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COMPUTER NETWORKS AND NETWORKING: A PRIMER

Mauri P. Collins, MA, Pennsylvania State University

"It would be nice," I thought, "If I could just understand what they are saying!" The earnest young person at our academic computer services helpdesk had, from the tone of her voice, answered my question. And I heard all the words, but it sounded almost like a foreign language. I had recently bought a modem for my home computer and had been told that a whole new world would be opening up to me--but it was turning out to be a world with a baffling language that didn't make very much sense to me.

I was asking the consultant what I thought was a relatively simple question. I needed just enough information to get my computer at home connected to my account on the university's mainframe computer. And that was all I needed to know right then. I was looking for an answer in terms of "Put this disk in your drive, (or load this program on your hard-drive) and type this..." But they insisted on explaining to me far more than I could possibly understand. I was bewildered by the complexity of their information and quite lost in their language. They seemed to be assuming that, because I was asking the question, I could understand their answer.

And I wondered how many of our readers had the same problems with the technical terminology, and the acronyms that it seems almost impossible to avoid. I have progressed in my understanding since I started and thought to share, in simple terms, some of the basics I have learned about networks and networking.

A MODEM

A modem is piece of equipment that turns characters into sound and back again, so that I can send messages that I have typed, or am typing, out over a phone line to communicate with other computers and other computer users. My modem processes information at 2400 bits per second. (A "bit" (binary digit) is the smallest piece of information that can be processed and is actually an on or off electrical pulse. It takes a series of these bits to represent a single character.) This is fast enough for my needs, although the computer I use at work has a hard-wired connection (a direct line from the back of my computer to the mainframe computer) that transmits information back and forth at 9600 baud (four times faster than at home).

NETWORKS AND NETWORKING

Of all the terms a new user of computer-mediated communication has to deal with, "network" may be one of the most confusing. One use of the word refers to the permanent, physical connections between and among computers: the wires, fiber optic cables, microwave links, phone lines etc. that connect computers together, and allow their users to communicate with one another.

Another, more general use of the word refers to all those computers, while not physically linked together, that circulate messages with a particular set of headers (like Usenet NetNews articles). This kind of network can be referred to as a "virtual network". This means that the computers carrying the messages may not be permanently linked together in a network that physically exists, but are made by software to appear so (like "virtual" reality and "virtual" memory). It is in this sense that many people use the word "network".

The permanently connected networks comes in all sizes from local area networks (LANs) of 2 or 3 machines linked together in a single room to international, composite wide-area networks (WANs) that span the globe and include satellites and microwave transmission to move the information. The physical set up of networks can be likened to a variegated patchwork of independent telephone companies serving their own areas and yet linked together so that they can exchange the virtual equivalent of long-distance phone calls between distant locations.

THE INTERNET

The very first wide-area computer network in the United States was known as the ARPANET and linked research universities and military installations together so researchers could communicate with one another and expensive resources (like computers and databases) could be shared. Over the years this initial network was joined by an ever increasing number of

regional and local networks. The Internet is made up of over 10,000 of these individual networks connecting over 20 million users worldwide.

TCP/IP

With as many different kinds of computers and operating systems and software that are in use, it has taken a great deal of cooperation to come up with a common language and set of standards that could be used to exchange information. One of the most commonly used standards is TCP/IP (Transmission Control Protocol/Internet Protocol). "Protocols" are specific sets of instructions followed by computers for the transmission of data among them. THE TCP/IP protocols also provide several useful services to users, including FTP and TELNET.

Physical networks of permanently connected computers like BITnet (Because It's Time Network), which use another set of protocols, are connected to the Internet by "gateways" (computers that translate alternative protocol languages into something TCP/IP can understand, and they do it in a way that is transparent to the user).

