual message.

The preceding case study suggests that premature closure, a problem with early messaging standards creation, was avoided through social interactions among people with differing individual and organizational user identities. Alternative sophisticated email and collaboration tools existed during the case study’s period, such as NLS/AUGMENT, FORUM, EIES, and the “MARS” message archiving and retrieval service.⁷⁹ These systems (and their collaboration features) did not flourish because of their complexity, lack of transferability across technical systems, and, fundamentally, the lack of a broad constituency of providers and users. In comparison with these collaborative systems, email “makes virtually no assumptions about the nature and structure of collaboration.”⁸⁰ In its “arrested closure” form, the networked email standards eventually developed were simple, generalizable, and had an overwhelming constituency: everyone with the desire to communicate across computer hosts.

Decisions about email standards were made outside of MsgGroup in other small groups and decisions about their implementation were made in, depending on the specific standard, either a decentralized fashion site-by-site, or enforced by the agency funding ARPANET.⁸¹ Technical closure, such as it existed, resulted from discussion about “Request for Comment” files, which were typically created by a few authors (some of whom were MsgGroup members), as well as hackers’ support for overwhelming “good ideas” and pressure from the source of funds for the ARPANET: the Department of Defense. As one MsgGroup member

noted, there were two techniques: “by edict” (such as the TCP/IP transition deadline⁸² and the “ARPA order” with regard to CMU’s RDMAIL in 1979) and informal peer review: “Somebody does it, and the rest of us decide it’s a good idea” (#1978, 21 April 1983). In the latter case he gave the example of MIT’s mail list software: “remember when MIT was the only place that had mailing lists?”

The actual process of closure in the context of the ARPANET was administratively-influenced by the specific DoD office responsible for the network at that point.⁸³ This pressure was grudgingly accepted because that office controlled funding for the ARPANET. Yet closure was not enforced in the manner one might expect in an organization linked to the military. The “edict” technique described above required that network administrators cajole programmers—at least those at academic organizations—and receive criticism. Norberg and O’Neill argue that the IPTO had an unusually innovative and lean management structure strongly influenced by the academic research community.⁸⁴ The combination of edict and technical peer review supports this argument.

Besides the technical influence of MsgGroup members on email technology, such online standards groups also indirectly influenced the social process of Internet standards development. While the exclusive ARPANET committees lacked sufficient experience and authority to develop standards for the heterogeneous and decentralized ARPANET environment, the MsgGroup could not reach consensus because of polarized views and a multiplicity of opinions. Later efforts at building standards appear to have developed a middle ground that combines in-person consensus building groups with open membership, along with online discussions that encouraged debate about standards.

A prime example of middle-ground collaboration is the Internet Engineering Task Force (IETF), whose first meeting was in January 1986.⁸⁵ The IETF has “primary responsibility for the development and review of potential Internet Standards from all sources.”⁸⁶ Crocker, an influential email standards developer and former MsgGroup member, attributes the success of the IETF standards development process, in part, to “rough consensus,” diverse contributions, online collaboration, and the participants being users of the resulting technology.⁸⁷ He writes:

The original ARPANET effort involved very focused research on basic issues of packet switching. However, much of the use of the technology was subject to development by happenstance. The informality of the process had the detriment of relying entirely upon the energies of one or a few “champions” rather than the more deliberated outcome of an organizational commitment. ... Another feature of the informality was that a scribe could make “enhancements” to the specification and have them implicitly accepted—if no one objected too loudly. The original ARPANET mail facility was the result of just such a casual, private decision.⁸⁸

Crocker then describes the IETF's conflict resolution process, which does not rely on formal procedures such as voting (since there "is no formal membership") but allows parties to protest perceived slights. Similarly, MsgGroup and Header-People groups had no formalized membership and provided environments for objecting to specifications, for resisting closure on standards, and for protesting standards development processes and specifics.

Conclusion

This case study demonstrates the importance of assumptions about social interactions in relation to the development of email software and standards. Networked email—simple, reliable, and now taken for granted—proved technologically and socially challenging. Although originally started by an IPTO program manager as an attempt to encourage closure with regard to email standards, MsgGroup did not reach closure in either technical or social terms despite the use of voting, reports, and other organizational techniques.

The early ARPANET, and subsequently the Internet, linked a wide variety of technical and social contexts, enabling interactions among people with differing conceptualizations of email users. This study found "arrested closure" in email standards because of the wide variety of opinions and systems available on the network; that is, the conceptual leap in email standards development involved leaving them deliberately flexible in two ways: (1) by dividing the system into two components, the user agent (which could meet different users' needs) and the mail transfer agent (which adhered to specific standards); and (2) by defining the email "header" as having a minimum but expandable series of meta-data fields.

The key lesson learned, based on experiences working with different systems and differing interpretations of standards, was to simplify the challenge of interoperation by designing systems which would be flexible in accepting incoming data and consistent in producing outgoing data. This technical challenge was phrased in social terms, for example, to not foist "bad breath" on the network or be "anti-social."

The ARPANET case suggests that when developers are presented with a context in which they realize their own perspectives as users are not representative, they use information seeking strategies to extend their understanding of user identities. During this process, developers constructed and debated hybrid user/developer identities that resulted in alternative conceptualizations of the technology. The increasingly inter-networked environment in which email standards were developed shows evidence of both an increasingly broad range of user constructions, and

meta-discussions about the generalizability of developer-based identities. Social as well as technical interoperability was the goal of these online groups—members with quite different backgrounds and user constructions strove to collaborate, although the archived messages indicate that this process was quite frustrating at times.

