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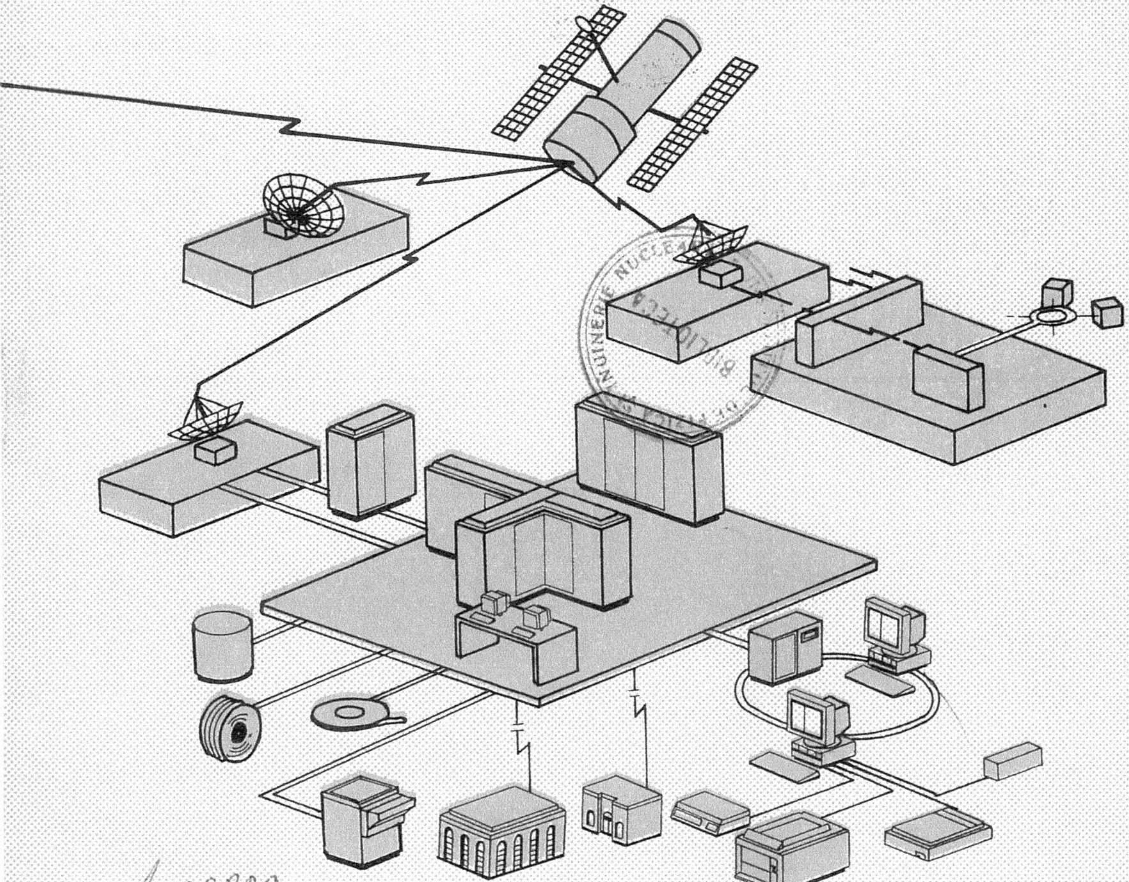
SUPLIMENT



EDITORIAL

Ultimii ani au marcat o extindere extraordinara a retelelor informationale academice, universitare, meteorologice, seismologice, industriale si comerciale, acestea devenind un lucru obisnuit in toate tarile Europei de vest si Americii de nord de la transmisie de videotext la posibilitatea accesarii marilor baze de date si transfer multi media de fisiere. Progresul tehnologic in comunicatii ca si cererea de piata crescanda au condus la realizarea unor legaturi rapide de 2 Mbs si mai mult. Reteaua europeana stiintifica leaga peste 350.000 de calculatoare cu doua milioane de utilizatori. Desi legaturile transnationale sunt in majoritate realizate pe 64 kbs, exista conditiile tehnice pentru trecerea la o structura paneuropeana in domeniul Mbs in urmatorii ani. La nivel national infrastructura este asigurata de oficiile postale (PTT) cu inchirierea liniilor respective diverselor categorii de utilizatori.

Situatia economica a tarilor Europei de est ca si infrastructura existenta, greoaie si depasita tehnologic incetinesc mult largirea zonei in tarile fostului bloc comunist. Chiar printre aceste tari Romania are un decalaj semnificativ fiind necesare eforturi financiare mari atat la nivel national cat si local. Prioritar, in momentul actual, este gandirea unei strategii informationale realiste care in contextul mondial si a conditiilor economice, sa fixeze jaloanele pasilor urmatori si fazele concrete. Este o actiune la care invitam sa participe pe oricine care are ceva de spus si facut.

Conjunctura internationala este favorabila colaborarii largi in domeniul informaticii si parte din dificultatile economice pot fi rezolvate cu ajutor extern. Societatea Europeana de Fizica a sprijinit material si logistic extinderea retelei informationale spre est si cateva tari au stiut sa foloseasca cu mult succes acest sprijin.

In dorinta de a informa cititorii nostri asupra stadiului actual al retelelor academice si de cercetare, reproducem textul difuzat de E.W.Lingeman*) in 1994 tuturor societatilor nationale de fizica. Pentru o minima prelucrare editoriala textul se prezinta in limba engleza.

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EUROPEAN PHYSICAL SOCIETY

Electronic Communications Working Group

The Internet

E.W.A. Lingeman

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Contents

1 The Internet

The Internet was born about 20 years ago (1968), out of an effort to connect together the US Defense Department network called the ARPAnet[1] and various other radio and satellite networks. The ARPAnet[1] was an experimental network designed to support military research – in particular, research about how to build networks that would withstand partial outages (like bomb attacks) and still function. In the ARPAnet model, communication always occurs between a source and a destination computer. The network itself is assumed to be unreliable; any portion of the network could disappear at any moment. It was designed to require the minimum of information from the computer clients. To send a message on the network, a computer simply had to put its data in an envelope, called the Internet Protocol (IP) packet and address the packets correctly. The communicating computers – not the network itself – were also given the responsibility for ensuring that the communication was accomplished. The philosophy was that every computer on the network could talk, as a peer, with any other computer.

With these assumptions, the US was able to develop a working network – the ancestor of the current Internet – and the academic and research users who had access to it were soon addicted. Demand for the networking quickly spread. Although the Organization for International Standardization (ISO) was spending years designing the ultimate standard for computer networking, people could not wait. Internet developers in the US, UK and Scandinavia, responding to market pressures, began to put their IP software on every conceivable type of computer. It became the only practical method for computers from different manufacturers to communicate. This was attractive to the governments and universities, which did not have policies saying that all computers must be bought from the same vendor. Everyone bought whichever computer they liked and expected the computers to work together over the network.

At about the same time as the Internet was coming into being, Ethernet local area networks (LANs)[2] were developed. LAN technology matured quietly until roughly 1983, when desktop workstations became available and local networking exploded. Most of these workstations came with Berkeley UNIX[3], which included IP networking software. This created a new demand: rather than connecting to a single large timesharing computer per site, organizations wanted to connect their entire local network to the ARPAnet. This would allow all the computers on that LAN to access ARPAnet facilities. At about the same time, many companies and other organizations started building private networks using the same communications protocols as the ARPAnet: namely IP and its relatives. It became obvious that if these networks could talk together, users on one network could communicate with those on another; everyone would benefit.

One of the most important of these newer networks was the NSFnet, commissioned by the National Science Foundation (NSF). In (1984) the NSF created five supercomputer centers at major universities.

[1]ARPAnet, Advanced Research Projects Agency network, United States)

o John van Neumann Supercomputer Center (JVNC) at Princeton University;
o San Diego Supercomputer Center (SDSC) on the campus of the University of California at San Diego (UCSD);
o National Center for Supercomputer Applications (NCSA) at the University of Illinois;
o Theory Center, a production and experimental supercomputer center at Cornell University (Cornell);
o Pittsburg Supercomputing Center (PSC) located in Pittsburg and managed by Carnegie-Mellon University (CMU), Westinghouse and the University of Pittsburg.

Up to this point, the world fastest computers had only been available to weapons developers and a few researchers from very large corporations. By creating supercomputer centers, the NSF was making these resources available for any scholarly research. Only five centers were created because they were so expensive - they had to be shared. This created a communications problem: they needed a way to connect their centers together and to allow the clients of these centers to access them. At first, the NSF tried to use the ARPAnet for communications, but this strategy failed because of bureaucratic and staffing problems.

In response, the NSF decided to built its own network, based on the ARPAnet's IP technology. It connected the centers with 56 000 bit per second telephone lines. It was obvious, however, that if they tried to connect every university directly to a supercomputing center, they would go broke. One pays for these telephone lines by the mile. One line per campus with a supercomputing center at the hub, like spokes on a bike wheel, adds up to many miles of phone lines. Therefore, they decided to create regional networks. In each area of the country, schools would be connected to their nearest neighbour. Each chain was connected to a supercomputer center at one point, and the centers were connected together. With this configuration, any computer could eventually communicate with any other by forwarding the conversation through its neighbours.

This solution was successful - and, like any successful solution, a time came when it no longer worked. Sharing supercomputers also allowed the connected sites to share a lot of other things not related to the centers. Suddenly these schools had a world of data and collaborators at their fingertips. The network traffic increased until, eventually, the computers controlling the network, and the telephone lines connecting them, were overloaded. In 1987, a contract to manage and upgrade the network was awarded to Merit Network Inc.[4], which ran Michigan's educational network, in partnership with IBM and MCI. The old network was upgraded with faster telephone lines (by a factor of 20) and faster computers.

The most important aspect of the NSF's networking effort is that it allowed everyone to access the network. Up to that point, Internet access had been available only to researchers in computer science, government employees, and goverment contractors. The NSF promoted universal education access by funding campus connections only if the campus had a plan to spread the access around. So everyone attending a four-year college could become an Internet user.

Internet comprises all the networks, using the IP protocol, which cooperate to form a seamless network for their collective users. Some non-IP networks, however, saw that the Internet was good and wanted to provide its services to their own clientele. So methods were developed of connecting these *strange* networks (e.g., BITNET[2], DECnets[3], etc) to the Internet. At first these connections, called *gateways*, merely served to transfer electronic mail between the two networks. Some, however, have grown to translate other services between the networks as well.

The Internet has no governing body. The ultimate authority for where Internet is going rest with the Internet Society, or ISOC. ISOC is a voluntary membership organization whose purpose is to promote global information exchange through Internet technology. It appoints a council of elders, which has responsibility for the technical management and direction of Internet.

