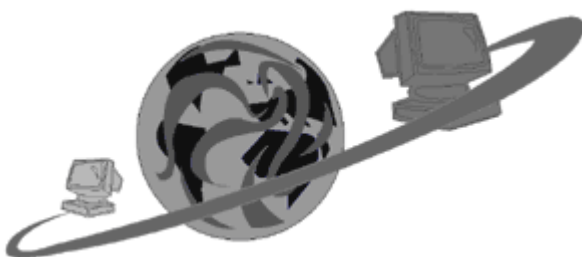


## The Journey Inside<sup>SM</sup>: The Internet Background Information, Part 1

### Growth of the Internet

It is almost impossible to make it through a day without hearing a reference to the Internet. The Internet began in 1969 as the ARPANET (Advanced Research Projects Agency Network). This computer network was created by the U.S. Department of Defense to link research scientists so that they could exchange and share ideas that would increase research results. ARPANET soon extended to include college and university researchers. From this restricted group of users, the Internet has evolved to serve millions of people all over the world.

The history of networking shows that large, wide-reaching networks preceded the smaller, more self-contained computer networks that are found today in offices or schools. The first computers were large, extremely expensive, and very scarce. Often, buying time on a computer miles away was cheaper than installing your own computer. The coordination of the timesharing approach to computer use provided the motivation for the development of networking hardware and software. ARPANET, now the Internet, is only one example of these early, large networks.



Many networks did not survive beyond these first early efforts. However, the Internet did, and is still evolving. At first known only within academic and scientific communities as a channel for exchanging text-based documents, today the Internet is a global network connecting computers all over the world. There are many smaller networks entwined in this complex, global connection of computers and people. Each computer that connects to the Internet is referred to as an Internet client.

The Internet is more than just computers and cables. The Internet is also a world of people with a very unique culture. Members come from all over the world, and many regard themselves as members of online communities that function in a similar fashion to their geographical community defined by where they live. Perhaps the best known part of the Internet is the World Wide Web (WWW or Web). It is responsible for popularizing the Web by allowing information to be linked with hyperlinks and enabling the transmission of all sorts of media. The Web can be thought of as a way to navigate major portions of the Internet. The Web includes text, graphics, and sounds in electronic documents called home pages or Web sites. Each Web site has a unique address. These addresses are referred to as URLs (Uniform Resource Locators). A critical aspect of Web sites is their ability to provide an electronic link to other Web sites. It is possible for almost anyone who wishes to create and maintain his or her own home page.

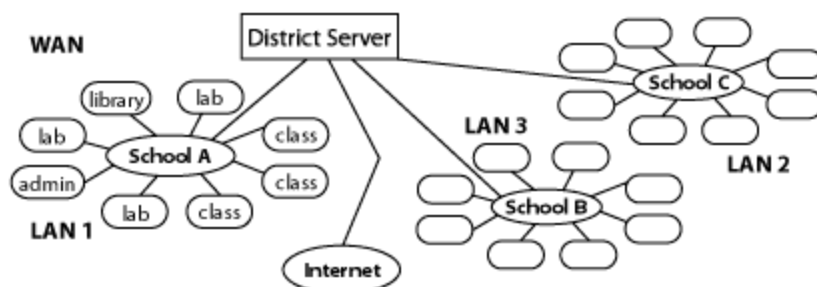
The vast collection of Web sites available on the Internet is almost beyond comprehension, and many tools have been developed to help users access whatever they choose. Using a browser, a program designed specifically for use with the Web, you can explore this vast

electronic library. Most browsers provide a graphical interface so navigating the Web is little different from navigating your own personal computer. Embedded links on Web pages allow you to move from one computer to another. The location of each computer is irrelevant.

Internet use has expanded far beyond its original vision. In every facet of our lives—business, education, and recreation—the Internet now plays an established role. It serves as a means of gathering, storing, processing, and sharing information.

## The Journey Inside<sup>SM</sup>: The Internet Background Information, Part 2

### LANs and WANs



Individual desktop computers provide a convenient way to accomplish a wide range of tasks. However, computers in schools, businesses, and other organizations are frequently connected to form a network. Computer networking provides a way for people to share information, computer applications, and devices such as printers. Any devices being used in a network can be called nodes. Such sharing is sometimes limited to people in one office or school; this is called a local area network (LAN). Sharing can also involve people in different buildings, cities, states, or countries; this is called a wide area network (WAN).

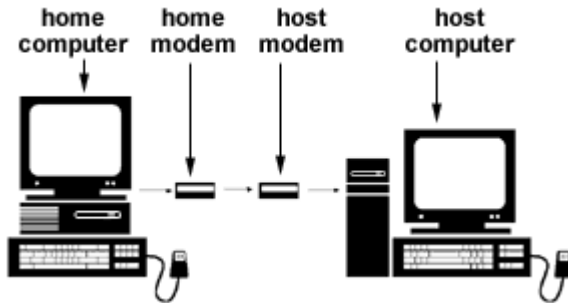
A network can be as simple as having two computers connected so that they can share files or make use of the same printer. A network can be as complex as the Internet to which millions of users are connected. In either case, the network is largely transparent as you work at your desktop computer. As a user, the setup and structure of the network is not particularly important. You need to consider what the network is only if you want to modify the network connections in some way, or make improvements if the network isn't working correctly.

