



Trevor D. Craddock,
PhD

THE WIDE WORLD OF INTERNET

THE INFORMATION SUPER-highway has recently received a great deal of media coverage. Its full potential has yet to be realized, but an information highway in the form of Internet has been in existence for many years and is growing exponentially. Researchers and academics have been taking full advantage of the services, but it has been a well-kept secret

within the academic community. With more commercialization, the veil over that secret is being lifted, and computer users who do not have affiliation with academic institutions are being provided access to the Internet and its wealth of resources.

The facilities available for connecting to the world at large may be divided broadly into four groups: electronic mail and list servers that allow individual users to contact and send messages to each other directly, and in the case of list-servers, to distribute any messages to a wider audience; file servers, which are, in effect, repositories for information and data that may be accessed via Internet to either send or receive particular files; UseNet, which constitutes a bulletin board-type of system—at last count there are some 2,700 topics groups of interest in this system; and several other services such as Archie, gopher, WAIS, World Wide Web and Mosaic, that use the facilities provided by the Internet so users may determine what is available and where it might be obtained and to browse the contents of a truly distributed database.

In a sense, Internet can be regarded as a huge repository of information like a library, and it is therefore necessary to know how to navigate in that environment and how to find the items of use to you.

Electronic mail

Electronic mail provides private communication between individuals. The sender composes a message which is then "packaged" within an electronic envelope by the e-mail software and is then sent to the recipient's mailbox, where it waits for the mailbox to be opened and the message read.

The advantages of electronic mail are that it provides rapid communication—on the order of seconds to hours to reach destinations across the world. If the particular mailing software allows it, large volumes of data such as source code can be sent by this means. The transmission of electronic mail is restricted to ASCII data so that it is not possible to send binary data unless it has been encoded in some way. Electronic mail avoids interruptions, as from telephone calls, and avoids the frustrating game of phone-tag.

Some disadvantages of electronic mail are that some nodes on the network tend to be "fragile," so that instead of mail being stored and forwarded when the ongoing links of a network are interrupted, the mail is bounced back to the sender.

When, however, one considers the huge numbers of nodes on the Internet (which was something on the order of 25 million in 1993), some of the nodes understandably may be fragile. Mail can sometimes disappear, though this is rare. The sender receives no acknowledgement of delivery, except in rare situations (this, of course, is no different than the standard postal service, unless one requests that a package be sent by registered mail). Electronic mail's efficiency depends greatly on the user reading the electronic mailbox at regular intervals. Many users have e-mail addresses but frequently forget about their mailboxes, and it is possible to send a message which, although it arrived at its destination, remains unread.

List Servers

When a number of individuals share a common interest, it is natural that mail sent between individuals within that group might well be of interest to others. This group interest has led to the establishment of list servers or mail bursters where messages can be sent to a central address where it is then burst to the larger number of individuals on this list. Some mailing lists are moderated by an editor to reduce the amount of junk that might otherwise flood the network.

The obvious advantages of mailing lists are that they provide information sharing to large groups of users and facilitate the online discussion of topics of interest. One such list server is the one established for the discussion of Interfile, which allows individuals involved in Interfile development to post suggestions to the group and seek discussions on various proposals.

Unfortunately, by its very nature, electronic communications can become somewhat impersonal. And when large groups who may not know each other are involved, it is easy to hide under the guise of anonymity and send messages intended to invoke hostility among list members—messages known as "flames." From a management viewpoint, it is difficult to maintain large lists due to the constant address changes and the problems associated with bounced mail resulting from unreachable nodes on the network. But software exists for automatic mailing list management, although this does take away from the personal nature of the list management.

File Servers

File servers are data repositories that serve the public or the needs of an interest group. They can be accessed by anonymous ftp—File Transfer Protocol—and in some instances data may also be retrieved by sending an e-mail message requesting the data to a particular server address.

The obvious advantages here are that file servers operate automatically and thus require little maintenance except by the data keeper, who is responsible for ensuring the data are up-to-date. Large data files can be stored in such file servers and, unlike electronic mail bursters which contact everyone on the list, access need only be made to the file server when informa-

tion is needed, reducing traffic.

