Issues in Computerized Communication: Components and Questions

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The history of communication via computers is brief. It was not until the early 1970s that computerized notesfiles and electronic mail (e-mail) systems began to make serious inroads. Systems such as PLANET (1) and notesfiles on the PLATO (2) system typified computerized communication during the last decade. By and large these systems operated on expensive "mainframe" computers and because of the cost of these systems and their interconnecting networks, experiments in communication were often conducted under the auspice of corporate research (3) or as an educational endeavor such as PLATO.

However, from the late 1970s continuing through the present day, massive changes have occurred both in the nature of computer-based communication and in the number of systems and their size. Increasingly, individuals are able to exploit private computer networks, commercial timesharing systems such as CompuServe and Prodigy. Perhaps even more importantly, the government has formalized some basic criteria regarding the interconnecting of computers. This criteria, which largely forms the basis of a system called Internet, will be described later in this paper.

What technological factors have spurred this enormous growth in computerized communications? Two major influences and several minor ones are readily identifiable. The first factor has been the rapid growth of the computer industry itself. This growth has brought enormous change in terms of both the power and cost of computer systems. In the late 1970s advances in computer hardware coupled with drastic price reductions opened up the massive household consumer market to computer manufacturers.

At the same time universities and other educational establishments were installing powerful "departmental" computers, such as Digital Equipment Corporation's VAX series, within certain academic departments and as general-purpose computing systems at traditional computing centers. And, those departments that could not afford their own computers could usually afford one of the mainstream personal computers which could then be connected to the computing center's computers. This resulted in a large rise in computer users at schools. No longer were students and faculty of the hard sciences the only ones likely to encounter and use computers. Computers lost much of the myth of inaccessibility during this period as people began to become comfortable integrating computers throughout their workaday lives. The net result was that a much larger audience of individuals came into regular contact with computers and computing systems. Moreover, this contact usually took place within the privacy of one's own office, departmental center, or the home, thereby helping the computer assume the ubiquitous nature of other familiar appliances. It became increasingly unnecessary to physically travel to and from a central computing center to use the computer. Because of this ease of access, users began to explore different avenues of computer use and one use that surfaced almost immediately was the use of computers as mediums of communication.

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A Brief Economic History of Digital Communication

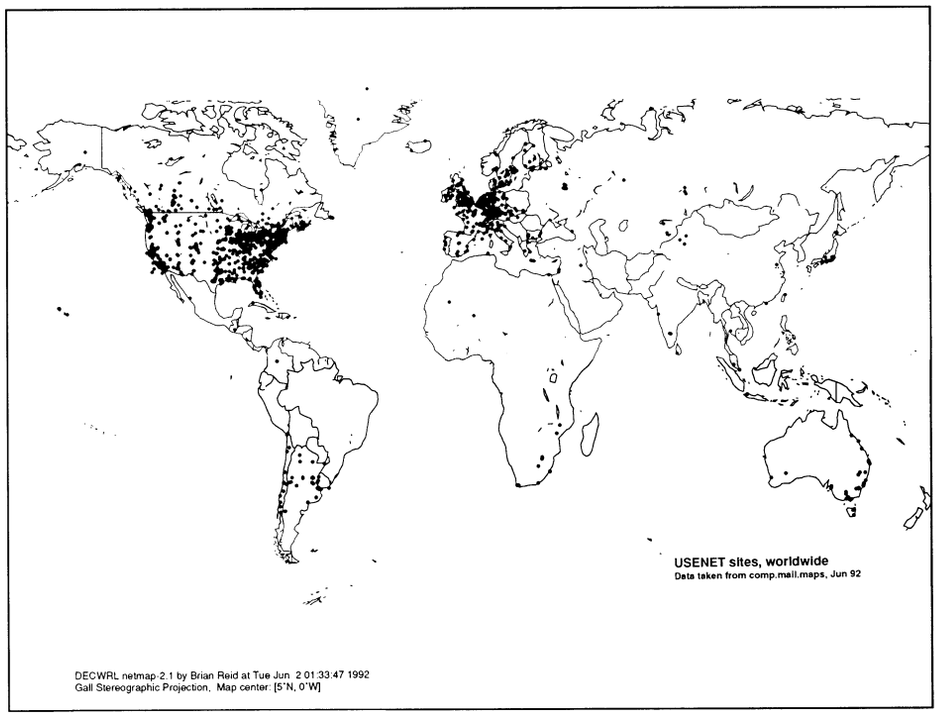
Just as the cost of computing has steadily fallen, so has the cost of physically connecting computers together so that they may communicate. The telephone system has been the traditional way to connect computers. To use the telephone system to connect computers, one normally uses a device called a modem, which is an acronym for MOdulator/DEModulator. The modem converts the digital pulses from the computers into analog tones that can be transmitted over the telephone system.