The development of networked email is an early example of informal inter-organizational online collaboration. ARPANET users and programmers had effectively pioneered an online “collaboratory” (a contraction of “collaboration laboratory”)⁸⁹ in which social interactions were key in negotiating the users and uses of the technology, as well as the experimentation, and rapid prototyping of a new communications system. Early online discussion lists such as these provide an important but neglected perspective on technological development—one not previously available from official documents or professional interviews.⁹⁰ As Lukesh notes, the broader social history of early online interactions urgently requires study before the data is unreadable and its contributors pass away.⁹¹

While the collaboration styles of groups such as the Network Working Group, MsgGroup, and Header-People presage those of the Internet Engineering Task Force,⁹² their contributions have been neglected apart from recent popular accounts such as Hafner and Lyon.⁹³ A group of authors concerned about the lack of user participation in the development of non-Internet electronic mail standards recently wrote that:

Within the past five years [i.e., since 1991], almost countless electronic fora ... devoted to user issues have sprung up on the Internet.... We suggest that standards organizations look urgently at how the exchange of views and dissemination of information afforded by these services could facilitate greater user-participation in standards-setting. ... It cannot help but seem ironic that communications standards committees are failing to exploit the communications technology to its full potential.⁹⁴

In essence, these authors are arguing for reinventing an MsgGroup or a Header-People, which together provided surveillance of existing standards and organizing responses, the announcement and demonstration of technical problems and the negotiation of solutions, the publicizing of “lessons learned” about social and technical issues, and a forum for collecting a variety of opinions.

The preceding analysis demonstrates a rich variety of social interactions and user constructions in early online discussions about the development of networked email, an apparently mundane communication technology. This supports the notion that software development, and especially *communication* software development, is a complex socio-technical process involving not only technical but also social interoperation challenges.

Iterations – Kilker – Social and Technical Interoperability

Julian Kilker, “Social and Technical Interoperability, the Construction of Users, and ‘Arrested Closure’: A Case Study of Networked Electronic Mail Development,” *Iterations: An Interdisciplinary Journal of Software History* 1 (September 13, 2002): 1-51.

Appendix A: Glossary and acronym list

ARPA	The Advanced Research Projects Agency (at certain times retitled “DARPA”)
BBN	Bolt Beranek and Newman
BRL	Ballistics Research Laboratory
CAHCOM	Computer Aided Human Communication
CCA	The Computer Corporation of America
CMU	Carnegie Mellon University
DARPA	<i>See</i> ARPA
DEC	Digital Equipment Corporation
IETF	Internet Engineering Task Force
IMP	Interface Message Processor; compare with TIP
IPTO	The Information Processing Techniques Office, part of ARPA
ITS	“Incompatible Timesharing System”
MSG	First all-inclusive email program providing replying, forwarding, and filing capabilities.
MsgGroup	Message Group, an online discussion list for issues related to email development.
NIC	Network Information Center, at Stanford Research Institute
NLS	The oN-Line System, Engelbart’s innovative—but subsequently underappreciated—“augmentation” system at the Stanford Research Institute. It was accessible on the ARPANET, but only operated on specific host computers.
NCC	Network Control Center, at BBN
RD	First email management program which listed and allowed selective reading, forwarding, and responding to messages. Written by Larry Roberts in 1973 while IPTO director.
RDMAIL	Carnegie Mellon University’s mail reader
RFC	Requests For Comment. These documents, most of which are available online, were started by Steve Crocker (then a graduate student at UCLA) in April 1969 to document the efforts of the informal Network Working Group.
SAGE	Semi-Automatic Ground Environment, a computerized air defense system.
SAIL	Stanford’s Artificial Intelligence Laboratory
SMTP	Simple Mail Transport Protocol originally specified in <i>RFC 821</i> (J. Postel, 1982). It defines how the envelope for delivering messages in RFC 822 format, and how to perform the delivery.
SNMSG	An early intra-machine email program by Ray Tomlinson of BBN for use on individual PDP-10s; in 1972 he

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modified it to send messages across machines, setting the stage for networked email.

TIP Terminal Interface Message Processor; compare with IMP

Appendix B: Networked email technologies

This table provides a select overview of email and computer conferencing technologies, and what connection, if any, their developers had with MsgGroup. This list is not comprehensive; for more information about email technologies and conferencing systems see J. S. Quarterman, *The Matrix: Computer Networks and Conferencing Systems*, 1990; M. A. Sirbu, “A Survey of Electronic Mail Technology,” in *Electronic Mail and Message Systems: Technical and Policy Perspectives*, eds, R. E. Kahn, A. Vezza, and A. D. Roth, 1981; and Appendix A of J. Postel, *RFC 808: Summary of Computer Mail Services Meeting Held at BBN on 10 January 1979*, 1982.

YEAR	EMAIL TECHNOLOGY: TECHNOLOGY BACKGROUND
1960s	<p>“Mailbox” programs were available on early timesharing systems such as CTSS at MIT’s Project MAC. See R. M. Fano and F. J. Corbató, “Time-Sharing on Computers,” <i>Information (A Scientific American Book)</i>, 1966: 76-95.</p> <p>Doug Engelbart’s oN-Line System (NLS) developed at SRI beginning in 1963, funded by ARPA. NLS was an “integrated office automation system, offering extensive document composition tools, forms systems, and other office-related tools” (#474, 18 March 1977). NLS was later renamed AUGMENT in the 1970s and transferred to the Tymshare network, owned by McDonnell Douglas. Engelbart was on the MsgGroup distribution list, but did not contribute to the group. Many NLS/AUGMENT developers and users were long-term members of MsgGroup.</p>
1970	<p>SRI included Journal Mail in its NLS collaboration system “to distribute messages, pre-prepared documents, data, line-drawn pictures, and other information” (#474, 18 March 1977). This was a “very sophisticated mail system with user identification, catalogs, and all sorts of fields that you could use to send and answers things. . . . you could send whole documents.” From D. Engelbart, “The Augmented Knowledge Workshop,” in <i>A History of Personal Workstations</i>, ed., A. Goldberg, 1988, p. 212.</p>
1972	<p>Ray Tomlinson of BBN developed message sending program SNDMSG and reading program READMAIL for BBN’s TENEX operating system for the DEC PDP-10 (#474, 18 March 1977). Tomlinson was not an MsgGroup member.</p> <p>Jacques Vallee and colleagues at Institute for the Future first implemented FORUM group communication system; first “real world” version 5 was available on the ARPANET in 1973; see Vallee, et al., <i>Group Communication Through Computers</i>, vol. 1, 1974. Two people associated with the FORUM project, Paul Baran and Dave Farber, were involved with MsgGroup (the latter as founder). FORUM had a very limited presence on the ARPANET after 1974 (#474, 18 March 1977).</p>

