Internet Access: A Course Diagram

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ABSTRACT: *Many large organizations are using the Internet as a vehicle for communication and marketing. Future IS professionals will require an understanding of how to use and configure this resource. At the University of Nevada Las Vegas, a semester course was designed and implemented to address both the specific needs of the IS computing community and the broader student community. First, IS students gained proficiency accessing the Internet as a vehicle to gather research information for other courses and communicate with their peers electronically. Second, these students gained an understanding of the computer hardware, software and data communications equipment necessary to install, configure and maintain an Internet connection. This paper describes the computer resources required to implement the course, the course curriculum, course adaptations for the future, and observations related to student understanding and development.*

KEYWORDS: *Internet, Mosaic, WWW*

INTRODUCTION

Corporations, governmental entities, educational institutions, and private citizens worldwide are establishing Internet connections. Currently over 1.3 million computers are connected to commercial networks and another 1.1 million to educational networks in the United States. Worldwide, nearly five million computers are connected. Table 1 and Table 2 illustrate the growth and size of the Internet today. [1]

Currently, most large companies, and nearly all computer vendors, use the Internet as a mechanism to disseminate and exchange technical and sales information to their customers, communicate internal memoranda, provide technical support, and obtain customer feedback. Furthermore, many startup companies provide Internet connectivity, advertising, and computer based retail shopping. Consequently, future IS professionals need to understand how to use Internet applications, and configure the appropriate computer hardware and software necessary to provide an Internet connection.

The Internet Access course is designed as a 3 credit hour seminar course for junior and senior level IS students possessing basic personal computer skills and a fundamental understanding of computer networks. The course is also appropriate for students who are not IS majors as they will be able to use the Internet as a research tool in their respective discipline.

Additionally, IS professionals will find this course suitable for continuing education.

The structure of the class consists of lectures accompanied by on line demonstrations of Internet access and host configuration. Regular assignments are distributed using electronic mail and returned to the instructor electronically. This is intended to improve the students proficiency with electronic mail, text editing and generally increase the amount of time the student spends using the computer. Additionally, this mechanism is intended to demonstrate practical uses of the network.

LEVELS FOR INTERNET ACCESS

Internet access has been categorized into four levels of service. [2]

1) Computers with full access have a permanent attachment to the Internet and are directly visible to other computers attached to the network

2) Computers with client access may run Internet applications but with part time access. These hosts may or may not be visible to the Internet at any given time

3) A user accessing the network from a terminal connected to an Internet service provider using telephone lines is considered to have mediated access.

4) A user having no access other than through electronic mail and Usenet News is said to have messaging access.

For the purposes of this course, laboratory

Table 1: Connected Computers

Date	Hosts
August 1981	213
August 1983	562
October 1985	1961
December 1987	28,174
October 1989	159,000
October 1990	313,000
October 1991	617,000
October 1992	1,136,000
October 1993	2,056,000
October 1994	3,864,000
August 1995	6,642,000

Table 2: Connected Computers

Date	Networks
October 1989	837
October 1990	2063
October 1991	3556
October 1992	7354
October 1993	17979
October 1994	41520
March 1995	50344

and demonstration computers with full or client access are used to access the network. Students with home personal computers may have mediated access either through a local Internet provider or the University network system.

## COMPUTER HARDWARE AND SOFTWARE REQUIREMENTS

A range of computer systems may be used by students in this course including but not limited to

- Personal computers running Windows version 3.1 or greater
- Macintosh systems
- Computers with graphical displays capable of running the X Window system such as Unix workstations or X terminals.

Nearly all Unix computers contain the required network adapters and appropriate system software to make a connection to an existing Ethernet network. Additionally, most Unix implementations contain software to make connections over standard serial ports and telephone lines using the Serial Line Internet Protocol (SL/IP) or Point to Point Protocol (PPP). Thus, for the purposes of this article the discussion will be confined to personal computers using the Windows operating system.