Modems are generally categorized according to the speed at which they can perform this conversion. Early modems typically operated at 300 baud. "Baud" is a unit referring to a tonal transition. A 300 baud modem is capable of 300 tonal transitions per second which equates, roughly, to 30 characters per second. Using a 300 baud modem, this paper could be transmitted in approximately twenty-two minutes. The author bought his first modem, a 300 baud unit, in 1977 for $400.

The next great leap was the 1,200 baud modem capable of four times the speed of the 300 baud unit. These units were available for $300 in 1983, only to be surpassed in 1986 with 2,400 baud modems at the same $300 price. Modems capable of 14,400 baud are now available for $400 (in 1992). A single "street" modem today has the communication speed of forty-eight modems of a decade and a half ago while costing less than half as much. It is important to note that this performance increase largely ignores any improvement in the basic telephone network—i.e., that today's modems are achieving such performance using yesterday's telephone lines.

One slightly amusing result of this has been an almost constant, but low-key, attempt by the telephone companies to impose tariffs or user fees on modem use. The telephone networks were built using the assumption that most calls would average less than three minutes in duration. The growth of personal modem use means calls lasting hours or even days from individual homes.

This modern practicality of high-speed, low-cost modems coupled with the inability of the telephone companies to place tariffs on modem use have made the computer an attractive and economic method of communication. This has combined in the last decade with general increases in the overall popularity of the home computer, increased interdisciplinary uses of computers at educational institutions, and the explosive growth of both commercial and public network systems, to create a large subculture which communicates largely via computer.



A Method of Connecting Computers So That They May Communicate: The Internet as Case Study

In the late 1970s units of the federal government sought to implement a "national data highway system." This system, analogous to the defense highway network (also known as the interstate highway system) would provide, through adherence to strict formal specifications, an infrastructure for data transport throughout the country. The responsibility for the creation of these data specifications, like interstate standards, was given to units of the Department of Defense acting in concert with universities and other participants. The name given to the aggregate networks adhering to these specifications was Internet. Portions of the actual Internet would be federally subsidized (through agencies such as the National Science Foundation), other portions would be paid for by universities, consortiums, and individual private concerns.

Early work with a system called ARPAnet provided much of the theoretic and real foundations of the Internet. The ARPAnet was an experimental nationwide network which was implemented in the early seventies under the auspices of the Advanced Research Projects Agency, now the Defense Advanced Research Projects Agency (DARPA). Whereas the ARPAnet was a singular physical entity with specialized hardware requirements, the Internet is a logical collection of numerous physical networks all interconnected via a common network protocol, the Internet Protocol (IP). It is conformity with this protocol which distinguishes parts of the Internet from other types of networks.

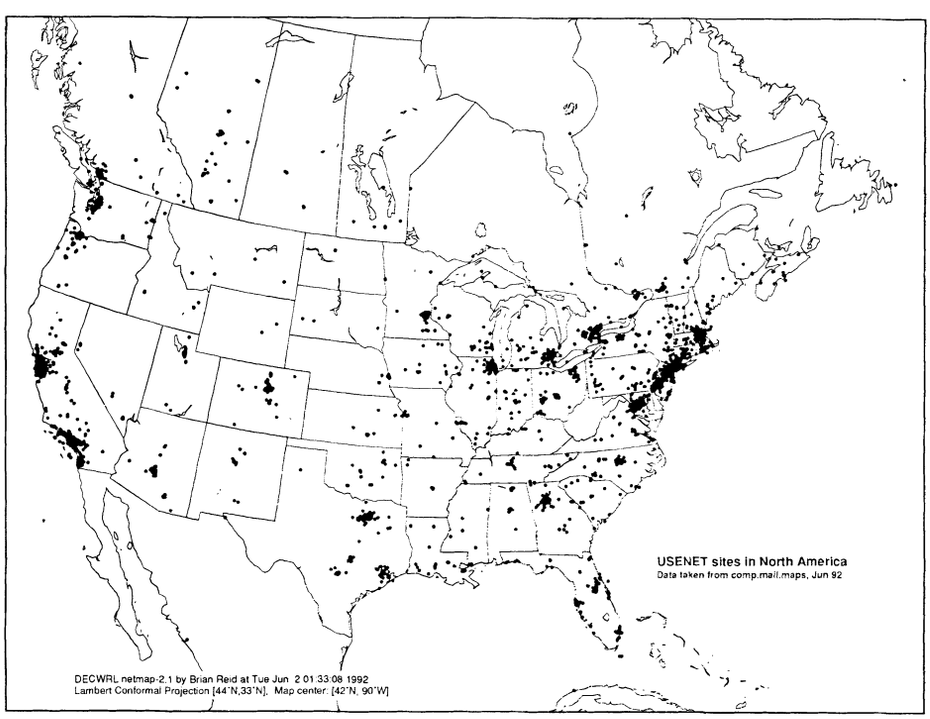
Because of this standardization, any computer system which is capable of communication using IP can connect to the Internet. All that is required is another computer system that is already connected to the Internet and which is willing to allow new connections. Once connected, a computer is individually identified on the Internet by its IP number. IP numbers consist of four distinct numbers separated by periods. Each of the four numbers may range from zero to 255. As an example IP number, the number of the machine on which this article is being composed is 192.146.245.10. The organization to which this machine belongs was assigned all the numbers from 192.146.245.0 through