[2]Because It's Time NETwork, is a cooperative network serving more than 2300 hosts at several hundred sites in 32 countries

[3]Digital Equipment Corporation

The council of elders is a group of invited volunteers called the *Internet Architecture Board*, or the IAB. The IAB meets regularly to *bless* standards and allocate resources, such as addresses. The Internet works because there are standard ways for computers and software applications to talk to each other. This allows computers from different vendors to communicate without problems. It is not an IBM-only or SUN-only or Macintosh-only network. The IAB is responsible for these standards; it decides when a standard is necessary and what it should be. When a standard is required, it considers the problem, adopts a standard, and announces it via the network. The IAB also keeps track of various numbers (and other things) that must remain unique. for example, each computer on Internet has a unique 32-bit address; no other computer has the same address. IAB does not assign addresses, but it makes the rules about how to assign addresses.

Internet users can express their opinions through meetings of the Internet Engineering Task Force (IETF). The IETF is another volunteer organization; it meets regularly to discuss operational and near-term technical problems of the Internet. When it considers a problem important enough to merit concern, the IETF set up a *working group* for further investigation. Anyone can attend IETF meetings and be on working groups; the important thing is that they work. Working groups have many different functions, ranging from producing documentation, to deciding how networks should cooperate when problems occur, to changing the meaning of bits in some kind of packet. A working group usually produces a report. Depending on the kind of recommendation, it could just be documentation that is made available to anyone wanting it, it could be accepted voluntarily as a good idea which people follow, or it could be sent to the IAB to be declared a standard. If a network accepts the ways of working of Internet, is connected to it, and considers itself part of it, then it is part of Internet. If it will find things it does not like and can address those concerns through the IETF. Some concerns may be considered valid, and the Internet may change accordingly.

1.1 The Internet Protocol (IP)

The different pieces of Internet are connected by a set of computers called *routers*, which connect networks together. The networks are sometimes Ethernets, sometimes token rings and sometimes telephone lines. The routers make decisions about how to route data (*packets*). Each router does not have a connection to every other one. The data are sent from one router to another till it reaches the destination. Each router only needs to know what connections are available and what is the best *next hop* to get a packet closer to its destination. Thus in Internet the router looks at where the data are going and decides where to send it next. It decides which pipe is the best and uses it.

There are rules that govern how the Internet operates. The rules are called *protocols*. The Internet Protocol (IP) takes care of addressing, or making sure that the routers know what to do with the data when it arrives. Some addressing information goes at the beginning of the message to be sent; this information gives the network enough information to deliver the *packet* of data. Internet addresses consist of four numbers, each less than 256. When written out, the numbers are separated by periods, like:

`192.128.37.6`

Since Internet is a network of networks, the beginning of the address tells the Internet routers what network one is part of. The right end of the address tells the network which computer or *host* should receive the packet. Every computer on the Internet has a unique address under this scheme.

For a lot of practical reasons information sent across IP networks is broken up into bite-sized pieces, called *packets*. The information within a packet is usually between one and about 1500 characters long. This prevents any one user of the network from monopolizing the network, allowing everyone to get a fair shot. It also means that when the network is overloaded, its behaviour gets slightly worse for all its users: it does not stop dead while a few heavy users monopolize it.

One of the amazing things about the Internet is that, on a basic level, IP is all you need to participate. It would not be very friendly, but you could get work done if you are clever enough.

As long as the data are put in an IP envelope, the network has all the information it needs to get the packet from your computer to its destination. Now there are several problems:

- Most information transfers are longer than 1500 characters.
- Things can go wrong. Networks sometimes lose packets, or damage them in transit.
- Packets may arrive out of sequence. There is no guarantee that two packets will take the same route, so the second can arrive first.

So the next layer of the network will give a way to transfer bigger chunks of information and will take care of the many distortions that can creep in because of the network.

1.2 The Transmission Control Protocol (TCP)

TCP is the protocol, frequently mentioned in the same breath as IP (TCP/IP), that is used to get around these problems. TCP takes the information, one wants to transmit and breaks it into pieces. It numbers each piece so receipt can be verified and the data can be put back in the proper order. In order to pass this sequence across the network, it has an envelope of its own which has the information it requires *written on it.* A piece of the data is placed in a TCP envelope. The TCP envelope is, in turn, placed inside an IP envelope and given to the network. Once one has something in an IP envelope, the network can carry it.

On the receiving side, a TCP software package collects the envelopes, extracts the data, and puts it in the proper order. If some envelopes are missing, it asks the sender to retransmit them. Once it has all the information in the proper order, it passes the data to whatever application program is using its services. In the real world not only do packets get lost, they also can be changed by glitches on telephone lines in transit. TCP also handles this problem. As it puts the data into an envelope, it calculates something called a *checksum*. A checksum is a number that allows the receiving TCP to detect errors in the packet. When the packet arrives at its destination the receiving TCP calculates what the checksum should be and compares it to the one sent by the transmitter. If they do not match, an error has occurred in the transmission. The receiving TCP throws that packet away and requests a retransmission.

1.3 User Datagram Protocol (UDP)

In some applications instead of TCP, UDP (user datagram protocol) is used. Instead of wrapping the data in a TCP envelope and putting that inside an IP envelope, the application puts the data into a UDP envelope, which goes in the IP envelope. UDP is much simpler than TCP because it does not worry about missing packets, keeping data in the right order, or any of those niceties. UDP is used for programs that only send short messages, and can just resent the message if a response does not come in a short time. for example, assume that one is writing a program that looks up phone numbers in a database somewhere else on the network, There is no reason to set up a TCP connection to transmit 20 or so characters in each direction. One can just put the name into one UDP packet, stick that into an IP packet, and send it. The other side of the application gets the packet, reads the name, looks up the phone number, puts it into another UDP packet, and sends it back. If the packet gets lost underway the program has to handle that: if it waits too long without getting a response, it sends just another request.

1.4 The Domain Name System

Fairly early on, people realized that number addresses were fine for machines communicating with machines, but humans prefer names. Therefore computers on the Internet were given names for the convenience of their human users. Of course, naming introduces problems of its own. For one thing, one has to make sure that no two computers that are connected to the Internet have the same name. One also has to provide a way to convert names into numeric addresses. After all, names are just fine for people, but computers really prefer numbers. One can give a program a name, but it needs some way to look that name up and convert it into an address.

In the beginning, when the Internet was a small folksy place, dealing with names was easy. The NIC (*Network Information Center*) set up a registry. One would send in a form, electronically of course, and the NIC would add it to the list of names and addresses they maintained. This file, called *hosts* file, was distributed regularly to every machine on the network. The names were simple words, every one chosen to be unique. If a name is used, the computer would look it up in the file and substitute the address.

Unfortunately, when the Internet went forth and multiplied, so did the size of the file. There were significant delays in getting a name registered, and it became difficult to find names that were not already used. Also, too much network time was spent distributing this large file to every machine contained in it. It was obvious that a distributed, on line system was required to cope with the rate of change. This system is called the *Domain Name System* or DNS.

The Domain Name System is a method of administering names by giving different groups responsibility for subsets of names. Each level in this system is called a *domain*. The domains are separated by periods:

```
ux.cso.uiuc.edu
nic.ddn.mil
yoyodyne.com
```

There can be any number of domains within the name, but one will rarely see more than five. Proceeding from left to right through a name, each domain one encounters is larger than the previous one. In the name **ux.cso.uiuc.edu**, **ux** is the name of a host, a real computer with a IP address. The name for that computer is created and maintained by the **cso** group, which happens to be the department where the computer resides. The department **cso** is part of the University of Illinois at Urbana Champaign (**uiuc**). **uiuc** is a portion of the national group of educational institutions **edu**. So the domain **edu** contains all the computers at the University of Illinois; and so on.

Each group can create or change whatever lies within it. If **uiuc** decided to create another group called **ncsa**, it could do so without asking anyone's permission. All it has to do is add the new names to its part of the worldwide database, and sooner or later everyone who needs to know will find out about the new name (**ncsa.uiuc.edu**). Similarly, **cso** can buy a new computer, assign it a name, and add it to the network without asking anyone's permission. If every group from **edu** on down plays by the rules and make sure that the names it assigns are unique, then no two systems anywhere on the Internet will have the same name. On can have two machines named **fred**, but only if they are in different domains.

The top level domain name **edu** was created by *fiat* when the domain system was invented. Originally there were six high-level domains:

Domain	Usage
com	for commercial organizations (i.e., business)
edu	Educational organizations (universities, secondary schools, etc.).
gov	Governmental organizations, non-military
mil	Military (army, navy, etc.)
org	Other organizations
net	Network resources

As the Internet became an international network, a way was needed to give foreign countries responsibility for their own names. To this end there are a set of two-letter domains which correspond to the highest-level domains for countries. Since **ca** is the country code for Canada, a Canadian computer might be named: `hockey.guelph.ca`. In the Appendix A the country codes and connectivity are given.

2 Telnet

telnet is the Internet remote login protocol. It lets one sit at the keyboard connected to one computer and log on to a remote computer across the network. The connection can be to any computer ion the world. Once connected it is as if your keyboard were connected directly to that remote computer. The simplest way to use **telnet** is to type:

```
telnet remote-computer-name
```

at command level. The remote computer will answer with:

```
login:
password:
```

etc.
One needs thus to have an account on the remote computer to get access.

The telnet application consists of two pieces of software that cooperate: the *client*, which runs on the computer that is requesting the service, and the *server*, which runs on the computer providing the service. The network, using either TCP or UDP services, is the medium by which the two communicate.

The client, which is the program that began running on the system after typing `telnet`, must:

- Create a TCP network connection with a server
- Accept input from the user in a convenient manner
- Reformat the input to a standard format and send it to a server
- Accept output from the server in a standard format
- Reformat that output for display

The server software runs on the machine delivering the service; if the server is not running, the service is not available. On UNIX systems servers are called *daemons*, systems jobs that run in the background all the time. When a typical server is ready to accept requests it:

- Informs the networking software that it is ready to accept connections
- Waits for a request in a standard format
- Services the request
- Sends the results back to the client in a standard format
- Waits again

That computers from any make can communicate comes from a set of rules, generally called a *protocol*. In this case, since it is a protocol used between pieces of an application, it is called *application protocol*.

3 Moving Files: FTP

ftp is named after the application protocol it uses: the "File Transport Protocol" (FTP). As the name implies, the protocol's job is to move files from one computer to another. It does not matter where the two computers are located, how they are connected, or even whether or not they use the same operating system. Provided that both computers can "talk" the FTP protocol and have access to Internet, one can use the **ftp** command to transfer files.

ftp is a complex program because there are many different ways to manipulate files and file structures. Different ways of storing files (binary or ASCII, compressed or uncompressed, etc.) introduce complications and may require additional thought to get things right. FTP can be used between two computers on which one has an account (a login name, and a password), if one does not have an account on the other computer, then one can use (if available) anonymous FTP.

