

DOCUMENT RESUME

ED 299 427

CE 051 056

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 TITLE Telecommunications/Networking. Course Four.
 Information Systems Curriculum.
 INSTITUTION Association of Information Systems Professionals,
 Deerfield, IL.; Houston Univ., Tex. Coll. of
 Technology.
 SPONS AGENCY Texas Higher Education Coordinating Board, Austin.
 PUB DATE 88
 NOTE 173p.; For related documents, see CE 051 053-059.
 PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC07 Plus Postage.
 DESCRIPTORS Behavioral Objectives; *Business Education; *Computer
 Networks; Computer Oriented Programs; *Computer
 Science Education; Computer Software; Curriculum
 Guides; Higher Education; Information Processing;
 *Information Science; *Information Systems; Learning
 Activities; *Telecommunications; Word Processing

ABSTRACT

This course is the fourth of seven in the Information Systems curriculum. The purpose of the course is to review data, text, graphics, and voice communications technology. It includes an overview of telecommunications technology. An overview of the course sets forth the condition and performance standard for each of the five task areas in the course. These components are provided for each task area: behavioral objective, suggested teaching strategies, content, and summary. Topics covered include telecommunications/networking terms, concepts, vocabulary, and principles; hands-on operational knowledge of telecommunications/networking systems and services; factors to consider in comparison and evaluation, selection, modification, and utilization of telecommunications/networking hardware and software; gathering information to design and create a basic office layout for a local area network; and setting up, revising, and disseminating written guidelines and documentation for using telecommunications/networking equipment. A glossary of telecommunications networking terminology follows task area 1. Appendixes include visuals (transparencies and other teacher materials), student materials (student handouts, work sheets, and exercise materials), evaluation (end-of-task and end-of-unit questions, test items, etc.), and references (including an eight-page bibliography, articles, and resources). (YLB)

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Telecommunications/ Networking

course four

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In Cooperation with
ASSOCIATION OF INFORMATION SYSTEMS PROFESSIONALS
(AISP)

This project was funded by the Texas Higher Education Coordinating
Board through a grant utilizing funds from the Carl D. Perkins
Vocational Education Act, Project No. 88103024, Project Year 1988.

CE 051056

Acknowledgements

Development of this Information Systems curriculum took place during the 1987-1988 school year, culminating in June, 1988. Much time, talent, dedication, and expertise were invested in this project by the following individuals who participated in the Information Systems Curriculum Advisory Committee--our sincere "thanks" to each of you:

Gary Baldwin, Datapoint Corporation, San Antonio
Mary Ann Beach, MBank, Dallas
Claudia Bryan, Fluor Daniel, Sugar Land, TX
Charlie T. Cochran, Xerox Corporation, Arlington, VA
Susie Coon, DISC, Inc., Houston
Robert Day, Texas Higher Education Coordinating Board, Austin
Camille Hatfield, North Harris County College, Houston
Allan J. Krueger, Hanscom AFB, MA
Leo Lefkowitz, The ELTU Corporation, Houston
Melody Locke, Texaco, Inc., Houston
Linda Mercer, Information Network, Houston
Gay Sweet-Harris, Thomas Jefferson High School, San Antonio

Also, appreciation is extended to all Association of Information Systems Professionals members who participated in various phases of the study and especially to the hundreds of individuals who responded to both rounds of the 300+ item questionnaire which formed the basis of the curriculum. The support of AISP has been wonderful mainly because of three dedicated individuals:

Glen R. Anderson, AISP Executive Director, Deerfield, IL
Claudia Bryan, AISP National President, Sugar Land, TX
Allan J. Krueger, AISP National Director, Acton, MA

Very special recognition is due Allan Krueger who has been a strong link between the project and AISP and who has given so generously of his time and expertise to assure quality products and to promote the project.

Recognition and gratitude also are expressed to Jim Bauser, Valerie Brantley, Bernard Chin, Cappel McNeill, and Donna Siegel, University of Houston, College of Technology, for their time, talents, and skills in the vital areas of administrative support, materials development, graphics layout, research, and writing in bringing this project to completion.

TELECOMMUNICATIONS/NETWORKING

This course reviews data, text, graphics, and voice communications technology and applications. Included is an overview of telecommunications technology, including modems, software, transmission methodologies and rates, standards, protocols, terminology, and concepts. Emphasis will be placed on hands-on applications and/or experience through the use of software or telecommunications case studies. Operational knowledge gained through field trips, vendor presentations and demonstrations, and/or in-depth discussions should be included.

Review of networking topology and software application to the point of operational knowledge and familiarity with vocabulary and methodologies is included in this course. Written communications skill through the setting up and revising of operating guidelines for telecommunications equipment and guidelines for an automated office situation also will be emphasized.

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Based on a case study, set up, revise, and disseminate written guidelines and documentation for utilizing telecommunications/networking equipment or prepare a feasibility report which recommends purchase and installation of telecommunications/networking equipment.

Appendices:

VISUALS

Includes transparencies and other teacher materials.

STUDENT MATERIALS

Includes student handouts, work sheets, and exercise materials.

EVALUATION

Includes end-of-task and end-of-unit questions, test items, etc.

REFERENCES

Includes bibliography, articles, resources, etc.

INSTRUCTOR NOTES

TELECOMMUNICATIONS/NETWORKING

CONDITION

PERFORMANCE/STANDARD

TASK AREA 1: Given a list of telecommunications and networking vocabulary, concepts, and terminology,

the student will be able to 1) define terms, equipment and delivery systems related to telecommunications, 2) define topologies, terminology, and major characteristics of local area networks, wide area networks, and public databases, and 3) describe and explain the use of executive and multiuser workstation configurations and the factors involved in networking workstations utilizing operational knowledge of network topology to the satisfaction of the instructor.

TASK AREA 2: Given a modem, electronic communication system, or other configuration in the classroom,

the student will be able to 1) demonstrate operational knowledge of telecommunications hardware and software, and 2) discuss and utilize modems to receive information from and transmit information to an electronic bulletin board and from other individual users (if equipment is available) with 90% accuracy (or to the level of mastery).

TASK AREA 3: Given a problem to solve in the area of telecommunications and/or networking,

the student will be able to 1) analyze methodologies, protocols, and systems for transmission of data, text, voice, and graphics; and 2) develop and use factors in selecting telecommunications hardware and software in an automated environment to the satisfaction of the instructor.

CONDITION

PERFORMANCE/STANDARD

TASK AREA 4: Given a particular automated office environment,

the student will be able to gather information to design and create a basic office layout for a LAN, tying together workstations, printers, modems, and other peripherals through an oral presentation to the satisfaction of the instructor.

TASK AREA 5: Given a specific automated office environment,

the student will be able to set up, disseminate, and revise written guidelines and documentation for utilizing telecommunications/networking equipment; OR prepare a feasibility report, recommending the purchase and installation of telecommunications/networking equipment--all to the satisfaction of the instructor.

TELECOMMUNICATIONS/NETWORKING

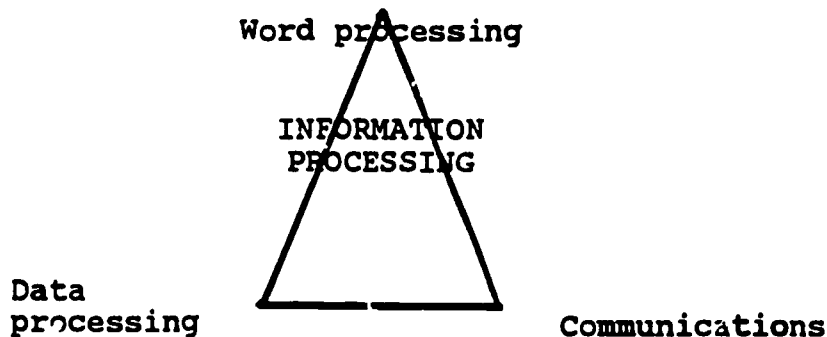
Task Area 1

Given a list of telecommunications and networking vocabulary, concepts, and terminology, the student will be able to 1) define terms, equipment and delivery systems related to telecommunications, 2) define topologies, terminology, and major characteristics of local area networks, wide area networks, and public databases, and 3) describe and explain the use of executive and multiuser workstation configurations, and the factors involved in networking workstations, utilizing operational knowledge of network topology to the satisfaction of the instructor.

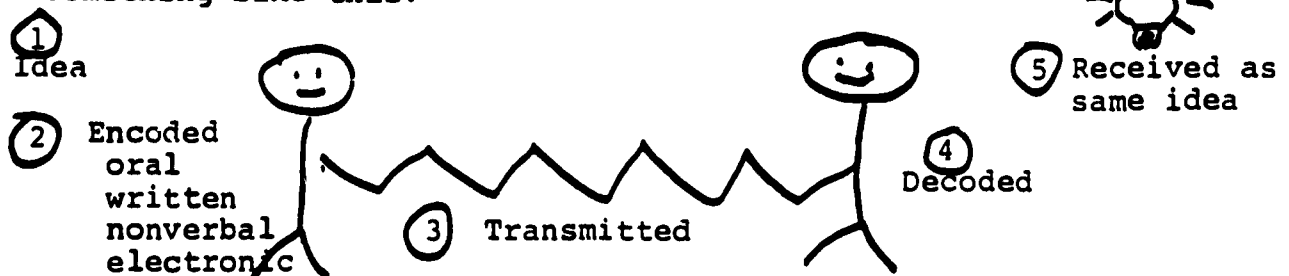
Suggested teaching strategies: Introductory lecture utilizing questioning techniques with transparencies which stimulate group discussions, and oral presentations by students on aspects of the subject from outside readings. The Glossary of Telecommunications/Networking Terminology is included at the end of this task area.

TELECOMMUNICATIONS

In this course, the element of the information processing triangle (displayed below) to be covered is communications, specifically, telecommunications. NOTE: Information processing is defined as the manipulation of data and text into final format and/or movement to its final destination.



The broad term, communication, means the exchange of information--a two-way process. The process may look something like this:



TELECOMMUNICATIONS is like communications, except that it involves communicating electronically across distances (generally over telephone lines) without any changes occurring to the original message. All forms of information may be sent electronically: voice, text, data, graphics, and video. The use of the computer as a communicating device has grown in importance in both business and personal applications. This side of the information processing triangle will continue to expand and change traditional methods of communication.

The history of telecommunications in this country has been influenced by the need for timely, reliable, high quality, and secure communications that can be delivered easily at the lowest possible cost. Organizational, governmental, military, and industrial forces requiring telecommunications to support increasingly complex activities are behind this motivation.

Many of the telecommunications systems used for private and commercial applications today were developed initially for military or governmental installations. It is easy to understand the military's need for high quality, secure communication as the impetus behind postal, telegraph, telephone, and satellite technology. Beginning with the Civil War and continuing today, governmental and military communications have played an important part in war and in peace.

Critical to the growth of telecommunications has been the development of the telephone. From the beginning, the telephone was perceived as an instrument which could be used for secure, personal, and reliable communications. Human factors played a significant part in the acceptance of the telephone for communication since it afforded immediate voice interaction to which users could add variations in tone, pitch, rate, and inflection. As the telephone technology has grown, so too has the ability to communicate over longer distances and for different kinds of communications.

The growth and development of the telephone system is generally credited to Theodore Vail, president of American Telephone & Telegraph (AT&T) in 1885. His four goals for telephone services within the U.S. at that time were far-reaching and farsighted: universal service, high quality service, interoperability, and development of new services and equipment as rapidly as possible. From 1885 until its divestiture in January, 1984, AT&T set the standards for telecommunications service in the United States. The "Bell System" has played the major role in establishing the

telephone system as it exists today.

Technological Discoveries

In order to get to the point in telecommunications where the technology is today, several significant technological breakthroughs were accomplished. The most significant are discussed below.

The invention of the Strowger switch in 1889 allowed users to automatically dial and be connected to another user. It is noted that this breakthrough occurred because Almon B. Strowger was afraid the telephone operator, who was the wife of a competitor, was purposefully misdirecting his incoming calls to her husband's mortuary. Strowger's fear of unreliable service led to automated switching which reduced costs by eliminating the need for telephone operators, provided better security, faster switching, and more reliable service.

In 1913, Lee DeForest invented the triode vacuum tube. The vacuum tube allowed wireless transmission over long distances. This discovery played a big role in enabling radio telecommunications and reducing signal-to-noise ratio: a ratio used to determine the amount of noise, interference, or distortion in a signal compared to the amount of usable information.

Multiplexing (also discussed later) emerged as a result of the discovery of the vacuum tube. Multiplexing is a technique which allows a large number of different transmission signals to pass over the same transmission media. Obviously, this technique reduces transmission costs by allowing many telephone conversations to pass through a transmission media, such as copper wires, coaxial cables, fiber optic cables, microwave, or satellite channels. Early computers also used vacuum tubes.

The vacuum tube persisted in use until 1948 when three scientists at Bell Labs, Walter H. Brattain, John Bardeen, and William Shockley, invented the transistor, replacing the vacuum tube. Transistor technology performs the same basic functions as the vacuum tube but used considerably less space, thus significantly reducing costs. Ultimately, the discovery of the transistor led to the development of integrated circuits and the silicon chip. These breakthroughs led to the replacement of mechanical switches with electronic switches which have brought about faster and smarter switching and paved the way for digital transmission, as well as breaking the ground for the creation of the computer industry.

The most recent breakthrough in telecommunications transmission media is fiber optics. These tiny, glass-like hairs have the capability of transmitting a large number of conversations at one time with less interference. The only drawback to the widespread use of fiber optics at the present time is the cost of producing fiber optics. However, it is anticipated that as the costs decrease, the use of fiber optics will increase.

Another form of voice communication--the radio--led to the development of microwave and satellite transmission. A microwave network includes transceivers, which generate and receive the signals, and repeaters, which boost the signal as it is transmitted and received. Transmission, however, is limited to line of sight (approximately 30 miles). Satellite communication is microwave transmission extended into space. Transmission via satellite offers point to multipoint communications, insensitivity to distances, and high quality transmission over long distances.

Cellular radios are used for interactive radio transmission and are becoming increasingly popular. Cellular radios make use of local exchange networks and do not rely on cables, wires, or other more common transmission media. The cellular radio is one example of how radio telecommunications will continue to play an important role in telecommunications applications.

In order to accomplish telecommunications, special communication equipment and sophisticated programs may be combined in a variety of configurations: small computers or terminals to large mainframe (host) computers, large computers to large computers, and small computers to small computers in local area networks. The hardware components which are necessary for communication remain the same regardless of the size of the computer.

Different types of communications software packages are available, depending on the users' requirements. The more sophisticated the software, the more dynamic the applications. For example, some software may allow large amounts of data to be transferred from a database on a mainframe to a personal computer for storage on auxiliary storage, (called downloading) or some software may allow data to be transferred from files on the personal computer to databases on the mainframe (called uploading). Some software may establish passwords and perform other security functions; as well as other applications. The selection of communications software depends on the user's needs, equipment, and budget considerations (purchase price, training time, compatibility costs, and expansion and upgradability).

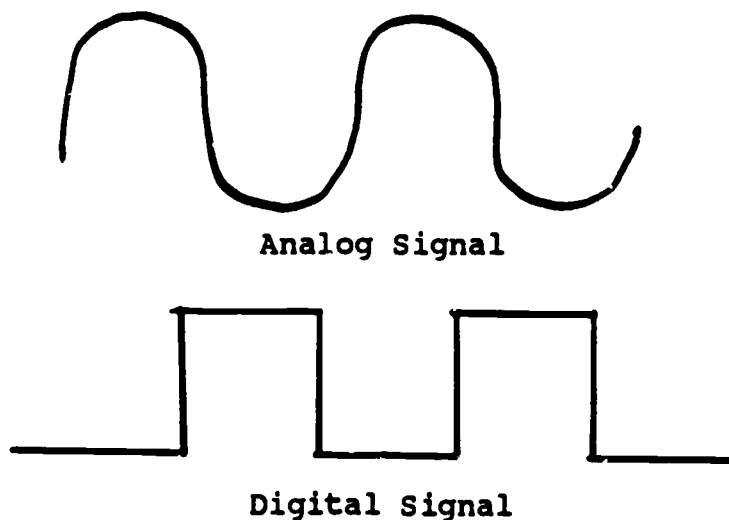
To gain a better understanding of what it takes for an organization to provide telecommunications capability, the following sections focus on the required communication hardware; transmission media; communication line configurations, modes, and speeds; telecommunications delivery systems; telecommunications regulations; networks; security; and workstations.

COMMUNICATION HARDWARE

Analog and digital technology are used to transport data, text, graphics, voice, and video. An electronic analog signal is created by a person speaking into a telephone or microphone. These signals are translated into a set of continuously varying electrical waves that correspond to the variations in the voice patterns of the speaker. Most telephone systems operate with analog transmission.

With the introduction of the computer chip, digital transmission became possible. Digital signals are represented electronically by a series of discrete binary electrical impulses represented by the values of 1 and 0. Digital signals differ from analog signals in that the binary electrical impulses are not a continuous electronic signal but rather they alternate between a high and low amplitude electronic impulses. Transmission and interpretation of digital signals require the use of prearranged codes, much like telegraph operators used the Morse code. However, in computer operations, the interpretation process occurs within milliseconds.

An illustration of the differences in these two signals is offered below:



For communication to take place from one computer to another in a remote location within a building and sometimes outside of or to other buildings, a special piece of hardware is needed:

- A. MODEM (MOduerator/DEmodulator) converts digital data generated by the computer to an analog signal which can be sent or received over communication channels and also converts analog signals received from telephone lines to digital signals which can be understood by the receiving computer. Usually the existing telephone network is used for data transmission because it is a well-established system for communication. Two modems are necessary--one at either end of the telecommunication process. Modems are required whenever data are transmitted over lines requiring an analog signal. Some communication channels are capable of directly transmitting a digital signal. These channels do not require a modem.

Modems may come in the following varieties:

1. An acoustic coupler is connected to the computer by a cable and utilizes a standard telephone headset which is placed into molded rubber cups on the acoustic coupler. The acoustic coupler converts the digital signals generated by the computer into a series of analog tones which are picked up by the mouthpiece in the headset in the same manner as if one were speaking into the telephone. The analog signals are then transmitted over the communication channel.

Advantages of acoustic couplers include portability: they may be plugged into any telephone, including a pay phone anywhere; and utility: the telephone can still be used to make telephone calls. A disadvantage is that it may be less reliable than other modems because small, outside sounds can be picked up by the acoustic coupler as sounds which are to be transmitted.

2. An external modem (also called a direct connect modem) is attached to the computer by a cable and is contained in a small boxlike structure placed next to the computer. A cord from the modem plugs directly into a standard telephone jack to allow

communication over telephone lines. There is no need for a telephone headset, only access to a telephone line.

3. An internal modem cannot be seen because it is found inside the computer. It consists of a printed circuit board with related electronics that is plugged into an empty slot on the motherboard of the processing unit of the computer.

There are several advantages to internal modems. No work space is required outside the computer, no computer-to-modem cable is required, and it often costs less than external units. A disadvantage is that the internal modem is machine dependent and is designed to fit a specific computer. An external modem can be used with any computer equipped with an RS-232 interface.

4. An intelligent or smart modem is a more sophisticated modem which contains a microprocessor that controls many functions and allows easier and more flexible use of telecommunications. For example, smart modems allow frequently-used telephone numbers that access host computers to be dialed automatically. A personal computer can be set to automatically answer an incoming call and accept data.
5. A fiber optics modem allows digital devices to interface with fiber optic cable and has many advantages: smaller error rate, higher degree of data security, less susceptibility to interference and loss of data, and transmission of larger amounts of data (in the gigabyte range).

Selection criteria for modems should include the following variables: (1) determination of current and future needs for throughput, portability, and security; (2) evaluation of the quality of service from telephone lines; (3) determination of need for speed; (4) determination of costs; and (5) compatibility with the network and communications software with which it will interact.

- B. If a personal computer is used to communicate with a mainframe computer, additional hardware often must be added (unless the computer is

manufactured with all the hardware required). This hardware usually consists of a circuit board called a COMMUNICATIONS ADAPTER. This adapter normally can be installed by fitting the board into an available slot on the motherboard in the processing unit of the computer. This adapter performs several functions:

1. It changes data from parallel form (where bits move in groups, such as 8, 16, or 32 at a time on a bus) to a serial form (where bits are transmitted one bit after the other) for transmission.
 2. It uses an RS-232C serial interface (RS stands for Recommended Standard; 232 is a number to reference this agreed-upon industry standard; C indicates a third revision of the standard) and acts as a pathway through which the computer transfers serial data to and from modems. This interface is sometimes referred to as a port and is located on the back of the central processing unit.
 3. It also adds and deletes required control bits, interfaces with software to control the speed of transmission, checks errors, and performs other task .
- C. When it is desirable to have one medium carry many transmissions at the same time, a MULTIPLEXER can accomplish this. Multiplexing, which has been defined previously as a technique which allows a large number of different transmission signals to pass over the same transmission media, can be used with both broadband and baseband media. Each of these media uses a different technique.

Broadband media use frequency-division multiplexing and can carry many channels, with each channel on its own frequency. An example is the single cable which can bring 30 television channels or more in to a TV set.

Baseband media must use time-division multiplexing, in which a narrowband wire carries signals first from one message, then from another.

- D. In a large mainframe system, a special-purpose computer called a FRONT-END PROCESSOR may be set aside to handle communications tasks, leaving the

central computer free to work on basic information processing. A front-end processor includes a multiplexer and many output ports connecting with different communications lines. The front-end processor acts as a "traffic cop", routing and sorting messages to available lines.

TRANSMISSION MEDIA

From the late 1950s to the mid-1970s, data communication flowed through the basic telephone networks using the same communication channels as voice. Since then, data are being carried over other communications networks and channels designed especially for such traffic. This does not mean that telephone networks are not being used; it only means that newer communications channels have been designed which are more suitable for the transmission of data. Sending voice, data, text, graphics, and video requires a link between the sender and the receiver:

A TRANSMISSION CHANNEL makes it possible to provide the link between the sender and receiver. The channel is the physical path that is used for sending information. Other terms for channel are line, link, circuit, facility, medium, or path. The different types of communication channels are discussed below.

