

An Overview of Computer Networks in Education: Computer Networks and Network Services

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1. Introduction

When one thinks of using a computer, it is often in terms of data analysis or word processing. There is a third area, communication, where computers may also be used. In this paper we wish to describe services available when computer is used as means for communication. While directed towards the reader with access to a mainframe system, the reader with a single PC and the appropriate software should have no difficulty using the information presented in this paper.

The authors wish to thank all the individuals who assisted in developing this paper. This includes individuals who provided us with information through some of the computer networks described in this paper [3].

2. Computer Networks

For the purposes of this paper, a computer network will be defined as two or more computers connected together. Such a collection of connected computers can, but need not, include a mainframe system. This may be done so that a common set of software or data files are shared by a group of users. In addition, a network may also provide means for these users to communicate with each other.

While it is possible for several remote terminals connected to a single mainframe system (otherwise known as a time sharing system) to accomplish the processes described above, computer networks offer other

advantages. First, if the mainframe is inoperable, the remote terminals will also be inoperable. In a network setting, an individual PC can retain its computing ability, even if the mainframe or network server is inoperable (keep in mind that if the network server is inoperable, the network is inoperable). The most important advantage for networks is that members of a computer network are not necessarily limited to a given academic or geographical area [4].

A school's resources should not limit the use of networks or the interaction between individuals. Even a school had only a single PC, it would still have the capability of connecting to a computer network. Several networks have been developed to take advantage of the presence of computers in elementary and secondary schools [5].

The WCU Micronet, in operation since 1982, connects 21 schools in western North Carolina. Access to the Micronet requires only a modem and a dedicated phone line. Network services are otherwise free of charge [6]. Elementary and secondary schools in the New York and Pennsylvania area can join a network known as the LEARNING LINK. The only charge is a one-time membership fee [7].

The Educational Native American Network or ENAN currently has 883 users making, on the average, 2100 calls per month of 15 min in length. The users are divided between students (30%), teachers (50%), and administrators (20%) at the elementary and

secondary level. This network allows Native American students to communicate between sites and to take courses through the University of New Mexico [8]. A fourth pre-college network is the Electronic School District (ESD) in Indiana [9].

Computer networks, then, can be seen as a way to provide communication between individuals about current events (research, recreation, travel, battles, etc.) for a given community. There are advantages (and disadvantages) to such communication. First, persons involved in computer network discussion need not be in the same place. Nor do they have to be available at the same time. The disadvantages are that there is a reliance on the written/typed word for communication (and this can be a very difficult medium in which to express emotions) and there is a lack of person-to-person contact. There is also the equipment problem. For the purposes of this paper, it is assumed that the reader has access to a network. If there are questions regarding this, the reader should first check with the local computer services support division.

Network communication may take the a variety of forms from a transfer of files between individuals and/or locations to the exchange of messages. In the remaining part of this paper we concentrate our attention on classifying the available methods of communication. Our classification network available services is based on increasing communication potential.

3. Transferring files

The simplest form of communication is transfer of data. This can be achieved by storing information on a floppy disk and physically transporting that disk from one PC to another. While useful for limited travel, it is not the easiest way to move items across the country. The best way of transferring files is by the file transfer protocol (or ftp). Ftp is a software package that is supported on most mainframe based networks. This is the simplest form of communication because it involves only one user and a minimum of two computers. Using ftp, an individual connects his or her computer with another computer

via a computer network and transfers the file. There is a set of files stored on one computer that the individual is interested in (much in the manner of a warehouse) and the individual merely selects the file of interest [10]. Such files may be computer programs, research papers, journals (in what is termed "electronic form"), or any other information. Ftp allows to transfer even very large files (allowing an easy access to research paper without having it mailed). All programs what are transferred via ftp are ready for immediate use. The disadvantage to this is that the user may not be aware of the contents or the contents may be too big for the storage on the home computer.