The disadvantages of such systems are that, although they can store large amounts of data, those data require significant storage space, which the individual node in effect donates to the community. The user also does not know what is in the file server or where they may exist.

Some file servers are very well known and are extremely popular. One file server serves as a repository for MS-DOS programs on SIMTEL 20. Because this server is so popular, access to it is difficult; sometimes the user may obtain files on it only when net traffic is slow—in the early morning or on weekends. File server maintainers need to be aware of network security because, if users are allowed to login to the system anonymously, there is then an access route to individuals who have less than legitimate goals.

UseNet

Most of the nodes connected to Internet also subscribe to UseNet, an immense bulletin board system. In June 1993, there were an estimated 25 million nodes connected to Internet, and UseNet had more than 2,700 different news groups or interest groups. Some of these news groups may be moderated, but most are not.

The advantages of UseNet are that it reaches a wide audience and almost any topic can be found, from alt.sex to rec.humor to (probably!) zoology.aardvarks. Because it is a bulletin board, a user may register for only the news groups of interest; by looking at the subject heading of the posted messages, the user may select the ones to read. This set-up differs from that of a mailing list, which has every individual on the list receiving messages sent to the central address. Because it is not a mailing list, UseNet does not require such list maintenance.

Once again the impersonality of electronic communication can lead to acrimonious verbal assaults on individuals (whether justified or not), and these will all be open to the public eye. Some of the news group subjects may be of questionable interest; some users may suggest that some subjects are "beyond the fringe." But one need not subscribe or view any such material. (It is from such sources that high school students have been able to download pornographic digital images.) One consequence of these dubious subjects is that some universities deny access to all of the alt.newsgroups.

With such a large number of news groups and multiple postings to them in every 24 hours, there is a requirement for a very high bandwidth on the network. Some users respect this requirement and keep their messages to a minimum or respond by direct electronic mail to the poster of messages that they may be interested in, even if their reply may not be of particular interest to other readers of the news group.

A user may respond to UseNet postings through three possible mediums. Should the response be of interest all of the news group readers the user should post a follow-up message. On the other hand, if one wishes to communicate directly with the poster of the original message and the information is not likely to be of interest to the whole group, then the appropri-

ate medium is electronic mail. And if one's response is likely to be provocative or insulting, the appropriate medium is the wastebasket.

Radiology Related List Servers

There are several facilities available to the radiology or nuclear medicine community.

Loyola University in Chicago operates a bulletin board service known as LUNIS, standing for Loyola University Nuclear Medicine Information Service (see *Newsline*, February 1994, p. 20N). This is primarily a bulletin board, although electronic mail facilities are available, and a form of file server is available as a library of files. For further information, contact jhalamalunis.nucmed.luc.edu.

The author manages an electronic mailing list known as nucmed out of the University of Western Ontario in London (see below).

George Sherouse of Duke University (Durham, NC) has been managing a mailing list directed towards radiation therapy physicists. One may contact medphys.request@radonc.duke.edu for further information.

Beth Harkness at Bowman-Gray School of Medicine (Salem, NC) has recently established a mailing list for users interested in PET technology. Address inquiries to beth@ncbap-sun2.pet.wfu.edu.

In diagnostic radiology, Alan Rowberg manages a mailing list for radiology interests out of the University of Washington in Seattle. For more information, contact radsig-request@washington.edu.

Radsafe is a list for radiation protection interests that is managed by Howard Mandel at the University of Iowa. One may subscribe to it by sending an e-mail message to listserv@romulus.ehs.uiuc.edu and, in the body of the message, place the words:subscribe radsafe your_name.

nucmed

The nucmed mailing list was established in April 1987, starting with about 25 names on the list. It was originally intended as a forum for discussing Interfile but rapidly developed into a mailing list of wider interest to the nuclear medicine community, although it still tends to address the needs of physicists and engineers rather than physicians. In March 1994, there were more than 850 names in the directory, and, of these, some 400 individuals were actually receiving mail through the mailing list. This list operates as a simple mail burster, and messages may be sent to nucmed@uwo.ca. Messages sent to that address will be distributed to all of the users on the list in as many as 31 different countries on all five continents. Not all of the electronic mail is burst from London, Canada; there is a sublist at the Academic Medical Centre, University of Amsterdam, and all of those users outside of North American and Argentina receive their mail through that sublist.