TRANSMISSION LINES - T3

The backbone of the Internet network in the United States is made up of what AT&T calls their "T3" communications lines. These are high speed data transmission lines permanently connecting the major routing computers in the network. These T3 lines can be considered as the super highways of data transmission. They have recently been upgraded from T1s which carried 1.544 megabits (million bits of information) a second to the T3s, carrying 44.736 megabits a second. This has significantly increased the available "bandwidth", which translates to the number and complexity of messages that can be carried simultaneously. Initially all messages transmitted were just text: characters and words. Now data sent over these lines encodes everything from plain text to interactive, two-way audio/visual teleconferencing.

IP NUMBERS

Each computer, large or small, which can connect to any of the national networks has its own address or IP (Internet Protocol) number. Each site with a national network connection is given a specific range of numbers that it can use for its internal machine addresses. The numbers are in the format of 123.456.789.123 with the last one or two sets of numbers pointing to a specific machine, perhaps on a faculty person's desk, or in a public computer lab. This is done so that mail and other traffic can be routed correctly, and machines can be identified when their user logs into other computers. We rarely use the IP numbers in addressing mail or anything else, usually preferring to use machine names in our addresses. I use a SUN SparcStation with the friendly name of Wilbur, but who is known to the network as 128.118.058.011. "Nameservers" are computers that hold the lists that match the IP numbers to computer names and locations and make these translations transparent to the user.

MOVING TRAFFIC

When messages and files are passed through permanently connected networks of computers like BITnet, the message "hops" from one computer to another which "store and forward" messages in a linear fashion, rather like a bus that stops at every bus stop on its route. If a machine is temporarily off-line (broken in some way, or being fixed or upgraded) then the messages just sit patiently until the way is open again. Despite the fact that electronic communication can move at the speed of light, I have sometimes had messages take 16 hours to get from Virginia to Nevada, and 4 hours from Washington, DC to Pennsylvania, and yet at other times transmission appears to be instantaneous.

Some sites have Internet connections, some have BITnet connections, some have both and some have neither. But there are an increasing number of "gateways" from one to another and to the commercial service providers. Some sites have leased telephone lines that tie them to the nearest major switching center. The lines are always open and available for traffic and their cost is usually shared by the connected institution and various governmental organizations.

FIDONET

Some sites run software that dials the nearest switching center during the early morning hours, collects all the files and mail that are waiting and delivers all the mail that it had collected during the day. That one phone call may be the only connection with the outside, networked world. "Fido" is one example of this kind of software. "Fidonet" is the collective name for the over five thousand computers owned by amateur computer hobbyists throughout the world that use the Fido software. Each computer is again assigned its own specific address so that messages can be routed to the correct place. The existence of Fidonet is not dependent upon universities or government funding. There are no permanent, fixed connections between these computers; all traffic goes over ordinary phone lines and the cost is usually paid out of the individual system owner's pocket. It doesn't matter where you are in the world, there is probably a Fidonet node within easy dialing distance. Fidonet provides person-to-person electronic mail, file sharing, and hosts a large number of discussion groups/conferences called "Echomail".

A brief introduction to Fidonet can be found at

FTP: lilac.berkeley.edu

File: /help/cat/mail/net/fidonet

and read on to find out how to get that file!

FILE TRANSFER PROTOCOL AND ANONYMOUS FTP

As I mentioned above, the TCP/IP protocols provide users with FTP (File Transfer Protocol). This service is most often encountered in the phrase 'anonymous FTP'. Many sites world- wide have

set aside disk space on their computers to archive (store) files and computer software and by using 'anonymous FTP' these files can be retrieved almost as easily as if they were on a local machine. You don't have to have an account at an archive site nor do you don't have to pay for them, but you do have to have FTP capability from your site (check with your local computer gurus to find out if you have). Computer usage at most sites is heaviest during the daytime, so please be polite and FTP your files in the evening, night or early morning hours.