4. Bulletin Board Systems

The next step in computer communication is the concept of a bulletin board system (or BBS). In addition to simple file transfer typical BBS has menu driven system and availability of message exchange (mail box). The Electronic School District Project is one example of a BBS-type solution. Using an IBM 4381 mainframe, the ESD has established the Student and Teachers' Electronic Productivity System (STEPS). This system is set up so that schools may either connect to the mainframe or interact with other schools in the network. The STEP System provides the user with a menu of possible choices based on the area of interest or discussion. The user is given a menu system which simulates a school building with rooms containing various settings, such as administration (mail, nurse's office, principal's office, teacher's workroom, etc.) and classrooms (the Math and Science wing contains the weather office, math classroom and labs for Physics, Biology, and Chemistry). The experienced user can go directly to the area of interest while the first time user has a series of questions and directions which leads them to the area of interest [9].

Today BBS's are very popular methods of exchanging "public domain" information or communicating with individuals. There are several large commercial BBS's, such as Prodigy and Comuserve, which are accessible nationwide using modems and telephone lines.

Establishing a BBS-type environment is simple and can be achieved in every school having already computers. It is enough to have one computer, defined as the "host" computer, that acts as a collection point for the transfer of information. This computer stores the information and operates under the appropriate BBS software. To retrieve the information an individual must connect to the host computer. It is worth mentioning that such connection can be established not only from the school building, but also from students home. After this is done, it is a matter of transferring the information to the user's computer. The host computer should have a large amount of disk storage available and be one of the fastest computers on the network. If the host is a PC then, to allow an efficient running of a BBS, it should be dedicated to this usage. One of the disadvantages of this method of communication is its slowness (especially when 1200 baud modems are used).

On VAX/VMS systems, there is a utility known as NOTES which can serve as a bulletin board system. Using NOTES, students in the science education methods classes at the University of Texas of the Permian Basin were able to continually update and maintain a readings list for the class. In addition, students were able to develop a book of demonstrations and experiments which they could take with them for their student teaching, and after graduation, regular classroom instruction. For a series of class assignments, students were assigned to groups. Using NOTES students kept other students in the group informed of their own progress and were appraised of the other students' progress of the group without having to be in contact. While the students in this course were using a common system (and thus using a time-shared system rather than a network), the NOTES system is set up to allow users from many different localities and computer systems to interact. Norman Coombs of Rochester University has also used the VAX NOTES system in some of the classes he teaches [11].

5. Interactive communication

As illustrated by the use of bulletin boards, networks do not have to use a mainframe computer system. A local BBS system using a PC-type host is already a computer network. Adding a mainframe computer system may expand the region available for communication. There are at least two ways in which this may happen. First, most mainframes provide support for some kind of BBS-type software (such as previously discussed NOTES) and allow to run it more efficiently by being much faster and providing bigger disk space. Second, using a mainframe allows individuals to interact through e-mail, interactive messages (SEND or PHONE commands on VAX VMS), and joint conferences (the BITNET RELAY command) [12].

For the purpose of clarity, this paper will consider primarily the BITNET network [13]. A reader without BITNET access need only make minor modifications to the information presented to implement the describe operations. If the reader is not clear what network they have access to, they should check with the computer support personnel at their institution.

6. Electronic Mail

The use of electronic mail (e-mail) is one of the most common usages of computer interaction. Its main advantage is that it is active. In a bulletin board system the only way a user knows if there have been any modifications is by checking the directory of the system for the time of the last update. In using e-mail, the user is usually informed (upon logging onto the computer) that there is mail waiting.

E-mail operates in a manner similar to the "spoke and hub" system employed by many airlines today. Messages are sent from the originating computer to a gateway computer (or node) which then forwards the message to the node where the computer of the message recipient receives mail.

In addition to individuals exchanging messages, it is usually possible to send a message to a group of persons. This may lead

to a seminar-type information exchange. A seminar is designed to allow a group of individuals to meet and discuss a topic of current interest. However, if these individuals are not at the same location or do not have compatible schedules, then such meetings cannot take place. Assuming each member of the group has access to a computer network, the exchange of information is possible.

This concept can be then expanded to a "continuous seminar" or "permanent discussion" where there are no fixed times of meetings. This is done by establishing a computer based discussion group or list.

7. Listservs

To simplify sending of a single message to a group of individuals, the idea of a list server (or Listserv) was developed. A listserv is a software package which facilitates the communication between members of the discussion group. Any mail sent to the discussion address is automatically distributed by the listserv to all members of the group [14]. For every listserv there is at least one individual identified as the "owner" of the list. This person is comparable to a system manager in that he or she is responsible for the administration and upkeep of the list [15].