YEAR	EMAIL TECHNOLOGY: NETWORKED EMAIL TECHNOLOGIES
1973	Larry Roberts, IPTO Director, developed RD based on Tomlinson's SNDMSG and READMAIL; RD was coded in TECO (a text editing program) macros (#474, 18 March 1977). Roberts was not an MsgGroup member.
1974	<p>Martin Yonke and John Vittal at USC's Information Sciences Institute (ISI) wrote WRD, and Yonke wrote BANANARD. Vittal was a member of MsgGroup.</p> <p>James Calvin of Bolt Beranek and Newman wrote HG (the chemical symbol for mercury). Ted Myer, also of BBN managed the development of MAILSYS, which became the ARPA-sponsored HERMES (Military Message-Handling Experiment) project. Both HG and HERMES systems combined mail reading and composing functions. Hermes was available to non-ARPANET users via Telenet, a commercial network based on ARPANET technology and owned by BBN. Myer and several others involved with the HERMES project were members of MsgGroup.</p>
1975	<p>John Vittal wrote MSG, a popular ARPANET message-reading program. Vittal was a member of MsgGroup.</p> <p>Mike Brooz, working under Al Vezza of MIT's Dynamic Modeling System project, developed a message program called MSGDMS which handled large message databases and automatic archiving. Vezza was an early member of MsgGroup.</p> <p>Carnegie-Mellon's RDMAIL program developed by Phil Karlton, based on Vittal's MSG, with later assistance from students in the CMU Computer Science department. Karlton and several other CMU programmers/students were MsgGroup members.</p>
1976	<p>Dave Crocker of Rand Personal Computing project began development of MS message system. Crocker was an MsgGroup member. See T. H. Myer and J. Vittal, "Message Technology in the ARPANET," paper presented at the National Telecommunications Conference, New York, 1977.</p> <p>New Jersey Institute of Technology's collaboration-oriented Electronic Information Exchange System (EIES) began operation. EIES was based on an earlier system, EMISARI, designed for crisis management. There was an extremely limited presence of EIES developers late in MsgGroup's existence. See S. R. Hiltz and M. Turoff, <i>The Network Nation: Human Communication via Computer</i>, 1978.</p>
1978	Swedish National Research Institute's COM conferencing software developed based on EIES. Subsequently revised as PortaCOM (1984), SuperKOM (1989) and KOM-96; partially funded by European Community (EC) and used mainly at European academic sites. Jacob Palme, COM's development manager, was a late member of MsgGroup, and a few other COM users participated.

YEAR	EMAIL TECHNOLOGY: NETWORKED EMAIL TECHNOLOGIES
1979	<p>Rand Message Handling (MH) system developed by Bruce Borden, Stockton Gaines, and Norman Shapiro. MH comprised a flexible set of programs each having a different task and usable from within the UNIX shell. (In 1981, UC Irvine began developing MH.) Gaines was a member of MsgGroup.</p> <p>MMDf (Multi-channel Memo Distribution Facility) designed by Dave Crocker, Ed Szurkowski, and Dave Farber. MMDf later implemented the SMTP (Simplified Mail Transport Protocol) for CSNET. MMDf was also used by MAILNET, a joint project of MIT, EDUCOM, and fifteen sites with funding from the Carnegie Foundation. MAILNET was an “inexpensive mail network connecting heterogeneous computer systems at academic institutions” until 1986; from J. S. Quarterman, <i>The Matrix</i>, 1990, p. 146. Crocker and Farber were MsgGroup members.</p>
1981	<p>Doug Brotz, Roy Levin, Mike Schroeder, and Ben Wegbreit build the Laurel user mail system for the Xerox Alto. Brotz was an MsgGroup member. See B. Lampson, “Personal Distributed Computing: The ALTO and Ethernet Software,” in <i>A History of Personal Workstations</i>, ed., A. Goldberg, 1988: 291-344.</p> <p>Eric Allman developed Sendmail, an internetwork mail router that handles converting mail formats and address structures. Subsequent versions now route and deliver most Internet email. Allman was briefly a member of MsgGroup after developing the initial version of Sendmail. See E. Allman, <i>Sendmail, an Internetwork Mail Router, (Unix Programmer’s Manual 4.2)</i>, 1983.</p>
1982	CSNET email implemented.
1989	<p>Pine, a “simple, easy-to-use mailer for administrative staff at the University of Washington in Seattle” was developed for UNIX by the university’s Office of Computing and Communications (it was ported to PC-DOS in 1993). Part of the software—the “C-Client library and IMAPd”—was authored by Mark Crispin, a former member of MsgGroup, at UW Seattle. Crispin originally authored the Message Access Protocol (IMAP), which provides a way to manipulate mailboxes on remote servers as if they were local. The other Pine developers were not MsgGroup members.</p> <p>In “the 80’s” Steve Dorner created the Eudora email client at the University of Illinois at Urbana Champaign (as well as PH, an email and telephone directory program). In 1992, Dorner left for the Qualcomm Corporation, which now owns the rights for Eudora. Dorner was not an MsgGroup member.</p>