A classroom personal computer running Microsoft Windows version 3.1, (A 80486/66mhz or faster is recommended for rendering of graphics and network communication) or greater is needed to run the Internet client programs. For demonstration purposes, the classroom computer should be connected to a projection screen. Preferably, a high speed Internet connection (10 megabits per second or greater) such as Ethernet or FDDI should be installed. A serial modem operating at minimum of 14,400bps and running software to emulate the Internet protocols will provide a functional alternative if a high speed network connection is unavailable. Both shareware and commercial Winsock programs are available to support telephone modem connections using both the serial line Internet protocol (SL/IP) and the point to point protocol (PPP). These protocols are used to generate Internet Protocol (IP) packets over standard telephone modem connections. SL/IP and PPP connections require that the dialup modem must be configured to support SL/IP and PPP protocols; see (Figure 1). Technology improvements and changes in FCC legislation involving telephone service providers are, and will continue to, create several other connection options

Figure 1: Internet Connection Options
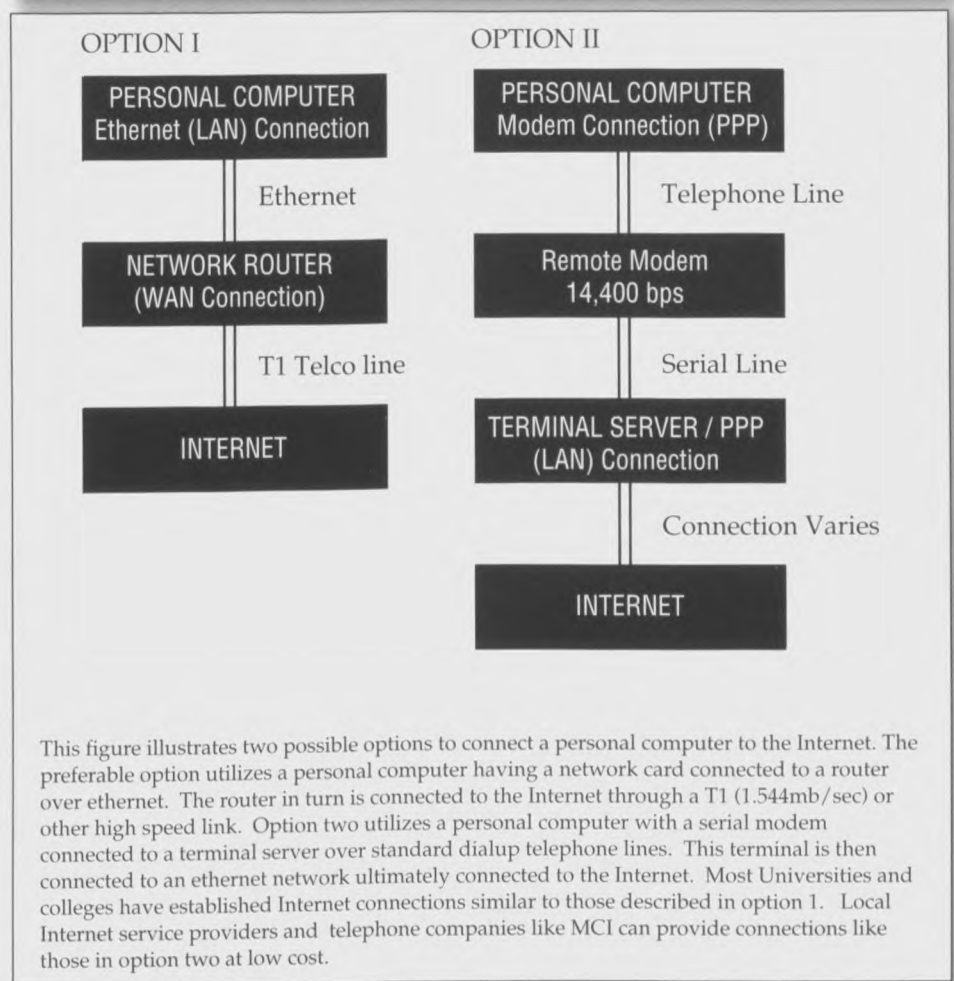
This figure illustrates two possible options to connect a personal computer to the Internet. The preferable option utilizes a personal computer having a network card connected to a router over ethernet. The router in turn is connected to the Internet through a T1 (1.544mb/sec) or other high speed link. Option two utilizes a personal computer with a serial modem connected to a terminal server over standard dialup telephone lines. This terminal is then connected to an ethernet network ultimately connected to the Internet. Most Universities and colleges have established Internet connections similar to those described in option 1. Local Internet service providers and telephone companies like MCI can provide connections like those in option two at low cost.
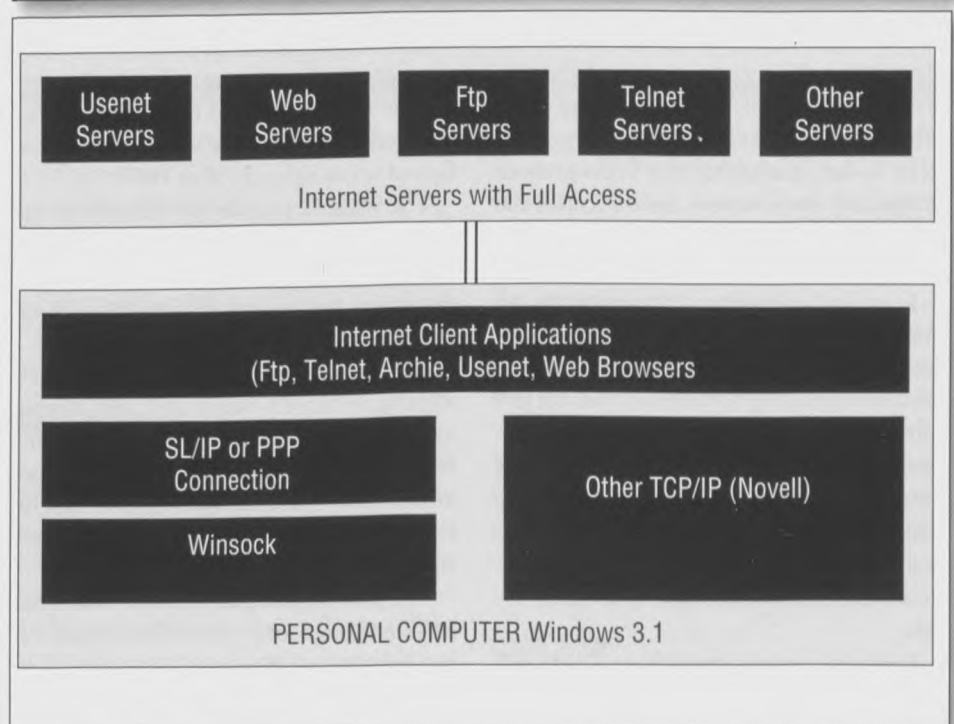