Like **telnet**, **ftp** requires to specify the machine with which one would like to exchange files. This can be done with the command:

```
ftp remote-machine-name
```

This starts the **ftp** program and connects the named machine. When **ftp** makes the connection with the remote computer, one will be asked to identify oneself with a login name and password. After the remote system has accepted the login name and password, one is ready to start transferring files. **ftp** prints `ftp>` to prompt for further commands. **ftp** can transfer files in two directions. It can take a file on the local machine and **put** it on the remote machine; or it can **get** a file from the remote machine and place it on the local machine. The **get** and **put** commands have the syntax:

```
ftp> get source-file destination-file
ftp> put source-file destination-file
```

After finishing transferring the files one terminates the **ftp** program by giving the command **quit**; the command **bye** does the same.

ftp has two commonly used ways ("modes") of transferring data, called "binary" and "ASCII". In a binary transfer, the bit sequence of the file is preserved, so that the original and the copy are bit-by-bit identical. ASCII mode is really a misnomer: it should be called "text" mode. In ASCII mode, transfers are treated as sets of characters; the client and server try to ensure that the characters they transfer have the same meaning on the target computer as they did on the source computer.

On the Internet, many hypertext files are stored in a format called HTML, which stands for "hypertext markup language". This is an ASCII format that is used by World Wide Web. There are many places on the Net where various types of video images (weather maps, satellite images etc.) are available. The most important file formats for video images are called GIF and JPEG, both of which can encode elaborate multicolor images; and MPEG, which is used for "movies". These are all in binary formats, and should therefore be transferred in binary mode.

3.1 FTP Command Summary

The following table summarizes **ftp**'s most useful commands. These commands are available on most, if not all, **ftp** clients. **ftp** will show the commands that are available if one types: **help**.

account *info*	Supplies additional accounting or security information which must sometimes be given within a session.
ascii	Enters ASCII mode, for transferring text files.
binary	Enters binary mode, for transferring binmary files.
cd *remote-directory*	Changes the working directory on the remote machine.
close	End the **ftp** session with a particular machine and returns to **ftp** command mode. After a **close**, one can **open** a connection to a new system or **quit** from **ftp**.
delete *filename*	Deletes the named file on the remote system.
dir *file destination*	Gives a full directory listing on the remote machine. *file* and *destination* are both optional. *file* can either be a single file or a wild card construction. The listing shows all filenames that match the specification. If *file* is omitted, the listing shows all files in the current remote directory. The *destination* is where the output should be put. It can either be a file on the local machine or a command through which to filter the file. If *destination* is omitted, the listing appears on the terminal.
hash	Tells **ftp** to print a # sign every time a block of data is transferred by a **get** or a **put** command. Useful if one is not certain the network is working; it gives one a visual signal that the data are actually moving.

help *command*	Print a short bit of documentation about the command.
lcd *directory*	Changes the default directory on the local machine to the named directory.
ls *file destination*	Gives a short directory listing on the remote machine. The arguments are the same as for **dir**.
mget *file-list*	Gets multiple files from the remote machine. The file list can be either a list of filenames separated by spaces or a wildcard construction.
mput *file-list*	Puts multiple files onto the remote machine. The file list can be either a list of filenames separated by spaces or a wildcard construction.
open *machine-name*	Connects to the named machine: This is useful if one wants to **connect** to a new system after transferring files from another system. One must **close** the old connection first.
prompt	With **mget** or **mput**, the **prompt** command tells **ftp** to prompt for confirmation before transferring each file. This is useful if one wants to make sure one is not needlessly transferring files (or worse) overwriting files that already exist. If prompting is already enabled, giving the **prompt** command makes **ftp** to turn it off.
pwd	Prints the name of the current remote directory.
quit	Closes the connection.
user *username*	Sends the username to the remote machine to log in. This is useful if the username or password is typed incorrectly.

3.2 Anonymous FTP

Anonymous FTP allows users who do not have a login name or a password to access certain files on a machine. There are strong restrictions: anonymous users can normally only **get** files (i.e., copy them); they cannot install new files or modify already existing files. And, there are strict limits on which files one can copy.

There is a possibility, that archive managers can create directories that can be written by anonymous FTP users. Such directories are often used to let users submit articles or software for inclusion in an archive. If an archive manager has set up an incoming anonymous FTP directory, one can use the **ftp**'s normal **put** and **mput** commands to place the files there.

When anonymous FTP is enabled, a special login name is created called *anonymous* as the login name to be used, **ftp** will accept any string as password. It is generally considered good form to use one's electronic mail address as the password, so the managers of the server have some idea of who is using it and can easily contact you if necessary. (in fact, some systems are starting to demand to use a valid email address before they will let you in.) After signing in as *anonymous* one is allowed to **get** thosde files which are expressly permitted to the anonymous FTP users.

When one enters a system anonymously, one is placed at a particular place in the file directory system. That initial directory is the starting point for all anonymous FTP access. From there, one can only move to subdirectories by giving the name of the subdirectory, or move back from a subdirectory to its "parent" by using the .. argument. Positioning oneself absolutely, by specifying a directory beginning with a slash (/), is not allowed. Technically, it is legal; but **cd/pub** has been redefined to mean "move to the *pub* subdirectory of the initial anonymous FTP directory." One can use **cd /** if one gets lost in an anonymous FTP session and needs to get back to the starting point; the other option is **cd ..** repeatedly to move up to where one started.

4 Electronic Mail

Electronic mail (email) is not and "end to end service": the sending and receiving machine need not be able to communicate directly with each other to make it work. It is known as a "store and forward" service. Mail is passed from one machine to another until it finally arrives at its destination.

If the destination and the source are not on the same network, there needs to be a place where the email from one network is handed to a email service of another. Points of connection between email networks are computers called "application gateways". They are called "gateways" because they can be viewed as magic doors between worlds; the are "application gateways" because they know enough about the email applications on both sides to reformat messages so they are legal on the new network. To send mail through a gateway, one frequently has to give an address which contains both information about how to get to the gateway, and information how to deliver the mail on the other side.

Before one puts a postal letter in a mailbox, one puts it in an envelope, the same must be done for email, where the envelope is called *mail header*. The header is **To:**, **From:**, **Subject:** stuff on the front of the message.

Whether or not email gets to its destination depends almost solely on whether or not the address is constructed correctly. Unfortunately, email addresses are a bit more complex than the simple host addresses we have seen sofar. They are more complex for several reasons:

- The world of email is bigger than the Internet.
- Email needs to be addressed to a person, not just a machine.
- Personal names are sometimes included as comments in email addresses

On the Internet, the basis for all mail is the domain name (see section 1.4) of the machine which is acting as a mall agent (the machine that is handling the addressee's mail. In fact, this is all the network, *per se*, worries about. Once it has delivered a message to the named machine, the network's task is over. It is up to that computer to deliver it the rest of the way, bit the machine requires more information about further routing: at a minimum, the name of a user, but possibly extended information for routing the mail to another kind of network. So, how does one send mail to other networks?

Bitnet Bitnet addresses normally have the form *name@host,bitnet*. If this does not work change this address to something like *name%host*, and use that for the login name part of the address. Use the address of a Bitnet-Internet gateway for the machine name side (e.g., **cunyvm.cuny.edu**). Separate the two with an (@) sign. For example rewrite the address **krol@uiucvmd.bitnet** as **krol%uiucvmd@cunyvm.cuny.edu.** If one is going to do regularly, find out the best gateway to use from someone local.

Compuserve Compuserve addresses consist of two numbers separated by a comma. Change the comma into a period and use that on the left-hand side of the address. To the right of the @ use **copuserve.com**. So a Compuserve address of 76543,123 would be addressed **765434.123@compuserve.com.**

Fidonet Fidonet addresses consist of a first and a last name, and a set of numbers of the form `a:b/c.d`. Separate the first and last names with a period (.) and send to **pd.fc.nb.za.fidonet.org**. For example, send mail to Willie Martin at 1:5/2.3 by using the address **willie.martin@p3.f2.n5.z1.fidonet.org**. Some machines still may have trouble with an address like this. If this is so, try sending the above address to the gateway machine: **wille.martin%p3.f2.n5.z1.fidonet.org@zeus.ieee.org**.

Sprintmail Complete Sprintmail addresses look like "John Bigboote" /YOYODYNE/TELEMAIL/US. If the address is used within Sprintmail, it can be abbreviated to John Bigboote/YOYODYNE. These first two parameters are the person and an organization. When someone gives a Sprintmail address, this is all they will provide. The positional parameters neesd to be plugged into a command like the following: `/PN=John.Bigboote/O=YOYODYNE/ADMIN=TELEMAIL/C=US/@sprint.com`. Even if this person only gives the first two parts of the address, the complete address should be used when sending it to **sprint.com**

MCImail There are multiple ways of addressing MCImail. MCImail boxes have both an address and a person's name associated with them. The address looks a lot like a phone number. If that is what you have, then use that number on the left side of the @, and use the gateway name **mcimail.com** on the right side. For example: **1234567@mcimail.com**. If you are given the name of a person on MCImail, you can send mail by addressing it to **firstname_lastname@mcimal.com**, like **John_Bigboote@mcimail.com**.

UUCP Change the UUCP address, which looks line **name@host.uucp**, to *name%host*. Use that for the login name portion of the address. Use the address of a UUNET-Internet gateway as thwe machine name. Internet service providers provide these gateways for these constituents. Of course, separate the two with a (@) sign. For example, a user receiving mail via uucp from PSI, Inc. should be sent mail through **uu.psi.com**, like **john_w%yoyosdyne@uu.psi.com**. One can ask one's email or system administrator for a good gateway to use.

Many people also give UUCP addresses in the form **..!uunet!host!name**. This is a UUCP "path"; it means "figure out how to get the mail to the system named **uunet**, and the **uunet** will send it to **host**, which will deliver it." Convert this to: *name%host@gatewaymachine*. One picks the proper gateway by examining the UUCP path address. It it has **uunet** as a part of the address one could use **uu.psi.com**, etc. On very rare occasions, one may see gateway names other than **uunet** or **uupsi** in the path; one has then to figure out the Internet address of the gateway. Giving addresses as "paths" is, fortunately becoming less common. If one is forced to use a UUCP path address, be careful. When one uses the UNIX C shell, one must "quote" the exclamation points with a backslash (\), like `mail \!uunet\!host\!name`. If the address is given inside the **mail** program, the backslashed are not needed.

Notes This table is copied from Ed Krol's *The Whole Internet*, pp 108

BITNET (Because It's Time NETwork is a cooperative network serving more than 2300 hosts at several hundred sites in 32 countries

CompuServe is a commercial system, it provides many database services as well as CMC (Computer Mediated Communication). Its email system is called EasyPlex.

FidoNet is a cooperative network that has connected personal computers, originally IMB PCs or compatibles running MS-DOS, since 1983.

MCImail is a commercial mail system. It is interconnected with CompuServe and Telex. The Intermail gateway at `a.isi.edu` provides mail exchange with the Internet.

UUCP The name of the UUCP network comes from that of its transport protocol, which is an acronym for UNIX to UNIX Copy Program. The network started in 1978 and is one of the oldest dialup networks in the world.