In addition to serving as a distribution point for all mail, the listserv manages the group's archive and allows an individual (who may or may not be a member of the group) to examine earlier discussions. Some listservs also provide users with the possibility of file storage and recovery. One can send a file to the list and make it available to those interested in it without having to send it to everybody. This can be especially useful when one wants to discuss ideas contained in a 40 page essay [16]. While the file storage facility is available on most BITNET listservs, it may not be the case for other listservs; the reader is advised to check the documentation that is generally sent when one becomes a member of the discussion group (see Appendix A for information on how to become a member of a group).

Listservs can be classified in a number of ways: the size of the group involved, the way

messages are distributed, and the amount of intervention by the list owner. The size of list may range from a discussion group based on a geographical region or campus based setting (such as Philonca, a 50 member list used to exchange information about philosophy related events in Ontario, Canada) to large lists such as the Word Perfect Users Group Discussion List which is located on three different computers (one of them in Europe). While many lists are educationally oriented [17], lists like the Word Perfect Discussion List or the Chess Discussion List will have subscribers in educational, government, or commercial positions. Most lists would be classified as moderate, meaning there are between 50 and 300 members.

Listsers may also be characterized by the way in which messages are distributed. In an unrestricted listserv, all messages are distributed immediately to all subscribers. In a digested listserv, messages are collected and distributed from time to time. Redistribution of messages (daily, every other day, once a week, etc.) depends upon the amount of traffic. Certain lists are available in both modes and the subscriber needs to declare which mode he or she wishes to receive.

The degree of control set by the owner of the list can do a lot to reduce the message traffic of the group and the degree to which emotions rise [18]. The PHILOSOP list, for instance, allows replies to a topic to be directed specifically to the sender. This makes the list more scientific and research oriented [19].

The last type of list control is the moderated list. In this case, the content of list directed messages is controlled, reviewed, and edited by the list owner. The PSYCOLOGY list, a psychology discussion list [20], is an example of a list where the information is sent to the listserv and a digested form of the material is sent to the group members [21]. As the degree of control and intervention increases, moderated lists begin to take the form of an electronic journal.

8. Electronic Journals

The electronic journal, like its paper counterpart, may take two forms. At Rice University, an electronic newsletter is used to announce research opportunities and is published on a bi-weekly basis. As the campus is fairly computerized, it is possible to send a copy of this newsletter to contacts in each department or those faculty who wish to receive it directly. Recipients can then convert the electronic copy into a printed copy for distribution to other members of the department. Based on the feedback from the faculty, it seems that this approach is an effective means of reaching the research community with a minimum cost and effort. This approach also allows for separate newsletters to be sent to various departments, thus allowing more information of interest to be given to the appropriate persons [22].

Another form of an electronic journal is the fully reviewed journal. Postmodern Culture [23], and the newly created EJournal [24] represent examples of this type. Postmodern Culture is dedicated to the discussion of postmodern culture and is distributed via e-mail. EJournal will examine various issues related to the creation and dissemination of electronic based text. In addition to the electronic versions, this journal will also provide the author with a printed copy of the issue.

It is also possible for the more traditional journals to be available in electronic form. The journal Reach is now available via ftp [25].

9. Conclusions

The information presented in this paper illustrates the type of network based services one can use to establish communication between individuals. Because of time and space limitations, we choose not to examine how the reader might use such services nor the outcomes of such usage. It is, however, a well known fact that currently, computer networks are used to teach courses [26] or conduct seminars [27]. We hope the reader is able to use the information to expand their knowledge about computer networks and to

find their own way to use them for educational purposes.

APPENDIX A

How does one get on a list? First, as previously stated, one must have e-mail capabilities and access to at least one computer network. Second, you must know what lists are available in the areas you are interested in. As provided by Marty Hoag of North Dakota State University (nu021172@vml.nodak.edu), there are several lists which can tell you what lists are available:

1) The "Internet Groups List of lists", is available from ftp.nisc.sri.com (192.33.33.33). The best way to obtain this list is via FTP. It can also be obtained via electronic mail. Send a message to "mail-server@nisc.sri.com" (quotes are not part of the address) with the following message:

```
Send netinfo/interest-groups
```