192.146.249.255; roughly one-thousand numbers. This numbering scheme allows a theoretic maximum of over four billion machines. However, the four fields are broken down administratively (all numbers are ultimately assigned by the Defense Department) so that the practical limit on connections to the current Internet is somewhat less. While four billion possible numbers may seem sufficient, it should be noted that a new standard has been proposed that would allow as many as 280 trillion machines.

From any machine connected to the Internet one may connect to or exchanges files with any other machine on the Internet. Much like ZIP code and street address for a home, all that is required is a knowledge of the other machine's IP number. For convenience sake, and because IP numbers may change, machines often have "names" associated with them. These names can be used in lieu of IP numbers; specialized software takes care of converting the names to numbers. This machine's canonical name on the Internet is *saltydog.dpsi.com.* Knowledge of this name alone is usually sufficient to connect to it from any other machine on the Internet.

The details of the connections between the machines are completely transparent. Because of its size and complexity, the Internet may provide several physical paths between machines A and B. In such a case, low-level software on an intermediate machine (called "routers") will usually pick the "best" route. The notion of "best" may be based solely on the speed of the connection or it may have other considerations such as the cost of using a certain line or the reliability of the line. The key concept here is that the two machines have no concept of their physical connection. It is possible, although unlikely, that two machines in, say, Boston, communicate via a circuit that travels through California.

The Internet has grown tremendously in the past decade. Because IP numbers are usually assigned in blocks, it is difficult to say exactly how many machines are actually extant today, but estimates number well over a million (compared with a few hundred original machines on the ARPAnet). IP numbers make no distinction between types of machines. Certainly a majority of the IP numbers are single-user machines, but a significant portion of IP numbers represent large "mainframe" systems supporting tens or hundreds of users. Estimates of the total number of individuals with access to the Internet in one form or another is currently about ten million.