5 Gopher

Gopher is a lookup tool that let one prowl through the Internet by selecting resources from menues. If one wants to use one of the resources that Gopher presents, it helps to access it. Thus, Gopher, or more accurately "the Internet Gopher" allows one to browse for resources using menus. When one finds something, one can read or access it through Gopher without having to worry about domain names, IP addresses, changing programs, etc. Gopher lets one browse through the Internet's resources, regardless of their type.

To access the Gopher system, one needs a **gopher** client program. The special client software must be installed on a computer that is on the Internet. There are free **gopher** clients for just about any computer one might have: UNIX, Macintosh, IBM/PC, X Windows, VAX/VMS, VM/CMS, and probably many more.

Public Gopher Access Sites		
Computer	Login	Location
consultant.micro.umn.edu	gopher	North America
ux1.cso.uiuc.edu	gopher	North America
panda.uiowa.edu	*non required*	North America
gopher.msu.edu	gopher	North America
gopher.ebone.net	gopher	Europe
info.anu.edu.au	info	Australia
gopher.chalmers.se	gopher	Sweden
tolten.puc.cl	gopher	South America
ecnet.ec	gopher	Ecuador
gan.ncc.go.jp	gopher	Japan

The **gopher** client will choose an appropriate utility for dealing with the resource one selects, whatever it is. If it is a file, the client **ftps** it. If the resource is a "login" resource (i.e., a system one can log in to) it creates a TELNET session. If it is a collection indexed by Archie or WAIS (see there), gopher uses Archie or WAIS to find out what is relevant. The **gopher** client one is using allows to speak to it in a screen-oriented menu driven fashion. It takes what one says and turns it into real commands for the appropriate application. So, if one is in Gopher, one never has to type an **ftp get** command. Getting started is easy. Just give the command: **gopher** or **telnet** to one of the public address clients.

6 Archie

Archie is a system which allows to search indexes to locate files that are available on public servers. Archie indexes about 1200 servers and 2.5 million files. One asks it either to find filenames which contain a certain search string or to suggest files whose description contains a certain word. It returns the actual filenames that meet the search criteria and the name of the servers containing those files. Once one decides which of the files is most likely to meet the needs, one can easily move the file to the home computer with anonymous FTP.

To use Archie, one must choose an Archie server. There are a number of servers who have the same information.

Available Archie Servers	
Name	Usage Area
archie.au	Australia
archie.edvz.uni-linz.ac.at	Austria
archie.univie.ac.at	Austria
archie.uqam.ca	Canada
archie.funet.fi	Finland
archie.th-darmstadt.de	Germany
archie.ac.il	Israel
archie.unipi.it	Italy
archie.wide.ad.jp	Japan
archie.kr	Korea
archie.sogang.ac.kr	Korea
archie.rediris.es	Spain
archie.luth.se	Sweden
archie.switch.ch	Switzerland
archie.ncu.edu.tw	Taiwan
archie.doc.ic.ac.uk	United Kingdom
archie.unl.edu	USA
archie.internic.net	USA
archie.rutgers.edu	USA
archie.ans.net	USA (for ANS customers)
archie.sura.net	USA

The common way to use it, is to **telnet** to the hostname. For example:

```
% telnet archie.au
...Welcome to etc.
...
login: archie
Last login: ...
...
Archie.au>
...
Archie.au> quit
```

quit terminates the TELNET session and returns to the local computer.

A much more friendlier way is to use Archie under the X Window System: **xarchie**[4]. It provides a nice graphical interface to the Archie service. In addition it includes a built-in FTP client, so one can use **xarchie** to explore directories at FTP sites – and even to retrieve files.

7 WAIS

WAIS, Wide Area Information Service, is another of the Internet services. WAIS is a tool for working with collections of data, or databases. Wais is a distributed text-searching system. It is based on a standard (named Z39.50[5]) that describes a way for one computer to ask another computer to do searches for it. WAIS is one of the first systems based upon this draft standard.

To make a document available through a WAIS server, someone must create an index for that server to use in the search. For textual information, every word in the document is usually indexed. When one requests a search from a WAIS client, it contacts the servers that handle the libraries that are suggested. It asks each server, in turn, to search its index for a set of words. The server

[4] xarchie is available via anonymous FTP from **ftp.cs.rochester.edu**.

[5] Z39.50 is a draft ANSI standard for requesting bibliographic information.

then sends a list of documents that may be appropriate, and a "score" telling how appropriate it thinks each one is. The scores are normalized, so that the document that best matches the search criterion is given a score of 1000; others get proportionally less. So, if one says, "Find me documents that contain 'clinton and gore,'" WAIS looks in the index and counts how many times each document contains the word "clinton", the word "and" and the word "gore". The sum of these counts, weighted slightly by what the word is, is converted to a score for a document. After all the libraries have been searched, WAIS gives the titles of the documents that received the highest scores. There is a limit to the number of documents it reports – usually between 15 and 50, depending on which client one uses. One can then pick which documents to view, and WAIS will display them.

Accessing WAIS is not like accessing Gopher. In order to use it, one needs a computer running a WAIS client program. The graphical client **xwais**, which runs under X Windows is the easiest to use. A non-graphical WAIS client, a line-oriented one is **swais**. This client is available at a number of public-access sites around the Internet.

7.1 Building Own Sources

The software archives that provide WAIS clients also provide programs and documentation for creating one's own sources and offering one's own servers. One of these, **waisindex**, takes a set of files and builds an index from them. It knows about various forms of data: normal text, various text formatters (e.g., LaTeX), mail folder format, etc. These formats are shown in the following table:

Name	Description
text	Simple text files
bibtext	BibTeX/LaTeX format
bio	Biology abstract format
cmapp	CM applications fronm hypercard
dash	Entries separated by a row of dashes
dvi	*dvi* format
emacsinfo	GNU documentation system
first_line	First line of file is headline
gif	*gif* files, only indexwes the filename
irg	Internet *Resource Catalog*
mail_digest	Standard Internet mail digest format
mail_or_rmail	mail or rmail or both
medline	MEDLINE format
mh_bboard	MH bulletin board format
netnews	Net news format
nhyp	Hypertext format, Polytechnic of Central London
one_line	Each line is a document
para	Paragraphs separated by blank lines
pict	*pict* files, only indexes the filename
ps	PostScript format
refer	**refer** format
rn	Net news saved by the rn newsreader
server	Server structures for the *directory-of-servers*
tiff	*tiff* files, only indexes the filename

8 World Wide Web

The World Wide Web, or WWW (W3), is the newest information service to arrive on the Internet. The Web is based on a technology called *hypertext*[6]. Most of the development has taken place at

[6] In 1989, Tim Berners-Lee, a CERN programmer invented a system to organize his own information that used hypertext – a concept for linking pieces of information on personal computers

CERN[5] the European Particle Physics Laboratory; but it would be a mistake to see the Web as a tool designed by and for physicists. While physicists may have paid for its initial development, it is one of the most flexible tools – probably the most flexible tool – for prowling around the Internet. The Web and its tools are still under development.

To try the Web, **telnet** to **info.cern.ch**. Thisd will automatically drop you into a public-access client program (or *browser*[7], to use the Web's terminology). This is a line-oriented browser that will work with a traditional terminal. Several other browsers are available. If one wants to install one's own browser, which is highly recommended if the Web is used frequently, then one can choose between the line-oriented browser and several browsers for the X Window System, the NeXT workstations, the Macintosh and PCs[8]. The most advanced, and most widely used, browser available is called Mosaic. Mosaic works on UNIX under the X Windows system (where it is called **xmosaic**), the Macintosh and Microsoft Windows. There is another line-oriented browser called **lynx**, similar as **www** but has some additional features. A public address **lynx** client is available by **telneting** to **ukanaix.cc.ukans.edu**. Some Internet service providers offer **lynx** browsers to their clients[9]. An important helpdesk is available at: **http://www.charm.net/~web/Providers.html**.

Mosaic[10] was designed as a World Wide Web browser. It presents a multimedia interface to the Internet. It does more than present hypertext, with links to other documents; it is a *hypermedia* tool, which means that it can handle audio, pictures, and even video (moving pictures). And it simplifies the interface to different services. Mosaic requires a direct connection to the Internet, it cannot be run if one is only dialing into a timesharing account. Also, Mosaic will be painfully slow if one does not have a 9600-baud (or better) modem.

Information about the EPS WWW-Server can be found in Appendix B, C and D.

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[7] More precisely a *browser* is any program for readfing hypertext

[8] A good software source is the anonymous FTP site **info.cern.ch**. Look in the directory *pub/www/bin*, here are directories for several different machines. The best place, however, to look at is NCSA's FTP archive: **ftp.ncsa.uiuc.edu**.

[9] The software is available via anonymouus FTP from **ftp2.cc.ukans.edu** in the directory *pub/lynx*

[10] Dave Thompson, a software developer at the NCSA, had seen the Web, and suggested the NCSA to build a browser that would take full advantage of it. Along with Mark Andreesen and Eric Bina they set to work. In 1992 they came up with NCSA Mosaic – a way of accessing the Web using icons and a mouse

Hypertext[a]

Hypertext is a method of presenting information where selected words in the text can be "expanded" at any time to provide other information about the word. That is, these words are *links* to other documents, which may be text, files, pictures, anything. For the sake of illustration let us assume that the library has a hypertext card catalog. Pulling up the card for a particular book, it might look like:

TITLE:	The river and the *prairie*: a history of the *Quad-Cities*, 1812 - 1960
AUTHOR:	*Roba, William Henry.*
PUBL.:	(Davenport Iowa): Hesperian Press,
DATE:	1986
SUBJECT:	*Quad Cities* (Iowa-Ill) - - History. *Davenport* (Iowa-Ill) - - History.
FORMAT:	157 p. : ill., map ; 24 cm.
CONTENTS:	Includes bibliographical references and notes.

If the italicized words are links, one can expand the author's name and get a bibliographical sketch. If one expand "prairie", one might end up in a hypertext Oxford English Dictionary and see:

> **prairie ('pre&schwa,rI). Also 8, 9 parara, pararie, 9 praire, prairia. a A tract of level or undulating grass-land, without trees, and usually of great extent; applied chiefly to the grassy *plains* of North America; a *savannah*, a *steppe*.**

Since this is another hypertext document, there are links in it as well. One can plunge deeper by expanding *savannah*, ending up in a hypertext emcyclopedia positioned at a whole article on savannahs - complete with pictures and possibly even movies. On can repeat the process as long as one likes, getting deeper and deeper into the topic.

The amount of hypertext on the Net has exploded in the past few years. Many museum exhibitions, magazines, and other hypertext presentations are available, including O'Reilly & Associates' *Global Network Navigator* (GNN). The big problem is a scarcity of tools to built the linked structure. Most of the hypertext documents, available now were painstakingly built by hand. Hypertext editors are just being written: as time goes on, one will begin to see more hypertexts, and better tools for creating them.