### LANs and WANs Via Modem

From a home, a connection to a WAN, such as the Internet, is commonly done through a modem and phone line. A modem (modulator/demodulator) is a device that is used to convert the digital information used inside the computer to the analog or continuous signals that can be transported on a telephone line.

The home computer uses its modem to dial the telephone number of a modem attached to a remote site, called the host site. The software used with such a modem connection might be provided by a commercial service such as America Online. The remote terminal provides digital information, so its modem has to convert the digital information to analog pulses to send them to the home computer. The modem attached to the host site also converts any

analog pulse signals received from the home computer back to digital information so the host computer can understand, use, and respond to the information.



The speed at which this type of network connection can function depends on a number of things. Most important is the kind of modem you are using. The following table gives some sample load times for common file sizes found on the Internet.

Connection Type	Speed	File Size	Load Time
Standard Connection	56Kbps	500K	00:01:12
DSL	1.5Mb	500K	00:00:02
Cable	1.5Mb	500K	00:00:02

The top speed given for a modem does not guarantee your data will move at that speed. For example, heavy traffic on the line can slow your transmission. Also, if you connect to a host that is not capable of handling the speed of your modem, the transmission rate adjusts to a slower speed. Even the kind of cable carrying the data can affect the transmission rate.

In the table, the DSL and cable modem speeds are very fast. DSL stands for digital subscriber line and is a technology that enables a computer to send and receive information digitally. That means there is no need to convert outgoing data to an analog form and no need to convert incoming data back into a digital form. Cable modems use a home's cable television connection to connect to the Internet.

## The Journey Inside<sup>SM</sup>: The Internet Background Information, Part 3

### Network to Network

Moving data among computers requires special organization. Just as your home has a unique postal address, every computer on a LAN or WAN has a special address. This address combines a logical address—Smith@gladstone.uqueen.edu—assigned to the client by the network supervisor, and a physical address—08:00:07:4F:FF:BB—given to the hardware components in the computer.

The parts of the logical address each indicate special information. The *Smith* indicates the user's account name, *@gladstone* indicates the person's network server, *uqueen* gives the location of the server, and *edu* indicates the type of institution to which the user is a member. Institution types include edu for education, gov for government, mil for military, net for Internet administrative organization, com for commercial, and org for miscellaneous organization.

The Internet consists of a multitude of networks. The networks may not all use the same hardware or software, yet a particular message may travel on many of them before reaching its destination. If you send an email message from a LAN in Florida to an Internet account in California, the message may travel through many different networks and encounter many types of hardware and software combinations.

A **router** decides which pathway to use and provides a way of changing enough information on the message to allow it to move between networks using different rules. Routers use the logical address.

A **bridge** moves information between networks and can determine if information is being sent outside the originating network or not. A bridge ignores anything that is staying within the network where the message began. Bridges add a level of data security and traffic control to a network because they can distinguish between LAN and WAN traffic. A bridge uses the physical address of each user on the network.

A **repeater** is used to extend the physical limits of a network by increasing the strength of the signal at various intervals.

A network **gateway** is used to allow two dissimilar networks to communicate with each other by translating the network protocols—network rules for transmitting data—from those used on one network to the protocols required for a different network.

As technology improvements continue, engineers and inventors are finding ways to combine many of these different services into one machine. Already, devices exist that combine the abilities of many devices. One device may function as a combined router, bridge, repeater, and gateway.

Every network, like the one in a school or business, makes use of special networking software. A network often dedicates one machine called a server to communicate with other computers on the network. Each user of the network, called a client, has some way of accessing the server. In many networks a formal login procedure is used to establish a connection. Once a connection is established, using the software on the server is little different than using software on an individual computer. A logout procedure is used to disconnect from the server.

To make networking as efficient and convenient as possible, the networking industry has developed a standardized organization scheme for handling data. Both hardware and software developers try to adhere to the standard established by the International Standards Organization (ISO) for worldwide communication. The ISO seven-layer structure ensures that data can be transmitted from network to network with a minimum of difficulty or errors.