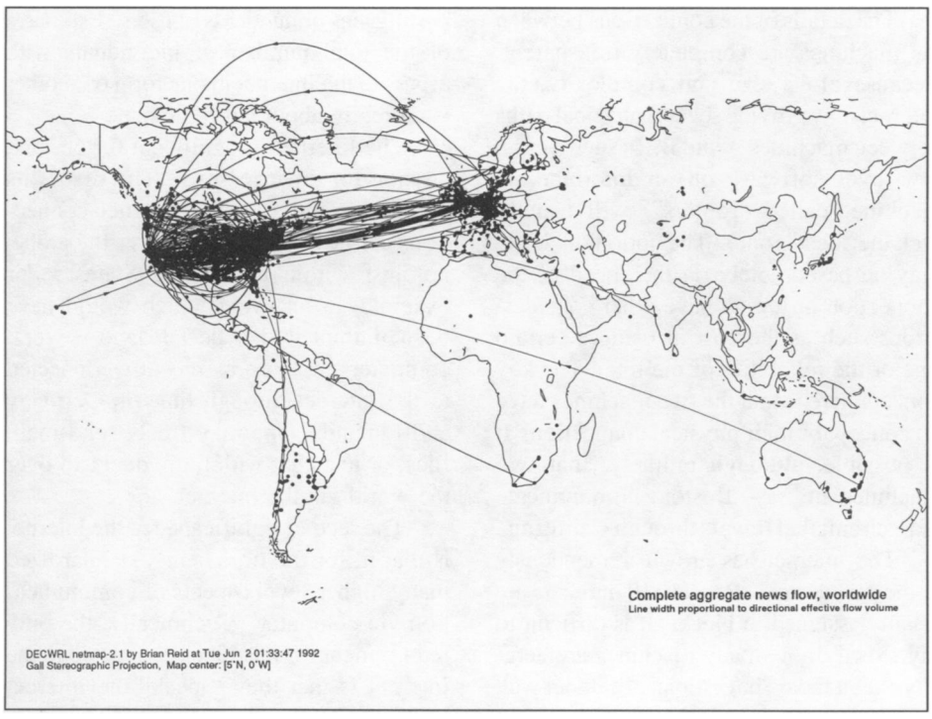


The Internet is significant for our discussion for three reasons. The first is its popularity and spread. Internet connections are now available all over the globe, not just within the United States. For example, in an event which would have been unthinkable a decade ago, several computers in Moscow recently connected to the Internet through links in Germany and Finland. One may freely send mail, files, or just chat with individuals all over the world via the Internet.

The second significance of the Internet is that it, for the time being, standardized many higher-level aspects of communication via computer. Technically, the only requirement for machines connected to the Internet is that they "speak" the Internet Protocol (IP). IP does not dictate any requirements for the types of data that cross the Internet nor does it know anything about higher-level programs, such as e-mail programs, which might exploit the Internet.

However, many of these higher-level protocols had been developed under the ARPAnet and they were quickly adopted by most users of the Internet. Other protocols were developed during the last decade. Examples of the protocols include the Simple Mail Transfer Protocol (SMTP) which describes a very simple low-level method for transferring electronic mail from one machine to another. Another example is the File Transfer Protocol (FTP) which describes a generic protocol which allows one machine to ask another machine for a specific file.

These simple protocols, the specifications for which are in the public domain, made it easy for people to develop communication applications for virtually every type of computer that connected to the Internet. The protocols assume very little in the way of computer power or capability so that it is just as easy to share mail over the internet between two large computer as it is between a large and a small computer. The Internet facilitates the exchange of



information via computer much as standardized railway lines facilitate the exchange of goods and services.

The third factor is cost. Connection to the Internet is nominally free with a small one-time charge for IP number assignment. The details of the connection are left up to the individual or organization seeking to connect. Connections can range from a simple across-town modem connection of 1200 baud, to a sophisticated connection involving Internet routers and a high-speed dedicated link of 56,000 baud or higher. Once connected to an Internet node, a connection to a machine 10,000 miles distant costs no more than one next door.

Two Ways of Using the Computer for Communication

1. USENET

We have talked about the Internet, which provides only the infrastructure for wide-spread communication via computer. However, like a highway, Internet is useless without something to take advantage of its ability to connect computers together. One way to use the Internet then is to use it to connect two or more computers together so that humans can exchange ideas using the computer as the medium.

One of the most popular communication mediums is something called USENET. USENET refers only to a certain logical grouping of what are called "newsgroups" which are arranged hierarchically. Within each newsgroup are individual articles read and written by people who have access to USENET machines.

Top-level newsgroups include: "rec." for discussion of recreation topics; "comp."for computer related topics; "news." for discussion of USENET itself; and "soc."for social issues.

Within each top group are subgroups, such as: "rec.aviation" (aviation discussions), "soc.singles" (a place for singles to talk), and "comp.sys.ibm" (a discussion group for IBM systems).

The major distinguishing feature of USENET is that it nominally has no centralized administration and does not belong to any corporation. Policies as to newsgroup's creation or demise are formed by true democratic consensus. Furthermore, computer sites are free to connect to USENET, without charge, provided an arrangement can be made with another willing computer site already connected to USENET (4).

Individuals participate in USENET discussions via software generally called "newsreaders." Several such programs exists with different characteristics to suit different tastes. They all accomplish the same goal: the ability to read and write notes to the USENET system.

2. Personal and Restricted Communication: Electronic Mail

The distinguishing feature of electronic mail is that it is most often a direct exchange between two individuals instead of a posting by a single individual to a large audience. Whereas electronic bulletin boards have only a weak correlation to traditional bulletin boards (the thumbtack and cork type), there is a very close resemblance between electronic mail and ordinary mail one gets from the post office.

Personal, junk, and informational mail are all within the electronic domain. The only differences are is that it doesn't cost a stamp, it almost always gets there, and it usually gets there within an hour. Indeed,this difference between electronic mail and "regular" mail has already been noted, as a threat:

". . . yet clearly, telecommunications advances most affect mail service."