2) The LISTSERV global list database. Within the framework of BITNET are several LISTSERVs. If you sent your local LISTSERV the following command (where "somewhere" is a specific computer site)

```
SEND LISTSERV@somewhere  
"GET INDEX"
```

you would receive a list of all the lists served by that particular listserv. You can get a composite of all lists by sending the following mail message to LISTSERV@NDSUVM1 (internet users would use

```
LISTSERV@VM1.NODAK.EDU):  
LIST GLOBAL
```

(Note, this is a mail message with the command in the body of the message. Some listservs will accept interactive messages, some both mail and interactive messages, some only mail messages. Also, note that this command will only work with a backbone listserv. A backbone listserv is one located on a computer common to several network branches. If the listserv is a local one,

the LIST GLOBAL command will not work.)

3) There is also a list of groups available for those with access to USENET News or NETNEWS servers. Information about this group can be obtained through anonymous FTP with VM1.NODAK.EDU. This information is located in the "BITINFO" directory.

The above information will give you information about the existing discussion groups or lists. By subscribing to either NETMONTH or NEW-LIST, one can find out about newly created lists. To subscribe to NETMONTH, send the following command to LISTSERV@MARIST or LISTSERV@YALEVM:

```
*SUB NETMONTH yourfirstname
yourlastname*
```

Note, use your real first name and last name instead of your computer name. To subscribe to NEW-LIST, use the same sub command (replacing NETMONTH with NEW-LIST) and send the command to LISTSERV@VM1.NODAK.EDU (NDSUVM1 if on BITNET).

APPENDIX B

Table of addresses

The following represent a sampling of the computer discussion lists that the authors subscribe to (along with the listserv you would send the sub command to in order to subscribe):

CHESL-L (The Chess Discussion List),
LISTSERV@GREARN
CNEDUC-L (Computer Networking
Education Discussion List),
LISTSERV@TAMVM1.
CW-EMAIL (Campus-Wide Electronic Mail
Systems Discussion List),
LISTSERV@TECMTYVM.
DTS-L (Dead Teachers Society Discussion
List), LISTSERV@IUBVM.
Equestrian Digest, send subscription request
(in the form of a letter) to
horse-request@ccp.bhn.com.
ERL-L (Educational Research List),
LISTSERV@TCSVM.

HELP-NET (BITNET/CREN/INTERNET
Help Resource),
LISTSERV@TEMPLEVM.

KIDS-91 (KIDS-91 Project List),
LISTSERV@VM1.NODAK.EDU. (There
is another list, "KIDCAFE", set up where
children can communicate with each
other.)

NA-NET, send subscription request (in the
form of a letter) to

na.digest@na-net.ornl.gov.

NEW-LIST (NEW-LIST - New List
Announcements),
LISTSERV@NDSUVM1.

NSP-L (Noble Savage Philosophers mailing
list), LISTSERV@RPIECS.

PHILONCA (Philosophical Issues in Ontario,
Canada), LISTSERV@YORKVM1.

SEDS-L (Students for Exploration and
Development of Space),
LISTSERV@TAMVM1.

SEDSNEWS (Students for Exploration and
Development of Space),
LISTSERV@TAMVM1.

WP50-L (WordPerfect Corporation Products
Discussion List), LISTSERV@UBVM.

APPENDIX C

Accessing ftp files

Anonymous ftp is one way of transferring files from a common storage to one's own computer. To get the list of ftp sites from the computers at the University of Maryland, the following procedure is used (the \$ used in this example is the DCL prompt for the VAX/VMS system at UTPB):

```
$ ftp umd5.umd.edu
This computer will respond with
UMD5.UMD.EDU>
You type in user anonymous
The computer responds with Password:
guest is an acceptable password but it is
preferred that you leave you name.
The computer responds with
UMD5.UMD.EDU>
You type in cd /pub/netinfo
This will get you a listing of information
about networks. At the UMD5.UMD.EDU
prompt (UMD5.UMD.EDU>) you type get
ftp.sites. The computer will respond with (to
local file) and you type in the name you wish
to use on your machine.
```

To log off this computer, type exit or quit. You will then be returned to your home computer.

At the prompt, you can type dir or ls to get a list of various directories on file.