- A. Telephone lines can be connected to a location by open twisted wire pairs or cable. The twisting of the cable helps to prevent outside interference. This is common telephone cord. Twisted pairs consist of wire cables that have been insulated and twisted into pairs; each pair is capable of carrying one telephone channel; many hundreds of these wire pairs may be grouped together in large cables; often laid under city streets and provide a path between a user's premises and a telephone company's local exchange office. It is the least expensive of transmission material available. Twisted pair is limited in the distance it can carry information without adding repeaters to extend the distance capability of the twisted pair.
- B. Coaxial cables consist of hollow copper cylinders surrounding a single wire; they may be bundled into a large cable that contains a number of coaxial cables. A single coaxial cable composed of 20 cables can handle up to 18,740 telephone calls at the same time at a higher speed than twisted pairs. Coaxial cables can transmit voice,

video, and data simultaneously over a distance of up to 50 miles. Underground and underocean cables are generally coaxial, as are the connections between computers and microwave relay systems. Coaxial cable is generally more expensive than twisted pair wires.

A thin wire cable is a newer type of more flexible coaxial cable used for connecting personal computers and other computing systems. It is designed to deliver data between devices at 10 million bits per second.

- C. Fiber optics and laser systems are becoming more prominent as a transmission media and as a replacement for conventional wire and cable. With the use of lasers, fiber optic cables (high-purity glass fiber cables) offer the tremendous potential for transmission of large amounts of data outside the already crowded radio frequency media. Fiber optics can carry a larger volume of messages at a lower cost and at a lower weight and size savings. Fiber optics also is immune to electrical interference from radios or wiring and is highly secure, offering protection from illegal taps.

In comparison to other conventional transmission methods, one and one-half pounds of fiber optic cable can transmit the same amount of data as thirty pounds of copper wire; a standard coaxial cable can carry up to 5,400 different voice channels while a single fiber optic cable can carry up to 50,000 channels.

- D. Microwave systems are relay systems which transmit data through open space much like radio or TV signals. The stations consist of antennas or towers spaced about 30 miles apart in a grid that spreads across the country. The antennas or towers may be positioned on tops of buildings, towers, or mountains. Data are transmitted on a line of sight path to other stations since microwave frequencies do not bend. These systems provide the main competition for coaxial cables because a microwave system can carry many thousands of data or voice channels and do not require the laying of cable. Microwave signals can carry data at speeds from 9,600 to 56,000 bits per second.
- E. Satellites communicate electronically from one earth station to another from their position in

space approximately 22,300 miles above the earth. They can relay signals over longer distances because they are not hampered by the curvature of the earth, mountains, and other obstacles as are microwave systems. Typically, a message is sent from a ground station to the satellite which, in turn, amplifies the message and sends it to another ground station that may be halfway around the earth.

Satellites have been put into orbit by such organizations as NASA (COMSAT), International Telecommunications Satellite Organization (INTELSAT), Western Union, GTE Spacenet Corporation, RCA-Americom, and American Satellite Corporation.

- F. Digital lines are being used to replace older, worn-out analog lines so that data can be moved at greater speeds. These lines do not require modems and can transmit voice, photography, video, and data digitally.
- G. Open wire transmission consists of a pair of copper wires carrying one voice-grade channel that serves only two points at a time. Most wire pairs have been replaced by other transmission media but they still may be in use in certain rural areas and Canada. These wire pairs offer poor line quality for data transmission because of interference and loss of signal.
- H. A carrier system is a multiplexing technique which uses various transmission media to accommodate many channels on the same physical line. The media may be cable, coaxial cable, or a microwave system. Each media is placed at a different frequency level for transmission to avoid interference with each other.

COMMUNICATION LINE CONFIGURATIONS, MODES, AND SPEEDS

- I. LINE CONFIGURATIONS. There are several methods by which terminals, personal computers, and large computers can be connected to a host computer or to each other. Companies rely on common carriers such as AT&T and Western Union to provide the connections or channels (lines) to them. Amount of data and cost are two considerations which determine whether point-to-point or multidrop or multipoint connections are used. These two considerations are discussed below:

- A. A point-to-point line, as the name implies, is a direct line between two computers (any size) or a terminal and a computer. Point-to-point lines are used when communication will take place almost on a continuous basis and fast response time is needed or when only occasional communication takes place at the user's discretion. Only one terminal or computer is used for each line to the other computer or host. A point-to-point line may be of two types:
1. A leased line is a permanent circuit to connect a personal computer, terminal, or large computer with another computer. This line also may be referred to as a dedicated line or hard-wired line. The device at one end of the line is always connected to the device at the other end of the line. Merely touching a character key (or turning on the terminal or computer) will initiate contact between the host and the terminal or computer. Since the terminal or computer is always connected to the other computer, the electronics of the systems are established so the host computer electronically listens for a request from the terminal or personal computer to send data for a period of time. The line then is changed so the terminal listens for a request from the host computer to send data.
 2. A switched line is established through the regular telephone system rather than a direct connection as with a leased line. The switching center primarily used for voice application is called a PBX (Public Branch EXchange). The switching center used for data applications is called a PABX (Private Automatic Branch EXchange). Each time a terminal or personal computer communicates with a host computer over a switched line, different circuits may be used because the circuitry will be selected by the telephone company switching devices (hence, the name).

When using a switched line, the user initiates contact with the host computer by dialing the telephone number of the host computer (much like making a telephone call). The modem for the line at the host computer is assigned a telephone number just as if it

were a regular telephone. When its number is dialed by the terminal or personal computer user, either manually or automatically, the modem answers the call and establishes the line connection. The modem also informs the terminal or personal computer through the use of a control character sent down the line when it is ready to receive data.

When a switched line is used, the terminal or personal computer and the host computer are connected only when data communications are occurring. When the user is finished communicating with the host computer, the connection is terminated. The same process must occur each time the user wishes to communicate with the host computer.

- B. The second line configuration, multidrop or multipoint line, has more than one terminal, personal computer, or large computer on a single line connected to a host computer. Only one terminal at a time can transmit to the host computer; however, more than one terminal on the line can receive data at the same time. Line costs decrease considerably when using a multidrop line because the line is used by many terminals. The number of terminals placed on one line is a decision made by the designer of the network based on the amount of traffic and hours of use.

A leased line almost always is used for multidrop line configurations. Contact is established between the terminals or personal computers and the host in one of two ways:

1. Polling is performed by the host computer and the associated communications control unit. The host asks each terminal or personal computer if it has some data to send through the use of special control characters. If the terminal does not have data to send, it responds with negative control characters and the next terminal on the line is polled. If a terminal does have data to send, it gains control of the line and sends the data.

Polling generally does not continue once a terminal gains control of the line. Because it is possible for a terminal to keep control for a long time, some systems include a programmed time-out. A programmed time-out

allows the terminal to control the line for a specified period of time before the connection is broken so that other terminals are not excluded from using the line.

2. Addressing is a technique whereby the host computer addresses the particular terminal on the line and sends the message to that terminal. Only the addressed terminal receives the message from the host computer, even though there may be multiple terminals connected to one line.

II. MODE OF TRANSMISSION. A mode of transmission is defined as how information is sent from one communication device to another and is affected by the frequency of transmission, quantity of material to be sent, and the rate at which it will be sent. Generally, these are of two types of transmission: asynchronous and synchronous. Each of these is discussed below:

- A. When asynchronous transmission is used, one character at a time is transmitted or received. Each character (consisting of 7 or 8 bits) is identified by a start bit and a stop bit. The start and stop bits indicate to the receiver the arrival of data. Asynchronous transmission is slow; however, it is used for modems which transmit either 300 bits per second (bps) or 1,200 bps.
- B. Synchronous transmission allows characters to be sent down the line in a continuous stream of bits without start or stop bits. The sending and receiving devices are synchronized by a timing mechanism within the modem at specified intervals. Several special characters called SYNCH characters are placed at the beginning of each message. Transmission speed is enhanced to 19,200 bps and higher using synchronous transmission.

III. INTERCHANGE RULES. There are three basic ways in which communication channels are used for transmitting data. They relate to the direction in which the information will travel. The three terms used to describe the direction or directions in which digital information is allowed to travel over telephone lines are: simplex, half-duplex (duplex), and full-duplex. Deciding which of these lines to use depends upon the user's applications. Each of these terms is described below:

- A. Simplex allows data to be transmitted in one direction only. Data go in one direction with no return. That is, a personal computer could only send but could never receive information. These lines are rarely used in data communications. Radio and TV broadcasts are examples of simplex transmissions.
 - B. Half-duplex or duplex permits information to travel in either direction, but only in one direction at a time. When half-duplex lines are used, the transmission flow in one direction must be stopped each time the direction of transmission is reversed; the "turnaround time" is typically 50 to 250 milliseconds (thousandths of a second).
 - C. Full-duplex allows data to be transmitted in both directions at the same time. No turnaround time is required. This type of transmission is used most often when high-speed transmission is taking place between two computers. Full-duplex is the most versatile and the most expensive.
- IV. SPEED. Another important consideration in data communication is speed. Although a channel or line may have a certain capacity, the speed at which the modem, terminal, computer, or other device is capable of transmitting will affect the speed at which data can be sent. Information is transferred in bits per second (bps). Data are stored in a combination of on/off signals, called bits, an abbreviation for binary digits. A character is made up of a number of bits, expressed in 1's and 0's. The arrangement of bits (1's and 0's) determines the letter, number, or symbol that they represent. A specified number of bits grouped together creates a code. The number of bits required to make up a character (letter, number, or symbol) and the arrangement of 1's and 0's that stand for a particular character depends upon the coding system used to arrange the bits.

Characters most commonly are made up of either groups of 7 bits according to the American Standard Code for Information Interchange (ASCII), or in groups of 8 bits according to the IBM developed alphabet called Extended Binary-Coded Decimal Interchange Code (EBCDIC).

When a character is sent over transmission media, the individual bits of the character are broken down and sent one after another. The speed at which information is sent over telephone lines is called its transmission speed. These speeds vary according to media used:

- A. Modems are generally classified as low speed (1,200 bps and below or 130 wpm), medium speed (1,200 to 4,800 bps and above or 130 to 530 wpm), and high speed (4,800 bps and above or above 530 wpm).
- B. The capacity of the media for transmitting information is called bandwidth--a signaling technique that describes the range of frequencies a communication link has available for transmitting voice, video, data, and graphics. The two most common signaling techniques are described below:
1. baseband: When signals are sent at different times, the network is categorized as baseband. Generally, only one stream can be sent at a time and may be limited to only data communications, sometimes voice communications. Baseband cannot send video communications and cannot handle simultaneous multiple transmissions. Twisted pairs and coaxial cables are examples of baseband media. Transmission speed ranges from 1 million bits per second (Mbps) to 50 Mbps; distance of transmission is usually limited to less than 1 mile to 3 miles. Modems are not needed since the transmission is digitized. Ethernet is an industry standard for baseband transmission.
 2. broadband or wideband: when multiple data streams are sent simultaneously, the network is categorized as broadband or wideband. Cable TV or fiber optics are examples of broadband media, although coaxial cable is also used. Transmission speed is fast, generally several Mbps. Distance of transmission is many miles. Modems, which must be used in broadband networks, cable access devices, and cable must be considered into the cost of both baseband and broadband transmission. However, the technology with broadband is much more complex, with higher initial costs in design, installation, and support. Wangnet is an example of a broadband network.

ERROR DETECTION

Even with agreement on speed, mode, code, and type of information flow, errors can creep in. Transmission noise, signal distortion, or sender error can result in garbled messages.

A common technique used in the detection and correction of errors is the parity check which is used in ASCII code transmissions. ASCII uses seven bits to represent a character. To make a parity check, ASCII adds an eighth "parity" bit to each character. This bit is selected to make the totals for all characters consistently even (or in some systems, consistently odd). If interference in the transmission changes a digit in any byte of data, the total of its digits will no longer be even. The receiving computer sends an error signal to the sending computer and the byte is retransmitted until it reaches the receiver correctly.

This isn't foolproof, since interference could change two digits in a row in a character code. Parity checking is reasonably reliable since it is less likely to change more than one digit.

Computers carry out parity checks and other error correction techniques automatically. The end user's involvement may only be to set the microcomputer system for an odd or even parity check by responding to a prompt from its communication software.

File transfer operations among and between microcomputers and between mainframes and microcomputers require efficient error detection and correction. XMODEM was one of the first protocols developed to minimize errors during microcomputer file transfer operations. It was developed by Ward Christiansen and is in the public domain. It has been implemented on most bulletin boards and several public databases. It requires little memory buffer space, is simple to use, and easy to install.

XMODEM transmits data grouped into blocks of 128 characters with 3 fields: a prefix (Start Of Header), a block count and data field, and a suffix (Block Check Character) information added. Errors are detected in any of the fields and transmission is interrupted. Retransmission then will taken place.

In some satellite communications, error checking involves sending each bit three times in a row. Of course, this increases reliability, triples the communication time, and increases the cost.

TELECOMMUNICATIONS DELIVERY SYSTEMS

Traditionally, workers in the office have used the telephone, the business letter and memorandum, Western Union (TWX or telex), and the U. S. Post Office to deliver information. The technologies just described in the sections above are important in the development of telecommunications (electronic) delivery systems. In fact, these systems are changing the way the delivery of information is viewed in the automated office. They are now being considered the areas in which the greatest strides in productivity and cost savings can be realized. Bergerud and Gonzalez (1987) have established the following categories of formats into which information can be sent using electronic delivery systems: electronic message systems and computer-based message systems, public and private teletypewriter systems, facsimile, communicating word/information processors, and teleconferencing systems. The delivery systems in each of these categories is discussed below.

Electronic Message Systems

Computer-based message systems (CBMS) are value-added products on private branch exchanges (PBXs) and computer systems. A large part of this market is made up of the many electronic mail software packages which can be purchased off-the-shelf. However, these services also are provided by subscriber services from such companies as AT&T Information Services, MCI Communications Corporation, Western Union, ITT Dialcom, GTE Telenet, and McDonnell Douglas, to name a few. These systems are useful

- (1) when telephone tag is a problem;
- (2) when telephone interruptions are a problem;
- (3) when information is incomplete, late, or late appointments are a problem;
- (4) when time is wasted with social exchanges;
- (5) when a person wants to get in touch with someone but does not know where the person will be;
- (6) when time zones are different; or
- (7) when the message has to go to several people.

Computer-based voice message systems (CBVS) allow a caller the option of leaving a message with a message center or asking to be connected to a voice storage device. The system records voice messages, converts them to digital format, and stores them in a mailbox to be accessed by the appropriate recipient. This system can be used when a person wants to save time and choose whether to leave a message or talk to the person directly. Voice reminder systems and voice store and forward systems are also part of

voice message systems. These systems are useful

- (1) when a person needs to be reminded of important appointments, or
- (2) when a person prefers to leave a spoken message rather than a keyboarded message.

All of these voice message systems avoid the same problems as computer-based message systems (telephone tag, late appointments, differences in time zones, etc.)

Public and Private Teletypewriter Systems

A teletypewriter is a terminal or workstation that can be used to send or receive written messages. It combines two communications methods: telephone and letter. It uses telephone lines and provides a written document. Telex and TWX (Western Union) have been used to send messages electronically long before electronic mail or other electronic delivery systems were developed. It is basically a means of communicating in writing with another office equipped with a teletypewriter by dialing directly the telephone number assigned to that terminal or station. (This number is oftentimes listed on a company's letterhead as "TTY #-----".) There are approximately 148,000 teletype terminals in North America and 565,000 terminals overseas.

Telex/TWX is useful

- (1) when an office in another time zone is closed and the addressee can act on the message upon his/her return;
- (2) when saving time is important;
- (3) when a written record is needed;
- (4) when making a one-way call that needs no return response;
- (5) when requesting information that would require the receiving party to look up the information while the other party waits;
- (6) when a written record of statistical information is necessary;
- (7) when a number of people need to be contacted with an important message; and
- (8) when information needs to be gathered prior to an important telephone call.

A MAILGRAM is another example of a service offered by Western Union. Telephone and the U. S. Post Office services are combined to send a written message. Mailgrams can be used by persons who are not part of the teletypewriter network. The message is called to a Western Union operator

who keyboards the message and transmits it to the nearest post office. The message is printed out, placed in a special mailgram envelope, and delivered by a mail carrier to the final destination the next day (guaranteed). A Mailgram provides a useful delivery system

- (1) when a person wants to impress a reader with an urgent message (and attention may not come from a telephone call or letter),
- (2) when a written record is needed, or
- (3) when many people need to be contacted with the same message.

Facsimile

Facsimile (FAX) is a service which utilizes a type of copier that electronically sends an original document (letter, map, chart, picture, contract, etc.) from one location to another where it is reproduced as a copy or "facsimile" of the original document. Actually, the transmitting copy is scanned by a light source (lens, laser, or fiber optics) that converts original material into electronic signals. In many types of facsimile equipment, signals are sent by placing a telephone receiver into an acoustic coupler which then reverses the process and produces a hard copy. Another name for FAX is telecopier.

Speed, copy quality, and compatibility are important factors in selecting facsimile equipment. FAX can be used when a copy of a graph, chart, or picture is needed quicker than through traditional means and when a person's signature is needed.

FAX equipment is becoming more prevalent, more portable, and more affordable. FAX units can be carried in briefcases and installed in cars. It also is being used by many mail order companies as a means of transmitting advertisements for their products. Paper costs, privacy, and security are arising issues in this industry. In the future, it may be necessary to regulate access to FAX numbers in order to prevent the misuse of FAX equipment. (Note to instructor: Ask students to read an article regarding the uses and abuses of this equipment.)

Communicating Word/Information Processors

A communicating word/information processor is able to send keyboarded mail, messages, and documents electronically between two points or terminals. When a communicating word/information processor is connected to another piece of equipment that also communicates, it is said to be "on line". One important use of communicating word/information

processors is to be able to send large documents which need to be revised and/or worked on by several people. This saves rekeying, prevents errors, and saves time. A communicating word/information processor may be connected to peripheral equipment such as OCRs or phototypesetters for increased capabilities.

Teleconferencing Systems

The term teleconferencing means conferring, discussing, or communicating data, text, graphics, audio, and video by telephone or other media between two or more people at two or more locations. It provides information in a timely manner, saves travel and meeting time, and may save money. Elements of teleconferencing include interactive cable television, audio teleconferencing (voice only), and video teleconferencing. Links may include transmission via microwave stations, coaxial cable, cable television systems, satellites, or other means.

Audio teleconferencing is an example of a telephone conference call. Slow-scan video is a still-frame picture updated periodically (every 30 seconds using telephone lines) and is displayed on a TV screen. Cable TV is a mass communications medium with some audience involvement. Video teleconferencing is full-motion TV linking individuals or groups at two or more locations. Cost is increased as video capabilities are increased.

PROTOCOL

The term protocol describes the rules established to govern the sending of information from one piece of equipment to another. Devices at either end must be compatible; i.e., they must be able to accept and send data. Protocol involves exchanging a predetermined sequence of signals when the connection first is established between two types of equipment to determine if they are matched according to transmission technique, transmission rate, error-checking, codes used to store data, direction of transmission, and readiness to accept or transmit a message. This exchange of signals is sometimes called handshaking.

In a recent article published by the University of Houston Computing Center, an explanation was offered for the need for protocols so that increased and enhanced telecommunication between machines running on different operating systems can be accomplished. This article is reprinted with permission in the "References" section. The illustration below in Figure 1 is taken from this article:

EXAMPLES OF PROTOCOLS IN TELECOMMUNICATIONS

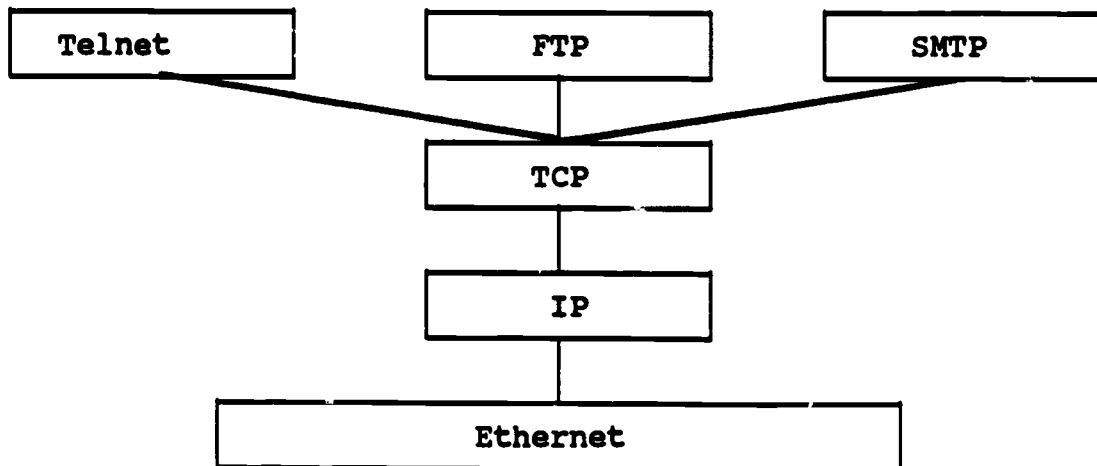


Figure 1.

In this example, as the article points out, protocols work like building blocks, with each protocol performing a different and specific role. IP (Internet Protocol) is a low-level protocol running on top of protocols used by a local network (Ethernet in this case). TCP (Transmission Control Protocol) then takes the services that IP gives a user (an addressing scheme and transport mechanism) and adds a reliable stream protocol for such applications as remote login, file transfer, and electronic mail. The TCP hookup allows access (in this case) to Telnet, a protocol used to provide terminal access to remote machines. FTP (File Transfer Protocol) provides a means for transferring files between hosts on the Internet and frees the user from worrying about the specifics of character codes; and SMTP (Simple Mail Transfer Protocol) provides a means for exchanging electronic mail between dissimilar hosts.

This illustration provides a succinct example of how protocols allow communication between different systems, as well as points out some of the issues in telecommunication. Generally, these protocols are transparent to the end user, although the user will need to know the commands in order to access file transfer, electronic mail, or other telecommunication functions.