"A Canadian Post Office study has estimated that 45 percent of first class mail begins and 20 percent ends up in a computer. Much regular business and ground communication could easily be carried out through computers networks" (5).

Just about anyone who has used electronic mail, especially in the workplace, raves about its ease of use, speed, and convenience. Electronic mail is quickly eclipsing other forms of messaging as the primary means of direct, non-spoken, communication within larger technology-oriented corporations. Yet there is a danger of particular interest for the historian as corporations and other entities increasingly depend on electronic communication for internal matters. Unlike written memos and inter-departmental memoranda, the character of a particular e-mail message is not discernible by its outward appearance. There are often no clues given

by lists of recipients (which are easily hidden on e-mail systems) nor are there physical hints, such as grades of paper or letterhead, on typical e-mail messages. In short, without detailed analysis and some knowledge of the players and the background, it is often extremely difficult to separate banal and unimportant e-mail from that which represents major decisions or upheavals.

A recent article in the *Wall Street Journal* noted a "Historic Crusade to Preserve E-Mail." The story dealt with issues surrounding e-mail sent between executives using the White House computer system concerning the Iran-Contra affair and illustrates this point well.

"Feb 1, 1986, an executive sat at his office computer and sent a colleague a message via electronic mail: 'Bill, Ed. . . Don . . . and I are fully on board this risky operation, but most importantly President and VP are solid.' "

Thousands of office workers send notes like this every day. But this executive was U.S. National Security Advisor John Poindexter, and the "operation" he had in mind was a covert plan to sell arms to Iran. When investigators found a copy of this message and hundreds of others on computer backup tapes, they unraveled a vast scandal that tarnished a president" (6).

Issues of Computerized Communication

The Problems Associated With Universal Access

The wide-spread growth of systems such as USENET has created a dilemma for administrators. Should the networks be subject to censorship and, if so, what type of censorship? Participants on the networks, especially those using computer systems owned by educational institutions, tend to view the network as being completely open and free. Attempts by administrators to limit subject matter are typically viewed as violations of the participants' rights to free expression. These arguments are typically countered by administration with the view that the machines used to connect to Internet are the property of the particular institution which may freely set limits on the acceptable use of said equipment. However, this puts the administrators, who often lack training to deal effectively with such conflicts, in editorship roles.

A particularly interesting dilemma currently faced by USENET revolves around the rights of revisionist historians to post their view. Because USENET consists of a mosaic of interconnected sites without any central authoritative administration there is no binding editorship. As we have seen, individual users on a single computer can often effectively be censored by the entities that own or administer the computer system, but what guidelines should be followed when an entire user population of a particular computer, or a computer dedicated to those with a singular view, connects to a system such as USENET?

Traditionally, there have been a number of responses. The first has been an appeal to the sites through which the offending site connects to disconnect. A site may be "cut off" from USENET by the sites to which it connects at any time. This response is often met by the compelling counter argument that the sites should be free to express their views irrespective of content.

Those portions of the Internet that are funded by government agencies, such as the NSF, are subject to governmental censorship. The NSF publishes strict guidelines regarding the use of publically-funded Internet links. However, these guidelines are often overlooked or ignored. As a result of lax enforcement today, coupled with the explosive growth of the Internet, it is possible that in the future, the NSF will find itself in a position that the NEA is finding itself today.

Even if the NSF were to forbid all but the most businesslike transactions on those portions of the Internet which it funds, the question remains about those portions of the Internet under private control. The Internet Protocol specifications are in the public domain. No government entity has the power to regulate an Internet connection between, and paid by, two private concerns.

The FCC has a long drawn a distinction between communication and data processing. With regard to computer networks, the FCC considers them a data-processing function. Since FCC regulates communication, but not data-processing, it has largely been blind to the increasing use of computer networks as a communicative tool (7).

USENET is currently too specialized for this to be much more than an academic question. The future, however, promises unique challenges for organizations such as the FCC as they face the implications of extremely wide-spread computer communication.

Universal Access?

Although we noted the general downward trend in both computer and communication costs, there is a danger that certain societal elements may be locked out of important cultural exchanges as the uses of computers for communication become more widespread. Today only a fraction of the population uses computers for communication on a regular basis but it is completely conceivable that this will have changed a decade in the future. Is it possible that computerized communication will eclipse newspapers, television, and public debate as mediums for policymaking? And, if so, will certain segments of the population be excluded from the discourse (8)?