Appendix C: Overlap of in-person meetings and MsgGroup

YEAR	EVENT	OVERLAP
1973	February: In-person meeting held at SRI-ARC to discuss network mail system specifications using FTP. See M. D. Kudlick, <i>RFC 469: Network Mail Meeting Summary</i> , 1973.	Four of the 15 attendees were later MsgGroup members.
1979	January: In-person meeting held at BBN to discuss the “state of computer mail in the ARPA community and to reach some conclusions to guide the further development of computer mail systems such that a coherent total mail service would continue to be provided.” From J. Postel, <i>RFC 808: Summary of Computer Mail Services Meeting Held at BBN on 10 January, 1979</i> , 1982, p. 1.	Twelve of 33 attendees were MsgGroup members; most attendees were from non-academic institutions such as BBN, ARPA, and RAND, although two MIT hackers were present.
1982	January: Two in-person meetings held at USC Information Sciences Institute. The first, on January 11, was to anticipate addressing of computer mail as mail relaying was to become common with the internet. See J. Postel, <i>RFC 805: Computer Mail Meeting Notes</i> , 1982. The second, on January 12, was to “discuss common interests in multi-media computer mail experiments, and to agree on some specific initial experiments.” From J. Postel, <i>RFC 807: Multimedia Mail Meeting Notes</i> , 1982, p. 1.	Six of 22 attendees were MsgGroup members. Three of 18 attendees were MsgGroup members.
1984	July: In-person meeting held at BBN to address “progress by groups who are building multimedia mail systems.” From H. Forsdick, <i>RFC 910: Multimedia Mail Meeting Notes</i> , 1984, p. 1.	None of the 12 attendees were MsgGroup members; most were contractors.

¹ J. Katz and P. Aspden, “Motives, Hurdles, and Dropouts,” *Communications of the ACM* 40(4) (1997): 97-102.

² H. Taylor, “On-line Population Spends an Average of Six Hours on the Internet or per Week,” *Poll Summary 18* (New York: Louis Harris and Associates, March 24, 1999).

³ D Lake, “Metrics: Message in a Packet.” *The Industry Standard*, (July 24, 2000): 202-3.

⁴ U.S. Department of Commerce, *A Nation Online: How Americans are Expanding Their Use of the Internet* (February, 2002). Available: <http://www.ntia.doc.gov/ntiahome/dn>.

⁵ The ARPANET research network, the precursor to the Internet, was developed under the auspices of the Information Processing Techniques Office (IPTO) of the Department of Defense’s Advanced Research Projects Agency (DARPA). While a comprehensive discussion of ARPA, the IPTO, and the genesis of the ARPANET is beyond the scope of this paper, its development has been examined by historians emphasizing the IPTO’s innovative organizational perspective and relying on interviews with administrators and project reports; see A. L. Norberg and J. E. O’Neill, *Transforming Computer Technology: Information Processing for the Pentagon, 1962-1986* (Baltimore, MD: Johns Hopkins University Press, 1996). It has also been examined by journalists focusing on the computer talents of a small group of employees at Bolt Beranek and Newman (BBN), the contractor for the underlying network technology; see K. Hafner and M. Lyon, *Where Wizards Stay Up Late: The Origins of the Internet* (New York: Simon and Schuster, 1996). The transition from ARPANET to the Internet and the flexibility of the network technology are covered by J. Abbate, *Inventing the Internet* (Cambridge, MA: MIT Press, 1999).

⁶ Norberg and O’Neill, *Transforming Computer Technology*.

⁷ The shift of focus on an institutional rather than social interpretation of “communication” is reminiscent of early views of the telephone as a business tool rather than social device; see C. S. Fischer, *America Calling: A Social History of the Telephone to 1940* (Berkeley: University of California Press, 1992). Similarly, the initial design of the French *Minitel* system emphasized instrumental rather than social communication over computer networks; see A. Feenberg, “From Information to Communication: The French Experience with Videotex,” in *Contexts of Computer-Mediated Communication*, ed. M. Lea (London: Harvester-Wheatsheaf, 1992), 168-87.

⁸ T. J. Pinch and W. E. Bijker, “The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other,” in *The Social Construction of*

Technological Systems, eds., W. E. Bijker, T. P. Hughes, and T. J. Pinch (Cambridge, MA: MIT Press, 1987), 17-50.

⁹ R. Rosenzweig, “Wizards, Bureaucrats, Warriors, and Hackers: Writing the History of the Internet,” *The American Historical Review* 103 (1998): 1530-1552.

¹⁰ I have defined recurring acronyms and technical terms in Appendix A.

¹¹ Some of the works examining email are Abbate, *Inventing the Internet*; T. Bardini, *Bootstrapping* (Stanford, CA: Stanford University Press, 2000); Hafner and Lyon, *Where Wizards Stay Up Late*; Norberg and O’Neill, *Transforming Computer Technology*; M. T. Rose, *The Internet Message: Closing the Book with Electronic Mail* (Englewood Cliffs, NJ: Prentice Hall, 1993); and P. H. Salus, *Casting the Net: From ARPANET to Internet and Beyond*. (Reading, MA: Addison-Wesley Pub. Co., 1995), among others.

¹² Abbate, *Inventing the Internet*.


¹³ P. E. Agre, “Conceptions of the User in Computer Systems Design,” in *The Social and Interactional Dimensions of Human-Computer Interfaces*, ed., P. J. Thomas (Cambridge: Cambridge University Press, 1995), 67-106.

¹⁴ D. A. Norman, *The Design of Everyday Things* (New York: Doubleday, 1988).

¹⁵ Bardini, *Bootstrapping*.