ENDNOTES

1. E-mail address
t_mitchell@utpb.pb.utexas.edu or
T_MITCHELL@UTPB
2. E-mail address
m_paprzycki@utpb.pb.utexas.edu or
M_PAPRZYCKI@UTPB
3. We have included a list of network based discussion lists that we authors belong to and from where much of our information was obtained. Instructions for accessing these lists are also included (see appendices A and B).
4. "Computer Networks for Learning", Alfred Bork, T.H.E. Journal, May, 1987.
5. See A Survey of Education Computer Networks, Thomas R. McAnge, Jr. and others, Virginia Polytechnic Institute, Blacksburg, VA 20461-0524, June, 1990 for a list of 49 statewide networks currently in existence or being developed and 46 public access networks and databases. Many of the networks listed contain a contact person and phone number.
6. Penny Johnson, johnson@wcvax1.
7. See Harvard Graduate School of Education Bulletin, Fall, 1990, for a discussion of this network. Additional information provided by Chris Clark, gcc1@psuvm.
8. David Basham, basham@navax.
9. Michael Halla, Electronic School District Project, University Computing Services, Indiana University, Bloomington, IN 47405, mhalla@insteps.
10. There is a large number of computers worldwide that allow an individual to use this process. To find the list of such computers, one needs to access via ftp the address umd5.umd.edu. The procedure for doing this is given in Appendix C.
11. "Liberation Technology: Equal Access Via Computer Communications", Norman Coombs, Instructional Computing Update, Vol. 2 no. 2., December 1990, pp 2 - 4.
12. A general discussion of these formats may be found in a file entitled BITNET USERHELP, available from any listserv (which we will discuss later in this paper).
13. We need to make two points.
 - a. First, it is important to distinguish between a computer network being a set of computers connected to each other by some kind of hardware connections -- telephone lines or dedicated lines; and BITNET (INTERNET) networks meaning a set of computers that communicate with each other through BITNET (INTERNET) software and for which the hardware considerations are not important.
 - b. Second, if the reader is interested in more information about the INTERNET network, it is suggested that you obtain a copy of "The Hitchhikers Guide to the Internet" by Ed Krol (krol@uuc.cs.uiuc.edu). This is available from several ftp sources, among them umd5.umd.edu. Go to the /pub/netinfo directory and get hitch.hike.
14. As a matter of etiquette, if you wanted to communicate with one specific individual in the group, you would write to that individual directly; it would be rather embarrassing to send a poignant love letter to the individual through the discussion address as every member of the group would receive the letter, not just the individual for whom it was intended.
15. It should be noted that the owner does not necessarily have to be at the computer site where the list is kept, though that is normally the case.

16. It is also worth mentioning that some systems would not accept such a large mailing and, would in effect, refuse to send it.
17. For the discussion of educationally oriented, BITNET based listers see: Pierce, J.W., Glass, G.V., Byers, J.L., Computer Networking for Educational Researchers on BITNET, Educational Researcher, Vol. 20 (1), 1991, pp 21-23.
18. The Noble Savage Philosophers List (NSP-L) is an example of an unrestricted, unmoderated list. If the discussion starts to be "to hot," the owner of this list (Barry Floyd) steps in and tries to resolve the issue.
19. Nollag MacKenzie, Setting Up an Electronic Philosophy Bulletin Board: The Listserv Way, APA Newsletter, July 1990.
20. psych@fnhutc
21. Other lists where the discussion is moderated by the list owner are NANET, a numerical analysis discussion group, and Equestrian Digest, a discussion list directed towards horse owners.
22. Jean Vorhaben, jev@ricevm1.rice.edu (note, this is an internet address rather than a bitnet address).
23. pmc@ncsuvm
24. ejournal@albnyvm.s.bitnet or ejournal@rachel.albany.edu
25. ucboxu.ucsb.edu or 128.111.122.50
26. The address for the course is spacetim@uwf. If you wish to audit the course, contact st-audit@uwf.
27. There are currently two seminars that we are aware of being conducted through the networks or planned for the networks. The first is a seminar on the topic of supervenience being organized and conducted by Al Essa (ESSA@YALEVM). The second is EduTel: A Forum for Considering CMC (computer-mediated communication)

Applications in Educational Contexts. This is being organized by Norman Coombs and can be joined by sending an interactive message or e-mail message to COMSERV@RPIECS with the Subscribe EduTelFirst_nameLast_name as the body of the text.