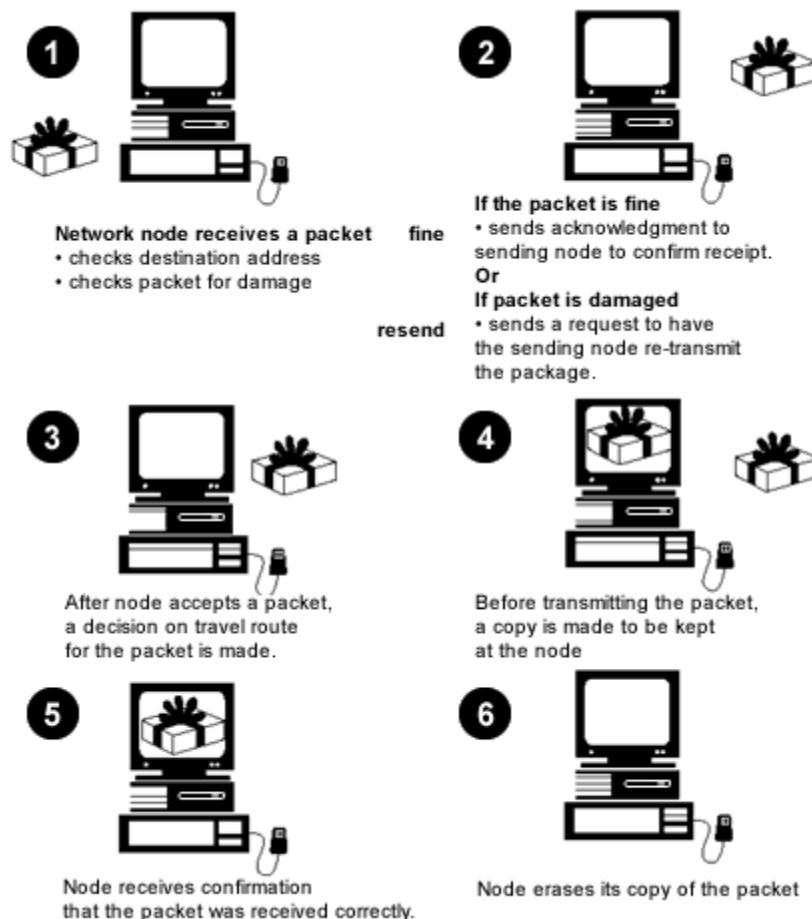
## The Journey Inside<sup>SM</sup>: The Internet Background Information, Part 4

### Packet Switching

People using a network tend to create short bursts of data with pauses between these bursts. Some messages are short. Some are very long. If a network sends one message at

a time and in one complete block, network bandwidth is wasted. Once a particular user starts a transmission, no one else will be able to do so until the first person is done.

A method of signal transmission was created to take advantage of the power of the network and keep it constantly working. Every network operates according to a set of rules or protocols. For many networks, some form of packet switching—organizing the data into small pieces—is used to transmit information between users. Each packet moves along in the following manner:



Vinton Cerf and Robert Kahn, originators of this concept, were awarded the 1997 National Medal of Technology for their contributions to networking.

Every message is split into small pieces, called packets. Each packet has a header containing the destination address combining the logical and the physical addresses, a sequence ID that numbers each packet in the order it is contained in the overall message, a data block that is a specific size or portion of the message, and an end-of-message identifier.

When every message is cut into packets, each person's message begins to move almost immediately. The waiting is avoided, and the network is able to work more closely to its maximum ability. Each packet is created and formatted according to the protocols of your local network. Regardless of the type of file being transmitted, the packet size and definition is maintained according to each network's rules.

Many packets are traveling on the network at the same time. However, these packets are not necessarily from the same message. In addition, the packets made from the same message might travel along completely different pathways. If the message is being sent as an email message, the receiving node waits until it has the entire set of packets making up the message. The message is reassembled and held until the person accesses the email account to read the message. The person can then delete the message or download it to a machine where it looks much as it did when the sender created it. Like many other features of networking, the exchange of messages is taken for granted by network users. They are seldom concerned about the complex steps taken to ensure that the process works.

## Resources

The first two resources are annotated and are appropriate for both teachers and students:

- Dyson, P. (1995). *Dictionary of Networking* (2nd ed.). Alameda, CA: Sybex, Inc.  
This book is filled with careful, nontechnical explanations for translating the terminology used when discussing networks and will increase your ability to understand and use your network effectively.
- Kee, E. (1994). *Networking Illustrated*. Indianapolis, IN: QUE.  
This incredible collection of graphics and text will provide a simple, but complete introduction to networking,
- Derfler, F. & Freed, L. (1996). *How Networks Work* (2nd ed.). Emeryville, CA: Ziff-Davis.
- Eager, B. (1994). *The Information Superhighway Illustrated*. Indianapolis, IN: QUE
- Eddings, J. (1994). *How the Internet Works*. Emeryville, CA: Ziff-Davis.
- Feibel, W. (1996). *Encyclopedia of Networking*. (2nd ed.). Alameda, CA: Sybex Inc.
- Flaherty, T. (Ed.). (1990). *Communications*. Richmond, VA: Time-Life Books.
- Freed, L. & Derfler, F. (1994). *Building The Information Highway*. Emeryville, CA: Ziff-Davis.