TELECOMMUNICATIONS REGULATIONS

The history of telecommunications is marked by regulatory decisions which begin with a 1913 threatened antitrust lawsuit brought against AT&T by the Justice Department and end with the landmark AT&T divestiture decision in January of 1984. In between the following regulations have been imposed:

In 1934, the Federal Communications Commission (FCC) was created to regulate radio-television transmission and all interstate telecommunications services. Some of the rulings made by the FCC have included: (a) designating AT&T as the sole manufacturer of telephone and data equipment which required compatibility of telephone service to enhance interoperability; (b) setting interstate tariffs for telephone services between states; (c) preventing AT&T from entering the data processing and computer markets through a "consent decree" signed in 1956; (d) ruling that all telephone equipment must interconnect with AT&T equipment; and (e) allowing automatic answering and recording devices to be connected to the telecommunications network through a data access arrangement (DAA) which protects the public switched network from harm caused by a terminal device such as an automatic answering machine.

In 1968, the most significant ruling made by the FCC allowed the Carterfone Communications Corporation to interconnect their equipment directly to the public telephone network. This landmark ruling has come to be known as the Carterfone decision and paved the way to create the multibillion dollar interconnect industry. This industry includes any telecommunications device that can be connected to the telecommunication system including telephone sets, modems, PBXs, automatic dialers, speakerphones, and others. This decision, more than anything else, has led to the expansion of the telecommunications equipment industry. This was followed closely by the 1969 ruling to allow MCI to compete with AT&T in the long-distance market. This paved the way for competition in this market from other companies: US-Sprint, GTE, and others. The FCC continues to regulate long-distance rates.

In 1981, the FCC completed Computer Inquiry II (CI2) which opened the door for AT&T to compete in the data processing industry. Almost immediately AT&T began offering a line of mini- and microcomputers. The drawback to this decision was that AT&T could not offer long-distance transmission services on its computers. The impetus behind this decision was that since AT&T controlled over 90 percent of the long-distance telephone market, it would offer unfair advantage for those who bought AT&T computers.

In September 1985, Computer Inquiry III (CI3) was initiated to access the role of the FCC in telecommunications and to examine further deregulation of the telecommunications industry. This inquiry is continuing. Several attempts have been made to offer legislation to limit the power of the FCC; none of these attempts has succeeded. The issue of regulation vs deregulation of the telecommunication industry remains unsolved. (Note to instructor: This is an excellent topic for students to research, for reports, or for in-class debates.)

Beginning in 1974 and culminating in January, 1984, AT&T completed divestiture of its 22 companies in order to provide free and open competition for the telephone market. What remains for AT&T is its long-distance services, a newly formed technologies division, Bell Labs (the research and development unit), and Western Electric (its manufacturing unit). The effects of divestiture are still being and will continue to be debated by business and industry, as well as the individual consumer. (Note to instructor: This is an excellent topic for class discussion and debate since everyone with a telephone has been affected by this decision.)

NETWORKS

The various hardware components of telecommunication must be organized into a system or network for efficient, effective use. Basically, a network is composed of computers of various sizes, workstations, communications hardware and software, and connections that enable the network to function productively. There are three kinds of networks: public databases, value-added or wide area, and local area which are described below:

- A. Public databases are networks which provide data transmission services throughout the United States and in some other countries. These services were intended originally for time-sharing computer applications. Many of these databases are designed by service organizations to be used in lieu of an independently designed (private) network. The Source (Reader's Digest Association, Inc.), Compu-Serve (H & R Block), and Dow-Jones News/Retrieval (Dow Jones) are examples of the largest public databases available. These databases offer marketing information, communications, entertainment, and a variety of other services. Costs to the end user include software, a registration fee, an hourly use fee,

and/or a monthly fee.

There are well over a thousand on-line telecommunication vendors in the United States. Some are gigantic utilities offering vast libraries of data. Most can be classified as modest bulletin board systems.

- B. A wide-area network, also called a value-added network (VAN), is defined as any transmission or reception of signals, of writing, and of sounds by wire, radio, visual, or electromagnetic systems. The companies which have developed these networks generally lease lines from common carriers. They are designed to interface voice, video, FAX, data communications, and teleconferencing capabilities. A partial list of wide-area networks include ARPAnet (Advanced Research Projects Agency), CYLIX (RCA Communication Network), ITT World Communications, Inc., SBS (Satellite Business System composed of IBM, COMSAT General Corporation and Aetna Life and Casualty), SKYNET (AT&T), SPRINT and TELENET (GTE Communications Corporation), GRAPHNET (Graphic Scanning Corporation), and TYMNET (Tymshare, Inc.). These services use a multitude of minicomputers, switches, and interfacing devices to organize the lines into a nationwide network.

One of the techniques that these specialized common carriers use is called packet switching, which allows a message to be broken down into groups of bits and distributed throughout the network. A message, therefore, consists of several groups of bits or packets. These packets, unlike the messages sent through a telephone switching center, go off in all directions. An entire message does not travel together and at its final destination, the packets are all gathered together, and the message is reconstructed. This is a good way to prevent eavesdropping. Baseband transmission operates on the principle of packet switching.

In addition, several other services are available through wide-area networks, such as EasyLink (electronic mail, message and voice systems), FAXPAX-ITT (facsimile network), MCI Mail-MCI (computer-based message system-CBMS), ROLM-Rolm Corporation (computer-based voice communications-CBVC), VMX, Inc. (computer-based voice communications), and WINC-Worldwide Integrated

Communications Service from Mohawk (CBMS).

- C. A local area network (LAN) covers a limited geographic area, is privately owned and user administered, is used mostly for the internal transfer of information within a business, is normally contained within a single building or adjacent group of buildings, and transmits data at a very rapid speed. A variety of office equipment may be connected into a LAN, such as word processing equipment, computer terminals, video equipment, personal computers, printers, file servers, mainframes, minicomputers, and others. The three most important applications of LANs include:
1. Hardware resource sharing places certain expensive devices on the network to allow each personal computer on the network to use that device such as laser printers, letter quality printers, file servers, and others. Rather than have a printer for each personal computer, users can share a single piece of hardware.
 2. Information resource sharing allows personal computer users on the LAN to access data stored on any other computer in the network. In actual practice, hardware resource sharing and information resource sharing are often combined. Also, frequently used software is another type of resource that often is shared on a LAN. Word processing, database, or other software can be stored on a hard disk and accessed by all users as needed. When purchasing this type of software, it is critical to be sure that this kind of access is permitted by the software company.
 3. Electronic mail or electronic text transfer provides the ability to communicate directly with other users of the LAN. A user can use the communication network to send a message using electronic mail, to receive a message, and to print the message.

LAN Topology. The equipment in a LAN is usually tied together in some kind of configuration or pattern, called a topology. The topology describes the pathway by which the devices on the network are connected to each other. There are three widely used topologies, bus, ring, and star,

as illustrated in Figures 2, 3, and 4 below. A special star configuration, called a tree, is illustrated in Figure 5.

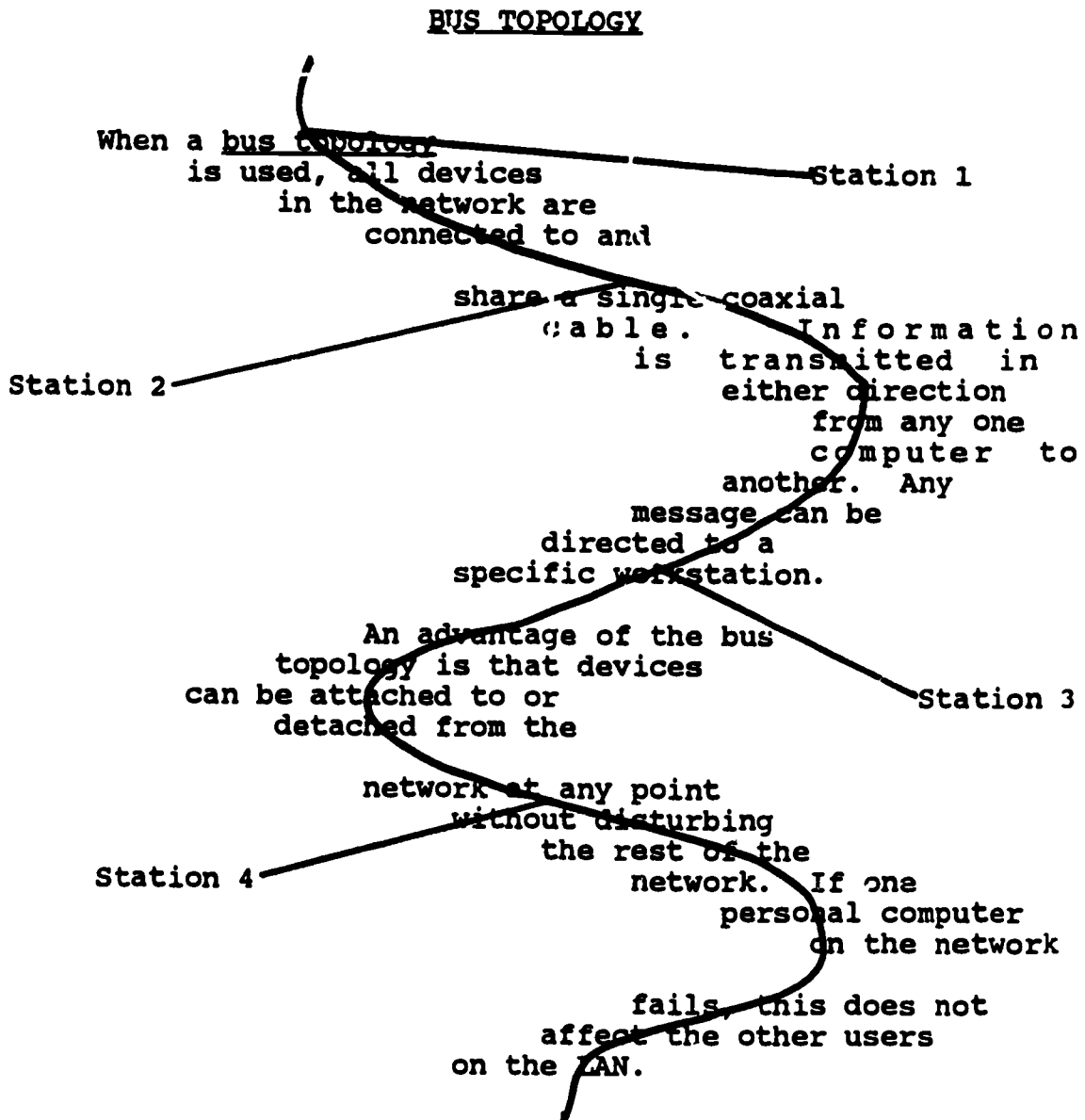


Figure 2.

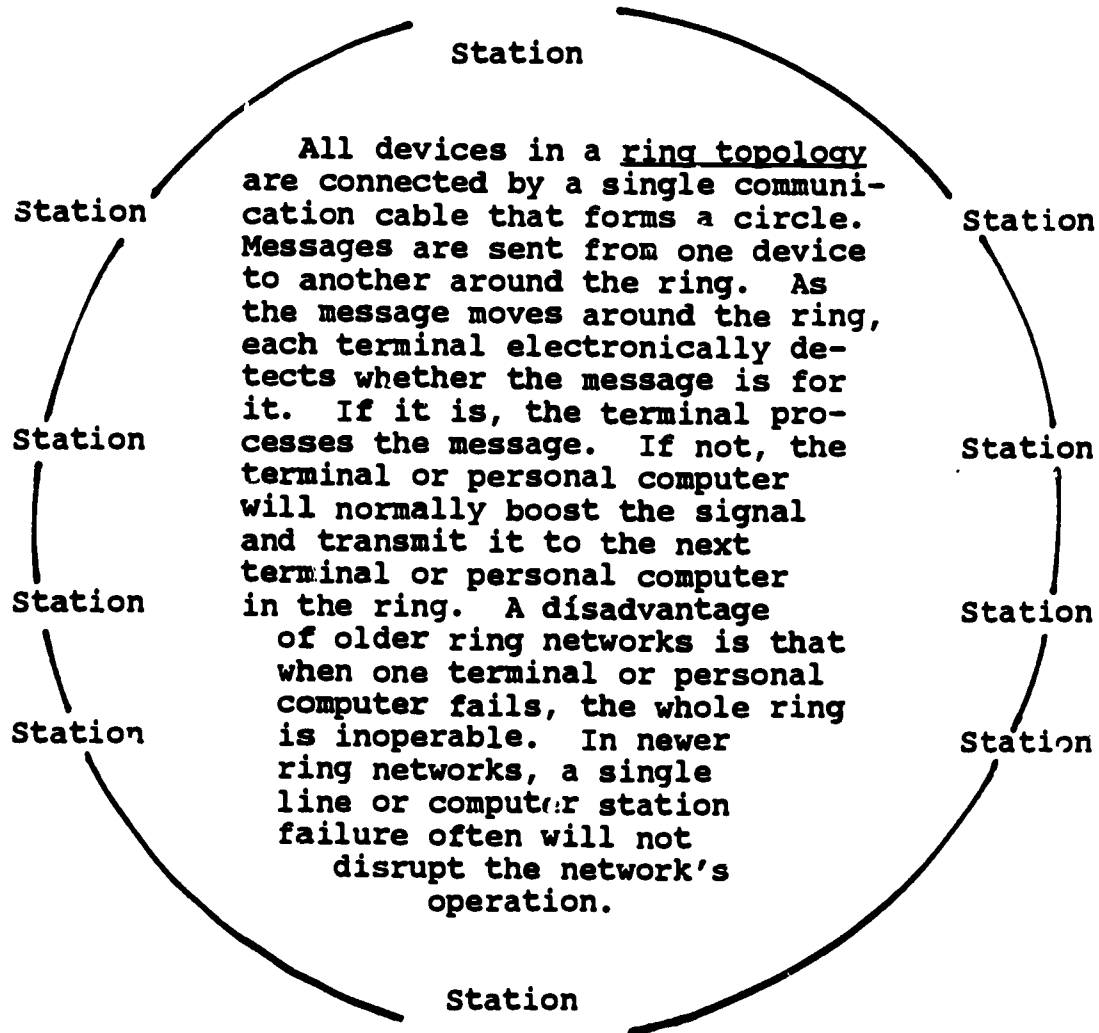
RING TOPOLOGY

Figure 3.

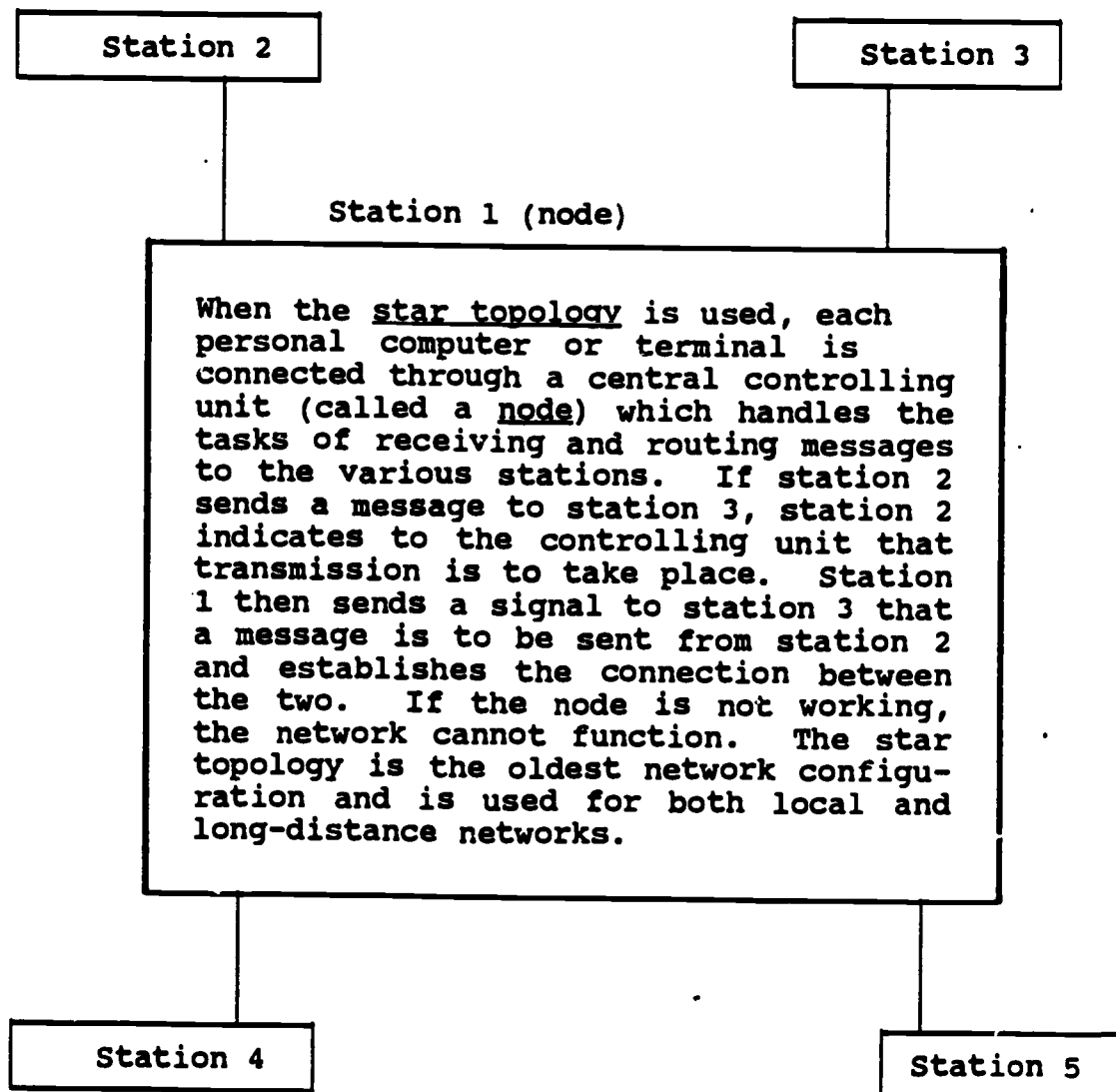
STAR TOPOLOGY

Figure 4.

TREE TOPOLOGY

A tree network is a variation of the star configuration. Several devices are connected to intermediate controllers, which in turn are directed by a master controller. Routing of messages is accomplished through several channels which are determined by the master controller:

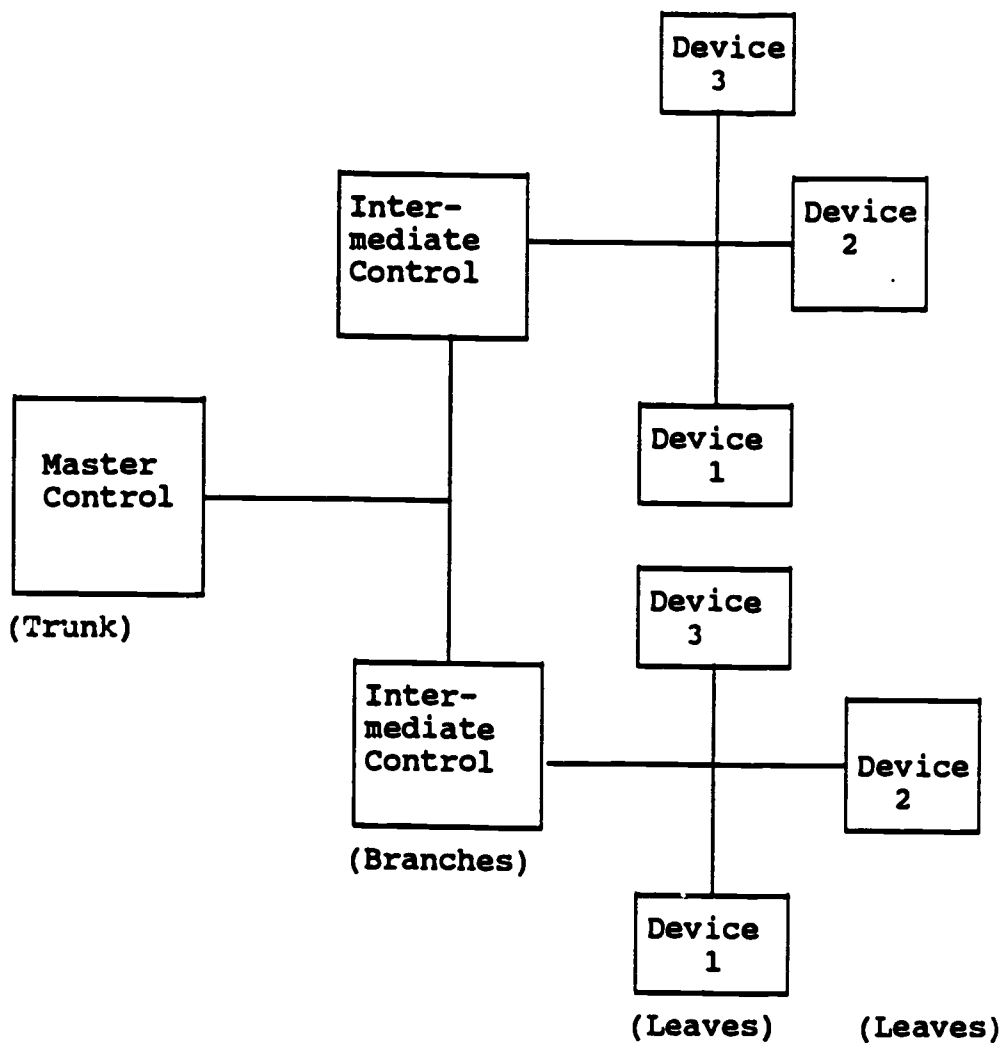


Figure 5.

- D. hybrid networks combine the advantages of public and private networks for access to off-site databases. They provide lower maintenance and operations costs since the network is maintained by the public network provider, shared management of the network, shared the communications overload on a private network, and take advantage of established transmission protocols. Examples of vendors who have built successful hybrid networks for large corporations include TELENET (GTE Communications Corporation), TYMNET (Tymshare, Inc.), and UNINET.
- E. Integrated Services Digital Network (ISDN) is a network designed to combine telephone communications services and all-digital facilities. ISDN is a new concept of information processing network which will be capable of treating all sources of information (voice, business machine-generated data, graphics, images, and video) as data and would take advantage of the latest available technology. At the present time, ISDN is in an evolutionary process that will span several years. As equipment, services, and capabilities become available, the ISDN features will be offered to users. It is anticipated that the ISDN network will provide the user lower costs; new services; the ability to merge different services on the same transmission line; simplified network interfacing, monitoring, and control; and the potential for new information processing opportunities as yet unknown. (Note to instructor: This is an excellent topic on future developments in networks for students to research and make reports.)