¹⁶ H. D. Hellige, “From SAGE via ARPANET to ETHERNET: Stages in Computer Communications Concepts between 1950 and 1980,” *History and Technology* 11 (1994): 49-75.

¹⁷ R. M. Fano and F. J. Corbato, “Time-Sharing on Computers,” *Information (A Scientific American Book)* (San Francisco: W.H. Freeman, 1966): 76-95. [Quote on p. 80.]

¹⁸ In this figure, the  represents a “dumb” terminal of the era, with which a user would access an email program (or other software) on a mainframe computer. Figure from V. G. Cerf, “Internetting and Electronic Message Systems,” paper presented at the AFIPS Workshop on Technical and Policy Issues in Electronic Mail and Message Systems, Washington, DC, 1980. Current email systems use a different “client-server” technology, in which the “client” is a personal computer that transfers complete email messages to and from the email “server” (which temporarily stores messages) as needed.

¹⁹ Norberg and O’Neill, *Transforming Computer Technology*, 174.

²⁰ Norberg and O’Neill, *Transforming Computer Technology*. The Information Processing Techniques Office (IPTO), an agency of DARPA, guided the original development of the ARPANET and was instrumental in early computer developments such as time-sharing, networking, graphics, artificial intelligence, and parallel-processing. On the innovative nature, within the military context, of IPTO management, see Norberg and O’Neill, *Transforming Computer Technology* and J. E.

O'Neill, "The Role of ARPA in the Development of the ARPANET, 1961-1972," *IEEE Annals of the History of Computing* 17:4 (1995): 76-81. The Advanced Projects Agency (ARPA) was founded in 1958 in response to Cold War concerns about falling behind in military technology and to stimulate military research in response to the Soviet Union's *Sputnik*. ARPA's name was changed to DARPA (adding "Defense" at the beginning) in 1971, back to ARPA in 1993, and back again to DARPA in 1996. See B. M. Leiner, et al., "The Past and Future History of the Internet," *Communications of the ACM* 40:2 (1997): 102-108. ARPA, which had a very lean management structure, sponsored high-risk projects without concern for economic success.

²¹ J. C. R. Licklider and R. Taylor, "The Computer as a Communication Device," *International Science and Technology* (April, 1968): 21-31.

²² *Ibid*, 21-22.

²³ See Hafner and Lyon, *Where Wizards Stay Up Late*; and Norberg and O'Neill, *Transforming Computer Technology*. Even though closer collaboration was a goal, this was seen from a functional rather than social perspective.

²⁴ The Network Measurement Center at UCLA studied the network traffic, the Network Information Center at SRI coordinated administration, and the Network Control Center at Bolt Beranek and Newman (BBN) monitored the network's operational status and handled IMP upgrades. BBN, a consulting firm in Cambridge, MA, with close connections to MIT, was the major contractor for the ARPANET's underlying technology (it received contracts for the IMPs and NCC). Licklider, the IPTO's first director in 1962, originally worked for BBN. See Hafner and Lyon, *Where Wizards Stay Up Late*; and Norberg and O'Neill, *Transforming Computer Technology*.

²⁵ Norberg and O'Neill, *Transforming Computer Technology*, 156.

²⁶ *Ibid*, 168.

²⁷ S. Crocker, *RFC 1: Host Software* (Network Working Group, 1969).

²⁸ S. Crocker, *RFC 3: Document Conventions* (Network Working Group, 1969), 1.

²⁹ Hafner and Lyon, *Where Wizards Stay Up Late*, 144-5, italics added.

³⁰ Leiner et al., "Past and Future History."

³¹ Hafner and Lyon, *Where Wizards Stay Up Late*.

³² F. Heart, interview conducted by Judy E. O'Neill, Cambridge, MA, 13 March 1990, OH 186 (Minneapolis, MN: Charles Babbage Institute, University of Minnesota).

³³ The ARPANET Network Information Center was located at Stanford Research Institute in Menlo Park. The NIC's "mandate was to act as a depository and dissemination center for network information, particularly documents, and to make this information available to network users," from E. J. Feinler, "The Identification Data Base in a Networking Environment," paper presented at the National Telecommunications

Conference, New York, 1977. The choice of SRI was influenced by the presence of Doug Engelbart's NLS team (see Appendix B), but Engelbart's interest in cultivating a large group of ARPANET users for the specialized NLS system was not successful because of the overriding interest among users in standards linking heterogeneous systems; see Bardini, *Bootstrapping*.

³⁴ The challenges of the NIC's information dissemination role are apparent in the RFCs it released. *RFC 95: Distribution of NWG/RFCs Through the NIC* (4 February 1971) describes the postal process, while *RFC 185: NIC Distribution of Manuals and Handbooks* (7 July 1971) asks for assistance in making copies of large documents for distribution. *RFC 511: Enterprise Phone Service to NIC From ARPANET Sites* (23 May 1973) describes spending about \$800/month on providing (voice) telephone access to the NIC for assistance calls from selected ARPANET sites, and problems with the answering service used during off hours.

³⁵ R. W. Watson, *RFC 196: A Mail Box Protocol* (Network Working Group, 1971).

³⁶ Ibid.

³⁷ J. Postel, *RFC 580: Note to Protocol Designers and Implementers* (Network Working Group 1973).

³⁸ R. E. Kahn, A. Veza, , and A. D. Roth, eds., *AFIPS Workshop on Technical and Policy Issues in Electronic Mail and Message Systems*, (Washington, DC: American Federation of Information Processing Societies, 1980).

³⁹ Norberg and O'Neill, *Transforming Computer Technology*, 178.

⁴⁰ S. J. Lukasik, "Organizational and Social Impact of a Personal Message Service," paper presented at the National Telecommunications Conference, New York, 1974: 386

⁴¹ R. R. Panko, and R. U. Panko, "An Introduction to Computers for Human Communication," paper presented at the National Telecommunications Conference, New York, 1977.