[a] this page is copied from: Ed Krol, *The Whole Internet*, pp 288

9 Connection to the Internet

9.1 Dedicated Access

Anyone, who wants to be connected to the Internet, can get access via a *service provider*. Corporations and large institutions should look into dedicated network access. This gives complete access to all of the Internet facilities. A service provider leases a dedicated telephone line at a speed, one can choose - the faster the line speed, the more it costs - and places a special routing computer at the location. That router is responsible for taking communications from the site destined for somewhere else and sending them on their way (and vice versa). Once the connection is set up, one can connect as many computers as one likes to connect to the Internet. To do so, the computers have to be placed on a local area network (LAN) along with the router. Dedicated connections are (very) costly and are impractical for home users.

9.2 SLIP/PPP

In the past years some less expensive techniques for "almost dedicated access" have appeared. These are called SLIP[11] and PPP. They are versions of the Internet software that run over normal phone lines, using standard high-speed modems[12]. One must buy the SLIP or PPP software and a more expensive modem, but one will not have the very high connection costs. The real advantage of SLIP and PPP is that it allows a full-fledged connection to the Internet. One is not using someone else's system as an "access point" to the Internet. SLIP and PPP are very appropriate for connecting a home computer to a larger local network, which is connected to the Internet.

9.3 ISDN Access

ISDN stands for *Integrated Services Digital Network*; which means using a digital telephone line between home or office and the telephone company's switching office. ISDN is widely used in Europe for a number of years and is becoming common use in the USA. ISDN access can either be dial-up or dedicated. The big advantage of ISDN is that it provides very high speed access at relatively low cost. One ISDN channel includes two 56 or 64 kb digital channels (depending on the implementation of the phone company.

9.4 Dial-up Access

With a timesharing account on a computer that has dedicated access one has the cheapest access to the Internet. Use the home computer to log in to this remote system. The hom› computer actually does not become part of the Internet; it is just accessing a service computer that is permanently connected to the network. Many organizations provide this kind of service. Since one is sharing the connection with others, the cost of these services is greatly reduced. The setback is that one cannot use fancy X-based applications like Mosaic to access World Wide Web.

9.5 UUCP Access

All UNIX systems support a set of services called UUCP[13], which transfer data over standard telephoner lines. If one finds a cooperating service provider (like UUNET), one can arrange to use UUCP to pick up Internet mail and USENET news. The system uses UUCP to dial into a remote system at regular intervals and transfer news and mail back home. One can therefore read mail on the own system rather than someone else's.

International Service Providers		
Provider	Coverage	Services
AlterNet		
AlterNet, operated by UUNET Technologies, Inc. 3110 Fairview Park Drive Suite 570, Falls Church VA 22042 +1 7032048000, +1 703 2048001 fax, (800) 4-UUNET-3, info@uunet.uu.net	Worldwide	Dedicated (9.6 kb - 10 Mb), dial-up, SLIP/PPP, UUCP
ANS (Advanced Networks and Services)		
ANS, 100 Clearbrook Road, Elmsford NY 10523, +1 703 7587700, (800) 4568276, info@ans.net	Worldwide	Dedicated (56k - 45Mb, dial-up, SLIP/PPP
Commercial Link Systems		
Internet Service Center, Sternstrasse 2, D - 24116 Kiel, +49 431 9790161, +49 431 978126 fax, info@cls,net	Schleswig Holstein	ISDN, dial-up, SLIP/PPP, UUCP

continues next page

[11] Serial Line IP

[12] high-speed is at least 9600 baud. A V.32bis or V.42bis modem is ideal.

[13] UNIX to UNIX CoPy

International Service Providers		
Provider	Coverage	Services
CNS (Community News Service) 1155 Kelly Johnson Blvd, Suite 400, USA Colorado Springs CO 80920, (800) 5921240, +1 719 5921240, service@cscns.com	USA	Dedicated (56kb - 1.5 Mb), dial-up, SLIP, UUCP
Connect.com.au Connect.com.au Pty Ltd., 29 Fitzgibbon Crescent, AUS - Caulfield Vic 3161, +61 1800 818262 or +61 03 5282239, connect@connect.com.au	Australia	Dedicated, dial-up, SLIP/PPP, UUCP
CONNECT CONNECT, UK PC User's Group, PO Box 360, UK - Harrow HA1 4LQ, +44 81 8631191, +44 81 863 6095 (fax), +44 81 8636646 (data), info@ibmpcug.co.uk	United Kingdom	dial-up, UUCP
Demon Internet Ltd. Demon Systems Ltd., 42 Hendon Lane, UK - London N3 1TT, +44 81 33490063, internet@demon.co.uk	United Kingdom	Dedicated (14.4 kb - 64kb) dial-up, SLIP/PPP
The Direct Connection The Direct connection, PO Box 931, UK - London SE18 3PW, +44 81 3170100, +44 81 3172222 (data), helpdesk@dircon.co.uk	United Kingdom	dial-up, SLIP/PPP, UUCP
EUnet Limited EUnet Support, +31 20 5925109, +31 20 592 5163 (fax), info@eu.net	Europe, North Africa, CIS	Dedicated, ISDN, duial-up, UUCP
EUnet GB EUnet GB Support, +44 227 475497, sales@britain.eu.net	United Kingdom	Dedicated (64 kb - 1.5 Mb), ISDN, dial-up, UUCP, SLIP/PPP
HoloNet Information Access Technologies Inc., 46 Shattuck Square, Suite 11, USA - Berkeley CA 94704-1152, +1 510 7040160, +1 510 7048019 (fax) info@holonet.net, support@holonet.net	USA	dedicated (64 kb - 1.5 Mb) dial-up, SLIP/PPP, UUCP
HookUp Communications 1075 North Service Road West, CND Oakville Ontario M2L 2G2, +1 905 8478000, (800) 3630400, info@hookup.net	Canada	Dedxicated, dial-up, SLIP/PPP/CSLIP, UUCP
Institute for Global Communications/IGC Networks 18 De Boom street, USA - San Francisco CA 94107, +1 415 4420220, +1 414 5461794 (fax), support@igc.apc.org	Worldwide	dial-up
		continues next page

International Service Providers		
Provider	Coverage	Services
Individual Network eV c/o Thomas Neugebauer, Neusser Gasse 93, D - 50259 Pulheim +49 2238 15071 (data) login: IN-info, IN-Info@Individual.net	Germany	ISDN-IP, SLIP/PPP, UUCP
Individual Network eV – Rhein-Main Oliver Böhmer, Linkstrasse 15, D - 65933 Frankfort, +49 69 39048413, info@rhein-main.de	Rhein - Main Area (Frankfurt)	ISDN, SLIP/PPP, UUCP
Interconnect Australia Pty Ltd 29 Fitzgibbon Crescent, AUS - Caulfield, Victoria 3161, +61 3 5822239, +61 3 5285887 (fax), info@interconnect.com.au, sales@interconnect.com.au	Australia	dial-up
Internetworking Systems Gaswerkstrasse 11, PO Box 101312, D - 44543 Castrop-Rauxel, +49 2305 356505, +49 2305 25411 (fax), info@ins.net	Ruhrgebiet, Northrhine Westfalia	Dedicated, ISDN, dial-up, SLIP/PPP, UUCP
MAZ Internet Services Karnapp 20, D - 21079 Hamburg, +49 40 766 291623, maz-isc@maz.hh.de	Germany	Dedicated, ISDN, dial-up, SLIP/PPP
Millenium Online One Corporate Drive, USA - Clearwater FL 34622, 800 7360122, 800 7740122, info@mill.com, jjablow@mill.com	Worldwide	dial-up, Dedicated
MUC.DE. eV Frankfurter Ring 193a, D - 80807 München, +49 89 32468311, postmaster@muc.de, vorstand@muc.de	Großraum München	dial-up, SLIP/PPP, UUCP-Polling
OARnet Ohio Supercomputer Center, 1224 Kinnear Road, USA - Columbus OH 43085, +1 614 2929248, alison@osc.edu	USA	Dedicated, ISDN, Frame Relay, dial-up, SLIP/PPP
PSI (Performance Systems International) 510 Huntmar Park Drive, USA - Herndon VA 22070, +1 703 7090300, (800)82PSI82, +1 703 9041207 (fax), (800)FAXPSI1 (FAXBACK info), info@psi.com	Worldwide	Dedicated, (19.2 kb - 1.5 Mb) ISDN, dial-up, SLIP/PPP, PSILink, UUCP
SpaceNet GmbH Frankfurter Ring 193a, D - 80807 München, +49 89 3246830, info@spacenet.de	Europe	
UUNET See AlterNet		
UUNorth Inc. 3555 Don Mills Road, Unit 6-304, CND - Willowdale, Ontario M2H 3N3, +1 416 2258649, c.smith@uunorth.north.net	Canada	Dedicated, dial-up, SLIP/PPP, UUCP
		continues next page

International Service Providers		
Provider	Coverage	Services
The WELL 1750 Bridgeway, Suite A-200, USA - Sausalito CA 94965, +1 415 3324335, info@well.sf.ca.us	Access through X.25 and direct dial	dial-up
WinNET (UK) PO Box 360, UK - Harrow HA1 4LQ, +44 81 863 1191, +44 81 863 6095 (fax), +44 81 863 6646 (data), info@win-uk.net	United Kingdom	dial-up, UUCP
The World Software Tool & Die, 1330 Beacon Street, USA - Brookline MA 02146, + 617 7390202, +1 739 0914 (fax) +1 617 739-WRLD (data), info@world.std.com	USA	dial-up
XLink NTG Netzwerk und Telematic GmbH, Vincenz Priessnitz Strasse 3, D -76131 Karlsruhe, +49 721 96520, +49 721 9652210 (fax), info@xlink.net	Germany	Dedicated, dial-up, SLIP/PPP, UUCP

10 The Evolution of Internet[6]

In July 1994 engineers met in Toronto to try to seal the Internet's rapid evolution from a 20^{th} century academic data network to a 21^{st} century public and corporate multimedia network.

The Internet Engineering Steering Group (IESG) discussed a proposal for a new version of the Internet Protocol (IP), called IP-Next Generation (IPng). Its purpose: to support a least 1 billion computer nodes, compared with 2.5 million computer hosts today, and improve the Internet's ability to handle voice, video, broadcast, mobile and multimedia traffic.

IPng, enthousiasts say, will make it possible, for the Internet to pull together a broad range of businesses, consumers, devices and applications. By the year 2010, shoppers will check their bank balances on the Internet using personal digital assistants. Vending machines will signal to central warehouses that they are empty. Home workers will set up multimedia conference calls to colleagues over desktop workstations. Children in the same homes will call up cartoons over the TV.

Others, however, are less optimistic. The proposed transition from a datagram-based network that lets academics exchange messages and files to a global web that provides every kind of video, voice and data service, is they suggest, fraught with pıoblems, some of which are already emerging.