NETWORK ACCESS

NETWORK ACCESS is accomplished when designing the network by deciding how the various devices will gain access to the network to transmit and receive messages. The most common access methods are polling, contention, and token passing.

- A. Polling (as discussed previously) is the method whereby the central controller goes around the network in order, asking each terminal if it wishes to transmit. Polling is used primarily with star topology.

- B. Bus topology uses contention as the most common access method. The contention is that each device has access to the network when the network is not busy, much like a telephone party line. When a terminal has data to send, it first electronically listens to the network communication channel to determine if any other terminal or computer is transmitting data. If transmission is taking place, the terminal waits a short period of time (milliseconds) and again listens to the line. This process continues until the terminal finds the line free; then it transmits its message.

Several contention methods are used with LANs. The most common is carrier sense multiple access (CSMA). CSMA utilizes two methods to ensure that devices do not transmit messages at the same time. This phenomenon is called a collision. When this occurs, neither terminal can transmit data. They wait a random short period of time (each waiting a different amount of time) and then attempt the transmission again. Systems which operate in this manner are called CSMA/CD (collision detection). Another method used with CSMA to prevent devices from transmitting messages at the same time is collision avoidance (CA). With CSMA/CA, special electronics in the networks guarantee that only one device can transmit at a time.

- C. Token passing can be used in bus or ring networks. A token is a string of bits that constantly travels around the network. The string of bits contains a source, room for a data message, and a destination address. Any terminal or personal computer which wishes to transmit data must wait until it receives the token from the previous station in the network. When the station receives the token (giving it permission to transmit), it transmits its data and then passes the token to the next station. Each terminal also looks at the address in the token to see if the message is for it, and if it is not, the token is passed along the network until it gets to its destination. Because only one token exists in the network at a time, only one computer can use the network at a time. The IBM PC network is a token ring network.

NETWORK SERVERS

Several devices are often needed in a network in addition to terminals or personal computers. Some of these additional pieces of equipment include:

- A. A file server controls the access of users to information stored on a hard disk. It locks up a record that is being accessed by one user so others cannot access it at the same time. If many people were to access and change a record simultaneously, many of the changes might be lost. A file server also may be responsible for establishing private areas for each user by keeping track of passwords.
- B. A printer server allows the output from a particular terminal or personal computer to be directed to the appropriate output device.
- C. A gateway device may be needed to perform the necessary protocol translations when LANs are connected to mainframe computers or to communication networks outside of a specific LAN.
- D. A bridge is an interface device that allows two similar LANs (same model/type/manufacturer) to communicate.
- E. A utility server is needed to allow access to special devices, such as modems, which are attached to the LAN and are not handled by any other server on the network.

COMPATIBILITY

Special considerations must be observed in telecommunications in order to effect transmission of data and ensure compatibility. Two pieces of equipment must be able to send and receive information to and from each other. Factors which must be taken into account include speed and amount of information to transmit, mode of transmission (asynchronous and synchronous), protocols, and codes into which bits are placed in traveling along the line. While it may be possible for two computers with incompatible codes to communicate, the results may not be satisfactory.

Connectability is the ability to receive information that has been sent. The system may receive keyboarded numbers, symbols, and letters, but margin settings, paragraph indentions, and other format instructions are not

communicated to the receiving system. The person at the receiving end must reinsert these instructions. From the designer's point of view, high priority is given to compatibility.

Editability describes the ability to receive information in the format in which it was sent. True compatibility does not exist unless the communication has editability.

PLANNING CONSIDERATIONS

Generally, a user does not rush right out and "buy a LAN." A LAN is a semi-customized package made up of cables, transmission devices, interface units, network management hardware and software, end-user devices and applications software, and other components. The user must take into consideration the following questions:

Is a LAN really needed?

What type of information will be transported by this network? Will it be data only, or will voice and video communications also have to be accommodated?

What types of and how many devices are to be interconnected? Will the connections be point-to-point or will switching need to be accommodated?

What are the status and characteristics of the physical environment in which the LAN will be employed? Does the physical environment have any special requirements or problems? How great are the geographical distances that need to be covered? Is there existing wiring, ductwork, or other facilities already in place?

What traffic volume is expected on the network? What level of performance and throughput is required? What are the maximum user data rates to be supported?

Will multiple devices have to be able to access the network concurrently?

What length of response time and access time delays can be tolerated? Must the network guarantee access to some or all users?

Will the local network be interconnected to any other type of network, either public (such as Tymnet or Telenet) or private network?

What services will the network be required to perform for current applications and for applications which may evolve in the future? Can any other host system in the network share some of the responsibility for network services?

What level of reliability is required for transmission, user devices, nodes, links, and for the network as a whole? What level of transmission error control must be supported by the network? How quickly and predictably must the network be able to recover from node or link failure?

How easily must the network be able to accommodate expansion and other types of configurational changes? What kinds of growth/changes are expected? Additional nodes? New types of traffic? Changes in existing traffic types or volume? Movement of user equipment from one work area to another?

How easy must the network maintenance be? What price, in terms of both money and downtime, can be afforded to pay for network maintenance? Will the user need (or be willing to add) experienced network maintenance personnel to the staff?

What are the financial limitations?

The focus of the answers to these questions should be in a "bottoms-up approach", considering whether it might be beneficial to install hardware now, what the network can do, how the network does it, etc. Familiarity with various topologies, media, and access methods helps in understanding the basic limitations of LAN as a concept. A LAN is a transport mechanism. It cannot solve problems that may exist within an office environment. Compatibility, connectibility, editability, and integration of equipment are not assured just because the devices are physically tied together on the same cable. Honest answers to the above questions will save an organization's time and money in the long run.

WORKSTATIONS

To accomplish the work of the automated office (which has generally been the manipulation of information), several components fit together in what has been termed a workstation. Generally, the workstation is composed of a keyboard, video display, central processing unit, storage unit, and possibly a printer. These are the components of a personal computer. This workstation also may be connected

to a local area network which will expand its communications capabilities.

Retrieving data from a computer, communicating with others through written and spoken word are recognized as activities common to executives, managers, and a large number of workers throughout an organization. To accomplish these tasks efficiently and effectively, integrated workstations (sometimes called executive workstations) have been developed which provide both telephone and computer terminal capabilities within a single unit by allowing both voice and data communication.

The purpose of the integrated workstation is to provide a single, convenient location with easy access to a number of functions. Numerous research studies have shown that executives spend a substantial part of their time communicating both orally and in writing. Combining both telephone and computer capability into a single workstation seems to be a logical step in automating office tasks performed by both executives and administrative support workers alike. Connecting these workstations to large databases from which to access information; installing communications, desktop management, electronic mail, and decision support software, as well as word processing support tools; and providing ease of access to the organization's information truly integrates information processing into all levels of the organization.

SECURITY

A major consideration in evaluating systems (which include workstations, networks, or other systems) is the amount of protection provided from accidents and from criminal tampering. Accidents occur from several sources: user error, user ignorance, power outages, and lack of provision for back-up copies due to a disk "crash". Some software actually holds deleted files in a temporary storage buffer which can be brought back with a special command; some software asks for confirmation before deleting files. Some safeguard is needed against changing data in a central record. A variety of methods is discussed below.

- (1) One method is to provide read-only access to central data so that users can see and work with information on their microcomputers but cannot change the central record.
- (2) One protection against criminal activity may be to install passwords whereby users are required to log on with a sign-on number.

- (3) Another technique is encryption whereby data are scrambled by a special program and then unscrambled only for users who enter the required codes.
- (4) Many programs also provide audit trails which show exactly what was done to a file, when it was done, and which password was used to gain access to the file. In this way and if needed, sabotage or errors can be traced to the origin and preventive measures taken.
- (5) Automatic close features can be installed to shut down a computer terminal when it is not used for a certain period of time. This also may be called a time-out parameter. When a terminal has not been in use during a three- to ten-minute range, the terminal shuts off and closes the door to data access by passersby.
- (6) Mechanical keyboard locks on terminals offer another security solution. These locks allow an operator to lock up the terminal when leaving for a short time without having to log off the computer.

This summary is included in the "Student Materials" section as Exercise 1-1.

SUMMARY

1. Concepts, vocabulary, and terminology to be reviewed:

Strowger switch, triode vacuum tube, network, topology, three most common network topologies (bus, ring, star, and tree), cellular radio, workstation, chip, FCC, CI2, CI3, Carterfone decision, AT&T divestiture, telecommunications, communication, information processing, modem, acoustic coupler, types of modems, RS-232C, serial, parallel, interface, communications adapter, transmission media, lines, link, fiber optics, coaxial cable, twisted pair, open wire, telephone line, satellite, microwave, baseband, digital, broadband or wideband, bandwidth, digital lines, point-to-point line, multidrop or multipoint line, dedicated line, switched line, leased line, hard-wired line, polling, analog, addressing, token passing,

asynchronous, synchronous, simplex, half-duplex or duplex, full duplex, ASCII, EBCDIC, protocol, value-added network, wide area network, local area network, ISDN, hybrid network, packet switching, public databases, electronic mail, information resource sharing, multiplexer, contention, hardware resource sharing, node, CSMA/CD, CSMA/CA, network servers, compatibility, XMODEM, connectibility, editability, PBX, PABX, encryption, delivery systems, password, teleconferencing, CBMS, CVMS, automatic close or time-out parameters, mechanical keyboard locks, telecopier, security, integrated workstation, facsimile, and front-end processor.

2. Knowing the capabilities of telecommunications, networks, equipment, and software, as well as workstations, how would you...
 - a. Communicate with your company's headquarters located in Atlanta, Georgia, if you were in Richmond, Virginia, or Washington, D. C.? Name the pieces of equipment in the communications network you would use.
 - b. Communicate with your company's office in London, England, if you were in Dallas, Texas? Identify the specific pieces of equipment in the telecommunications process you would use.
 - c. Leave a message for your staff regarding a meeting for the following day from your workstation? How would you know when each of your staff received the message?
 - d. Find out the closing prices for your company's stock for a particular day on that day?
 - e. Send a facsimile copy of a blueprint to a company in Japan? Name the pieces of equipment in the communications network you would use.
 - f. Determine the need for a local area network in your company? What are some of the questions you would ask? Who are some of the people with whom you would talk? Where would you go to look at other networks?
 - g. Find out who could speak German in your company by using your integrated workstation?
 - h. Determine the best methods of sending information electronically to locations such as Lebanon,

Beirut; Paris, France; London, England; Berne, Switzerland; and Canada; and other locations in the United States if your company did not have this capability?

3. Find out the telecommunications software that is available for large mainframes, as well as for personal computers by reading at least two articles. Report your findings to the class.
4. Expand your knowledge of telecommunications by reading at least one article which contains a term or item that was not mentioned in class. Explain the term or item to the class and relate it to what you have learned in this task area.
5. Interview someone in an organization in the area of telecommunications. Questions could be asked might include the following:

Do they have networks? What is the main use?
What configuration(s) do they use and why?
What grade of lines do they use and why?
What mode of transmission: asynchronous or synchronous? Why?
What type of lines (simplex, half-duplex, full duplex) and why?
Are their lines switched or leased?
Do they use ASCII or EBCDIC?
Do they use packet switching?
Do they use hard-wired (point-to-point) or multidrop lines?
Do they use public databases? Which ones? Why?
Do they use wide area networks? Why? Which one(s)?
What kind of communication software do they use?
What kind of security is provided?
Other questions.

6. Arrange for a visit to the organization at the time of the interview. What new terms or items were mentioned or seen that were not covered in class?
7. Arrange a field trip to this same organization (or another) for the class.
8. Be prepared to explain how protocols are used in telecommunications to a friend who is not familiar with the information systems field.
9. Discuss one of the landmark regulatory decisions affecting the telecommunications industry--Carterfone decision, the 1956 "consent decree", the divestiture

decision, CI2, CI3--as to the effects on the evolution of telecommunications. Speculate on what possible effects this decision would have had on telecommunications if the decision had been the reverse.

(Note to instructor: Suggested test instruments (with solutions) are found in the "Evaluation" section.)

GLOSSARY OF TELECOMMUNICATIONS/NETWORKING TERMINOLOGY

acoustic coupler is a type of modem connected to the computer by a cable which utilizes a standard telephone headset which is placed into molded rubber cups on the acoustic coupler.

addressing is a technique whereby the host computer addresses the particular terminal on the line and sends the message to that terminal. Only the addressed terminal receives the message from the host computer.

asynchronous transmission is accomplished when one character at a time is transmitted or received. Each character (consisting of 7 or 8 bits) is identified by a start bit and a stop bit. The start and stop bits indicate to the receiver the arrival of data.

audit trails is a security feature which show exactly what was done to a file, when it was done, and which password was used to gain access to the file.

automatic close is a security feature which can be installed to shut down a computer terminal when it is not used for a certain period of time. This also may be called a time-out parameter. When a terminal has not been in use during a three- to ten-minute range, the terminal shuts off and closes the door to data access by passersby.

bandwidth is the capacity of the media for transmitting information--a signaling technique that describes the range of frequencies a communication link has available for transmitting voice, video, data, and graphics.

baseband signals are sent at different times. Generally, only one stream can be sent at a time and may be limited to only data communications, sometimes voice communications. Baseband cannot send video communications and cannot handle simultaneous multiple transmissions. Ethernet is an industry standard for baseband transmission.

bit is an abbreviation for binary digits. A character is made up of a number of bits, expressed in 1's and 0's. Characters most commonly are made up of either groups of 7 bits according to the American Standard Code for Information Interchange (ASCII) or in groups of 8 bits according to the IBM developed alphabet called Extended Binary-Coded Decimal Interchange Code (EBCDIC).

bridge is an interface device that allows two similar LANs (same model/type/manufacturer) to communicate.

broadband or wideband data stream signals are sent simultaneously. Cable TV or fiber optics are examples of broadband media, although coaxial cable also is used. Wangnet is an example of a broadband network.

carrier sensed multiple access (CSMA) is used on bus networks. This is also called contention access. The contention is that each device has access to the network when the network is not busy, much like a telephone party line. When a terminal has data to send, it first electronically listens to the network communication channel to determine if any other terminal or computer is transmitting data. If so, the terminal waits a short period of time (milliseconds) and again listens to the line. This process continues until the terminal finds the line free; then it transmits its message. When two terminals begin transmitting data at the same time, this phenomenon is called a collision. When this occurs, neither terminal can transmit data.

carrier system is a multiplexing technique which uses various transmission media to accommodate many channels on the same physical line. The media may be cable, coaxial cable, or a microwave system.

Carterfone decision allowed competition by the Carterfone Communications Corporation in the interconnect industry. This ruling by the FCC helped create the interconnection of telecommunications devices (telephones, automatic dialers, speakerphones, PBXs, etc.) to the telecommunications system.

cellular radios are used for interactive radio transmission and are based on the principle that local exchange networks can eliminate the stringing of wires or cables for interactive communication.

coaxial cables consist of hollow copper cylinders surrounding a single wire; may be bundled into a large cable that contains a number of coaxial cables. A single coaxial cable composed of 20 cables can handle up to 18,740 telephone calls at the same time at a higher speed than twisted pairs. Coaxial cables can transmit voice, video, and data simultaneously over a distance of up to 50 miles.

common carriers are companies which supply communications equipment and lines for commercial use; e.g., AT&T, GTE, Western Union, etc.

communicating word/information processor is able to send keyboarded mail, messages, and documents electronically between two points or terminals. When a communicating word/information processor is connected to another piece of equipment that also communicates, it is said to be "on line".

communication is the exchange of information--a two-way process.

communications adapter is installed by fitting the board into an available slot on the motherboard in the processing unit of the computer if a personal computer is used to communicate with a mainframe computer (unless the computer is manufactured with all the hardware required). This adapter performs several functions: it changes data from parallel form (where bits move in groups, such as 8, 16, or 32 at a time on a bus) to a serial form (where bits are transmitted one bit after the other) for transmission. It uses an RS-232C serial interface (RS stands for recommended standard; 232 is a number to reference this agreed upon industry standard; C indicates a third revision of the standard) to act as a pathway through which the computer transfer serial data to and from modems. This interface is sometimes referred to as a port.

compatibility is achieved when two pieces of equipment are able to send and receive information to and from each other.

computer-based message systems (CBMS) are value-added products on private branch exchanges (PBXs) and computer systems.

computer-based voice message systems (CBVS) allow a caller the option of leaving a message with a message center or asking to be connected to a voice storage device. The system records voice messages, converts them to digital format, and stores them in a mailbox to be accessed by the appropriate recipient. Voice reminder systems and voice store and forward systems are also part of voice message systems. These systems are used when a person needs to be reminded of important appointments, or when a person prefers to leave a spoken message rather than a keyboarded message.

Computer Inquiry II (CI2) held by the FCC allowed AT&T to compete in the data processing industry but prevented them from marketing their long-distance services on their equipment.

Computer Inquiry III (CI3) was initiated in September, 1985, to assess the role of the FCC in telecommunication and to examine further deregulation. This inquiry continues.

COMSAT is a communication satellite put into orbit by NASA.

connectibility is the ability to receive information that has been sent.

contention is the most common access method used in bus topology. The contention is that each device has access to the network when the network is not busy, much like a telephone party line. When a terminal has data to send, it first electronically listens to the network communication channel to determine if any other terminal or computer is transmitting data. If transmission is taking place, the terminal waits a short period of time (milliseconds) and again listens to the line. This process continues until the terminal finds the line free; then it transmits its message.

CSMA/CA (collision avoidance) uses special electronics in a LAN to guarantee that only one device can transmit at a time.

CSMA/CD (collision detection) is a system which detects possible collisions (when two terminals begin transmitting data at the same time) and adjusts for access to a network.

data access arrangement (DAA) protects the public switched network from harm caused by a terminal device such as an automatic answering machine.

digital lines are being used to replace older, worn-out analog lines so that data can be moved at greater speeds. These lines do not require modems and can transmit voice, photography, video, and data digitally.

downloading is the term used when large amounts of data are transferred from a database on a mainframe to a personal computer for storage on auxiliary storage

editability describes the ability to receive information in the format in which it was sent.

electronic mail or electronic text transfer provides the ability to communicate directly with others users of the LAN. A user can use the communication network to send a message using electronic mail, to receive a message, and to print the message.

encryption is a security technique by which data are scrambled by a special program and then unscrambled only for users who enter the required codes.

external modem (also called direct connect modem) is attached to the computer by a cable and is contained in a small box-like structure placed next to the computer. A cord from the modem plugs directly into a standard telephone jack to allow communication over telephone lines.

facsimile (FAX) is a type of copier that electronically sends an original document (letter, map, chart, picture, contract, etc.) from one location to another where it is reproduced as a copy or "facsimile" of the original document.

Federal Communications Commission (FCC) was established in 1934 to regulate radio-television transmission, all interstate telecommunications services, and to establish interstate tariffs.

fiber optics is a technology based upon the ability of smooth hair-thin strands of material to conduct light with high efficiency. Fiber optics can carry a larger volume of messages at a lower cost and at a lower weight and size savings.

fiber optics modem allows digital devices to interface with fiber optic cable.

file server controls the access of users to information stored on a hard disk.

frequency-division multiplexing assigns signals to the various frequencies contained in the transmission channel.

front-end processor is a special-purpose computer set aside to handle communications tasks for a large mainframe computer, leaving the central computer free to work on basic information processing. A front-end processor includes a multiplexor and many output ports connecting with different communications lines. The front-end processor acts as a "traffic cop", routing and sorting messages to available lines.

full-duplex allows data to be transmitted in both directions at the same time. No turnaround time is required.

gateway is a device that may be needed to perform the necessary protocol translations when LANs are connected to mainframe computers or to communication networks outside of a specific LAN.

half-duplex or duplex line permits information to travel in either direction, but in only one direction at a time.

hardware resource sharing places certain expensive devices on a network to allow each personal computer on the network to use that device, such as laser printers, letter quality printers, file servers, and others.

hybrid networks combine the advantages of public and private networks for access to off-site databases. They provide lower maintenance and operations costs since the network is maintained by the public network provider, shared management of the network, shared the communications overload on a private network, and take advantage of established transmission protocols.

information processing is defined as the manipulation of data and text into final format and/or movement to its final destination.

information resource sharing allows personal computer users on the LAN to access data stored on any other computer in the network.

Integrated Services Digital Network (ISDN) is a network designed to combine telephone communications services and all-digital facilities. ISDN is a new concept of information processing network which will be capable of treating all sources of information (voice, business machine-generated data, graphics, images, and video) as data and would take advantage of the latest available technology. It is in the process of evolution at the present time.

integrated workstations (sometimes called executive workstations) have been developed which provide both telephone and computer terminal capabilities within a single unit by allowing both voice and data communication.

intelligent or smart modem is a more sophisticated modem which contains a microprocessor that controls many functions, such as automatic redialing, answer incoming calls automatically, and accept data.

INTELSAT is a communicate satellite put into orbit by the International Telecommunications Satellite Organization.

internal modem cannot be seen because it is found inside the computer. It consists of a printed circuit board, with related electronics, that is plugged into an empty slot on the motherboard of the processing unit of the computer.

leased line is a permanent circuit to connect a personal computer, terminal, or large computer with another computer. This line may be referred to as a dedicated line or hard-wired line, also.

local area network (LAN) covers a limited geographic area, is privately owned and user administered, is used mostly for the internal transfer of information within a business, is normally contained within a single building or adjacent buildings, and transmits data at a very rapid speed.