⁴² See D. Crocker, *RFC 822: Standard for the Format of ARPA Internet Text Messages* (Network Working Group, 1982); J. Postel, *RFC 821: Simple Mail Transfer Protocol* (Network Working Group, 1982); and R. Braden, *RFC 1123: Requirements for Internet Hosts—Application and Support* (Network Working Group, 1989).

⁴³ B. Lampson, "Personal Distributed Computing: The ALTO and Ethernet Software," in *A History of Personal Workstations*, ed., A. Goldberg, (New York: ACM Press, 1988), 291-344.

⁴⁴ E. S. Raymond, and G. L. Steele, eds., *The New Hacker's Dictionary* (Cambridge, MA: MIT Press. 1991).

⁴⁵ Raymond and Steele, *The New Hacker's Dictionary*, 4-5.

⁴⁶ D. E. Denning, "Concerning Hackers Who Break into Computer Systems," paper presented at the 13th National Computer Security Conference, Washington, DC., October, 1990.

⁴⁷ Raymond and Steele, *The New Hacker's Dictionary*.

⁴⁸ Ibid, 364.

⁴⁹ Ibid, 364.

⁵⁰ Ibid, 300.

⁵¹ Ibid, 212. ITS is the acronym for “Incompatible Timesharing System,” an operating system “written for PDP-6s and PDP-10s at MIT and long used at the MIT AI lab.”

⁵² Ibid, 230.

⁵³ Ibid, 230.

⁵⁴ Ibid, 254.

⁵⁵ T. Nelson, *Computer Lib/Dream Machines* (Chicago, IL: Self published, 1974), 12, emphasis in original. Here, Nelson is emphasizing the user as opposed to computer experts, although he is also inadvertently reflecting the largely male-oriented computer culture. I address gendered user constructions later in this article. See also T. Bardini and A. Horvath, “The Social Construction of the Personal Computer User,” *Journal of Communication* 45:3 (1995): 40-65.

⁵⁶ Raymond and Steele, *The New Hacker's Dictionary*, 234.

⁵⁷ A rare example of an attempt to enforce a standard was *RFC 733: Standard for the Format of ARPA Network Text Messages*. This RFC was “supported by the Defense Advanced Research Projects Agency of the Department of Defense, under contract Nos. N00014-75-C-0661, MDA903-76-C-0212, and DAHC15-73-C0181,” and was written by a subcommittee of ARPA’s Committee on Computer-Aided Human Communication (CAHCOM). Another example of funding was minimal support for the moderator of MsgGroup, the online discussion group examined in this paper.

⁵⁸ This case study was conducted as part of my doctoral research. MsgGroup archives were made available by The Computer Museum in Boston (now part of the Museum of Science, Boston). Details about MsgGroup, including its context, participants, and lifecycle, as well as further information about my research methodology for this case study, are in J. Kilker, “Networking Identity: A Case Study Examining Social Interactions and Identity in the Early Development of Email Technology” (Ph.D. diss., Cornell University, Ithaca, NY, 1999). An analysis of design identities and their implications for collaborative development based on MsgGroup interactions is published in J. Kilker, “Conflict on Collaborative Design Teams: Understanding the Role of Social Identities,” *IEEE Technology and Society* 18:3 (1999): 12-21. A popular account of MsgGroup and the development of networked email are in Hafner and Lyon, *Where Wizards Stay Up Late*. Dave Farber and many other MsgGroup and Header-People (a parallel group) participants were and remain influential in Internet circles, although they have received varying degrees of attention and acknowledgement. Participants Einar Stefferud, Ken Harrenstein, Dave Farber, Richard M. Stallman,

Richard Gumpertz, Raymond Panko, Mark Crispin, Rich Zellich, and David Crocker kindly responded to my requests for interviews.

⁵⁹ In my interviews of former MsgGroup participants, the central role of MsgGroup and parallel more technically-oriented group Header-People in email development were described as follows:

[MsgGroup] was *the* list - lots of other traffic took place on it because there were no other pertinent lists. Other mailing lists that were formed at the beginning stayed pretty much on topic, because people were already using MsgGroup as the catchall forum (sort of an “everybody who is anybody is on MsgGroup, so that’s the place to ask my question” situation). It was also probably the most serious and important set of discussions going on at the time, too (Richard Zellich, personal communication, 1998).

At the time, [MsgGroup] was *the* place for discussion of these issues. I was actively involved in implementing and maintaining email systems and other ARPANET systems at UCLA and/or Rand at the time (depends on the period we’re talking about), and we all represented a pretty small universe in absolute numbers back then. It was natural for those involved to participate in the group... (Lauren Weinstein, personal communication, 1998).

I designed the MU mail program for Unix and participated in the design and roll-out of MM for TOPS-20 and DEC’s product MS. MsgGroup played a part in all three programs (Stuart McLure Cracraft, personal communication, 1998).

I would say that between MsgGroup and Header-People nine-tenths of the development of interoperability standards was there. In terms of development of how email worked, that sort of thing (Richard H. Gumpertz, personal communication, 1998).

A more tempered view is that MsgGroup facilitated rather than broadened the participation in email development. A long-time member of MsgGroup noted that

We all knew each other, both professionally and personally. ... MsgGroup was one of the means that we used to communicate with each other. It was the collection of people, not the mailing list, that caused the influence. We would have all known each other even without MsgGroup; it was however a useful vehicle (Mark Crispin, personal communication, 1998).