There are 15-20 postings per month, including a monthly updated calendar of nuclear medicine meetings, reports of meetings, requests for help and responses, and comments on

topics of interest to list members (including radiation protection).

nucmed File Server

This file server is included within the general file server at the University of Western Ontario. It may be accessed by anonymous FTP to the address **uwovax.uwo.ca** or the IP address **129.100.2.13**. You may also access the file server by e-mail by addressing a message to **service@uwovax.uwo.ca**. The files of particular interest to nuclear medicine are contained in a directory called **pub:[000000.nucmed]** and its sub-directories.

This file server, established in January 1988, was originally intended to serve the needs of the COST-B2 Working Group

Root	— List of files plus calendar
Infertile	— Official Internet documentation
Meetings	— Reports of Meetings
People	— Listing of e-mail addresses
Phantoms	— Some sample software phantoms
Programs	— Public Domain Programs

Table 1. Subdirectories within the file server.

#1, mandated to develop Interfile. Since then, the interests have widened so that several subdirectories exist within the file server (Table 1.) Financial support for both the nucmed mailing list and the file server is provided by the Society of Nuclear Medicine Computer and Instrumentation Council, the American Association of Physicists in Medicine Nuclear Medicine Special Interest Group, and the Medical Faculty Central Computing Facility, University of Amsterdam.

Jim Halama at Loyola University (Chicago, IL) manages the LUNIS bulletin board, which originated as RADnet on CompuServe. Although not financially viable on CompuServe, LUNIS now receives financial support from Siemens Medical Systems, Toshiba American Medical Systems, Medipysics, the Bruner Foundation, and Loyola University.

The major emphasis is on a bulletin board system; however, e-mail can be sent to other subscribers on LUNIS and outside to other Internet nodes, and subscribers to LUNIS may receive e-mail from Internet nodes. There is an online conferencing facility, but this seems to be very little used. A library of files similar to a file server exists, although access is restricted to LUNIS subscribers. It is not possible to use anonymous ftp to download files from the library. Access is via either 9600 band modems or 2400 band modems and 800 numbers throughout North America. The TELENET address is **147.126.104.1** for those who may wish to access LUNIS from the Internet. A user with Internet activity is encouraged to use this route to keep charges low as possible.

LUNIS began in May 1990, with origins in June 1988 on CompuServe. There are now well over 800 subscribers, of whom about 200 login at least once per month, averaging about 70 logins per day. Twenty percent of those logins are from Internet-connected subscribers. The topics of discussion

are primarily clinical, educational, economics, and nuclear medicine politics in the U.S., although radiation protection and safety are sometimes addressed.

radsafe

Radiation Safety Officers primarily subscribe to this mailing list, which deals with radiation safety issues, particularly licensing conditions in the U.S. There is often comment about non-ionizing radiation. Postings run at about two or three per day, and, like most mailing lists, someone occasionally raises a controversial issue that will prompt a flood of replies.

Imaging Related News groups

Of the many available UseNet news groups, several may be of interest to users in nuclear medicine. **alt.image.medical** includes discussion of image formats such as Interfile and DICOM as well as queries and responses relating to file formats for CT and MRI images. Another news group called **comp.protocols.dicom** has been established to address DICOM-3.

comp.graphics.visualization does not deal specifically with medical images but may at times have discussion of some interest to users dealing with nuclear medicine imaging and image processing.

sci.med.physics sees discussion on a wide range of topics, but much seems to be inquiries into hazards of radon and low frequency electromagnetic radiation or to come from students seeking graduate schools for medical physics. **Sci.med.physics**, begun in June 1989, claimed on the order of 2,000 readers that year—about 0.5% of the total UseNet readership at that time. By March 1992, the number of readers had risen to about 20,000 or 0.9% of the total UseNet readership. The factor of ten in growth of readership but only two in growth of percentage of readership reflects the exponential growth of UseNet. The average posting rate in early 1994 is about three to four postings per day, reflecting an even greater audience. With the millions of potential readers around the world, it becomes very difficult to estimate the total readership.