MAILGRAM is another example of a service offered by Western Union. Telephone and U. S. Post Office services are combined to send a written message. Mailgrams can be used by persons who are not part of the teletypewriter network. The message is called to a Western Union operator who keyboards the message and transmits it to the nearest post office. The message is printed out, placed in a special mailgram envelope, and delivered by a mail carrier to the final destination the next day (guaranteed).

mechanical keyboard locks on terminals offer another security solution. These locks allow an operator to lock up the terminal when leaving for a short time without having to log off the computer.

microwave systems are relay systems which transmit data through open space much like radio or TV signals. The stations consist of antennas or towers spaced about 30 miles apart in a grid that spreads across the country. The antennas or towers may be positioned on tops of buildings, towers, or mountains. Data are transmitted on a line of sight path to other stations, since microwave frequencies do not bend.

modem (MOdulator/DEModulator) converts digital data generated by the computer to an analog signal which can be sent or received over communication channels and also converts analog signals received from telephone lines to digital signals which can be understood by the receiving computer.

multidrop or multipoint line has more than one terminal, personal computer, or large computer on a single line connected to a host computer. Only one terminal at a time can transmit to the host computer; however, more than one terminal on the line can receive data at the same time.

multiplexing is a technique which allows a large number of different transmission signals to pass over the same transmission media.

multiplexer can be used when it is desirable to have more than one medium carry many transmissions at the same time. Multiplexing can be used with both broadband and baseband media. Broadband media use frequency-division multiplexing and can carry many channels, with each channel on its own frequency. Baseband media must use time-division multiplexing, in which a narrowband wire carries signals first from one message, then from another.

network is composed of computers of various sizes, workstations, communications hardware and software, and connections that enable the network to function productively.

network access is accomplished when designing the network by deciding how the various devices shall gain access to the network to transmit and receive messages.

packet switching allows a message to be broken down into groups of bits and distributed throughout the network. A message, therefore, consists of several groups of bits or packets. These packets, unlike the messages sent through a telephone switching center, go off in all directions: an entire message does not travel together. At its final destination, the packets are all gathered together and the message is reconstructed.

parity check is a common technique used in ASCII code transmissions to detect and correct errors. ASCII uses seven bits to represent a character. To make a parity check, ASCII adds an eighth "parity" bit to each character. This bit is selected to make the totals for all characters consistently even (or in some systems, consistently odd). If interference in the transmission changes a digit in any byte of data, the total of its digits will no longer be even. The receiving computer sends an error signal to the sending computer and the byte is retransmitted until it reaches the receiver correctly.

passwords are scrambled codes which users are required to know and use in order to log on to a computer system for security purposes.

point-to-point line is a direct line between two computers (any size) and a terminal and a computer.

polling is performed by the host computer and the associated communications control unit. The host asks each terminal or personal computer if it has some data to send through the use of special control characters. If the terminal does not have data to send, it responds with negative control characters and the next terminal on the

line is polled. If a terminal does have data to send, it gains control of the line and sends the data.

printer server allows the output from a particular terminal or personal computer to be directed to the appropriate output device.

protocol describes the rules established to govern the sending of information from one piece of equipment to another. Devices at either end must be compatible. This exchange of signals is sometimes called handshaking.

public databases are databases usually designed by service organizations and which be used in lieu of an independently designed network.

satellites communicate electronically from one earth station to another from their position in space approximately 22,000 miles above the earth. They can relay signals over longer distances because they are not hampered by the curvature of the earth, mountains, and other obstacles as are microwave systems. Typically, a message is sent from a ground station to the satellite which, in turn, amplifies the message and sends it to another ground station that may be halfway around the earth.

simplex allows data to be transmitted in one direction only. Data go in one direction with no return.

Strowger switch, invented in 1889 by Almon B. Strowger, allowed users to automatically dial and be connected to another user. Eliminated individual telephone operators and made telephone communication more secure and reliable.

switched line is established through the regular telephone system rather than a direct connection as with a leased line. The switching center primarily used for voice application is called a PBX (Public Branch EXchange); the switching center used for data applications is called a PABX (Private Automatic Branch EXchange).

synchronous transmission allows characters to be sent down the line in a continuous stream of bits without start or stop bits. The sending and receiving devices are synchronized by a timing mechanism within the modem at specified intervals. Several special characters called SYNCH characters are placed at the beginning of each message.

telecommunications entails a two-way process, except that it involves communicating electronically across distances (generally over telephone lines) without any changes occurring to the original message.

teleconferencing means conferring, discussing, or communicating data, text, graphics, audio, and video by telephone or other media between two or more people at two or more locations. Audio teleconferencing is an example of a telephone conference call.

teletypewriter is a terminal or workstation that can be used to send or receive written messages. It combines two communications methods: telephone and letter. It uses telephone lines and provides a written document. Telex and TWX (Western Union) have been used to send messages electronically long before electronic mail or other electronic delivery systems were developed. It is basically a means of communicating in writing with another office equipped with a teletypewriter by dialing directly the telephone number assigned to that terminal or station.

time-division multiplexing takes digital signals and assigns them to given time slots within a transmission link, allowing them to be packed together on a given channel.

token passing uses a token (a string of bits) that constantly travels around the network. The string of bits contains a source, a data message, and a destination address. Any terminal or personal computer which wishes to transmit data must wait until it receives the token from the previous station in the network. When the station receives the token (giving it permission to transmit), it transmits its data and then passes the token to the next station. Each terminal also looks at the address in the token to see if the message is for it. If it is not, the token is passed along the network until it gets to its destination. Because only one token exists in the network at a time, only one computer can use the network at a time. Token passing can be used in bus or ring networks.

topology describes the configuration of the pathway by which the devices on a network are connected to each other. Common topologies found in networks include bus, star, ring, and tree.

transmission channel makes it possible to provide the link between the sender and receiver. The channel is the physical path that is used for sending information.

transmission speed is the speed at which information is sent over telephone lines.

triode vacuum tube, invented in 1913 by Lee DeForest, allowed wireless transmission over long distances.

twisted wire pairs or cable is common telephone cord.

uploading is the term used when data are transferred from files on the personal computer to databases on the mainframe

utility server is needed to allow access to special devices, such as modems, which are attached to the LAN and are not handled by any other server on the network.

wide-area network, also called a value-added network (VAN), is defined as any transmission or reception of signals, writing, sounds by wire, radio, visual, or electromagnetic systems.

workstation is composed of a keyboard, video display, central processing unit, storage unit, and possibly a printer.

XMODEM was one of the first protocols developed to minimize errors during microcomputer file transfer operations. It was developed by Ward Christiansen and is in the public domain.

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TELECOMMUNICATIONS/NETWORKING

Task Area 2

Given a modem, electronic communication system, or other configuration in the classroom, the student will be able to 1) demonstrate operational knowledge of telecommunication hardware and software and 2) discuss and utilize modems to receive information from and transmit information to an electronic bulletin board, as well as to and from other individual users (if equipment is available) with 90% accuracy (or to the level of mastery).

Suggested teaching strategies: Outside readings, vendor visits, field trips, set up classroom bulletin board, lab assignments regarding hardware and software operation.

1. Build on knowledge of telecommunication hardware acquired in Task Area 1 by suggested activities which will reinforce learning:
 - a. Field trips to organizations which utilize telecommunications/networking (LANs, specifically). At least two field trips, if possible.
 - b. Outside speakers from organizations which utilize telecommunications/networking equipment or vendors who will demonstrate equipment, including software. Representatives from PC users' groups.
 - c. Field trip to your school's computing center. Many of these centers are very involved in telecommunications/networking.
 - d. Required outside readings from recent computing magazines and other literature specifically related to network (LAN) systems, hardware and software, network management, network configurations, network standards, FCC rulings, regulation/deregulation issues, etc. Share with class.
 - e. Demonstration of telecommunications/networking hardware and software available in classroom or lab.
2. There are an overwhelming number of commercial LANs available on the commercial market. An awareness of some of them will contribute to students' knowledge base and point up the relevant factors related to each.

The local area network market has divided itself into several distinct categories according to applications: broadband networks for high-speed data transfer between mainframes; broadband networks for factory automation; general-purpose baseband/broadband networks for office automation applications; and networks designed especially to link personal computers. These last two applications are of most concern to the students in this course.

It is not critical to this course to understand the underlying architectures of the networks, but it is critical to understand the basic capabilities of each.

The buyer wants to be sure the benefits outreach the costs since most local area networks require a great deal of on-site engineering to ensure efficient location of stations, ease of reconfiguration and expansion, accessibility for testing and repair, and compliance with building and fire codes. Minimum specifications for an effective local area network may include resource or information sharing, added-value applications (E-Mail, access to user documents and databases, etc.), compatibility, distribution of hardware, integration of hardware and information processing functions, distributed processing, high speed, low error rate, longer-distances than point-to-point networks, ease of use, security, and full connectivity. The important consideration is that the end-users' needs are met.

As each of the local area networks is discussed below, attention to these factors will be emphasized. (Note to instructor: It is crucial to this discussion that students bring articles related to commercial local area networks which are on the market. The technology is changing so rapidly in this area that it is impossible and impractical for you to stay up-to-date with text materials.)

Several of the more popular networks are explained below.

AppleTalk network is a recent development from Macintosh. It links Macs, Apple II's, and IBM's, as well as printers, together on the same network. Very inexpensive; modems are not needed.

Interactive Systems/3M's Videodata LAN/1 offers multiple access on a single channel. It can share the cable with current point-to-point Videodata applications and with CATV (cable TV) services.

Sytek offers IBM's BSC protocol on its LocalNet product and provides a multiport network interface with its LocalNet 20 system.

Ungermann-Bass' local area network features a network management station that runs under the CP/M operating system.

Ethernet (Xerox) is a baseband, CSMA/CD bus network. It has been recognized as a LAN standard by IEEE (Institute of Electrical and Electronics Engineers).

ARCNet (Datapoint) is a token-passing network.

WangNet is a broadband network that features dual cable and is designed to serve a single vendor (Wang). However, Wang has opened its network to other vendors' products. It is now offering an IBM 3270 cable-saving multiplexer that runs over WangNet. Support of the IBM PC on the network is also planned.

IBM's PC Net is a broadband network for personal computers using the CSMA/CD random access method. Up to 1,000 IBM PCs can be connected in a campus environment for occasional communication.

Corvus Omninet is a twisted-pair-based CSMA network that uses Corvus' Winchester hard disk systems for file sharing among a diverse array of PCs.

Nestar Systems' PLAN Series uses the ARCnet token-passing architecture at the lower levels and the XNS protocols at the higher levels to link Apple II, IBM PCs, and their plug-compatible competitors.

Novell offers a twisted-pair local area network.

Apple's AppleBus, CompuCorp's OmegaNet, and North Star's Northnet are proprietary networks, designed to work only on the vendors' products. These kinds of LANs give users greater assurance of trouble-free performance and a single source to deal with should the system "crash".

EasyLAN, Server Technology, Sunnyvale, CA. A network that links 2 to 10 IBM PCs and/or compatibles through a 30-foot cable and RS-232 serial connectors in a star configuration. The product only transfers data at a speed up to 19,200 bps and does not supply full intersystem connectivity. It has been criticized because it did not adjust itself to prevailing market

dictates--that of editability and speed.

SNA (introduced by IBM around 1975) stands for Systems Network Architecture and offers a link between large host computers and remote terminals. It has evolved into a strong non-LAN alternative to Ethernet and other LANs. SNA is an overall plan determining the way data are sent over lines. Establishing relationships with other communications protocols such as the Virtual Telecommunications Access Method (VTAM), IBM software which gives other software access to SNA networks, SNA is in effect a structure of numerous protocols. One major link advancing SNA has been synchronous data-link control (SDLC). SDLC controls, checks, and otherwise governs communications among devices using SNA in full-duplex mode. Being at heart a protocol-converting program, SDLC enables devices to transmit virtually any bit sequence or character string. It does this transparently--meaning that the user does not see all the code translations and other operations that support the "simple" command to transmit.

...and others.

3. When reading about telecommunications and networking protocols, equipment, hardware, and software, one will come across standards which have been established in these areas. The following information is provided in an attempt to give an overview (not an in-depth study) of the terminology and standards for telecommunications and networks which have been and are being established and the organizations which are establishing them:

Data Interchange Format (DIF) is support software which automatically reformats files downloaded from a host for immediate use on a microcomputer and developed as a VisiCalc file format by Software Arts of Wellesley, MA.

Protocol Converter translates for one machine what a foreign machine just said. The trade sometimes calls the converters "black boxes". Protocols are communications standards and rules. There are dozens of different kinds. Mainframes and minicomputers use slower asynchronous ones. A recent development called Microm Networking Protocol (MNP) has shown promise of becoming a protocol standard. It was released by Microm, a Norwood, MA, software house. It has received endorsements from AT&T, GTE, IBM, and Apple, among others.

CCITT (Consultative Committee of International Telephone and Telegraph) sets standards for manufacturers of long-distance communication transmission equipment, such as facsimiles.

American National Standards Institute (ANSI) is another organization which has set standards related to interchanged documents based on a page image format (PIF). ANSI, CCITT, and ISO are working together to develop standards on the logical and layout structure of a document to effect interchange.

A document interchange format is simply the digitally encoded representation of a document intended for exchange or storage among different equipment. Types of equipment which could utilize a standardized interchange format are word processors, electronic typewriters, communications terminals, electronic copiers, character printers, typesetters, and computers. Any device which handles text can benefit from a standardized interchange format.

International Organization for Standardization or International Standards Organization (ISO) sets standards relevant to document interchange. These standards support the ASCII character set through its International Reference Version (IRV). ISO has developed a standard reference for the translation and distribution of documents from one workstation to another that is recognized as the ISO/OSI (Open Systems Interconnection). The ISO/OSI model was designed to provide connections between diverse equipment. It is a layered system, with standards defined for connection at every possible level between the physical link (wire, microwave, optical fiber) and the application itself. It defines seven layers of communication protocol as illustrated below:

ISO/OSI PROTOCOL MODEL

Application	(7)
Presentation	(6)
Session	(5)
Transport	(4)
Network	(3)
Data Link	(2)
Physical	(1)

- (1) The physical layer is concerned with transmission of digital data through analog physical media.
- (2) The data link layer provides for reliable transfer of data across the physical circuit created at the physical layer.
- (3) The network layer provides independence from relaying and routing considerations and from particular data transfer technologies used in the 'real networks' that transfer data.
- (4) The transport layer provides reliable, full-duplex data transfer between end-systems, using the network service to cross intervening subnetworks and provides end-to-end flow and error control.
- (5) The session layer provides basic mechanisms for establishing, organizing, and structuring dialogue interactions between application processes.
- (6) The presentation layer provides application process independence from differences in data representation (syntax).
- (7) The application layer provides information exchange and remote operations required by application processes.

Standards definitions have been prepared for the lower two levels. Work is proceeding on levels three through seven (Datapro, 1986). (Note to instructor: A graphic example of the use of the ISO/OSI model is included in the "References" section.)

The Institute of Electrical and Electronics Engineers (IEEE) has developed a series of standards for token ring and contention-based (CSMA) networks over a variety of media. Ethernet is an example of this kind of commercial network. The protocols in these standards address only the movement of bits from computer to computer and not applications.

Integrated Services Digital Network (ISDN) is the interface for accessing different existing networks or their services (telephone, telefax, telex, teletex, line switching/packet switching data, and cable-TV networks). Without this interface, separate in-house lines would be needed to access each of these devices, separate devices would be needed to use these services, and separate network subscription fees would be assessed.

X.25 is a packet-switching standard adapted by the Consultative Committee of International Telephone and Telegraph (CCITT).

4. Some of the software driving these local area networks and telecommunications capabilities is discussed below. Others should be added from student input.

MS-Net (Microsoft Network) is an extension of its own MS-DOS operating system, enabling the sharing of resources between multiple microcomputer systems by linking applications software and networking hardware. (Requires MS-DOS 3.0 and PC-DOS 3.1.)

Netware/S-Net by Novell, Inc. of Orem, UT, is used on the Novell network operating system. Netware/S-Net also can be used by other LAN manufacturers on their network products.

The following network software is available for mini and mainframe computers:

AT&T:	Dimension 75/85
Data General:	CEO
Digital:	All-in-One
Hewlett-Packard:	Desk Manager

IBM:	Profs
Wang:	Office

Integrated software for multi-functional activities (including telecommunications) for microcomputers includes:

Ability	Corporate MBA
Enable	Framework
Open Access II	Smart System
Symphony	...Others (from student input)

(Networkable versions of each of these packages also may be available.)

5. Assign the students (either individually or in project teams) the project of visiting a computer dealer or vendor showroom. Have them write down the names of the hardware and software that are available for telecommunications or networking. They should then choose one piece of hardware and one software package to review and make an oral presentation to the class and a written evaluation to the instructor: Provide time for demonstrations in showrooms or lab time to evaluate. (A suggested evaluation form is provided in the "Student Materials" section as Exercise 2-1.)

Hardware which could be evaluated: FAX, TWX/Telex, file servers, printer servers, modems, cables, black boxes, and network configurations.

Software which could be evaluated: telecommunications, electronic mail, integrated, or network applications software.

Services which could be evaluated: electronic mail, bulletin boards, videotex, dial-up services, time share, and others.

7. Suggestions for setting up hands-on electronic communication experience:
 - a. Ideally, a workstation in the classroom with a modem which provides full access to E-Mail or other electronic communications capability is preferred.
 - b. If there is a workstation in the classroom or lab attached to the college network, arrange for a demonstration of how to access the system and use the system for electronic communication. If there

is one available, arrange to access and utilize the college or departmental bulletin board for class assignments and announcements so that students have actual experience. Require them to respond to the announcement or assignment or actually use the system to input the assignment materials.

- c. Within the classroom or lab itself, a single microcomputer could be attached to one or two microcomputers. Using a null cable from the serial port of one microcomputer to the serial port of the other microcomputers, set up a host and workstations/slaves to demonstrate electronic communications.

To demonstrate and facilitate use, put students' assignments or class announcements on the system. Ask students to respond to the assignment or message. Set up electronic exchange of files by students.

- d. Purchased time on a commercial system, such as CompuServe, The Source, Dow Jones News/Retrieval, Dialog Information Retrieval, BRS, or a local videotex system, may be made available to students for a specific period of time for hands-on electronic communications. A lab fee to pay for the purchased time may be necessary.

Many college libraries do on-line computer searches, using commercial systems. If this is available at your institution, you may be able to set up a demonstration for the class.

More and more college libraries are providing on-line access for students' use. These services might include ERIC, Dialog, Reader's Guide to Periodical Literature, etc. Ask students to research information on a topic pertaining to telecommunications, print out a listing of bibliographic data, and find and bring to class at least three of the articles found in the library.

- e. Computer users' groups on a local and a national basis also use bulletin boards to communicate ideas, solve problems, pass along ideas, and keep in touch with other computer users. Bulletin boards use roughly the same sort of log on procedures, passwords, and commands to access them. If a bulletin board is set up and used, remember that everyone using it has access to the

message.

Beware of viruses! See the two articles in the "References" section.

8. If telecommunications equipment or demonstrations are not possible, hands-on applications and/or simulations may be available which will familiarize students with telecommunications/networking or projects could be assigned to students which will focus on telecommunication and networking. For example:
 - a. MECC (Minnesota Educational Computing Corporation, 3490 Lexington Avenue North, St. Paul, MN 55126) has a learning package (disk and exercises) entitled "Information Manager", as well as other software training packages.
 - b. Applications Using the Personal Computer (Nancy Groneman and Susan Owen, South-Western Publishing Company) includes E-Mail applications exercises.
 - c. Applications Manual for Electronic Office Procedures (Rosemary Fruehling and Constance Weaver, Gregg/McGraw-Hill Book Company) includes exercises related to communications and E-Mail. Memos and telegram materials from conventional typewriting/keyboarding textbooks also provides practice in composing E-Mail correspondence.
 - d. Case studies in textbooks which point out the uses of telecommunication and networking could be assigned for students to suggest equipment and software which might be utilized in those uses. For example, the "Case Study: Today", on page 146 in Insight into Office Automation (Sally Saffer, South-Western Publishing Company), is a good explanation of telecommunication capabilities. What specific equipment (hardware) and software are needed to accomplish these applications? Students could research this or other case studies and make an oral presentation to the class.
 - e. Assign a case study to students to come up with a network configuration for the classroom. Provide budget limitations and constraints within which they must work--just as in the "real world".
 - f. Assign students to correspond with network manufacturers, such as Novell, ArcNet, WangNet, Corvus, IBM, Apple, etc. and ask for literature related to their products. Ask students to

present their findings to the class. Make a list of the similarities and differences between the products of the network manufacturers.

Any on-line exchange should demonstrate capabilities of the system, potential problems, the need for backup, and "weaning" from paper.

SUMMARY: From the exercises in this task area, students should begin to understand and appreciate the advantages, disadvantages, capabilities, and limitations of telecommunications and networking.

TELECOMMUNICATIONS/NETWORKING

Task Area 3

Given a problem to solve in the area of telecommunications and/or networking, the student will be able to 1) analyze methodologies, protocols, and systems for transmission of data, text, voice, and graphics; and 2) develop and use factors in selecting telecommunications/networking hardware and software in an automated environment to the satisfaction of the instructor.

Suggested teaching strategies: Speakers, panel of speakers, case studies, and development of evaluation factors from reports in Task Area 2 and guest speakers.

1. Identify speakers from local companies who will participate in a panel discussion regarding the implementation of telecommunications and/or networks in their organizations. In effect, these are oral case studies with solutions.

If a panel of speakers is not possible, identify individuals who will present their organizations' case studies.

Identify individuals in organizations which specialize in telecommunications or networking equipment, media, or services, information systems consultants, or vendors who will demonstrate equipment or services to the class.

Follow-up with a field trip to at least one of these organizations.

2. The class as a whole should develop a list of factors to be considered in comparison and evaluation, selection, modification, and utilization of a local area network, including software, hardware (computers, modems, cables, topology, transmission media, speed of transmission, method of transmission), number of workstations supported, space needed, training required, documentation. As a minimum, the resulting list may include the following factors:

Name of network

Version number and date

Developer (vendor, manufacturer)/name of company

Cost: list vs actual? what is included with the network? vendor availability for problems [toll-free number]? are updates available at low cost? networkable software available? cables and other interfaces required? Etc.

Requirements to run software: Compatibility with hardware (specifically, type of PC, model #, etc.)? RAM required to support network? other peripherals required or supported? cabling required and available?

Requirements to use hardware/network: Compatibility with what software? Expandable and upgradable? How many peripherals will the hardware/network support? Cabling and other interfaces required?

Printers supported or system configuration requirements

Description of the scope of the functions of the network: What it is purported to do? ease with which it accomplishes the functions?