⁶⁰ MsgGroup messages are cited in this manner with message index number and date sent information. The group’s moderator inserted a sequential index number in the message’s subject line and archived all messages; for unmoderated messages (those sent after the list was automated) I extended this indexing system to identify all archived messages. The final index numbers range from #1 on June 7, 1975 to #2578 on June 11, 1986. I do not attribute online discussion quotes even though these discussions were “public” and there was little, if any, expectation of anonymity. At the time of this writing, the Computer

Museum (now part of the Museum of Science, Boston) Web site maintains copies of these files at <http://www.tcm.org/msggroup/>.

⁶¹ To clarify meaning, I have made only minor corrections to spelling, grammar, and typographical case. The archived messages often contain errors because their authors either were typing informally or could not correct their typing. People using older messaging systems, for example those based on Teletype terminals, noted that they could not easily review messages before sending them.

⁶² Einar Stefferud, a computer management consultant with a professional interest in email, was subcontracted to maintain the list and was initially paid a token sum by ARPA for his efforts. The group's day-to-day maintenance requirements were high because of the rudimentary mailing list technology at the time and because of the steps necessary, at least in the group's early days, to index and archive the messages. The moderator's role varied depending on the technical structure of the discussion list which changed both as the technology matured and other people assisted in providing technical resources. From 1975 until early 1979, the moderator sent administrative messages to the group indicating address additions, removals, or changes (for those who wanted or needed to use address directly) and was responsible for redistributing the group's messages. In February 1979, the list was converted to an automatic redistribution list based at MIT when the moderator went on vacation (#824; #828, 25 February 1979) and in July 1982, the list was moved to a Ballistics Research Labs (BRL) site (#1797, 17 August 1982). While the moderator guided the discussion at times, there is no evidence from the postings or my subsequent interviews that he excluded messages.

⁶³ The boundaries and overlaps among these groups are discussed in Kilker, "Networking Identity." The existence of "Header-People" demonstrated the challenges of email in undermining traditional organizational structures. The group was controversial among ARPA administrators because of both its unofficial nature and the emotional intensity of its technical discussions. According to "Header People" founder Ken Harrenstein, archives of the group exist on 7-track computer tape, a format for which it is exceedingly difficult to find a reader. This problem of the gradual loss of digital data as the storage technology (data readers, the media, and the standards) becomes obsolete is increasingly common; see, for example, comments about the apparent loss of early Usenet articles in J. S. Quarterman, *The Matrix: Computer Networks and Conferencing Systems Worldwide* (Bedford, MA: Digital Press, 1990), 244-5. Harrenstein was able to locate printouts of the group's early discussions and send me photocopies; I used these messages in addition to those from MsgGroup.

⁶⁴ I use "membership" loosely here, as membership in the list was neither formalized nor exclusive (beyond the inherent exclusivity of access to ARPANET email).

⁶⁵ J Vallee, H. M. Lipinski, and R. H. Miller, *Group Communication through Computers; Volume 1: Design and Use of the FORUM System (R-32)* (Menlo Park, CA: Institute for the Future, 1974).

⁶⁶ I define substantive threads as having five or more messages; shorter threads typically contained “For Your Information” exchanges rather than discussions. Discussion topic threads are cited by dominant subject title, dates of first and last message, and total number of messages in the thread.

⁶⁷ I focused on the identification and categorization of developers and users of email technology present in MsgGroup and early discussions on Header-People. My methodology involved developing a database of MsgGroup’s participants with identifying information (both self-described and from other sources) and descriptive membership statistics, developing a database of messages contributed to the group, and categorizing the group’s discussion threads by their social and technical content. I then used these databases to identify message threads, themes, and social identifications. Obtaining background and role information about each member involved gathering information from that person’s and other people’s postings, as well as examining RFC documents and using present-day searches on the Internet to locate online CVs. I was not able to locate any information for 175 of the 329 contributors to the group; 126 of them were either people who contributed a single message without any identifying information whatsoever (118 cases) or were on the group’s distribution list but did not contribute a single message (8 cases). The development of these databases was complicated and time-consuming for the following reasons, some of which were due to the specific research context and some of which are likely to be shared by other research projects on long-term online groups: (1) key terminology—such as that for “messaging systems”—varied substantially during this period, see Panko and Panko, *Computers for Human Communication*; (2) the standards used in the email headers (such as the date formats) changed during the ten years; (3) regular distribution lists for the list were not available; (4) people had others post messages for them, or posted documents with multiple authors; (5) people could—and did—post messages from different mailbox addresses, including those of other group members; (6) people neglected to “sign” their messages with identifying information; (7) people disappeared from the group for long periods of time; and (8) some people received messages from the list through intermediaries rather than directly through the distribution list, either forwarded by colleagues or through mailboxes on the list that either rebroadcast or archived messages from the group (there were at least five such mailboxes). Despite these challenges, I was able to create reasonably comprehensive databases summarizing the group’s activities.

⁶⁸ Header-People messages are cited in this manner with message subject and date sent information. There are no index numbers because Header-People had no moderator. For reasons noted earlier, the Header-People archives are not currently available in machine-readable format.

⁶⁹ Norberg and O’Neill, *Transforming Computer Technology*, 270.

⁷⁰ Conflicts in programmer and the Department of Defense views about work habits and security were addressed in several MsgGroup threads. One of these (16 to 17 December 1979, 13 messages) describes the challenges programmers faced when they needed assistance. In it, a participant noted that most serious problems occurred at odd hours when people were difficult to locate by telephone but might be online. He complained about another person’s message: “Buried in your message was the implication that those ‘odd’ hour people are just hackers who should be willing to wait for the ‘real’ day if they want to do any serious work” (#1435, 16 December 1979).