Figure 2: Computer Software Requirements

- The **Archie** system searches indexes stored on Archie servers to locate data contained in the FTP archives around the world. Several Archie servers have been set up to respond to the requests from clients. On a regular basis, the indexes of the servers are updated to reflect the current information contained on many of the FTP sites on the Internet.
- **Electronic Mail** programs allow users to create messages and send them to other Internet users. Several computers exist to relay messages to other networks like Compuserve and Bitnet. Other hosts are configured to support mailing lists for multiple subscribers. Common electronic mail applications include Eudora, Pine, MH and CCMail.
- **Ftp** is the application most often used to transfer data from remote Internet sites to a local computer. This data may be public domain computer software or research data from any of the several public databases maintained by public and private institutions.
- The **Gopher** application allows users to browse information contained on the Internet using a textual menu based interface. The contents of the menu based systems are maintained by administrators of Gopher Servers. Unfortunately, the indexing of these systems is not standardized between one gopher server and another.
- **Mosaic** is a viewer of information of the World Wide Web. The Web contains textual, graphical and audio information organized in a Hypertext manner. In addition to Mosaic, there are other viewers under development to navigate the Web including **Netscape 2.0**, and **Hot Java**.
- Multi-User Dungeons (**MUDs**) have evolved from games into useful educational tools, and informational discussion forums.
- **Talk** is used to establish a two way direct connection between two Internet users located on the same or different computers.
- **Telnet** is used to log in to computers across the Internet. Many computers have been established as a repository for public databases, and are configured to allow direct Telnet access to anonymous users.
- The **Usenet** system is nearly equivalent to several special interest bulletin board systems connected together. It is organized into categories of information (newsgroups). Users may read information contained in these groups and contribute their opinions, question and answers to the discussion group. Usenet is accessed through one of several news readers like rn, trn or tin.

- FTP
- Mosaic /Netscape or other Web browser.

Finally, the local system should either have configured, or have access to on a remote server the following application software:

- Electronic Mail user agents such as Eudora, MH, or mail
- One or more Usenet news readers such as tin, rn or trn
- An Archie client
- Gopher
- Talk

Both commercial and shareware software versions of these applications are available. PC/TCP network software is available from FTP software and supports Winsock and the applications described in Figure 3. Additionally, the Internet Chameleon is available from Netmanage, Inc.. Shareware Winsock software can be downloaded from the anonymous FTP server "ftp.trumpet.com.au" in the /winsock directory. Netscape is available from ftp.netscape.com and Mosaic from 'ftp.ncsa.uiuc.edu' in the /Mosaic/Windows/ sockets directory. Because much of this software is evolving rapidly, software updates are frequent. Note that installation of the shareware software requires some knowledge of Windows initialization files.