As the much vaunted Internet "community" gets bigger and more diverse, so community values become more pluralistic. Many corporate interests are far removed from those of traditional Internet users, and some corporations have publicly expressed skepticism about IPng.

Conspiracy theorists surmise that commercial interests are lurking in the shadows of the network, ready to impose their own solutions should the IPng proposal presented by the Internet engineering priesthood fail to win support.

10.1 Unprecedented Surge

Virtually everyone in the Internet community agrees that the network is reaching a critical juncture. One road leads to its acclamation as the global information super-highway; the other to a chaotic cyber-jungle filled with congested, virus-infested tributaries that lead nowhere in particular.

Advocates of the Internet "as universal network" take as their starting point the surge in user numbers, the major motivation behind IPng.

For each of the past 10 years, the amount of host computers and end-users connected to the Internet has doubled. And demand is accelerating. The NSFNet, part of the US Internet backbone, recorded a 20% rise in traffic in March 1994 alone, and most commercial providers of Internet services are struggling to cope with month-on-month rises in subscriber numbers. In Europe, growth is just as fast. The number of host computers connected rose to 750 000 from 450 000 between December 1993 and April 1994.

By April 1994, roughly 2.5 million host computers were connected to the Internet. Since each host connects an average of 10 individuals, that figure represents about 25 million "*Internauts.*"

10.2 New Applications

Growth in new applications is even more startling. In particular, **Mosaic**, an easy-to-use "point-and-click" applications package that allows users to browse the Internet's huge resources, is pushing traffic to new heights.

Mosaic, which became publicly available less than 12 months ago, already accounts for more than 5% of traffic on the NSFNet. It is widely seen as the "killer application" that will propel the Internet into pole position in the race to build national information super-highways.

Developer Mosaic Communications Corp. says it intends to join with CERN (the Geneva based European particle physics research laboratory) and MIT (the Massachusetts Institute of Technology) to develop international standards for Internet navigating systems.

The surge in subscribers and traffic is leading some to predict that the Internet will be to the 21^{st} century what the telephone network was to the 20^{th}.

Vinton Cerf, senior vice-president of data architecture with MCI Communications Corp. and president of the Internet Society says:

> "It's beginning to feel more and more like that. Some people - especially in business - are saying their Internet connection is now more valuable to them than their telephone connection. There is a positive feedback loop forming"

Some go further. Whereas today the Internet is to some degree a sub-system of the public telecoms infrastructure, the next decade could see a reversal in roles.

Robert Cailliau of CERN, which has played a key part in the development of the Internet's popular World Wide Web application says:

> "While everyone in the telecoms industry is sitting on the beach discussing the future, there is a tsunami building up out there. ... I firmly believe that the Internet is going to roll over everything, including the telephone network. It is going to win because it is driven by users and especially by their need for interoperability."

10.3 Addressing Issues

But IP does not, in the engineering vernacular, scale forever. And so the Internet Engineering Steering Group set up an "area" last September to create a new protocol that will ensure that the Internet does not run out of address space.

IT is, however, widely recognized that any new protocol must do a lot more than simply provide more address space if it is to create the basis for a ubiquitous Internet and attract new users.

Robert Hinden, an engineer at SUN Microsystems Inc. who has led development of one of the IPng proposals, the Simple Internet Protocol Plus, argues that future Internet growth will not be led by computer installations but by entirely new markets. These will include mobile PCs and digital assistants; networked entertainment, in which every TV set becomes an Internet host; and control for devices such as lighting equipment and vending machines.

Scott Bradner, a Harvard University professor who is one of two experts who made the initial recommendation on IPng in Toronto, and colleague Allison Mankin, of the US Naval Research Laboratory in Washington, identify the following major engineering issues:

- *Better security.* In Bradner's view, it is the most important issue, and widely seen by corporations as the key requirement of any new protocol.
- *Proliferation of mobile hosts.* Designers want to create a protocol that allows for routing to the user's location, wherever that might be.
- *Flows and resource reservation.* This is the essential requirement where end-to-end delay is important, for real time commercial Internet applications such as video- and audioconferencing and multimedia, and for guaranteed quality of service.
- *Better routing control.* Routers will soon have to deal with tables running to 100 000 routes or more, creating a large overhead. A form of hierarchical routing has been deployed, but the problem is likely to arise again before the end of the decade.
- *Policy-based routing.* Source hosts and access providers could increasingly demand that packets be routed in particular ways to conform to ulterior commercial, cost or performance goals. At present, this demand is not handled well in the Internet.
- *Accounting.* IPng may have to include more sophisticated accounting models to accommodate increasing commercialization.

10.4 IP Or Not IP?

Whether a new version of IP is required to meet these other need is moot. Bradner says,

> IP version 4 has proved "*incredibly malleable* and can probably handle most requirements, but a new protocol would make some of the easier. ... new protocols will not be used without strong reasons."

In a blunt submission to the IPng area, Eric Fleischmann, senior principal scientist with Boeing Computer Services' Delivery Systems Architecture and Technical Planning Group, says:

> " ...large corporate users generally view IPng *with disfavor*. Among other things the IEFT generally has a world view which presupposes that data access should be unrestricted and widely available. By contrast, corporations generally regard data as a *sensitive* corporate asset: If it is compromised, the very viability of the corporation may be at risk. Corporations therefore, want data exchange to be restricted."

Fleischmann's remarks go to the heart of anxieties over where the Internet is headed – and who is in the driver's seat. IPng is only one mechanism for taking the Internet onward. Others may be driven not by the Internet community but by commercial interests.

According to Bradner the decision on what succeeds IP will most likely be taken not by the Internet technical community but by ***a few individuals at Microsoft, in the cable TV companies and among the cellular data companies.*** These companies will overwhelm the existing Internet user community, and will thereby dictate what is used – whether IPng or something else. Bradner says:

> "There is a tremendous amount of money involved here. Look at Wellfleet and Cisco and the money they are making from IP. Then consider the money that Microsoft will earn from 40 million copies of Chicago with built-in IP, or the cable companies from 90 million subscribers with Internet connections."

Tony Rutkowski, executive director of the Internet Society says:

> " ...commercial interests will not hijack the Internet. There is a widespread understanding that commitment to engineering excellence is what made it happen in the first place. You might almost say that the Internet is defined by its process of technology transfer. Even the new entrants will have a strong stake in keeping that."

11 An Audio-Visual Internet

If, as some hope, the Internet is to become a truly universal network, it must be capable of carrying real-time voice and video traffic as well as conventional data. How and when it makes that transition is among the most hotly debated issues in the Internet community.

The Internet Engineering Task Force agreed in Toronto to move forward with the new version of the Internet Protocol, IPng. In addition to enabling the Internet to handle billions of connections, IPng will support different service classes and multicasting. According to plan, the first production software will meet the new standard by the end of 1995.

Meantime, hundreds of manhours are being devoted to adapting the existing protocol, IP version 4, for today's real-time conferencing and multimedia demands on the Internet. For example:

- **Mosaic**, the fastest growing application on the network, lets users incorporate images, audio and moving video.
- **Academics and researchers** have been holding real-time conferences, in which tens of participants have conversed and exchanged documents, for more than two years. Interest is growing in computer-supported collaborative working, in which dispersed groups *meet* over the Internet in multipoint conferences to discuss work-in-progress.

The Multicast Backbone, a 3-year old virtual network that already carries conferences between hundreds of sites in some 15 countries, is the main conduit for such multimedia traffic. M Bone shares the Internet's physical media but uses a parallel system of dedicated multicast routers and *tunnels*.

The catch: No matter how audio and video are pumped over the Internet, it does not always work. Pictures break up, voice is out of sync with video and connections are unexpectedly dropped.

The problem arises because the Internet is based on packet, not circuit switching. All bit streams are split into frames of varying lengths and sent separately. Hence, the packets may arrive in a different order, or they may not arrive at all because the Internet drops packets if the network is congested.

This setup is a particular problem for audio traffic, since the humain ear is very sensitive to delay and degradation. Much work needs to be done before real-time audio and video services will be commercially viable. TCP/IP includes non of the requirements for service guarantees that commercial users will want.

Jon Crowcroft, an M Bone developer and a senior lecturer at University College London says

> " ...quality can vary. Some carriers over-engineer their backbones. Others under-engineer them. So multimedia can work fine on some links but not on others."

11.1 Addressing the Problem

Researchers upgrade IPv4 protocols to make them more acceptable for mainstream use. Among the key areas of work are:

- *The real-time protocol.* RTP is an experimental - though already much used - protocol that reduces end-to-end delay and errors. Its developers are hoping to resolve outstanding issues with the protocol within the next few months.
- *Multicasting routing protocols.* These are required to determine how and where to route multicast traffic, setting up and releasing virtual connections among many participants. Key tasks include informing other routers about changing group membership and building "distribution trees," which make the most efficient use of network resources. Existing examples include Protocol Independent Multicasting, an Internet Request for Comment (RFC) created two years ago that should soon appear in a number of commercial products.
- *Resource reservation protocols.* A key disadvantage of IP is that it does not allocate a specific piece of bandwidth to a particular session, so bandwidth can vary widely and unpredictably, making conversation impossible. A number of solutions proposed perform the same kind of function as Q.931 signaling in a circuit switched network.

  Most widely used has been Internet Stream Protocol Version 2, an RFC completed about 18 months ago. It mimics connection-oriented networks by working across different types of networks to reserve enough bandwidth on each link until the target is reached. This pre-allocation allows data packets to be forwarded with low delay, low overhead and low probability of loss from congestion, according to its designers, and is especially suited to high-quality video.

  A more recent protocol, almost complete, is RSVP. Its designers say it is best-suited to multicast conferences that involve many changing participants. With RSVP, the receiver identifies the quality of service required and sends a message back via the path.
- *Service definitions.* The IETF's Integrated Services Working Group is developing definitions of different types of service, including real-time and multicast services, and their needs. This information can then be included in devices such as routers, which can then prioritize, queue and route different traffic flows in different ways - giving priority to time-sensitive traffic, for instance.

11.2 Commercial Horizon

All these efforts will take a while to become commercially viable, Delgrossi from IBM says:

> "They are fine for small experimental networks, but I think commercial application in large networks is two to three years away."

Supporters, however, argue that the Internet's datagram model can be turned to its advantage, especially in view of the increasing interest in computer-supported cooperative working and groupware.

Unlike with ISDN, the bandwidth of an Internet link can vary dynamically and automatically. Users can add and drop applications during a single link without to having to dial up or drop capacity.

Moreover a single IP multicast bit stream uses the same bandwidth in the backbone network whether it is being routed to one or 10 or 100 correspondents, making it much more bandwidth-efficient whenever there are more than two corresponding partners.