For the time being, it seems that concerns such as these are overstated. Ten years down the road, computers, or at least terminals capable of network connection, are likely to cost no more than a television set. In fact, it is likely that they will cost considerably less. Still, those without the ability to articulate themselves clearly will be largely ignored. However, it is not clear how computerized communication makes the previous statement any more odious than it is in reality today.

The Character of Electronic Communication

What can be said about the character of computer-based communication? One study had this to say about the fundamental nature of such communication:

"It is important to remember that this is a *print-based* medium . . . Also, it is possible for communication to occur without all participants being "present simultaneously" (9).

Motivation plays a large role in determining which and to what extent people participate in computer-based communication. To the present, those with moderate technical skills and interests in machinery in general are the majority of participants. Those with prior computer experience are the most likely to easily embrace computerized communication. And, of course, those with an ability to type will find less frustration than those who are forced to participate via a "hunt-and-peck" typing style.

It is a well-known and interesting phenomena on USENET that the individuals actually composing messages for others to read comprise approximately ten percent or less of the total number of people with access to and who regularly read articles on USENET. The slang term "lurker" denotes those individuals, the silent majority, who read but do not post. The great disparity between "lurkers" and active, posting, members of USENET can probably be explained by the reasons given above and with consideration of the fact that people are often timid to express themselves in public.

For example, Figure 1 represents the statistics on readership for the month of December, 1991 for the aviation-related group **rec.aviation**.

Note that, even with 42,000 estimated readers, this group is read by only 2.4 percent of the entire USENET population.

Figure 1
USENET Readership Statistics for "rec.aviation" Newsgroup
(December 1991)

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      +- Estimated total number of people who read the group, worldwide.
      |     +- Actual number of readers in sampled population
      |     |     +- Propagation: how many sites receive this group at all
      |     |     |      +- Recent traffic (messages per month)
      |     |     |      |      +- Recent traffic (kilobytes per month)
      |     |     |      |      |      +- Crossposting percentage
      |     |     |      |      |      |    +- Cost ratio: $US/month/reader
      |     |     |      |      |      |    |      +- Share: % of newsrders
      |     |     |      |      |      |    |      |   who read this group.
      V     V     V      V      V      V    V      V
  42000   947   80%    968  1958.4     2%  0.08   2.4%  rec.aviation
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Limitations of Electronic Communication

An unfortunate characteristic of electronic communication concerns the loss of information. Because computers have finite storage capacity and because of design economies, a typical computer keyboard usually represents only the alphabetic characters, the digits, and some special symbols such as percent signs, exclamation marks, etc. This leads to a certain type of information compression where authors are taxed to express their viewpoints within this limited set of symbols. The ability to arbitrarily enlarge, compress, or distort characters is not usually available. Few systems provide the ability to include graphics into the text. Those systems that do provide such a capability often make it extremely difficult to do so.

This makes it difficult to express oneself subtly or to add various personal touches to an electronic document. Satire and sarcasm are particularly difficult to convey. Various conventions have arisen on the popular networks in an attempt to overcome these obstacles. By far one of the most popular is the use of the "sideways face" to graphically depict the authors emotive state. For example, a sarcastic statement that the author feels may be misinterpreted is often followed by a "smiley" face:

"It is fairly obvious that Mr. Smith has an extremely high regard for this year's freshman class. I have never heard a disparaging comment from him. :-) "

Conversely, something that displeases the author might warrant a frown:

"I left the office early today, only to get caught in traffic for two hours. :-("

Other personality traits and subtle emotive clues that are apparent when communicating in person or via a telephone are also lost in typewritten communication. A key difference between using the computer for communication as opposed to a typed or handwritten letter is that the former is usually much more informal in nature. Handwritten letters and notes are often sent to those who know us well while typewritten ones are usually have some degree of forethought and formality involved in their creation. A message sent via computer is often hastily composed and sent to hundreds of relatively anonymous individuals.

The Implications of Electronic Communications: Privacy, Ethics, Society, and the Individual

Because of its digital origin, communication via computer lends itself to easy distribution, storage, and verbatim quoting. By and large these are generally considered desirable qualities. However, there are several possible implications for the individual who contributes within a society that communicates electronically.

One implication is the great danger that the individual may be quoted out of context. As we already saw, many nuances and personality traits of individuals can be lost when the person's viewpoint is compressed to fit within the electronic lexicon. Add to that the fact that it is easy to make a flippant or accidentally offensive remark when access to a keyboard is easy (10).

All of us say things we later regret. Most of the time, thankfully, such things are expressed as spoken words which are quickly forgotten by those around you. But what happens when such things are typed into a computer bulletin board? What implications for a person's character are there when a flippant, off-color remark can be recalled verbatim years later and instantly circulated to an enormous audience?