Searching the Internet

Navigation through the Internet requires the software to access other nodes. In one case, using ftp may open a connection to a remote node and either send or receive files from that system. The size of files is without limit, and they may be either ASCII or binary files. A large number of machines that act as repositories of information or programs allow access by anonymous ftp, meaning that the user does not need an account on that machine to gain access. In all circumstances, the scope of access is limited, and in many cases the user will, for security's sake, only be able to fetch files from the system, not send them.

Access to a remote host by ftp may be regarded as a relatively passive process. To run programs at a remote host, it is necessary to use the program telnet, which connects the user to a remote host and allows the user's computer to act as a terminal to that host. Thus the user could, for example, open and

examine files on the remote host rather than transfer the files for further reading. The sorts of programs that one might wish to run on a remote host (described below) all relate to searching for or looking at information on remote hosts.

A major problem associated with Internet is knowing where and how to find the information that the user realizes must exist somewhere on one of the connected machines. Many Internet users have faced this dilemma, and several services have consequently been developed to provide easier access to files and facilities.

One such server program is Archie, which allows a user to locate a file by name. It has a limited facility to search for a file by topic, the limitation primarily being that one must know the name of the file being sought. Archie indexes about 1,200 anonymous FTP servers, with a total of over 2 million files online. (Table 2 shows public archive servers that may be accessed in different countries.) Archie indicates where to look for data. For example, a user wanting information on pencils would issue the command:

```
%archie -s pencils
```

for which the response might be:

```
Host blandsworth.usnd.edu
```

```
Location: /pub
```

```
Directory drwxr-xr-x 512 May 17 05:19 pencils
```

This response indicates that there is a directory called pencils (that might be expected to contain some useful information) on the machine called blandsworth at the host usnd.edu.

Wide Area Information Servers (WAIS)

As stated, one difficulty with Archie is the fact that in most instances one must know the name of the file for which the search is being made; Archie merely returns the locations at which that file may be found. When one needs to search for information of a more general nature with only a few available key words, it is necessary to use a service like WAIS. With WAIS, database sources become available and searches can be made based on text strings. Entry of key words enable WAIS to search whole libraries and return with the information of where the relevant data may be. A score is attached, giving a relative ranking between 1 and 1,000 of how closely the item matches the inquiry. Once the data source has been established, one can use a service such as Archie to access that source to retrieve the information. For example, using WAIS, it was possible to search the index of the local London Free Press for all items relating to "public health" and return a list of 40 headlines that could be accessed at the library.

gopher

This menu-driven system provides access to hundreds of Internet resources and services with a single interface that is simple to understand and easy to use. Although the user may appear to be selecting an item from a menu on a local server, that server may in actuality then refer the user to one of hundreds of other gopher servers around the world which will then provide access to the requested information. The information available on gopher includes weather reports, electronic phone books, access

Country/State	Archie Server name
Australia	archie.au
Canada	archie.mcgill.ca
Finland	archie.funet.fi
UK/Ireland	archie.doc.ic.ac.uk
Maryland	archie.sura.net
Nebraska	archie.unl.edu
New York	archie.ans.net
New Jersey	archie.rutgers.edu

Table 2. Public Archie Servers.

to libraries around the world, technical reports, databases, literature, and of course information about the user's local site. Gopher does not provide information such as the source and location of a file the user may want to retrieve, so it will unlikely provide sufficient information to allow the user to use Archie to find a file's location. In a sense, gopher behaves like a reference library, but it is actually a large number of reference libraries connected so the user can seamlessly move from one client server to another to obtain information (Table 3).