There are lists of 'anonymous FTP sites' which give some indication of the kinds of files they have stored. To retrieve the file via anonymous FTP:

```
FTP: pilot.njin.net
```

```
File: pub/ftp-list/ftp.list
```

That is the kind of cryptic instructions that just did not translate into anything I could use...let's take it slowly:

To retrieve such a list, at your system prompt type "FTP pilot.njin.net". (Only don't type the "", they are just there to make the things you have to type easier to see in this text.) And case-sensitivity is important (unix machines need you to type "ftp pilot.njin.net"). Another important reminder is that file names are case sensitive. You have to ask for files by exactly the same name as they have in the directory listing. If it says "ftp.list" or "KERMIT.help" or "Kermit.HELP", that is what you must type.

Once you are connected it will ask for your name. You type in "anonymous" and you have to spell it out and spell it correctly! The machine will then tell you that "Guest login ok, send e-mail address as password". Here you type in your full e-mail address. This is often difficult, because what you type for a password does not show on the screen. If you get it wrong, the machine will chide you, but usually lets you in anyway. And leaves you sitting staring at:

```
Guest login ok, some restrictions apply
```

```
ftp>
```

The file you are looking for is called pub/ftp-list/ftp.list. This means that the file is called "ftp.list" and is in a directory called "ftp-list" which is in a directory called "pub". If you type "ls" at the first ftp> prompt you will see a list of names. The top one is "pub", the directory you are looking for. Typing "cd pub" at the ftp> will get you into the public directory (it tells you that you have changed directories) and leave you staring at another ftp>. Typing "ls" again will give you another list of names, with "ftp- list" about halfway down. Type "cd ftp-list" to get into that directory, and to another ftp>. You can type "ls" again and a list of filenames about fills your screen. About the middle of the screen is a file called "ftp.list".

To bring a copy of the file home, type "get ftp.list" and the archive machine will send a copy of the file to your machine. You can, of course, type "cd pub/ftp-list/" at the first ftp> to go right to that directory, but it is often interesting and productive to browse on your way to the file you are looking for. And if you type "dir" instead of "ls" you will get a directory listing that shows you how big the files are, and when they were last updated. To get back to your own machine again, when the archive machine tells you it has successfully delivered your copy to you, type "bye" at the ftp>. That usually works, but sometimes it needs to be "quit" or "exit". Just try until you hit the right one.

Different kinds of files are stored in different kinds of formats. Text files are often stored in ascii (American Standard Code for Information Interchange) and require no special instructions to the machine before you ask that it be sent to you. Some text files have special formatting so they can be printed from a laser printer. They are perhaps labeled something like "<filename>.ps" indicating they are Postscript files. Those you would want to get just exactly as they are (as you would a computer program, too) so you have to do one more step before you ask the machine for the file. Because you want the file exactly the way it is stored with no changes at all, you need to type "bin" or "binary" at the ftp>, before you say "get <filename>". If there is any question about what kind of file you are dealing with, use binary transfer (the file comes in machine language - the equivalent of ones and zeros - makes no sense to you, but the computers can understand them perfectly).

In order to save space on archive sites, files are often compressed in a number of different ways. The programs needed to uncompress them are usually stored at the same site, or your local computer guru could help you. If files have any of the following after their names, it is a clue they have been compressed: .tar; .tar.Z; .tar.uu; .hqx; .sit; .zip; .arc; .Z. Use binary transfer for these kinds of files.

A brief description of FTP is available from:

FTP: nic.sura.net

File: /pub/nic/network.service.guides/how.to.FTP.guide

If your site does not have an internet connection, BitFTP is a mail interface that allows BITnet/NetNorth/EARN users to FTP files from sites on the Internet. Most of the Internet FTP commands can be used with BitFTP except the commands are sent in a mail message, instead of interactively. This service tends to be slow and your requested files may take hours or days to reach you, so be patient. To get a brief guide to BitFTP, send a message in the following form:

To: BITFTP@PUCC (or BITFTP@PUCC.Princeton.edu)

HELP

This service is also available at no charge from Digital Electronics Corporation's western regional mainframes. You can receive information by sending a message in the following form:

To: FTPmail@decwrl.dec.com

help

TELNET

TELNET is another basic TCP/IP service that allows an interactive connection with another machine. TELNET is both a protocol (TCP/IP remote login protocol) and a program. TELNET is used for two major purposes: to remotely login to a machine that you have access to (i.e. a userid and a password) so you can use it as if you were actually at that site; and to remotely login to public access catalogues and databases.