Terminology encountered: familiar or too many new terms? who could use it in the automated office and for what purposes?

Report on at least one review of the network in a current computing magazine or research service write-up to get the users' viewpoint. (These services include DataPro or Seybold reports.)

Value of the network to the automated office: Will it save time? enhance decision making? etc.

Documentation: easy to read? learning disk or tutorial included? on-line help?

Limitations encountered with the network: What do you see as the drawbacks (keeping in mind that the perfect piece of software is never available)?

Recommendations: Is it worth the cost? Is it going to automate repetitive tasks or enhance decision making? What will be accomplished through the purchase of this software/hardware/network by a company? Will documentation need to be rewritten? How much and what kind of training would be required? Other?

(Note to instructor: Have the panelists or speakers utilized in #1 above evaluate the list for completeness.)

3. Students will access, evaluate, and respond to the three case studies which have been logged on to the bulletin board in the classroom or lab. Each student will access the bulletin board, print out a copy of the case studies, formulate responses, and log on their responses.

(Note to instructor: Ask the speakers or panelists from #1 above to evaluate the responses.)

4. The class as a whole should discuss the "Questions for Discussion" prior to beginning project or individual work for a more complete understanding of each case.

(Copies of the case studies are included in the "Student Materials" section as Exercise 3-1, Exercise 3-2, and Exercise 3-3.)

CASE STUDY
Exercise 3-1

- #1 Suppose you are a sales representative for a national chemical company headquartered in another part of the country. You must call on five customers daily, taking new orders and handling customer complaints. You also spend time communicating with technical specialists in the various labs in the headquarters, as well as other locations, who may or may not be available when called. This part of the job requires getting back in touch with the customer on a timely basis. By the end of the each day, you have accumulated a great deal of information in the form of new orders, requests for specialty product information, and customer complaints. The orders must get to the headquarters purchasing, production, and shipping personnel immediately. The complaints must be routed to the appropriate departments involved. In the past, you have used the telephone exclusively for all of this business. You are convinced there are better methods of transferring this information (delivery systems) which will save time and money and enhance customer relations.

Write a memo to your manager (instructor) explaining how you could transmit and store the data for orders to the appropriate people in headquarters and make contact with technical specialists and customers where telephone tag and time spent to get needed information could be better spent. Be specific as to the type of telecommunications delivery systems which would enhance your job.

Questions for discussion:

1. What is the job of a sales representative as far as you know?
2. What are some of the data that could be communicated to the headquarters on a daily basis by the sales representative?
3. How will the administrative support person at the headquarters receive the information? What specific equipment will be needed by the support person?
4. What will be done with the information after it is received?
5. Discuss the format of the memo that you require.

(Possible suggestions:

- (1) portable microcomputer with communicating capabilities via telephone to transfer letters;**
- (2) memos to a support professional for editing, as well as enough memory capacity to store letters and reports for future reference;**
- (3) the same capability also allows access to the mainframe in headquarters for instant access to production inventory records;**
- (4) a portable telecopier to transfer copies of orders and complaints;**
- (5) computer-based or voice-based message system in headquarters which would avoid telephone tag and long waits for needed information, as well as provide access to your phone to receive and leave messages during off hours; and**
- (6) appropriate software to complete travel expense reports on a daily basis would speed up reimbursement.)**

CASE STUDY
Exercise 3-2

- #2 Gene Newton, office automation specialist, wanted to provide a large number of users with enhanced personal-productivity tools that would do what a pencil, paper, typewriter (create, edit, print), telephone, calendar, to-do list, and calculator would do. He also wanted to save money by letting users share these tools. The shared system he envisioned required fast, efficient communications, and used off-the-shelf software.

Questions for Discussion:

1. What is your understanding of the office in which Newton envisioned using communications hardware and software?
2. List the kinds of productivity tools used in the traditional office.
3. List the kinds of productivity tools which could be used in the automated office in this case study.
4. When he says he "wanted to save money by letting users share these tools", what kinds of tools were in his plan?

(Possible solution: Newton chose Plan 4000 from Nestar. The vendor provided 54 IBM PCs and the ability to hook them together. The Nestar 4000 allows users to share both software and peripherals, and has built-in electronic mail features. Newton circumvented a lot of expense and mess by installing the new wiring for his LAN in the floor below. "It may have disturbed the people in the office beneath us, but they don't work for us", he commented. Nestar also offers Plan 2000 and Plan 3000 for smaller clusters of microcomputers. The vendor's products support Apple computers as well as IBM PCs and XTs.)

CASE STUDY
Exercise 3-3

- #3 You are employed as a consultant in information systems. A multinational company in your area comes to you for advice for enhancing communications with offices in other locations. Specifically, this organization has decided to explore the feasibility of using satellite communications and video teleconferencing. They are not at the point of purchase or decision making. What they want you to do is 1) prepare a bibliography of 10 articles related to satellite communications and video teleconferencing; 2) prepare a vocabulary list to assist them in understanding the literature, and 3) research the names and addresses of possible vendors to meet this need.

Questions for Discussion:

1. What is the role of a consultant?
2. Verbalize your understanding of what this multinational company is expecting from the consultant.
3. Where can you go to find a bibliography of articles related to satellite communications and video conferencing?
4. Without discussing an exhaustive list, what are some of the vocabulary terms which might come from this bibliography?
5. Where can you go to find names and addresses of vendors to meet the stipulated need in this case?

(Responses will vary. The instructor will have to be the judge of whether the information has met the intent of the case.)

TELECOMMUNICATIONS/NETWORKING

Task Area 4

Given a particular automated office environment, the student will be able to gather information to design and create a basic office layout for a local area network, tying together workstations, printers, modems, and other peripherals through an oral presentation to the satisfaction of the instructor.

Suggested teaching strategies: Case study, oral presentations, project teams. Students' efforts will be directed toward problem solving and decision making in the case study.

From the classroom bulletin board, the students (in project teams) will access Exercise 3-2 from Task Area 3 and develop the layout of the network. The network layout should include microcomputers, printers, modems, network topology, host or mainframe computer (if needed), and suggested software.

The project team will make an oral presentation to the class. A written report will be handed to the instructor. Oral presentations will be enhanced with the use of visual aids--slides, overheads, model--which illustrates the layout of the network.

(Note to instructor: Several suggested layouts can be found in the "Evaluation" section for use with the class and for evaluation purposes. Discuss review questions with class before individual or groups proceed with assignment.)

CASE STUDY

Exercise 3-2

Gene Newton, office automation specialist, wanted to provide a large number of users with enhanced personal-productivity tools that would do what a pencil, paper, typewriter (create, edit, print), telephone, calendar, to-do list, and calculator would do. He also wanted to save money by letting users share these tools. The shared system he envisioned required fast, efficient communications, and used off-the-shelf software.

Solution: Answers will vary. The instructor will be the judge of whether the proposed layouts meet the intent of the exercise.)

QUESTIONS FOR REVIEW:

1. What is an office layout and what are the elements of an office layout?
2. What is the first thing that must be done before deciding upon a layout?
3. Find an office layout or network arrangement in a textbook to help with this case study.

TELECOMMUNICATIONS/NETWORKING

Task Area 5

Given a specified automated office environment, the student will be able to set up, disseminate, and revise written guidelines and documentation for utilizing telecommunications/networking equipment; OR prepare a feasibility report, recommending the purchase and installation of telecommunications/networking equipment to the satisfaction of the instructor.

Suggested teaching strategies: Case study, oral presentations, project teams. Students' efforts will be directed toward problem solving and decision making in the case study.

1. The student will choose one element from the network layout in Exercise 3-2 from Task Area 4 and develop the written guidelines for the use of the element. This could include the access to the printers, access to the software, access to the network, how to send and receive electronic mail, etc. Project teams could be used for this exercise, also. (Note to instructor: An example of written guidelines for accessing an E-Mail system is included in the "References" section.)

OR

2. The student will conduct a feasibility study which will look at another network system for Exercise 3-2. Project teams could be utilized for this exercise, also. If a project team chooses to complete a feasibility study, the following points should be discussed related to conducting a feasibility study:

Define feasibility study: a study undertaken to determine if new office equipment technology or new procedures are needed. If appropriate, a feasibility study is undertaken to answer the following questions:

- (1) What types of documents are produced (one-time, revision or repetitive), where are they being produced, how frequently are they produced, and who produces the documents?
- (2) How long does it take to produce the documents and are there periods which are more slack than others?
- (3) What are the costs of producing the current documents?

- (4) Is there duplication of effort, files, or documents?
- (5) Who needs the documents?
- (6) How can (or should) similar work be coordinated to improve effectiveness?
- (7) What are the procedures being used to produce documents? Should they be revised at this time?
- (8) What kind of support is needed to produce the documents--administrative, keyboarding, etc.?
- (9) What standards are required of new equipment to produce the necessary documents? Who will and should use the new equipment? Where will the new equipment be placed in the organization?
- (10) What new procedures will be needed with new equipment?
- (11) How will individuals be trained on the new equipment: in-house, vendor, or outside?
- (12) Who will be responsible for writing, revising, and updating documentation and training?
- (13) What other equipment could be purchased at the same time to extend the capabilities of the users?

... Other questions.

3. Oral presentations will be made to the class. Written documentation for the use of one element in a network or a written feasibility report will be handed to the instructor for evaluation. A suggested outline for the oral and written presentation of the results of a feasibility might include the following elements:

TITLE
Name of Feasibility Team
Date

I. Introduction.

The office technology feasibility study was authorized by Mary Jones, president of McKay Products. The study began on June 30, 1988, and concluded on September 30, 1988. The chairman of the study was Mark Haynes with Jane Smith, Deborah Greene, and Gus Smith as committee participants.

II. Scope and Purpose.

The study was conducted in the Word Processing Center (WPC). The individuals who participated in the study are listed in the next section of this report, Study Organization. The purpose of the study was to: 1) determine if there was a need for new equipment, 2) assess the kinds of work currently being performed in the WPC, 3) assess the turnaround time of work being done on the present equipment, and 4) make recommendations, if any, for new or improved work procedures, for upward mobility for support personnel in the WPC, and for new equipment.

III. Study Organization.

It was determined that this study would be conducted in three parts in order to disrupt the work of the WPC as little as possible. The three parts included:

- Part 1: A review of documents being processed in the WPC.
- Part 2: A review of procedures of the WPC.
- Part 3: A review of the personnel in the WPC.

Participants in the study were: (list names.)

IV. Study Methodology.

Methods used to gather information were: a review of copies of documents, personal interviews, a review of time sheets and production records for each WPC employee, management and user interviews. Etc.

V. Observations and Comments.

Employees expressed concern about...
Managers and users expressed concern about...
Observations include duplicated effort...

Comments expressed in actual words of employees and managers/users, observations based on factual data, etc.

VI. Summary of Statistical Data.

Use bar, line, or pie charts to express in statistical format the data that were obtained in the study. Words to support the data might include:

This chart reveals that _____% of the work produced during the study was revising already stored documents. If this continues to be the kind of work submitted to the WPC, only half of the work force that is now in the Center will be needed.

VII. Recommendations.

This is the heart of the report--the bottom line so to speak--why the study was done. This section should include specific, well-thought-out recommendations.

Other sections which could be included in the report depending on the scope and purpose of the project include: Staffing, Justification, Procedures, Training, Implementation, Summary, and Appendices.

Because many reports of this kind are given to busy executives, it is recommended strongly that the body of the report be preceded by a cover page which includes a condensed summary that tells management the nature of the problems, recommended solutions, and benefits of the solutions.

(Note to instructor: Many other formats could be utilized for the written report. Please share whichever format you prefer with your class.)

● Telecommunications/ Networking

course four

Visuals

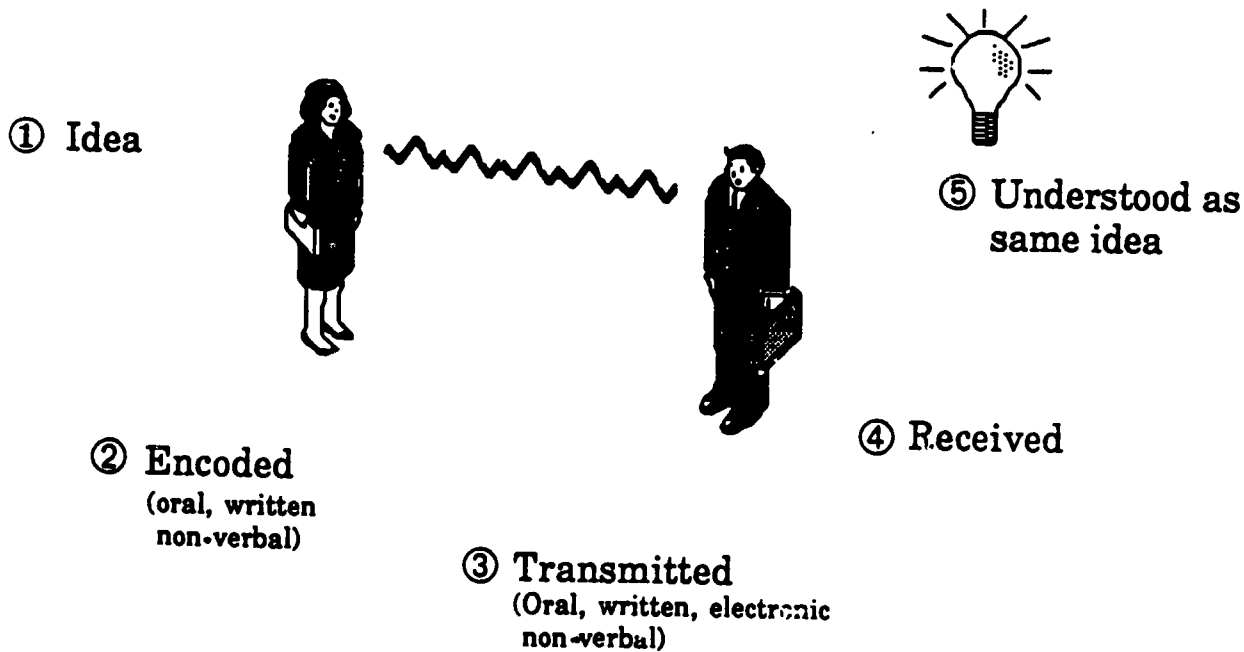
Word Processing

**Information
Processing**

Data
Processing

Communication

Communication The exchange of information - a two-way process



**TELECOMMUNICATIONS
IS USING AUTOMATED TOOLS
TO COMMUNICATE OVER
DISTANCES**

**ALL FORMS OF INFORMATION
MAY BE SENT ELECTRONICALLY:**

VOICE

DATA

VIDEO

TEXT

GRAPHICS

**TECHNOLOGICAL DISCOVERIES
PERTINENT TO
TELECOMMUNICATIONS**

STROWGER SWITCH

TRIODE VACUUM TUBE

MULTIPLEXING

TRANSISTOR

INTEGRATED CIRCUITS

SILICON CHIPS

FIBER OPTICS

MICROWAVE RELAYS

SATELLITES

CELLULAR RADIOS

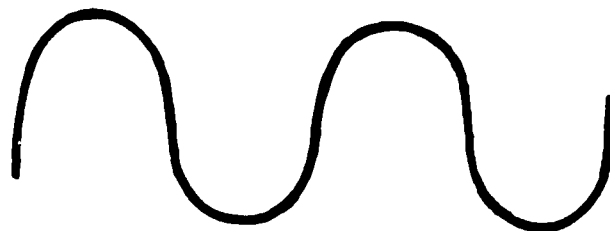
WHAT IS NEXT?

COMMUNICATIONS
SOFTWARE PACKAGES
MAY OFFER THE
FOLLOWING:

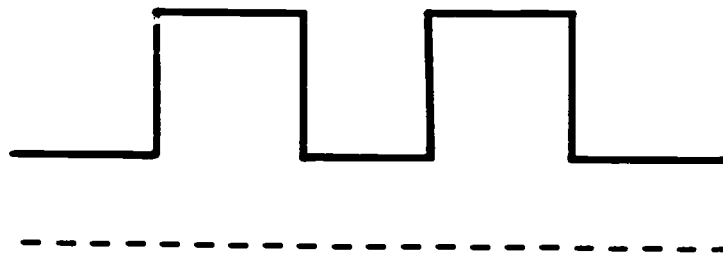
- DOWNLOADING LARGE AMOUNTS OF DATA TO BE TRANSFERRED FROM A DATABASE ON A MAINFRAME TO A PERSONAL COMPUTER FOR STORAGE ON AUXILIARY STORAGE
- UPLOADING DATA TO BE TRANSFERRED FROM FILES ON THE PERSONAL COMPUTER TO DATABASES ON THE MAINFRAME
- ESTABLISHING PASSWORDS
- E-MAIL
- OTHER FUNCTIONS

COMMUNICATIONS HARDWARE

ANALOG SIGNALS



DIGITAL SIGNALS



MODEM
COMMUNICATIONS ADAPTER
RS232C INTERFACE
MULTIPLEXER
FRONT-END PROCESSOR

MODEMS

A PIECE OF HARDWARE NEEDED FOR COMMUNICATION TO TAKE PLACE FROM 1 COMPUTER TO OTHERS. USUALLY SENT OR RECEIVED OVER TELEPHONE LINES. TWO MODEMS ARE NECESSARY--ONE AT EACH END OF THE TELECOMMUNICATION PROCESS.

TYPES OF MODEMS

ACOUSTIC COUPLER

EXTERNAL

INTERNAL

INTELLIGENT/SMART

FIBER OPTICS

COMMUNICATIONS ADAPTER

SO THAT A PERSONAL COMPUTER CAN COMMUNICATE WITH A MAINFRAME, A CIRCUIT BOARD, CALLED A COMMUNICATIONS ADAPTER, MUST BE ADDED TO THE CPU OF THE MICROCOMPUTER TO ACCOMPLISH THE FOLLOWING:

CHANGE DATA FROM
PARALLEL TO SERIAL

UTILIZE A RS232C SERIAL
INTERFACE TO ACT AS A
PATHWAY TO AND FROM
MODEMS. SOMETIMES
CALLED A PORT.

ADD AND DELETE CONTROL BITS

INTERFACE WITH SOFTWARE
TO CONTROL
TRANSMISSION SPEED

CHECK ERRORS

OTHER FUNCTIONS

MULTIPLEXER

**CARRIES A LARGE NUMBER
OF DIFFERENT
TRANSMISSION SIGNALS
OVER THE SAME
TRANSMISSION MEDIA**

TWO TYPES:

**FREQUENCY-DIVISION
BROADBAND MEDIA
(EX. TV CHANNELS:
MANY CHANNELS ON
ONE CABLE)**

**TIME-DIVISION
BASEBAND MEDIA
(ONE SIGNAL AT A TIME
OVER A SINGLE CABLE)**

FRONT-END PROCESSOR

IN A LARGE MAINFRAME SYSTEM, A SPECIAL-PURPOSE COMPUTER MAY BE SET ASIDE TO HANDLE COMMUNICATIONS TASKS, FREEING UP THE MAINFRAME TO HANDLE BASIC INFORMATION PROCESSING. THIS SPECIAL COMPUTER IS CALLED A FRONT-END PROCESSOR. THIS COMPUTER INCLUDES A MULTIPLEXER AND OUTPUT PORTS. IT ACTS AS A "TRAFFIC COP" TO ROUTE AND SORT MESSAGES TO AVAILABLE LINES IN THE MAINFRAME.

**TRANSMISSION CHANNEL
PROVIDES LINK
BETWEEN SEND AND RECEIVER**

**A CHANNEL IS PHYSICAL
PATH USED TO SEND
INFORMATION.**

**OTHER TERMS FOR CHANNEL:
LINK
LINE
FACILITY
MEDIUM
CIRCUIT
PATH**

**TYPES OF CHANNELS:
TELEPHONE LINES
COAXIAL CABLES
FIBER OPTICS
MICROWAVE
SATELLITES
DIGITAL LINES
OPEN WIRE
CARRIER SYSTEM**

LINE CONFIGURATIONS

METHODS BY WHICH TERMINALS,
PERSONAL COMPUTERS AND
MAINFRAMES CAN BE
CONNECTED TO A HOST
COMPUTER OR TO EACH OTHER

COMMON CARRIERS, SUCH AS AT&T
OR WESTERN UNION CAN PROVIDE
THESE CONNECTIONS.