Mosaic and WWW

Perhaps the most exciting development in the past year has been Mosaic, an Internet "browser." This public domain software package is available for the Macintosh, Unix platforms, and the PC developed by the NCSA at Urbana, IL. (Look in the publicly accessible directory /pub/Mosaic.) It enables the user to browse hypertext or non-hypertext documents in publicly accessible file servers anywhere in the world using the World Wide Web (WWW) search protocols. The hypertext links built into the documents allow the reader to access other resources that may (or may not) be located at the same site. These hypertext resources are frequently in multimedia format, so that a medical text may describe the symptoms of a disease, allow the user to view an associated radiograph or nuclear medicine study, listen to the typical chest sounds, and even watch a movie clip of the patient demonstrating the condition.

The Radiology Department at the University of Iowa has contributed to a valuable teaching resource there called the VirtualHospital. The material is fairly limited now but is growing rapidly as the Iowa team produces more modules and makes them available. At Harvard, the Radiology Department has made a teaching file of bone scans available through Mosaic, and more such image databases will undoubtedly become available soon. Because such databases can be easily updated, this form of "medical textbook" will be able to present the most recent examples of studies and will constitute one of the major resources for continuing education.

Mosaic is not limited to medical data; indeed, the resources discussed above constitute a small part of the large bank of information available to Internet "surfers." For example, the pictures from the repaired Hubble Space Telescope were available within a couple of weeks of the repairs. It is possible to view the images from weather satellites and the movies of

Hostname	Login ID	Geographical Area
consultant.micro.unm.edu	gopher	North America
gopher.uiuc.edu	gopher	North America
gopher.uwp.edu	gopher	North America
panda.uiowa.edu	panda	North America
info.uiuc.edu	info	Australia
gdunix.gd.chalmers.se	gopher	Sweden

Table 3. Public Telnet Gopher Sites.

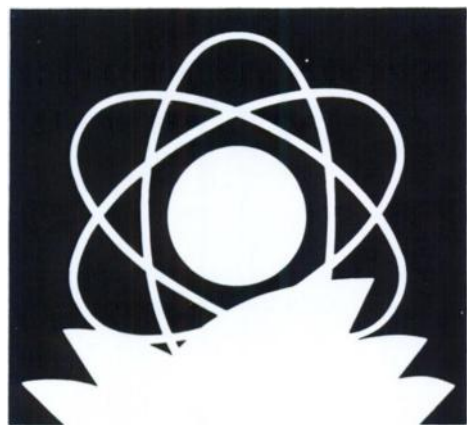
weather patterns used by forecasters.

Conclusion

The Internet provides a vast resource of information, data, and shared programs. On the more personal level, users may

communicate by electronic mail or via mailing lists and bulletin boards to exchange information and inquire where apparently elusive information may be. On a less personal level, users may access various services such as Archie, WAIS, gopher, and Mosaic to navigate through a Internet and gain access to this vast array of information. Once one has established a local area network, it should be connected to the Internet so the users may access these various services. This world-wide interconnectivity has allowed hospitals and universities to establish agreements with other remote institutions to engage in collaborations. Moscow State University signed an agreement last fall with the University of Western Ontario to collaborate in the teaching of medical students because of the access that the Internet can provide to teaching resources at UWO.

Trevor D. Craddock, PhD, FCCPM, ABMP



**6th WORLD CONGRESS
OF THE WORLD FEDERATION OF
NUCLEAR MEDICINE & BIOLOGY**

**23 - 28 OCTOBER 1994
S Y D N E Y**

**THE WORLD FEDERATION OF NUCLEAR
MEDICINE & BIOLOGY**

SIXTH WORLD CONGRESS

SYDNEY, AUSTRALIA

23 - 28 OCTOBER 1994

Pre-Congress Symposia will be held in Cairns, North Queensland on 19 - 21 October 1994. Pre & Post Congress Tours to the Great Barrier Reef, Ayers Rock & Northern Territory will be available.

FURTHER INFORMATION

Congress Secretariat
GPO Box 2609
Sydney NSW 2001
AUSTRALIA

Telephone: (61 2) 241 1478
Facsimile: (61 2) 251 3552