I use TELNET to log into my accounts in Nevada and Washington, D.C. from my computer account here at Penn State. When I am travelling (with laptop computer in hand), I usually arrange for login access at a local system so I can then TELNET back to my home machine and keep up with my mail. How? You find the e-mail address of a university or college nearest to where you are going to be and send an email message to postmaster@<that sitename>. You ask, very politely, for a guest account that you can use temporarily. Sometimes you get one, sometimes you are given the access information to get to a point in their system so you can TELNET out, sometimes you are invited to come to their public computer labs and sometimes they just say "No". It all depends on the administrative rules of the particular system. Getting a guest account may be a mixed blessing, because the kind of computer in use at the site may not be the one you are used to.

When I am working online, I no longer reach over to the shelf for my venerable and battered dictionary. I TELNET to hangout.rutgers.edu, and following their menus through Library and Reference and Dictionary, find the Short Oxford Dictionary (8th edition, 1991) that they have made available online there. Check them out, they have a lot of useful reference materials, and a helpful set of easy to use menus. A tip: when you have finished looking up your words hit the return once at the "Word(? for help):" prompt. That will take you back to a menu screen. From there typing "quit" gets you back to the main menu, and typing "quit" again returns you to your own system.

Some of the remote sites you can telnet to, like library catalogs and computers holding public access databases, need a login name but it is usually published with information about the service. These login names are case-sensitive, so type they exactly as they are listed. There are two documents listed at the end of this article that give the electronic addresses from which

you can retrieve lists of libraries, worldwide, who have made their catalogs available for searching online.

A brief description of TELNET is available from:

FTP: nic.sura.net

File: /pub/nic/network.service.guides/how.to.TELNET.guide

ELECTRONIC MAIL

And as soon as I had my modem set up, I immediately used it to become an emailer i.e. to send and receive electronic mail (email). In my own case, I used my modem to reach my account on one of Penn State's computers. However, I could have just as easily (but for a fee) used my modem to dial the local access number for any one of a number of commercial computer communication service providers, like CompuServe, America Online or Prodigy. Electronic mail is referred to as "asynchronous" messaging because both parties do not have to be in contact at the same time in order to communicate.

The first thing you have to know when you want to send email to someone is their address, and always the easiest way to determine that is to ask the person you want to send mail to. Electronic mail addresses look very different from ordinary post office addresses (called "snail mail" by email users). How an address looks depends on what network the computer that their account is on is connected to. I have accounts on machines that access two different networks, the Internet and BITnet.

To send mail to my home address you need to know:

my name mauri collins

my house number and street Calder Square, P.O. Box 10002

my city State College

my state and zip PA 16805-0002

To send electronic mail to my Internet address you need to know:

a login name (or userid)	mmc7	fay
a machine	@psuvm	@archsci.arch
a location	.psu	.su
a domain	.edu	.edu
a country code (outside US)		.au

ie: mmc7@psuvm.psu.edu or fay@archsci.arch.su.edu.au (Fay is in the architecture department at the University of Sydney, Australia)

Remember the periods or `dots' between the different parts of the address my address reads out loud as "mmc7 at psuvm dot psu dot edu"). Computers are confused by blank spaces in email addresses so you will see the underscore or hyphen sometimes used as a spacer as in mauri_collins@machine.location.domain.

Some addresses from other networks require an exclamation point (!, called a "bang") between the parts of the address as in psu!psuvm!mmc7 You just have to remember to copy addresses carefully, or use the `reply' feature on the mail program on your computer. It can generally be relied upon to take the correct information from the "header" on the mail you have received, but it is always an excellent idea to check.