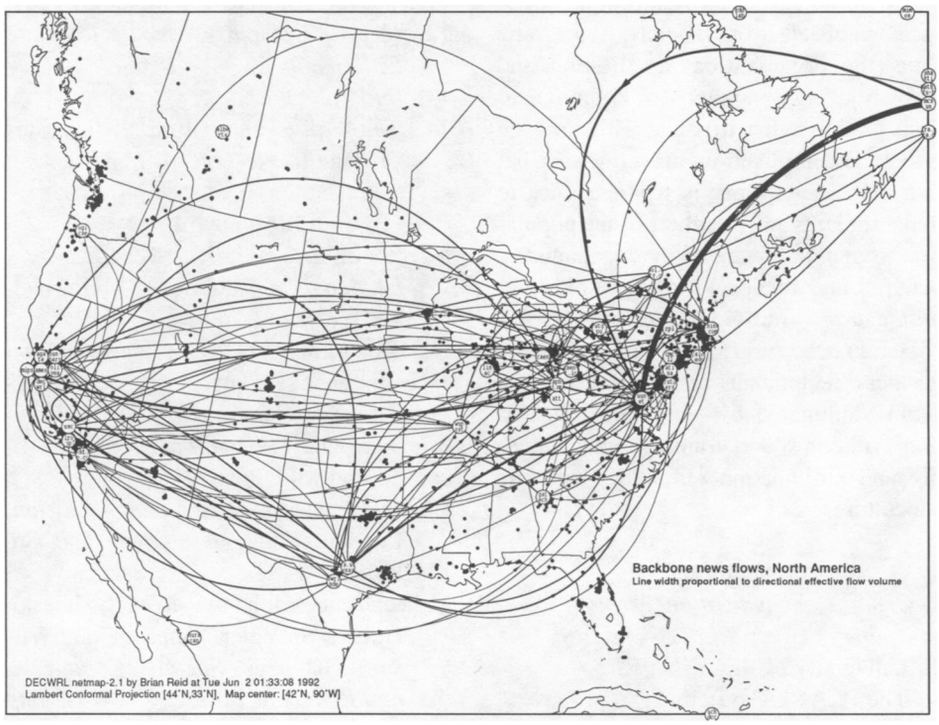
Government Monitoring

On a related note, the fact that more and more of our everyday transactions are tak-

ing place via computer makes it increasingly easy for the government, or private institutions, to compose an electronic personality profile based upon public bulletin-board postings, electronic mail, etc.

It was folklore in the 1970s that the government, particularly the National Security Agency, regularly intercepted long-distance telephone calls and subjected them to analysis by computers. The increasing use of microwave and satellite units for telephone transmission supposedly made it easy for the agency to passively intercept conversations, which they supposedly did with some regularity. As the legend goes, the NSA had rooms full of sophisticated software that could recognize certain keywords and begin recording conversations that employed those words (11).

It seems implausible now, given that in 1992 it is still extremely difficult to use computers reliably for voice recognition. As one source pointed out, it would have been more economical for the NSA to simply employ a bank of high-school students to do the same thing. However, it *is* extremely easy to intercept the communications between computers. Once again, computers employ a limited set of symbols both for internal representation and external communication. It would be relatively inexpensive to devise a system that listened to inter-computer communication. As more and more of our everyday communication moves into the digital domain there are dangers that individuals or organizations will be able to compile large electronic dossiers. What safeguards can we create to protect privacy?



Topics for the Historian

What are the implications of the growing trends toward electronic communication for the historian? A first consideration is preservation of historic material. Several factors make electronic documents attractive for this historian. It is easy to preserve electronic documents. Unlike paper, they do not "age." Several forms of electronic storage, particularly disk and tape, must be periodically "refreshed." Unlike the procedures for traditional paper-based material, these operations are straightforward, are usually necessary only every five years or so, and result in the total refurbishment of the media. The environmental concerns for electronic media are also much less stringent than those for traditional paper. It is almost certain that today's disk and tape storage methods will be obsolete within the decade and their replacements are likely to need no refreshing whatsoever or, at least, refresh periods measured in decades or centuries.

Secondly, it is trivial to index and search electronic information. Many, if not most, libraries in the United States and elsewhere are going to computerized card catalog systems. Such systems allow searching by title, author, subject, and even keywords. The future historian will likely spend much more of his or her time glued to the computer terminal in the office than down at the library browsing the stacks.