TWO TYPES OF CONNECTIONS:

POINT-TO-POINT

LEASED LINES

SWITCHED LINES

MULTIDROP OR MULTIPPOINT

POLLING

ADDRESSING

**MODE OF TRANSMISSION
(HOW INFORMATION IS SENT)**

* * * * *

ASYNCHRONOUS

* * * * *

**ONE CHARACTER AT A TIME
SLOW**

* * * * *

SYNCHRONOUS

* * * * *

**CHARACTERS SENT IN A CONTINUOUS STREAM
FAST**

INTERCHANGE RULES
(PERTAINS TO DIRECTION OF TRAVEL)

SIMPLEX
(ONE WAY ONLY: TV OR RADIO)

HALF-DUPLEX OR DUPLEX
(ONE DIRECTION AT A TIME:
TELEGRAPH)

FULL-DUPLEX
(BOTH DIRECTIONS AT THE SAME TIME:
TELEPHONE)

SPEED

DEPENDS ON

COMPUTER TERMINAL

MODEMS

AND BANDWIDTH

TRANSFERRED IN BITS

USING

ASCII CODE (7 BITS)

EBCDIC CODES (8 BITS)

ERROR DETECTION
IN INFORMATION
TRANSMISSION

PARITY CHECK

XMODEM

REPETITIVE TRANSMISSION
(USED IN SATELLITE
TRANSMISSION)

OTHER

**TELECOMMUNICATIONS
DELIVERY SYSTEMS**

**CBMS
CBVS
TELETYPE
MAILGRAM
FACSIMILE
COMMUNICATING WORD PROCESSORS
TELECONFERENCING**

**COMPUTER-BASED
MESSAGE SYSTEMS
CAN BE USED**

- 1
TO AVOID TELEPHONE TAG**
- 2
TO AVOID TELEPHONE INTERRUPTIONS**
- 3
TO AVOID WASTED TIME WITH
SOCIAL INTERCHANGES**
- 4
TO AVOID LATE OR INCOMPLETE
INFORMATION**
- 5
TO AVOID LATE APPOINTMENTS**
- 6
TO AVOID MISSING YOUR PARTY**
- 7
WHEN TIME ZONES ARE DIFFERENT**
- 8
WHEN MESSAGE HAS TO GO TO
SEVERAL PEOPLE**

**COMPUTER-BASED
VOICE MESSAGE SYSTEMS
CAN BE USED**

- 1
TO AVOID TELEPHONE TAG**
- 2
TO AVOID TELEPHONE INTERRUPTIONS**
- 3
TO CHOOSE WHEN TO LEAVE A
MESSAGE OR TALK DIRECTLY TO PERSON**
- 4
TO BE REMINDED OF
IMPORTANT APPOINTMENTS**
- 5
TO AVOID MISSING YOUR PARTY**
- 6
WHEN TIME ZONES ARE DIFFERENT**

**VOICE STORE AND FORWARD
AND
VOICE REMINDER SYSTEMS
ARE PART OF CBVS**

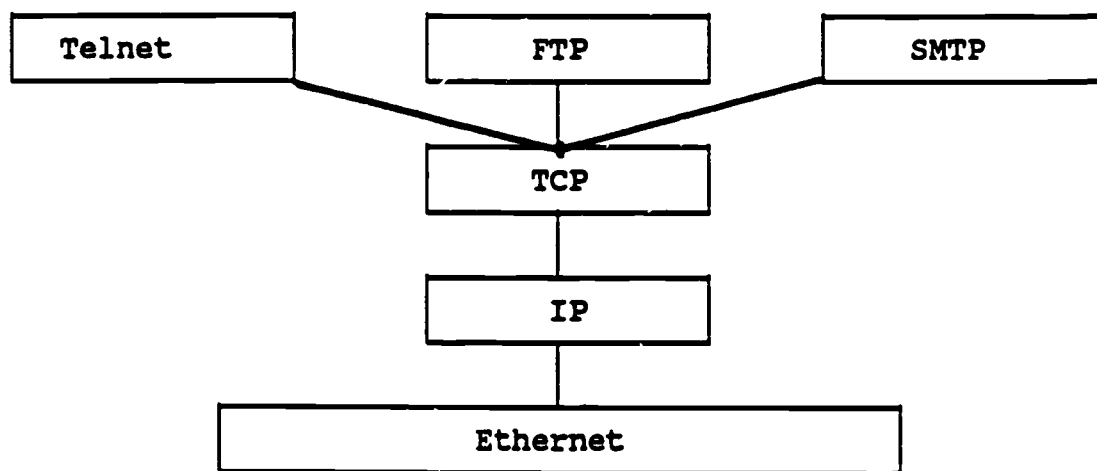
PROTOCOLS

THE RULES WHICH
GOVERN THE SENDING
OF INFORMATION
FROM ONE PIECE
OF EQUIPMENT TO
ANOTHER

ALSO CALLED
"HANDSHAKING"

DEVICES MUST BE
COMPATIBLE

EXAMPLE OF PROTOCOLS IN TELECOMMUNICATIONS



**TELECOMMUNICATION
REGULATIONS**

**FCC
INTERSTATE TARIFFS
DATA ACCESS ARRANGEMENT
CARTERFONE DECISION
INTERCONNECT INDUSTRY
COMPUTER INQUIRY II
COMPUTER INQUIRY III
AT&T DEREGULATION**