UCL's Crowcroft says:

> " ... Collaborative work on shared documents is technically the easiest real-time application. You do get delay variation, but it is quite acceptable for this kind of thing. We use it routinely in our work and people are very happy with it. Only when precise lip sync or eye contact are required does delay become a major factor."

Much of the software for Internet-based team working already exist. Tony Rutkowski, chief executive of the Internet Society, says:

> "Mosaic software could be easily adapted for collaborative working. You can already go to sites and hold discussions in real-time with other people."

Others note the recent success on the Internet of Multi-User Dimensions, which create virtual spaces participants can enter to play fantasy games. The software used for them has already been adapted to create virtual classrooms for dispersed students and could also be used for groupware and computer supported cooperative working.

Marcus Speh, a Danish researcher who recently helped establish an Internet-based teaching program called the Globewide Network Academy says:

> "MUDs are evolving into serious environments for communications."

Although significant technical obstacles remain to widespread use of the Internet for groupware, conferencing and the like, the collective expertise of the Internet community will likely remove them sooner rather than later.

12 Internet Expansion

The Internet is no longer in danger of running out of address space, thanks to a revamped protocol in the works. But the Internet faces a capacity crunch of a different kind – one that is putting pressure on the global computer network's conventional pricing schemes.

Within a year, any undergraduate with a new Macintosh will be able to plug in a video camera and transmit the videos home to Mom, demanding as much as 1 Mbps. Since the maximum throughput on current backbones is only 45Mbps, it is clear that even a few users with relatively inexpensive equipment could bring the network to its knees.

To do audio-visual services on a large scale we are going to have to do something different. Otherwise, the network will be swamped. It has to protect itself. Increasing the pressure are World Wide Web and Mosaic, free and easy-to-use software for PCs, Unix workstations and Macintosh computers that enable non-technical people to create, transmit and retrieve large multimedia documents. In July 1994 these applications accounted for nearly 7% of traffic on NSFNnet, part of the Internet's US backbone, representing a 25-fold increase over the same month in 1993.

On the face of it, the commercialization of the Internet should help end "free" access to it. The universities spend tens of thousands of dollars a year on Internet access. They pay just the same as non-educational customers, and it is only free to the university end-users in the same sense that light and power a free to them. Moreover, the proportion of the Internet subsidized by the US government is rapidly declining and is probably already below 10 percent.

However commercialization does not mean that congestion is no longer an issue. Most Internet providers do not charge users by traffic volume – number of packets sent – but for a contracted, leased bandwidth, generally the capacity of the access circuit to the provider's point-of-presence.

Increasingly, dial-up Internet providers also charge in this way. In the United Kingdom, forc example, Demon Internet Ltd. charges dial-up users $10 ($15) per month, but nothing for connect time. Users do have to pay for the telephone call to the Demon's nearest point-of-presence.

Similarly, Internet providers themselves often have no mechanism for charging one another by the volume of traffic presented.

The Commercial Internet Exchange, an association of commercial Internet providers, has a policy of zero settlement: It assumes that the amount of traffic swapped is about equal. All members must accept all traffic presented by other members' users. Where charges are made, these are usually flat-rate contracts for raw bandwidth (46 kilobits per second, 2 megabits per second, etc.). Some aspects of this approach may be unsustainable. Providers that are offering unlimited access at a very low (fixed) price are soon going to be in trouble. Either they change their pricing structure or quality goes through the floor. There has to be some relation between level of use and charging. Rationing by queuing is the ultimate and arbitrary way of controlling access.

Others argue that the big influx of commercial users will itself threaten flat-rate pricing. Commercial users are more price-sensitive and very adept at least-cost routing. The result is that they will route traffic onto the flat-rate charged Internet that is actually very unattractive for providers, e.g., trans-Atlantic video or very large file transfers. One suggests that a two-tier charging system will emerge in which users will pay more for services that require higher quality, such as real-time video conferencing, which requires high bandwidth and low end-to-end delay.

The low and falling cost of transmission means that it often is not worth charging by volume. This is especially true on a large packet-switched internetwork, where it is much more difficult and expensive to monitor traffic than on a circuit-switched network. The lack of volume-based charging on the Internet is partly a result of its great efficiency.

Because the Internet is a connectionless packet switching network, it uses capacity much more flexible and fully than the circuit switch-based public network.

Moreover, Internet providers bypass the mechanism telephone companies use to pay each other for terminating calls. Instead, they directly lease and sub-lease high speed lines, taking advantage of the large economies of scale such lines offer. Typically, 64-kbps of bandwidth derived from a 45-Mbps Internet backbone might be one sixth the price of an end-to-end 64-kbps line leased from a telephone company.

Internet economies may have an impact well beyond the Internet, because it passes the true costs of modern telecoms usage on to the end-user. Nowhere is this point more plainly exposed than in the relative cost of sending a 20-page intercontinental fax over the public switched network versus an equivalent document over the Internet. The former costs 5 to 10 US$; the latter costs 5 to 10 cents. The Internet access market is brutally competitive and highly innovative.

13 References

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A International Network Connectivity

The country codes (and their names are defined in an international standard document called ISO 3166.

Country Codes

- - - - -	af	Afganistan	- - - - -	al	**Albania**
- - - - -	dz	Algeria	- - - - -	as	American Samoa
- - - - -	ad	Andorra	- - - - -	ao	Angola
- - - - -	ai	Anguilla	- I - - -	aq	Antarctica
- - - - -	ag	Antigua and Barbuda	B I U F -	ar	Argentia
- - U - -	am	Armenia	- - - f -	aw	Aruba
- I U F o	au	Australia	B I U F O	at	**Austria**
- - U - -	az	Azerbaijan	- - - - -	bs	Bahamas
b - - - -	bh	Bahrain	- - - - -	bd	Bangladesh
- - u - -	bb	Barbados	- - U F -	by	**Belarus**
B I U F O	be	**Belgium**	- - u - -	bz	Belize
- - - - -	bj	Benin	- - u f -	bm	Bermuda
- - - - -	bt	Bhutan	- - u - -	bo	Bolivia
- - - - -	ba	**Bosnia-Herzegovina**	- - u f -	bw	Botswana
- - - - -	bv	Bouvet Island	B I U F O	br	Brazil
- - - - -	io	British Indian Ocean Territ.	- - - - -	bn	Brunei Darussalam
b I U F -	bg	**Bulgaria**	- - U - -	bf	Burkina Faso
- - - - -	bi	Burundi	- - - - -	kh	Cambodia
- - u - -	cm	Cameroon	B I U F O	ca	Canada
- - - - -	cv	Cape Verde	- - - - -	ky	Cayman Islands
- - - - -	cf	Central African Republic	- - - - -	td	Chad
B I U F -	cl	Chile	- - u - O	cn	China
- - - - -	cx	Christmas Island	- - - - -	cc	Cocos (Keeling) Islands
B - u - -	co	Colombia	- - - - -	km	Çomoros
- - u - -	cg	Congo	- - u - -	ck	Cook Islands
b I u f -	cr	Costa Rica	- - u f -	ci	Côte d'Ivoire
- I u F o	hr	**Croatia**	- - u - -	cu	Cuba
b I - - -	cy	Cyprus	B I U F -	cz	**Czech Republic**
b I U F O	dk	**Denmark**	- - - - -	dj	Djibouti
- - - - -	dm	Dominica	- - U f -	do	Dominican Republic
- - - - -	tp	East Timor	b I u - -	ec	Ecuador
b I U - -	eg	Egypt	- - - - -	sv	El Salvador
- - - - -	gq	Equatorial Guinea	- I U F -	ee	**Estonia**
- - - f -	et	Ethiopia	- - - - -	fk	Falkland Islands
- - u - -	fO	Faroe Islands	- I u - -	fj	Fiji
B I U F O	fi	**Finland**	B I U F O	fr	**France**

Country Codes

- - u - -	gf	French Guiana	- - u - -	pf	French Polynesia
- - - - -	tf	French Southern Territ.	- - - - -	ga	Gabon
- - - - -	gm	Gambia	- - U F -	ge	Georgia
B I U F O	de	**Germany**	- - u F -	gh	Ghana
- - - - -	gi	Gibraltar	B I U F O	gr	**Greece**
- I - f -	gl	Greenland	- - u - -	gd	Grenada
b - u f -	gp	Guadeloupe	- I - F -	gu	Guam
- - u - -	gt	Guatemala	- - - - -	gn	Guinea
- - - - -	gw	Guinea-bissau	- - - - -	gy	Guyana
- - - - -	ht	Haiti	- - - - -	hm	Heard and McDonald
- - - - -	hn	Honduras	b I - F -	hk	Hongkong
B I U F o	hu	**Hungary**	- I U F o	is	**Iceland**
b I U f O	in	India	- - u - -	id	Indonesia
b - - - -	ir	Iran	- - - - -	iq	Iraq
B I U F O	ie	**Ireland**	B I U F -	il	**Israel**
B I U F O	it	**Italy**	- - u - -	jm	Jamaica
B I U F -	jp	Japan	- - - - -	jo	Jordan
- - U f -	kz	Kazakhstan	- - - f -	ke	Kenia
- - u - -	ki	Kiribati	- - - - -	kp	Korea (People's Rep.)
B I U F O	kr	Korea	- I - - -	kw	Kuwait
- - U - -	kg	Kyrgyz Republic	- - - - -	la	Laos
- I U F -	lv	**Latvia**	- - - - -	lb	Lebanon
- - u - -	ls	Lesotho	- - - - -	lr	Liberia
- - - - -	ly	Libya	- I - f -	li	Liechtenstein
- - U F o	lt	**Lithuania**	B I U F o	lu	**Luxembourg**
- - - f -	mo	Macao	- - u - -	mk	Macedonia
- - u - -	mg	Madagascar	- - - f -	mw	Malawi
b I U F -	my	Malaysia	- - - - -	mv	Maldives
- - U - -	ml	Mali	- - u - -	mt	Malta
- - - - -	mh	Marshall Islands	- - - - -	mq	Martinique
- - - - -	mr	Mauretania	- - u f -	mu	Mauritius
- - - - -	yt	Mayotte	B I u F -	mx	Mexico
- - - - -	fm	Micronesia	- - u F -	md	Moldova
- - - - -	mc	Monaco	- - - - -	mn	Mongolia
- - - - -	ms	Montserrat	- - - - -	ma	Marocco
- - U f -	mz	Mozambique	- - - - -	mm	Myanmar
- - U f -	na	Namibia	- - - - -	nr	Naura
- - - - -	np	Nepal	B I U F O	nl	**Netherlands**
- - u - -	an	Netherlands Antilles	- - - - -	nt	Neutral Zone
- - U - -	nc	New Caledonia	- I U F -	nz	New Zealand
- - u - -	ni	Nicaragua	- - u - -	ne	Niger
- - - f -	ng	Nigeria	- - u - -	nu	Niue
- - - - -	nf	Norfolk Island	- - - - -	mp	Northern Mariana Islands
B I U F O	no	**Norway**	- - - - -	om	Oman
- - U - -	pk	Pakistan	- - - - -	pw	Palau
b - u F -	pa	Panama	- - u - -	pg	Papua New Guinea
- - u - -	py	Paraguay	- - U f -	pe	Peru
- - u F -	ph	Philippines	- - - - -	pn	Pitcairn
B I U F -	pl	**Poland**	b I U F O	pt	**Portugal**
- - - - -	qa	Quatar	- - u - -	re	Reunion
B I u f -	ro	**Romania**	B I U F -	ru	**Russian Federation**
- - - - -	rw	Rwanda	- - - - -	sh	Saint Helena