Different Internet address domains you may see are .com for business or industry, .mil for military address, .gov for governmental addresses, .org for non-profit organizations, and .edu for educational organizations. Addresses outside of the United States often require a country designation. While Internet email addresses generally go from the most specific to the most general, mail going to the United Kingdom, and onto their Jnet network needs to have the address turned around. If I were in the United Kingdom my address might look like mauri@UK.edu.psu.wilbur

On BITnet, each computer has its own distinct name, which may or not be the same as its Internet name. My BITnet address is now MMC7@PSUVM. However, when I was at another site, my Internet address was collins@helios.nevada.edu or just collins@nevada.edu, but my BITnet address was COLLINS@NEVADA3. When sending mail from a computer that does not have a direct connection to BITnet, it is usually necessary to add additional routing information to the address as in: COLLINS@NEVADA3.BITNET.

DISCUSSION GROUPS

One of the more popular uses of networks, after the exchange of electronic mail between individuals, is to join and read the incredible variety of discussion lists or groups and news groups that are available. Discussion groups come in many forms. Some are like the bulletin boards in the local grocery stores. Messages are posted and left for people to read and comment on; some groups focus around particular topics, others are strictly for announcements; while others read like the transcript of a cocktail party.

Discussion groups have been likened to newspapers or talk radio. Many people read or listen or, to use the networker's term "lurk", and a relatively small number of people contribute. However, readership in a discussion group can bring people together from all over the world, who might never have a chance to meet and talk; it fosters the exchange of ideas and information, and engenders a sense of co-operation and friendship.

LISTSERV

Many of these discussion groups are handled by a program called LISTSERV, written by Eric Thomas, that runs on IBM mainframe computers. The groups are often called discussion lists, because essentially what the LISTSERV software deals with is a subscription list of electronic mail addresses. When a message is received LISTSERV, depending on the instructions it has been given, will forward it to the moderator/listowner, or, if the list is unmoderated, copies the incoming message to each of the addresses on its subscription list.

If the list is moderated then the moderator will check the message against whatever formal or informal criteria exist that govern what goes to the list's readership and either send the message on, edit it, or return it to the sender. Most moderator's see their primary role as `controlling the signal- to-noise ratio'. This involves making sure that the discussion is kept within the limits set forth in the group's charter, and that discussion is conducted in a civil manner.

To join a discussion group, send mail to the LISTSERV at the address given for the discussion group (e.g. LISTSERV@...) with a single line in the body of the message, e.g.

```
TO:LISTSERV@guvm
```

```
-----
```

```
SUBSCRIBE IPCT-L YOURFIRSTNAME YOURLASTNAME
```

You need to substitute your own name as in: subscribe ipct-l mauri collins

A complete listing of the over 4000 LISTSERV groups can be obtained using anonymous FTP from

```
FTP: FTP.nisc.sri.com
```

```
File: /netinfo/interest-groups.
```

Beware before you get it, the file is HUGE (over a megabyte).

A list of discussion groups in the humanities (over 800 of them) is maintained by Diane Kovacs. The full list is available as are grouped subsets of the whole list. Information on the available files is available by anonymous FTP from

```
FTP: ksuvxa.kent.edu
```

```
File: library/acadlist.readme.
```

One unfortunate and often unpleasant aspect of discussion and NetNews groups is the occurrence of "flaming". With no available indication of tone or mood (except for the ubiquitous smilies :-) (tip head to left shoulder to see the grin) it is very easy for misunderstandings to arise and to escalate with alarming rapidity. Free from the sanction of others' immediate presence (and the fear of a pop on the nose for running off at the mouth), there are those who tend to run off at the finger tips and whose language becomes hostile, vulgar and profane. And then there are those who chose to communicate in that tone all the time. If a reasoned attempt to clear up the misunderstanding is unsuccessful, a gracious exit from the communication situation is often the best remedy, as censure or argument often seems to exacerbate the problem.