Local desktop systems will be used to access servers spread across the Internet. These servers typically use one of the following operating systems:

- Unix
- Windows NT
- VMS

While it is not always apparent to the user the type of hardware or software running on a remote computer, the identification of different software environments is important since subtle differences exist between application programs from different vendors. Finally, a student lab is required. Each computer connected to the Internet must have available each of the client applications described in Figure 3.

COURSE ORGANIZATION

The course was divided into three major sections beginning with a history of the Internet and a cursory overview of how it works. The second section focuses on using the Internet and its available tools. The third section, configuring and maintaining an Internet connection, is optional depending upon the student audience. While an IS major will likely be able to utilize this information, it would be of limited value to students outside

than those mentioned here.

Those institutions with access to Macintosh or Unix computers would be able to run all of the available Internet client applications and access each of the Internet services. In fact, availability of a heterogeneous computing environment demonstrates the connectivity and interoperability capabilities of the Internet.

Personal computers attached to an Ethernet or other network ultimately connected to the Internet must use some form of software supporting the Internet Protocol (IP) and Transmission Control Protocol (TCP). These protocols form the foundation defining how packets are transported across the Internet. Included in these packets is information specifying the source computer, destination computer, packet size, and reliability data.

Personal computers without a network connection will require a 14,400bps or faster modem, local software like Winsock to establish the TCP/IP stack, and finally, availability to a terminal server connected to the Internet and configured for dial in modem access. Additionally, this terminal server must be configured to run either SL/IP or PPP.

The Winsock program provides the necessary TCP/IP networking environment under Windows. There are a number of companies developing the winsock.dll. The Winsock application must be compliant with version 1.1 of the Winsock standard. If commercial networking software is being used, that company's winsock.dll must be obtained from the vendor. Note that both Windows NT and Windows 95 operating systems have built-in support for Winsock and third party software is not required.

The personal computer or Unix hosts must have configured locally the following application software (see Figure 3).

- Telnet

the IS domain.

Internet History and Topology (Section 1)

Section one contains an anthology of the Internet, a discussion of the basic network topology, and an overview of the fundamental system services that are required for the Internet to function. The historical subsection begins by discussing the creation of the Arpanet and describes some of the major milestones that have occurred in the past 20 years. Following that, the current status subsection is addressed. Topics include, operational issues, privatization efforts, and current implementation weaknesses, security considerations, growth statistics, and future developments. [3]

The technical overview of the Internet is designed for students with minimal networking, programming, or algorithmic knowledge. Topics include:

- Internet addresses
- Internet names
- Internet packets
- Internet protocols (TCP/IP)
- Transporting packets (Routing)
- Internet services.
  - Domain Name Service
  - Mail Service
  - Internet Daemons

Accessing the Internet (Section 2)

One fundamental goal of the course is to build skills navigating the Internet using the currently available tools [4]. Students use these tools through applied lab exercises. It is important to note that exercises are assigned via e-mail or through the World Wide Web. A local Usenet discussion group was established for the semester to facilitate electronic interaction between students for the purpose of solving coursework problems. It is intended that these techniques will improve proficiency of the students.

Supporting an Internet Connection (Section 3)

The final section should be considered optional, depending upon the background of the student population and their objectives. Again, the section goal is not intended to be a network design course but rather an applied approach enabling students to locate Internet providers, procure services, determine necessary hardware and software, and install and configure that equipment. The following summary describes the significant topics:

- Locating an Internet provider
- Obtaining an Internet address
- Registering an Internet domain
- Procurement of required equipment including telephone related equipment

Figure 4: Course Syllabus

Week I
- Introduction and history of the Internet

Week II
- Basic computer skills refresher (if necessary)

Week III
- Network description
- Identifying computers on the Internet (IP numbers and names)
- Internet protocols (TCP/ IP)
- Getting packets between sites (Routing)
- Getting information between sites (Services)
- Internet security considerations and legal requirements

Week IV
- Logging in (telnet, rlogin)
- Using electronic mail
- Lab exercise

Week V
- Introduce services that are available; rlogin, telnet, ftp, usenet, email,
- archie, mosaic, gopher, xnetlib, and veronica

Week VI
- Using FTP; Setting up an FTP server
- Using Archie Services

Week VII
- Midterm Examination

Week VIII
- Reading network news (rn/tin/ trn); How news works (cnews/inn/nntp)

Week IX
- Using Gopher services and finding users (finger/whois)

Week X
- Wide Area Information Services (wais)
- Introduction to the World Wide Web

Week XI
- Locating Internet providers
- Procurement of necessary hardware

Week XII
- Configuration of network routers

Week XIII
- Configuration of naming services and electronic mail

Week XIV
- Final examination.