In a later thread entitled “ARPANET access control” (19 to 20 March 1980, 11 messages), an SRI participant wrote that a “collection of hosts on the east coast at a well known institute [MIT]” give out accounts to “randoms [who] try their sharp hands at cracking and breaking into the various systems around the net” (#1489, 19 March 1980). His example problems caused by “randoms” included:

The piece de resistance of this was when Col. [name] was director of IPTO at ARPA, we got a link from “him” supposedly on the AMES-TIP via RSEXEC, which said “your contract has been canceled, and your host will be removed from the net”. The other piece de resistance was a link from “the almighty himself” from the UTAH-TIP (#1489, 19 March 1980).

⁷¹ While these are my analytical categories, they summarize terms used by group members who identified themselves during polarizing discussions and in introductions.

⁷² Bardini and Hovarth, “Social Construction of the Personal Computer User.”

⁷³ These messages end with secretarial initials such as “TOE/ph” (#7, 10 June 1975).

⁷⁴ K. Pogran, J. Vittal, D. Crocker, and A. Henderson, *RFC 724: Proposed Official Standard for the Format of ARPA Network Messages* (Network Working Group, 1977), 26.

⁷⁵ Crocker, *RFC 822*, 37.

⁷⁶ I. L. Janus, *Groupthink: Psychological Studies of Policy Decisions and Fiascos* (Boston: Houghton Mifflin, 1982).

⁷⁷ R. C. Cochrane, *Measures for Progress: A History of the National Bureau of Standards* (Washington, DC: U. S. Department of Commerce, 1966), iii.

⁷⁸ Rose, *The Internet Message*.

⁷⁹ On NLS/AUGMENT, see D. Engelbart, “The Augmented Knowledge Workshop,” in *A History of Personal Workstations*, ed., A. Goldberg (New York: ACM Press, 1988), 185-232. On FORUM, see Vallee, et al., *Group Communication through Computers*. On EIES, see S. R. Hiltz and M. Turoff, *The Network Nation: Human Communication via Computer* (Reading, MA: Addison-Wesley Publishing, 1978). On MARS, see J. Sattley, *RFC 744: MARS - A Message Archiving and Retrieval Service* (Network Working Group, 1978).

⁸⁰ S. Easterbrook, “Coordination Breakdowns: How Flexible is Collaborative Work?” in *CSCW Requirements and Evaluation*, ed., P. Thomas (New York: Springer-Verlag, 1996), 91-106. [Quote on p. 94.]

⁸¹ The in-person groups officially sanctioned by IPTO, Message Service Committee and CAHCOM, were chaired by established computer scientists and had limited memberships. Some in-person meetings about email were reported in RFCs (see Appendix C). This exclusivity, based on traditional goal-oriented meeting styles, alienated members of the wider ARPANET community who were charged with implementing the standards, yet perceived that they had little influence on them; the founder of Header-People summarized his impressions about standard creation as follows: “My sense is that most of the decisions were arrived at by a few people in back rooms” (Ken Harrenstien, personal communication, 1998) and MsgGroup’s moderator noted:

In general, actual standards in those early days were a result of ARPA funded research groups, so the actual drafting of specs was done outside MsgGroup, though some discussions were threaded through MsgGroup discussions (Einar Stefferud, personal communication, 1998).

The latter comment is supported by the partial overlap in MsgGroup participation and in-person meeting attendees (see Appendix C). Complaints about the exclusivity of standard discussions became particularly apparent when programmers encountered problems that were attributed to the lack of openness in the process.

⁸² Transmission Control Protocol/Internet Protocol (TCP/IP) is the Internet protocol suite developed between 1973 and 1981 partly under ARPA sponsorship; see V. G. Cerf and R. Kahn, “A Protocol for Packet Network Interconnection,” *IEEE Transactions on Communication* 22:5 (1974): 637-648. These protocols provided a robust communications architecture and one “that could accommodate multiple types of communications services over a wide variety of networks”; from Quarterman, *The Matrix*, 48. The ARPANET implemented TCP/IP in early 1983 (the official switchover was January 1, 1983, but some sites were delayed); this facilitated its interconnection with other networks and transformed the ARPANET into the Internet.

⁸³ The responsibility shifted slightly—not always IPTO in later years.

⁸⁴ Norberg and O’Neill, *Transforming Computer Technology*.

⁸⁵ G. Malkin, *RFC 1718: The Tao of IETF: A Guide for New Attendees of the Internet Engineering Task Force* (Network Working Group, 1994).

⁸⁶ L. Chapin, *RFC 1310: The Internet Standards Process* (Network Working Group, 1992), 3.

⁸⁷ D. Crocker, “Making Standards the IETF Way,” *StandardView*, 1:1 (1993): 48-54.

⁸⁸ *Ibid*, 50.

⁸⁹ National Research Council, *National Collaboratories: Applying Information Technology for Scientific Research* (Washington, DC: National Academy Press, 1993).

⁹⁰ Archives from early online discussion lists are important for both their under-examined perspectives and because of the lack of accessible official documents. For example, Norberg and O’Neill, computer historians with access to and funding from the DoD for IPTO research, noted that “not only are the IPTO records incomplete but, more important, they vary in content and quality over the twenty-five years of [our] study.” See Norberg and O’Neill, *Transforming Computer Technology*, ix.

⁹¹ S. S. Lukesh, “Email and the Potential Loss to Future Archives and Scholarship or the Dog that Didn’t Bark,” *First Monday* 4:9 (1999).

Available:

http://www.firstmonday.org/issues/issue4_9/lukesh/index.html.

⁹² P. Borsook, “How Anarchy Works,” *Wired* 3 (October, 1995): 110-118; Crocker, “Making Standards the IETF Way.”

⁹³ Hafner and Lyon, *Where Wizards Stay Up Late*.

⁹⁴ K. Jakobs, R. Procter, and R. Williams, “Users and Standardization: Worlds Apart? The Example of Electronic Mail,” *StandardView* 4:4 (1996): 183-191. [Quote on p. 191.]