Not only books can be cataloged electronically. Most of the discussions on USENET are archived for indeterminate periods; a collection of USENET archive sites contain postings from key engineers, policymakers, academics, etc. Often they are posting in response to specific questions put to them by other USENET participants. Over the years quite an exciting repository of primary source information will undoubtedly exist on USENET archives.

On the other hand, historians may be faced with information overload. The very things which make electronically encoded information so attractive—ease of storage and retrieval—also threaten to make it difficult to location substantive information. Within the more traditional forms of publishing, such as books and magazines, there exists a hierarchy. The hierarchy consists of the authors and their peers, editors, agents, and, of course, the subscribing public. All of these factors implicitly filter out material which is trivial, redundant, or simply incorrect. Furthermore, individual works are ensured of a healthy initial audience, which aid in accurate indexing, critical review, and the acknowledgement of other sources. With material published directly, say in an electronic bulletin board, magazine, or newsletter, there is no such peer review process.

Inherent in computers is a strong tendency to try and record everything both

because it is easily possible and it serves as a way to justify the computer system in the first place (12). An additional danger occurs because those responsible for maintaining the records may not be trained specifically in the fields represented by the record, such as a curator or librarian at a museum might be. They may instead be specialized only in the technical mechanics of generic computer storage. As a consequence, considerations for storage and the methods and indexes of the stored items may be "sometimes treated as if they were nothing more than questions of efficient technique. The pressure for establishing a simple, identification scheme for locating records in computer-based systems is a case in point" (13).

Furthermore, the record keepers may be politically or economically encouraged to record information in certain ways or to periodically "purge" information that is no longer needed or that might prove embarrassing later. And, often, information is simply deleted because it is not considered of importance by those maintaining it.

An excellent example of such tensions can be found in the article about e-mail referred to above:

"The saga of the Iran-Contra electronic mail is back in the news today because the Bush White House is fighting for the right to wipe out those backup tapes, including 98 that investigators never inspected. The tapes contain thousands of unknown messages from Mr. Poindexter, Oliver North, and dozens of other National Security Council Officials."

The case has erupted into a broad dispute over history and public accountability in the information age. Bush administration lawyers contend the Records Act doesn't cover electronic mail. Their opponents call that a dangerous distinction, now that electronic mail is so widely used through the highest reaches of government" (14).

The Future of Computerized Communication

We have given a very brief overview of the character of computerized communication, some considerations for the individual and society regarding its use, and a description of some of the existing and evolving methods of connecting computers so that they may be used for communication. It is fairly certain that computers will continue to be employed in ever-increasing amounts as the medium for the transmission, storage, and indexing of inter-human communication. We have seen that existing institutions, such as the law and certain government agencies, have been slow to respond to the increasing dominance of electronic communication and to formulate policies appropriate for an increasingly electronic society. At the same time, the organizations facilitating and actively using computers for communications have acted swiftly and with amazing effect. The implications are numerous, but one that seems clear is the necessity to make students and members of the population in general aware of the mechanisms, benefits, and drawbacks of electronic communication. Individuals cannot be expected to become effective policy makers, teachers, technicians and legislators in a future dominated by electronic information without sound training, understanding, and participation within the electronic subculture. ❑

Endnotes

1. *Group Communication Through Computers*
2. University of Illinois/CERL
3. The PLANET system
4. Although we are focusing on the Internet, it should be noted that articles are propagated from one USENET machine to another via any appropriate communication link. One of the most popular methods, after an Internet link, is via the UUCP (Unix-to-Unix Copy) program. Because USENET was began its development at the same time as Internet, early USENET systems did not use the facilities of the Internet to transfer messages. Additionally, many early USENET systems had no access to the older ARPAnet which was essentially restricted to government, military, and certain educational and commercial concerns. A UUCP link supplies a ready alternative that is not as flexible or reliable as Internet, but may be easier to obtain.
5. *Group Communication Through Computers*, Vol 5., p. 99.
6. *The Wall Street Journal*, "Historians Crusade to Preserve 'E-Mail'" 7. *Group Communication Through Computers*, Vol 5., p. 98.
8. *Group Communication Through Computers*, Vol 5, p. 100.
9. *Ibid.*, Vol 4, p. 111.
10. *Ibid.*, Vol 5, p. 101.
11. *The New Hacker's Dictionary*, p. 262.
12. *Records, Computers, and the Rights of Citizens*. p. 13.
13. *Ibid.* p. 23.
14. *The Wall Street Journal*, "Historians Crusade to Preserve 'E-Mail' "

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