Country Codes

- - - - -	kn	Saint Kitts and Nevis	- - u - -	lc	Saint Lucia
- - - - -	pm	Saint Pierre & Miquelon	- - - - -	vc	Saint Vincent & Grenadines
- - u - -	ws	Samoa	- - - - -	sm	San Marino
- - - - -	st	Sao Tome and Principe	B - - - -	sa	Saoudi Arabia
- - U f -	sn	Senegal	- - u - -	sc	Seychelles
- - - - -	sl	Sierra Leone	b I u F -	sg	Singapore
b I U F -	sk	**Slovakia**	- I U F O	si	**Slovenia**
- - u - -	sb	Solomon Islands	- - - - -	so	Somalia
- I U F O	za	South Africa	b I U F -	su	Soviet Union (former)
B I U F O	es	**Spain**	- - U - -	lk	Sri Lanka
- - - - -	sd	Sudan	- - u - -	sr	Suriname
- - - - -	sj	Svalbard and Jan Mayen	- - u - -	sz	Swaziland
B I U F o	se	**Sweden**	B I U F O	ch	**Switzerland**
- - - - -	sy	Syria	B I u F -	tw	Taiwan
- - u f -	tj	Tajikistan	- - - f -	tz	Tanzania
- I U F -	th	Thailand	- - u - -	tg	Togo
- - - - -	tk	Tokelau	- - u - -	to	Tonga
- - u - -	tt	Trinidad and Tobago	b I U f o	tn	Tunesia
b I - F -	tr	**Turkey**	- - u - -	tm	Turkmenistan
- - - - -	tc	Turks and Caicos Islands	- - - - -	tv	Tuvalu
- - - f -	ug	Uganda	- I U F -	ua	**Ukraine**
- - - - -	ae	United Arab Emirates	b I U F O	uk	**United Kingdom**
B I U F O	us	United States	- - U F -	uy	Uruguay
- - U F -	uz	Uzbekistan	- - u - -	vu	Vanuatu
- - - - -	va	Vatican City	- I U - -	ve	Venezuela
- - u - -	vn	Vietnam	- - - - -	vg	Virgin Islands (UK)
- - - f -	vi	Virgin Islands (USA)	- - - - -	wf	Wallis and Futuna Islands
- - - - -	eh	Western Sahara	- - - - -	ye	Yemen
- - u f -	yu	**Yugoslavia**	- - - - -	zr	Zaire
- - - f -	zm	Zambia	- - u f -	zw	Zimbabwe

Key to Connectivity Table	
Key	**Type of Connectivity**
- - - - -	No verified connectivity
B	b Itnet Connectivity
I	Internet Connectivity
U	UUCP Connectivity
F	Fidonet Connectivity
O	OSI Connectivity

Lowercase letters indicate minimal connectivity; uppercase indicate widespread Connectivity. The information in this list is available from the anonymous FTP site `ftp.wisc.edu` in the directory connectivity_table. Physical societies in **bold printed** countries are member of the European Physical Society.

B EPS on WORLD-WIDE-WEB (WWW)

The mainly used information retrieval systems on the Internet are GOPHER[14], WAIS[15] and the WORLD-WIDE-WEB. All work on a client-server paradigm, and all provide some degree of support for multimedia data.

WORLD-WIDE-WEB (Also known as WWW or W3) is a large-scale distributed hypermedia system. W3 is started and driven by CERN[16]. The Web consists of nodes (also called documents)

[14] The Internet Gopher is a distributed document delivery service. Gopher presents the user with a hierarchical arrangement of nodes which are either directories (menus), leaf nodes (documents containing text or other media types), or search nodes (allowing some set of documents to be searched using keywords, possibly using WAIS.

[15] The Wide Area Information Server (WAIS) system allows users to search for and retrieve information from databases anywhere on Internet.

[16] All information wanted about W3 can be retrieved from CERN, just do www CR and follow the rules

and links. Links are connections between documents: to follow a link, the user clicks on a highlighted word in the source document, which causes the linked-to document to be retrieved and displayed. A document can be one of a variety of media types, or it can be a search node in a similar sense to Gopher. The WWW addressing method means that WAIS and Gopher servers may also be accessed from (indeed, form a part of) the Web. WWW has a smaller penetration than Gopher, but is growing much faster. The Web technology is being revised to take better account of the needs of multimedia.

W3 can be used with client *browser* software responsible for fetching and displaying data. Originally aimed at the Particle Physics community, it has spread to all other areas.

Browser software is available for a large number of systems including: Line-mode dumb terminal, Terminal with Curses support, Macintosh, X/Motif, X11, PC/MS Windows and Next. Server software is available for: VM Mainframes, UNIX, Macintosh and VMS.

The WWW addressing mechanism means that an interface to Gopher and anonymous FTP information sources may be established in a way which is transparent to the user. The the whole of gopherspace is part of the Web. Transparent gateways to other systems are also available.

C EPS and EWCC

EWCC, the East-West Coordination Committee main task is to make information available for the physicists and physical societies in East- and Central Europe, the Baltic states and in the republics of the Former Soviet Union. World-Wide-Web is the obvious choice to present the available information to the people who need it. With the help of colleagues from CERN and NIKHEF a W3 server for EPS was set-up, first in experimental mode.

The full address is: `http://www.nikhef.nl/www/pub/eps/eps.html`.

The main page (and all other subsequent documents) is written in HTML the Hyper-Text Markup Language[17] and looks on an intelligent workstation as:

[17] see Tim Berners-Lee, Hypertext markup Language, CERN 1993

European Physical Society

The European Physical Society serves the dual purpose of providing a forum for individual physicists, and acting as a federation of national societies and academies.

Since the foundation of the EPS in 1968, its membership has steadily increased. About 4500 physicists from over 30 countries and with a variety of occupations, are **individual members**, while the number of member societies now totals 33. Essentially all the countries of **Europe** which have an active physics community are represented. Moreover, scientific communities with strong physics interests, more directly identified with other disciplines or regions of the world outside Europe, are involved as **collaborating societies**, while **research centres** and commercial organizations participate as **associate members**.

The EPS is governed by a **Council** which includes delegates appointed by the **member societies** and delegates elected by the individual members and by the associate members. Council elects from amongst its number an **Executive Committee** which is responsible for the running of the Society, with the support of two permanent **Secretariats**. The scientific activities of the EPS are organized through seven **Divisions**, covering the major sub-fields of physics, and six **interdivisional groups**. These are also represented in the Council.

In addition, five **Action Committees** are concerned with various aspects of international collaboration and interactions between the physics community and society.

In September 1990 the EPS General Assembly decided to help the East and Central European members to integrate in the European physics world. To that purpose the Executive Committee installed the East-West Coordination Committee **(EWCC)**.

EPS sponsored **meetings** are organized by EPS Divisions, Sections, Groups and Action Committees and have been approved by the EPS **Action Committee** on Conferences.

EPS publishes different **periodicals**. All members receive the monthly bulletin **Europhysics News**. latest information can be found **here**.

The EPS gives special attention to young physicists a.o. through the European Mobility Scheme for Physics Students operated by the **Mobility Committee**.

December 1993, revised January 1994, E.W.A. Lingeman (ed@nikhef.nl)

Clicking with the mouse on the bold printed words will give more information in another document. On systems without a mouse the words are followed by a number, typing this number brings one to the same document.

Behind **(EWCC)** more than sixteen documents are hidden in this test phase. One of the major documents, to be retrived by anonymous FTP is the newly published directory of the Physics Institutes in Central Europe. This book is available in print at the Geneva main secretariat for CHF 120.-

D The EWCC Page

The EWCC page, placed in an eps subdirectory `/eps/ewcc/` looks like:

European Physical Society
East-West Coordination Committee

The East-West Coordination Committee (EWCC) was created by the EPS Executive Committee (EC) on request of the EPS General Assembly at its meeting in Amsterdam in September 1990. The committee started as East-West Task Force of the Executive Committee, chaired by the EC member Otto Folberth. As secretary the EC appointed Eddy Lingeman, members were representatives from the physical societies of Poland, Czechoslovakia, Hungary, Romania and Bulgaria and Owen Lock from CERN.

Because of the very difficult financial situation of the EPS at the start of the Task Force, it was decided that the committee should provide its own finances. To that purpose the German Physical Society (DPG), the Institute of Physics (IOP) and the Dutch Physical Society (NNV) made the **Europhysics Foundation**. At the end of the term of professor Folberth as member of the Executive Committee, the Task Force was transformed into an action committee under its actual name *East-West Coordination Committee*, as chairman the EC appointed André **Landesman**. In 1992 **membership** almost doubled.

One of the tasks of EWCC is making available information about physics and physicists in East and Central Europe, in the Baltic countries, in Belarus, Ukraine and Russia.

This information is collected in directories, published by **EPS** in Geneva. These directories are also available through **anonymous ftp**. Published **documents and conference proceedings** are available via W3, anonymous ftp or on request at the **Geneva main office**.

December 1993, revised January 1994, E.W.A. Lingeman (ed@nikhef.nl)

The documents made availabe[18], to be retrieved by anonymous FTP are:

- `albania.ps` physics institutes in Albania
- `austria.ps` physics institutes in Austria
- `bulgaria.ps` physics institutes in Bulgaria
- `croatia.ps` physics institutes in Croatia
- `czech.ps` physics institutes in the Czech Republic
- `hungary.ps` physics institutes in Hungary
- `poland.ps` physics institutes in Poland
- `romania.ps` physics institutes in Romania
- `slovak.ps` physics institutes in Slovakia
- `slovenia.ps` physics institutes in Slovenia

The separate chapters of the EPS Directory of Physics Institutes in Central Europe. There are two more files available, these are compressed and retrievable in binary form. These are

- `baltic.ps.Z` Physics in the Baltic Countries: Estonia, Latvia and Lithuania, and the Nordic Countries: Denmark, Iceland, Norway, Sweden and Finland. The document is 154 pages long, ©EPS.
- `fsu.ps.Z` Physics Research in the Former Soviet Union (FSU), the 4^{th} revised edition. The document is 278 pages long, ©EPS.

Please look up this EPS information and send your comments, questions etc. to ed@nikhef.nl.

Amsterdam, 5 January 1994
E.W.A. Lingeman

[18] not all, in this test phase we do not have enough disk space to put all available documents in postscript format

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