USENET/NetNews

Usenet can be defined as computers that exchange messages with Usenet headers. It no longer refers to the physical network of UNIX-using computers that it started as. Much of the Usenet traffic is carried over the same computers that also handle BITnet and/or Internet traffic. There are currently over 2000 different usenet newsgroups. The usenet groups are divided into a number of major streams e.g. alt (alternative) comp (computer) soc (social) rec (recreation) etc. There is no central authority for usenet groups, although protocols have grown up that govern the creation of new groups. No matter what your interest you can probably find a Usenet group that discusses it; if not, you can gather some like-minded correspondents and start one. Some newsgroups are of local interest, like psu.jobs that advertises employment available on Penn States' campus to soc.women which is carried world-wide.

A complete list of NetNews groups is available via anonymous FTP from:

FTP: [rtfm.mit.edu](ftp://rtfm.mit.edu)

Files: [List_of_Active_Newsgroups,_Part_I](#)

[List_of_Active_Newsgroups,_Part_II](#)

[Alternative_Newsgroup_Hierarchies,_Part_I](#)

[Alternative_Newsgroup_Hierarchies,_Part_II](#)

DIFFERENCES BETWEEN LISTSERV AND NetNews

There are some significant differences between Usenet NetNews and the LISTSERV discussion groups residing on BITnet and the Internet, most of which show up from the computer user's perspective. A user subscribes as an individual to LISTSERV and similar discussion groups and the messages that LISTSERV forwards are received in their personal mailbox.

In order to read the NetNews newsgroups one's site has to receive some part of the "feed", the stream of NetNews messages which can be measured in tens of megabytes each day. This is stored at a central location on the site's mainframe and accessed by some kind of reader software. Sometimes NetNews messages are available on campus through the same system that handles on-campus discussion groups. Messages are held for whatever period of time the site administrators decide is appropriate and this is often dictated the amount of storage space available. A site may receive some, all or none of the newsgroups.

The first word in the name of the newsgroup is kind of a 'family' name, to indicate which of the main divisions the group belongs to: comp.misc is a computer-related group, soc.women is from the social science grouping, rec. deals with recreational topics, talk. indicates discussion groups, bit.LISTSERV indicates groups that are mirrors of BITnet/Internet LISTSERV groups.

GUIDES TO MORE INFORMATION

Always the very first source of information on anything that pertains to access to the computers at your site, how they are set up, what programs are installed and how to run them, is your very own site computer gurus. They are most knowledgeable about the idiosyncracies of their equipment and programs and can provide you with instruction, written guides, access to training classes etc. Often your own site will have an FTP server set up, or a public directory from which information, files, and programs can be downloaded (copied from the mainframe to your personal computer).

There are a host of extraordinarily good guides to the use of computer mediated communication, and lists of such guides. One comprehensive beginner's guide is the work of John December at Rensselaer Polytechnic Institute and is available via anonymous FTP from

FTP: ftp.rpi.edu

File: pub/communications/internet-cmc.

Another is Scott Yanoff's "Internet Sources Guide", This is updated bi-weekly and is posted to the NetNews group alt.internet.services, or is available by anonymous FTP from

FTP: csd44.csd.uwm.edu

File: pub/internet.services.txt.

I have been thoroughly enjoying my wanderings around in the networks, and have found a wealth of knowledge and a host of friends. But I will warn you--it can become a time-sink— with all your spare moments disappearing off into cyberspace.

Biographical note:

Ms Collins is pursuing a Ph.D in Instructional Systems at Penn State, after having earned both BA and MA in Sociology at the University of Nevada, Las Vegas. She is currently a research assistant in the Center for the Study of Higher Education working on a national study of the use of instructional technologies in higher education, funded by the Corporation for Public Broadcasting.

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