(CSUs/DSUs) or modems, routers, terminal servers
- Configuring routers
- Configuring software services including e-mail, Domain Name Service, Usenet client services, PPP and SL/IP
- Using network diagnostic software tools including nslookup, ping, and traceroute.

COURSE MATERIALS

Materials for this course included the text "The Whole Internet" published by O'Reilly and Associates. Additional course materials were obtained by downloading papers from the Internet or using one of the web browsers like Mosaic or Netscape. Again, the goal of using Internet materials as reading materials was to improve student proficiency. Some of the resource materials include the Request for Comments documents published by the Network Working Group. These documents are freely available from several Ftp sites including "ftp.uu.net" and describe nearly all of the Internet software services.

An increasing number of documents are available on the World Wide Web. Maricopa College has established "www.mcli.dist.maricopa.edu" with documentation about HTML. Microsoftware stores an array of technical information on the site "ftp.microsoft.com", and most web sites implement one or more search engines to assist users to locate other information.

CONCLUSION

Since this course was an experimental sem-

inar course, special efforts were made to note deficiencies with basic computing skills, comprehension of material, and the type of computing platform being used to access the network. It important to note that our University maintains student laboratories containing Windows based personal computers, Macintoshes, and several X-terminals connected to Unix hosts.

Many students were curious about the Unix environment, and had little or no experience. However they desired to use the Unix platforms because of the stability of the software and performance of the hardware. Thus, one session was added to provide basic Unix skills. Second, students tended to have a basic theoretical knowledge of network topologies, but were unfamiliar with actual pieces of computer hardware needed to make a network function. Thus, more time was allocated to describe the components of locally implemented networks.

As the size of the Internet grows, the number of available tools broadens and the sheer volume and diversity of information grows, it would be reasonable to expand the scope of this course and segment it so that additional topics could be presented with a greater level of detail. One possible implementation of the course might include dividing the course into two components. The first covering only Internet access and usage. The second would view the network from a systems management perspective.

Finally student evaluations were conducted at the end of the class. Those students who were IS majors were excited by the availability and volume of technical information . Specifically, access to various vendor knowledge bases and examples were useful in other courses. Some students enrolled in the course were not IS majors. Again these students found the diversity of information appealing.

REFERENCES

[1] Merit "history.hosts" , Anonymous ftp from nic.merit.edu /nsfnet/statistics/history.netcount /nfsnet/statistics/history.hosts, August 1995

[2] Crocker, D. "To Be 'On' the Internet", *Network Working Group Request for Comments number 1775*, March 1995

[3] Krol E. "The Hitchhikers Guide to the Internet", *Network Working Group Request for Comments number 1118*, Sept. 1989

[4] Kessler, G., Shepard, S, "A primer On Internet and TCP/IP Tools" *Network Working Group Request for Comments number1739*, December 1994

[5] Vetter, Ronald J, Spell, Chris and Ward Charles, "Mosaic and the World Wide Web", Computer, IEEE *Computer Society*, October, 1994

[6] Krol, Ed, "The Whole Internet", O'Reilly & Associates, 1994

[7] Estrada, Susan. "Connecting to the Internet: a buyer's guide", O'Reilly & Associates, 1993

[8] Cronin, Mary J. "Doing business on the Internet: how the electronic highway is transforming American companies", Van Nostrand Reinhold, 1994

[9] Cricket Liu ... [et al.] "Managing Internet information services", O'Reilly & Associates, 1994.
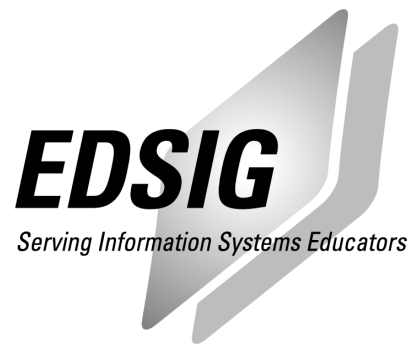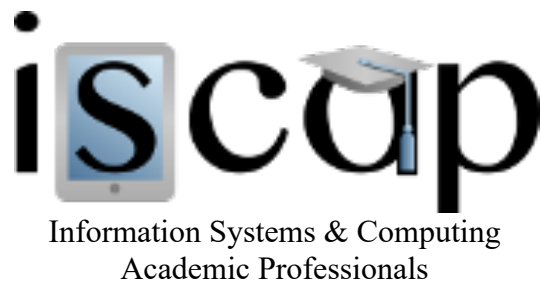
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