NETWORKS

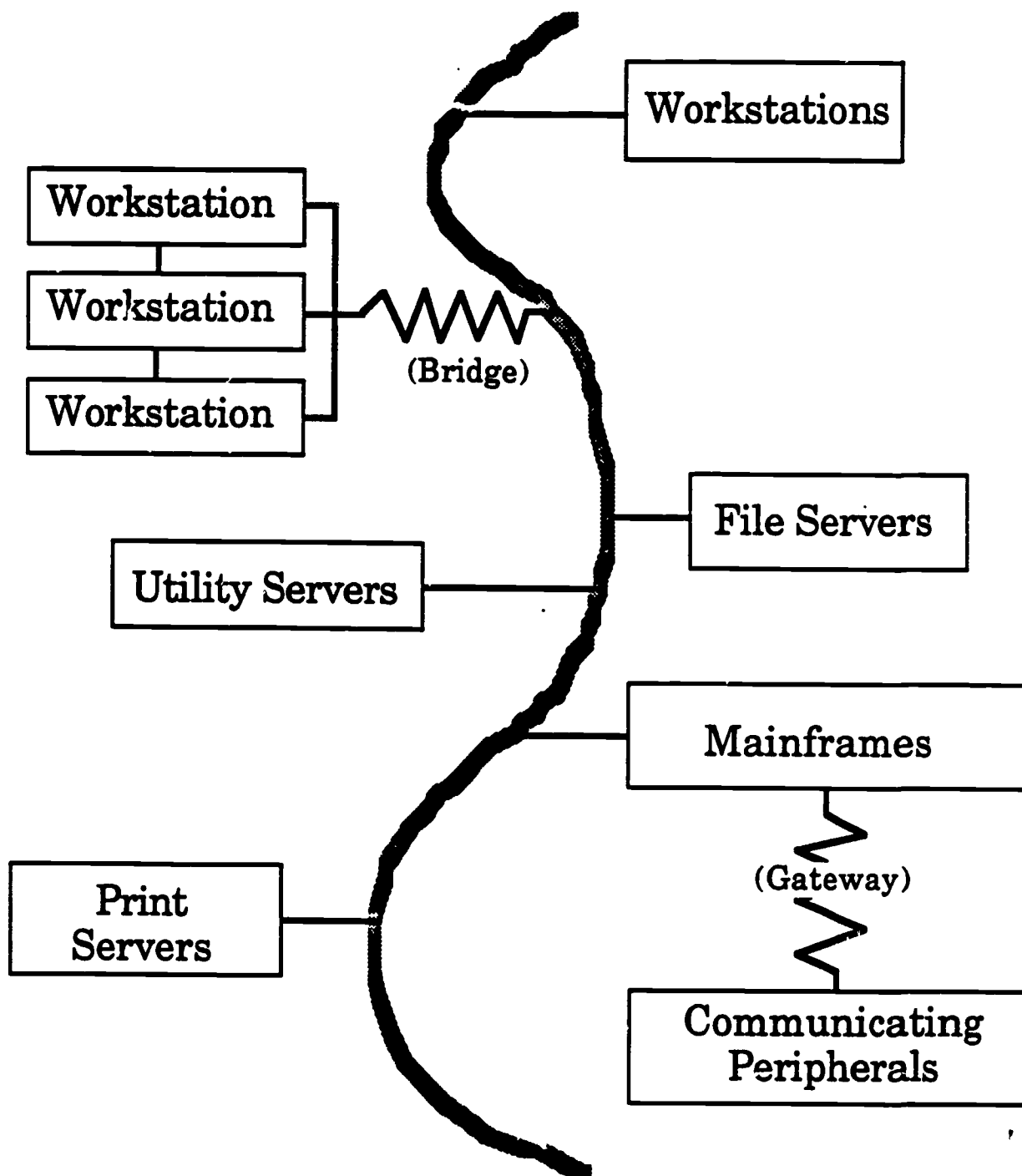
PUBLIC DATABASES
COMPU-SERVE
DOW JONES NEWS/RETRIEVAL
THE SOURCE

WIDE AREA (VAN)
ARPANET
TELENET
TYMNET
SKYNET

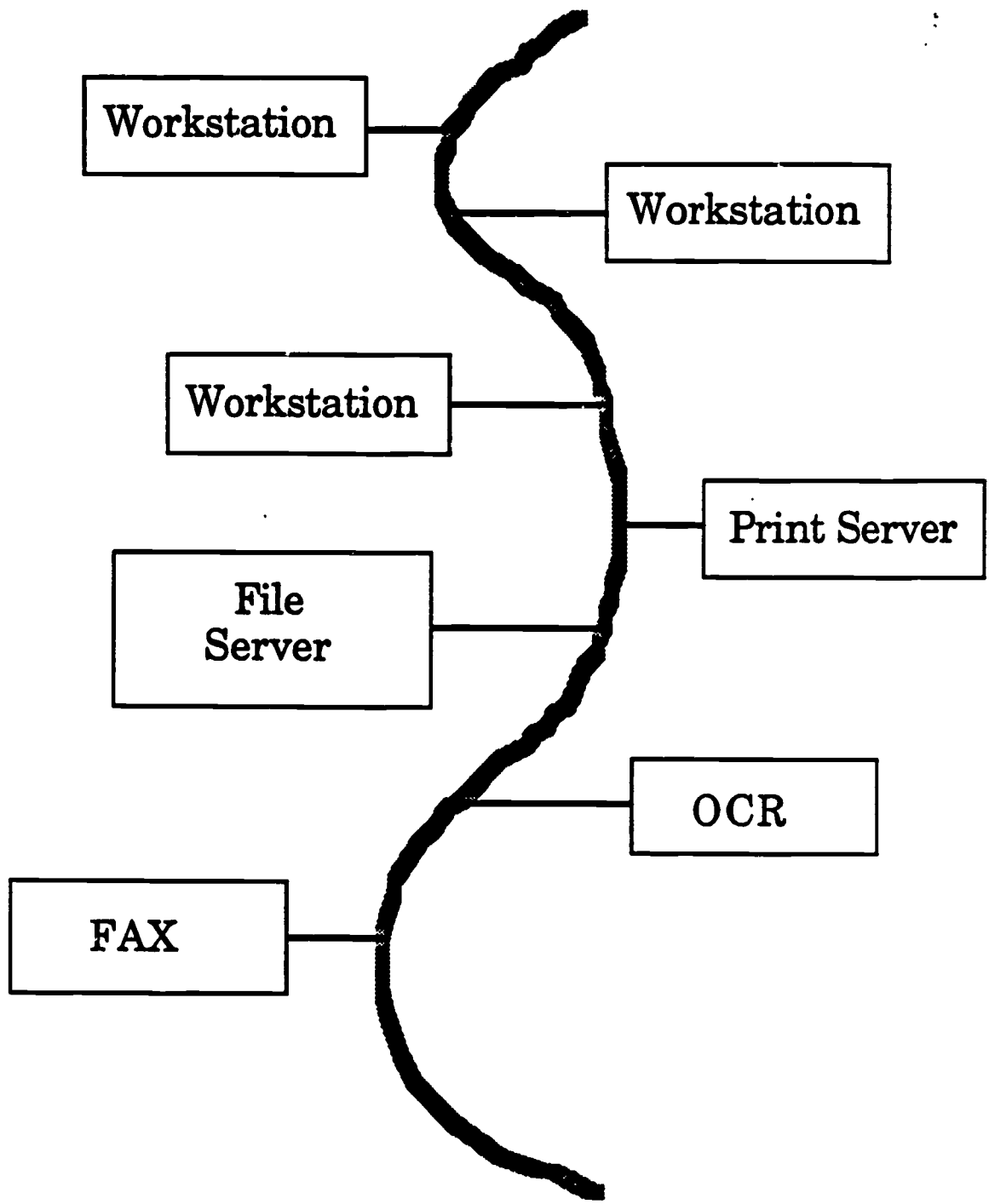
LOCAL AREA (LAN)
HARDWARE RESOURCE SHARING
INFORMATION RESOURCE SHARING
E-MAIL

LAN TOPOLOGY
BUS
RING
STAR
TREE

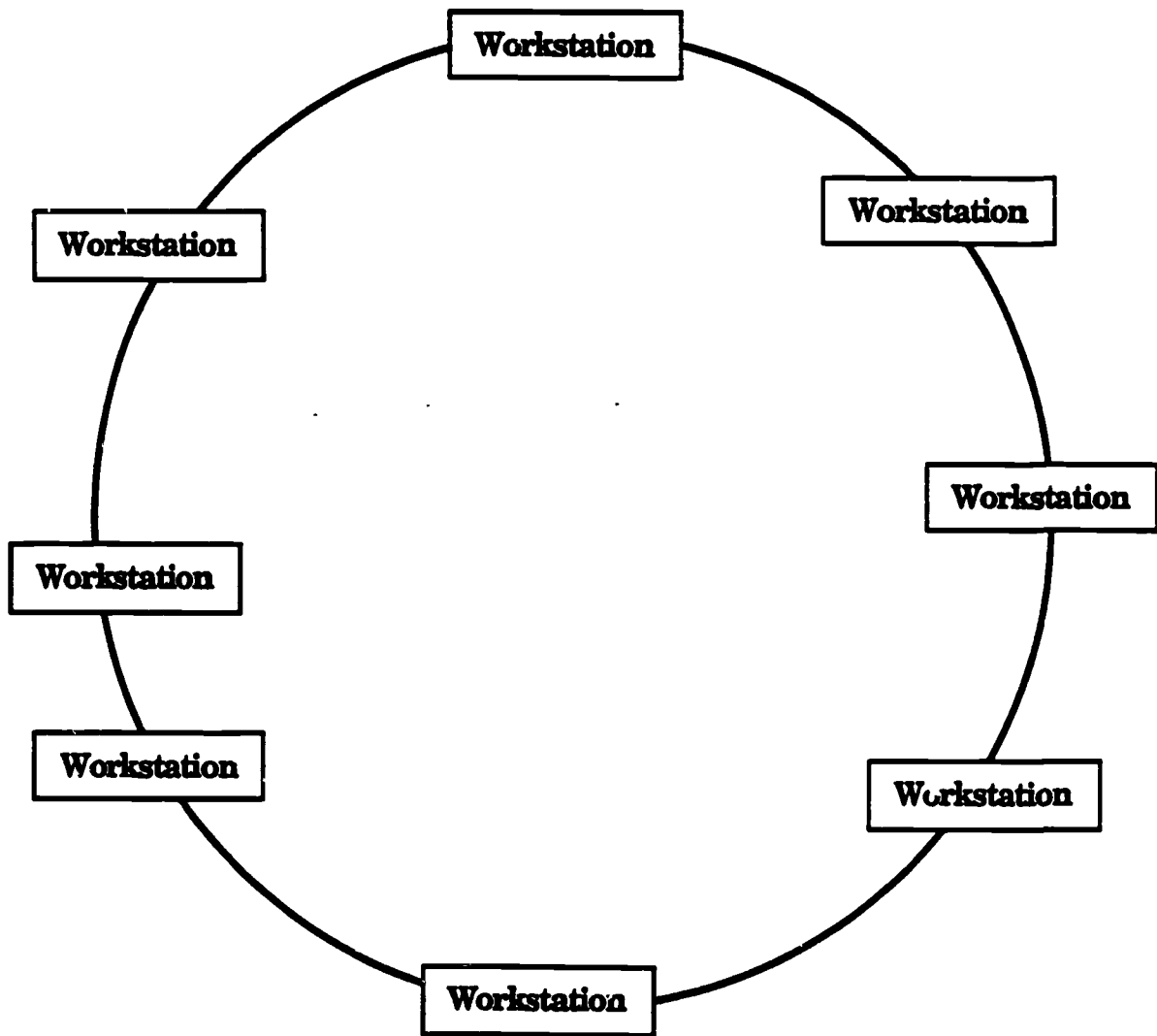
LOCAL AREA NETWORK



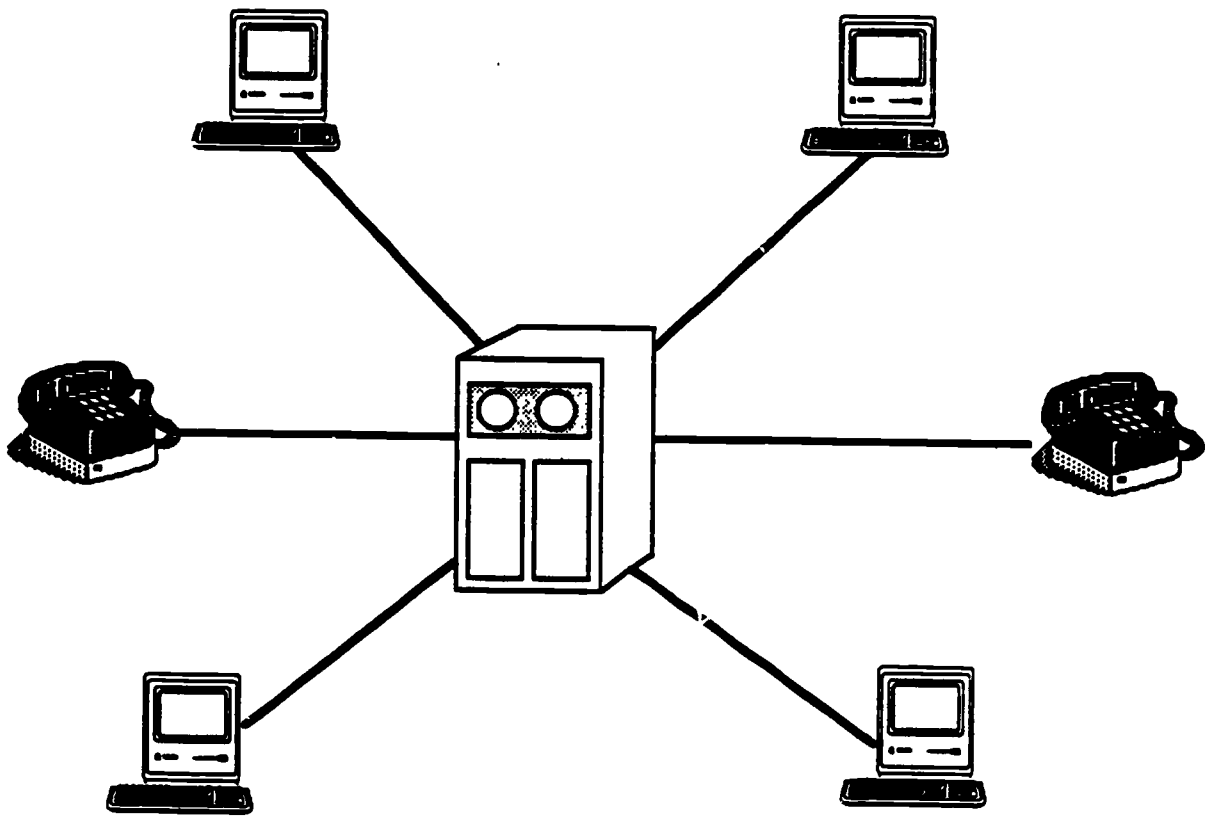
BUS TOPOLOGY



Ring Topology

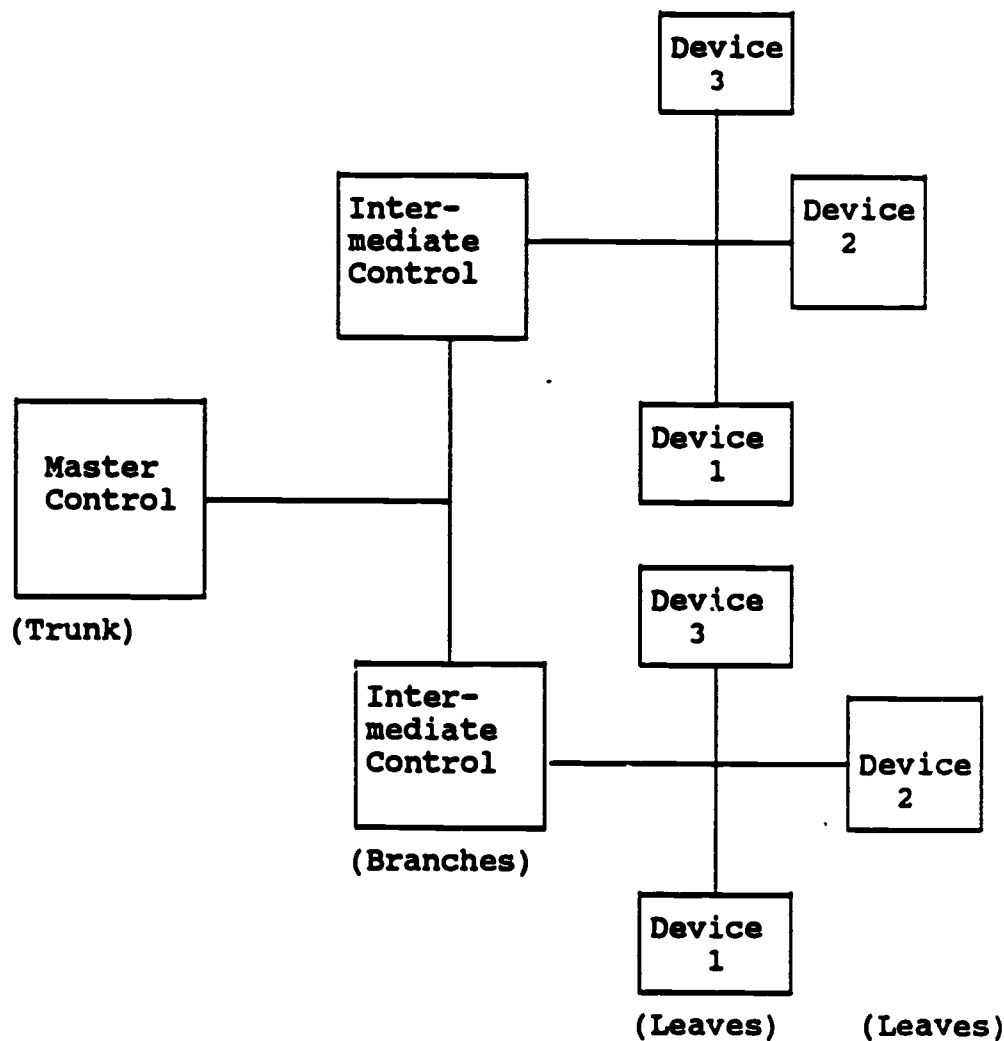


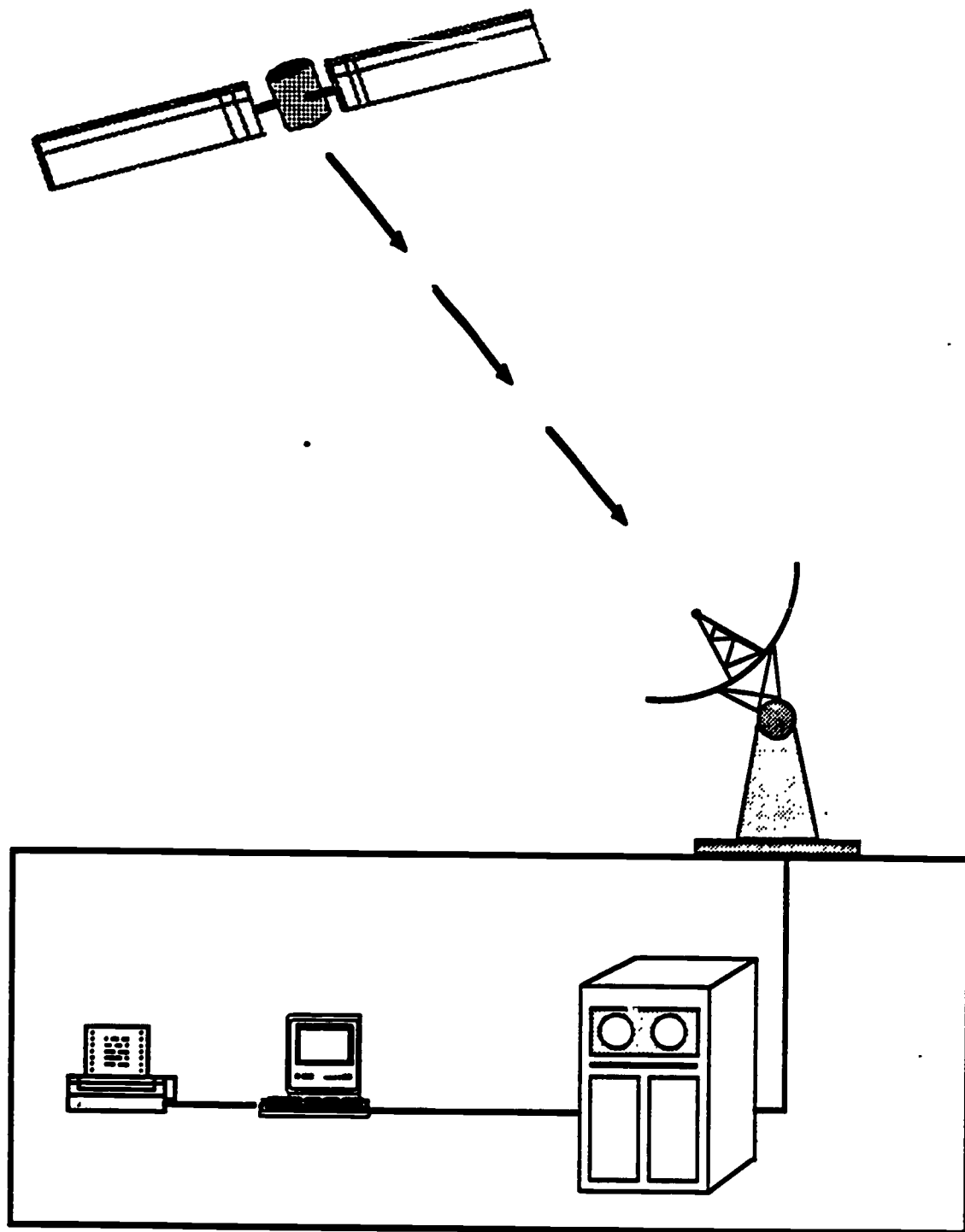
Star Topology



TREE TOPOLOGY

A tree network is a variation of the star configuration. Several devices are connected to intermediate controllers, which in turn are directed by a master controller. Routing of messages is accomplished through several channels which are determined by the master controller:





Satellite Networking

NETWORKS

HYBRID

**COMBINES THE ADVANTAGES
OF PUBLIC AND PRIVATE
NETWORKS**

INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

**COMBINES TELEPHONE
COMMUNICATION SERVICES
AND ALL DIGITAL FACILITIES**

**NETWORK OF FUTURE
STILL EVOLVING**

NETWORK ACCESS

POLLING

CONTENTION

CSMA-CD

CSMA-CA

TOKEN PASSING

**TELECOMMUNICATIONS
IS USING AUTOMATED TOOLS
TO COMMUNICATE OVER
DISTANCES**

TERMINOLOGY:

PROTOCOLS

CONNECTIVITY

INTERFACE

INTERACTIVE

EDITABILITY

PROCESSABILITY

MODEM

BLACK BOX

NETWORK

EBCDIC

ASCII

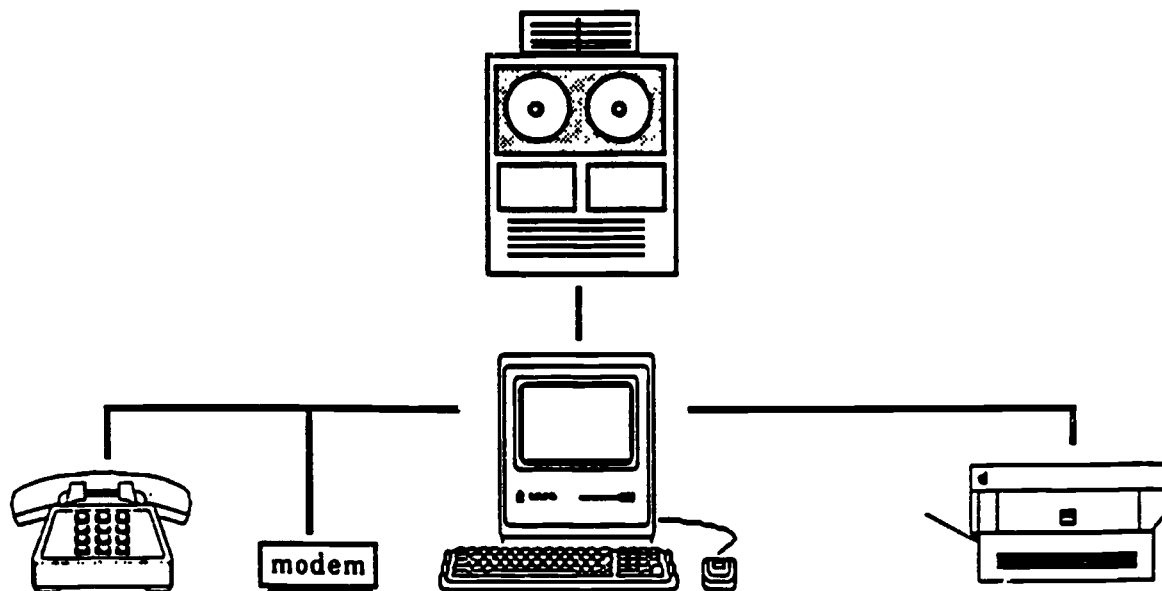
PLANNING CONSIDERATIONS FOR LOCAL AREA NETWORKS

- * IS IT NEEDED?
- * WHAT TYPE OF INFORMATION WILL IT HANDLE: DATA, VOICE, VIDEO, TEXT, ALL?
- * HOW MANY AND WHAT TYPES OF DEVICES WILL BE CONNECTED? HOW?
- * WHAT IS THE STATUS OF THE PHYSICAL ENVIRONMENT?
- * WHAT IS THE VOLUME OF TRAFFIC EXPECTED?
- * WILL THE DEVICES NEED CONCURRENT ACCESS TO LAN?
- * WHAT RESPONSE AND ACCESS TIME CAN BE TOLERATED?
- * WILL THE NETWORK BE LINKED TO A PUBLIC DATABASE OR OTHER PRIVATE NETWORK?
- * WHAT SERVICES ARE NEEDED FOR FUTURE EXPANSION AND GROWTH?
- * IS IT EASY TO USE? EXPAND? CHANGE?
- * WHAT IS MAINTENANCE AND SERVICE REQUIRED?
- * WHAT IS BUDGET?

THE PROFESSIONAL WORKSTATION

MICROCOMPUTER
TELEPHONE
MODEM
PRINTER
STORAGE MEDIA
SOFTWARE

COMBINED WITH ERGONOMICS



SECURITY

READ-ONLY ACCESS

PASSWORDS

LOG ON

SIGN-ON NUMBER

ENCRYPTION

AUDIT TRAILS

**AUTOMATIC CLOSE
(TIME-OUT PARAMETERS)**

MECHANICAL KEYBOARD LOCKS

EVALUATION FACTORS FOR SOFTWARE/HARDWARE/NETWORK REPORTS

*** * * * ***

NAME AND MANUFACTURER OF SOFTWARE/HARDWARE

VERSION NUMBER AND DATE

COSTS: LIST VS ACTUAL

HARDWARE/SOFTWARE REQUIREMENTS

PRINTERS OR OTHER SYSTEM CONFIGURATIONS

**DESCRIBE FUNCTIONS OF SELECTED
SOFTWARE/HARDWARE**

TERMINOLOGY

VALUE TO AUTOMATED OFFICE

DOCUMENTATION

ONE MAGAZINE REVIEW OF SOFTWARE

LIMITATIONS

RECOMMENDATIONS

● Telecommunications/ Networking

course four

Student Materials

TELECOMMUNICATIONS/NETWORKING

Exercise 1-1

1. Concepts, vocabulary, and terminology to be reviewed:

As you read text materials or outside readings and listen in class, prepare a study sheet with the definitions for the following concepts, principles, terminology, and vocabulary:

Strowger switch, triode vacuum tube, network, topology, three most common network topologies (bus, ring, star, and tree), cellular radio, workstation, chip, FCC, CI2, CI3, Carterfone decision, AT&T divestiture, telecommunications, communication, information processing, modem, acoustic coupler, DAA, types of modems, RS-232C, serial, parallel, interface, communications adapter, transmission media, lines, link, fiber optics, coaxial cable, twisted pair, open wire, telephone line, satellite, microwave, baseband, digital, broadband or wideband, bandwidth, digital lines, point-to-point line, multidrop or multipoint line, dedicated line, switched line, leased line, hard-wired line, polling, analog, addressing, token passing, asynchronous, synchronous, simplex, half-duplex or duplex, full duplex, ASCII, EBCDIC, protocol, value-added network, wide area network, local area network, ISDN, hybrid network, packet switching, public databases, electronic mail, information resource sharing, multiplexer, contention, hardware resource sharing, node, CSMA/CD, CSMA/CA, network servers, compatibility, XMODEM, connectibility, editability, PBX, PABX, encryption, delivery systems, password, teleconferencing, CBMS, CVMS, automatic close or time-out parameters, mechanical keyboard locks, telecopier, security, integrated workstation, facsimile, and front-end processor.

2. Knowing the capabilities of telecommunications, networks, equipment, and software, as well as workstations, how would you...
- Communicate with your company's headquarters located in Atlanta, Georgia, if you were in Richmond, Virginia, or Washington, D. C.? Name the pieces of equipment in the communications network you would use.
 - Communicate with your company's office in London, England, if you were in Dallas, Texas? Identify the specific pieces of equipment in the

telecommunications process you would use.

- c. Leave a message for your staff regarding a meeting for the following day from your workstation? How would you know when each of your staff received the message?
 - d. Find out the closing prices for your company's stock for a particular day on that day?
 - e. Send a facsimile copy of a blueprint to a company in Japan? Name the pieces of equipment in the communications network you would use.
 - f. Determine the need for a local area network in your company? What are some of the questions you would ask? Who are some of the people you would talk to? Where would you go to look at other networks?
 - g. Find out who could speak German in your company by using your integrated workstation?
 - h. Determine the best methods of sending information electronically to locations such as Lebanon, Beirut; Paris, France; London, England; Berne, Switzerland; and Canada; and other locations in the United States if your company did not have this capability?
3. Find out the telecommunications software that is available for large mainframes, as well as for personal computers by reading at least two articles. Report your findings to the class.
 4. Expand your knowledge of telecommunications by reading at least one article which contains a term or item that was not mentioned in class. Explain the term or item to the class and relate it to what you have learned in this task area.
 5. Interview someone in an organization in the area of telecommunications. Questions could be asked might include the following:

Do they have networks? What is the main use? How long have they had the network(s)?

What configuration(s) do they use and why?

What grade of lines do they use and why?

What mode of transmission: asynchronous or synchronous? Why?

What type of lines (simplex, half-duplex, full duplex)

and why?

Are their lines switched or leased?

Do they use ASCII or EBCDIC?

Do they use packet switching?

Do they use hard-wired (point-to-point) or multidrop lines?

Do they use public databases? Which ones? For what purposes? Who has access to them?

Do they use wide area networks? For what purposes? Which one(s)?

What kind of communication software do they use?

What kind of security is provided?

Other questions.

6. Arrange for a visit to the organization at the time of the interview. What new terms or items were mentioned or seen that were not covered in class?
7. Arrange a field trip to this same organization (or another) for the class.
8. Be prepared to explain how protocols are used in telecommunications to a friend who is not familiar with the information systems field.
9. Discuss one of the landmark regulatory decisions affecting the telecommunications industry--Carterfone decision, the 1956 "consent decree", the divestiture decision, C12--as to the effects on the evolution of telecommunications. Discuss and speculate on what possible effects this decision would have had on telecommunications if the decision had been the reverse.

TELECOMMUNICATIONS/NETWORKING

EVALUATION FORM - SOFTWARE/HARDWARE/NETWORK PRESENTATIONS

Exercise 2-1

Name of software/hardware/network

Type of software (if not readily recognizable in the name of the software)

Version number and date

Developer (vendor, manufacturer)/name of company

Cost: list vs actual? what is included with the software/hardware/network? license agreement? can back-up copies be made? vendor availability for problems [toll-free number]? are updates available at low cost? networkable versions available? cables and other interfaces required? Etc.

Requirements to run software: Compatibility with hardware (specifically, type of PC, model #, etc.)? RAM required to support software? other peripherals required or supported? cabling required and available?

Requirements to use hardware/network: Compatibility with what software? Expandable and upgradable? How many peripherals will the hardware/network support? Cabling and other interfaces required?

Printers supported or system configuration requirements

Description of the scope of the functions of the software/hardware/network: What it is purported to do? ease with which it accomplishes the functions?

Terminology encountered: familiar or too many new terms? who could use it in the automated office and for what purposes?

Report on at least one review of the software, hardware, or network in a current computing magazine or research service write-up to get the users' viewpoint. (These services include DataPro or Seybold reports.)

Value of the software/hardware/network to the automated office: Will it save time? enhance decision making? etc.

Documentation: easy to read? learning disk or tutorial included? on-line help?

Limitations encountered with the software/hardware/network:
What do you see as the drawbacks (keeping in mind that the perfect piece of software is never available)?

Recommendations: Is it worth the cost? Is it going to automate repetitive tasks or enhance decision making? What will be accomplished through the purchase of this software/hardware/network by a company? Will documentation need to be rewritten? How much and what kind of training would be required? Other?

TELECOMMUNICATIONS/NETWORKING

CASE STUDY Exercise 3-1

- #1 Suppose you are a sales representative for a national chemical company headquartered in another part of the country. You must call on five customers daily, taking new orders and handling customer complaints. You also spend time communicating with technical specialists in the various labs in the headquarters, as well as other locations, who may or may not be available when called. This part of your job requires getting back in touch with the customer on a timely basis. By the end of the each day, you have accumulated a great deal of information in the form of new orders, requests for specialty product information, and customer complaints. The orders must get to the headquarters purchasing, production, and shipping personnel immediately. The complaints must be routed to the appropriate departments involved. In the past, you have used the telephone exclusively for all of this business. You are convinced there are better methods of transferring this information (delivery systems) which will save time and money and enhance customer relations.

Write a memo to your manager (instructor) explaining how you could transmit and store the data for orders to the appropriate people in headquarters and make contact with technical specialists and customers where telephone tag and time spent to get needed information could be better spent. Be specific as to the type of telecommunications delivery systems which would enhance your job.

TELECOMMUNICATIONS/NETWORKING

CASE STUDY

Exercise 3-2

- #2 Gene Newton, office automation specialist, wanted to provide a large number of users with enhanced personal-productivity tools that would do what a pencil, paper, typewriter (create, edit, print), telephone, calendar, to-do list, and calculator would do. He also wanted to save money by letting users share these tools. The shared system he envisioned required fast, efficient communications, and used off-the-shelf software.

TELECOMMUNICATIONS/NETWORKING

CASE STUDY

Exercise 3-3

- #3 You are employed as a consultant in information systems. A multinational company in your area comes to you for advice for enhancing communications with offices in other locations. Specifically, this organization has decided to explore the feasibility of using satellite communications and video teleconferencing. They are not at the point of purchase or decision making. What they want you to do is 1) prepare a bibliography of 10 articles related to satellite communications and video teleconferencing; 2) prepare a vocabulary list to assist them in understanding the literature, and 3) research the names and addresses of possible vendors to meet this need.

● Telecommunications/ Networking

course four

Evaluation

TELECOMMUNICATIONS/NETWORKING

TEST 1

1. Define the following terms:

communication

telecommunications

downloading

uploading

modem

acoustic coupler

external modem

internal modem

intelligent (smart) modem

communications adapter

multiplexer

broadband media

baseband media

front-end processor

transmission channel

line configurations

point-to-point line

multidrop or multipoint

polling

addressing

asynchronous transmission

synchronous transmission.

simplex

half-duplex or duplex line

full duplex

computer-based message systems (CBMS)

computer-based voice message systems (CBVS)

facsimile

teleconferencing

protocol

network

local area network

topology

compatibility

connectivity

editability

integrated workstation

encryption

password

hybrid network

ISDN

2. Discuss what each of the following terms, people, inventions, or regulations have to do with telecommunications:

Strowger switch

FCC

Computer Inquiry II (CI2,

1956 "consent decree"

January 1984

triode vacuum tube

integrated circuit

silicon chip

multiplexing

Theodore Vail

AT&T divestiture

Carterfone decision

transistor

fiber optics

microwave stations

satellites

analog

digital

Computer Inquiry III (CI3)

3. Name and illustrate the four network topologies below:

4. Discuss one of the landmark regulatory decisions affecting the telecommunications industry--Carterfone decision, the 1956 "consent decree", the divestiture of At&T, C72, CI3--as to the effects on the evolution of telecommunications. Discuss and speculate on what possible effects this decision would have had on telecommunications if the decision had been the reverse.

5. Explain how protocols are used in telecommunications.

TELECOMMUNICATIONS/NETWORKING

Test 2

1. Telecommunications entails the same process as the broad term communications, except that it involves communicating _____ across distances without any changes occurring to the original message.
2. Name 3 forms of information that may be sent electronically:

3. What do the following terms mean:
"downloading" _____

"uploading" _____

4. A _____ is needed for communication to take place from one computer to another in a remote location, within a building, and sometimes outside to other buildings.
5. List the 4 different types of modems:

6. When using a personal computer to communicate with a mainframe, a _____ is needed.
7. When it is desirable to have one medium carry many transmissions at the same time, a _____ can be used.
8. Single cable that can bring 30 television channels to a TV set is an example of _____ media.
9. The _____ acts as a "traffic cop", routing and sorting messages to available lines in the mainframe computer.
10. Define telecommunications in your own words.

TELECOMMUNICATIONS/NETWORKING

Test 2 (Solutions)

1. Telecommunications entails the same process as the broad term communications, except that it involves communicating electronically across distances without any changes occurring to the original message.
2. Name 3 forms of information that may be sent electronically:

<u>(voice)</u>	<u>(data)</u>
	<u>(graphics)</u>
<u>(text)</u>	<u>(video)</u>
3. What do the following terms mean:

"downloading": (transferring data from a mainframe to personal computer)

"uploading": (transferring data from a personal computer to a mainframe)
4. A (modem) is needed for communication to take place from one computer to another in a remote location, within a building, and sometimes outside to other buildings.
5. List the 4 different types of modems:

<u>(acoustic coupler)</u>	<u>(external)</u>
<u>(intelligent/smart)</u>	<u>(internal)</u>
6. When using a personal computer to communicate with a mainframe, a (communications adapter) is needed.
7. When it is desirable to have one medium carry many transmissions at the same time, a (multiplexor) can be used.
8. Single cable that can bring 30 television channels to a TV set is an example of (broadband) media.
9. The (front end processor) acts as a "traffic cop", routing and sorting messages to available lines in the mainframe computer.
10. Define telecommunications in your own words. (Answers will vary. All should include the following elements: electronic transfer of data, over distances, and received or understood as the original idea)

TELECOMMUNICATIONS/NETWORKING

Test 3

1. A _____ makes it possible to provide the link between the sender and the receiver.

2. The _____ is the physical path that is used for sending information.

3. Name 4 other terms for channel:

4. Name the 4 different types of communication channels used when data are transmitted over long distances:

5. **Matching:**

- | | | |
|----------------------|-------|---|
| A. Digital lines | _____ | Least expensive transmission material available. |
| B. Satellite relays | _____ | Transmit data through open space. |
| C. Telephone lines | _____ | Communicate electronically from approximately 22,000 miles above the earth. |
| D. Microwave systems | _____ | Replace older, worn out analog lines so that data can be moved faster. |
| E. Coaxial cables | _____ | transmission media which use smooth, hair-like materials to conduct light. |
| F. Fiber optics | _____ | copper wires bundled into cable used as transmission media. |

TELECOMMUNICATIONS/NETWORKING

Test 3 (Solutions)

1. A (transmission channel) makes it possible to provide the link between the sender and the receiver.

2. The (channel) is the physical path that is used for sending information.

3. Name 4 other terms for channel:

<u> </u> (line) <u> </u>	<u> </u> (link) <u> </u>
<u> </u> (circuit) <u> </u>	<u> </u> (facility) <u> </u>
<u> </u> (medium) <u> </u>	<u> </u> (path) <u> </u>

4. Name the 4 different types of communication channels used when data are transmitted over long distances:

<u> </u> (telephone lines) <u> </u>	<u> </u> (microwave stations) <u> </u>
<u> </u> (satellite relays) <u> </u>	<u> </u> (digital lines) <u> </u>

5. **Matching:**

- | | | |
|----------------------|--------------|---|
| A. Digital lines | <u> C </u> | Least expensive transmission material available. |
| B. Satellite relays | <u> D </u> | Transmit data through open space. |
| C. Telephone lines | <u> B </u> | Communicate electronically from approximately 22,000 miles above the earth. |
| D. Microwave systems | <u> A </u> | Replace older, worn out analog lines so that data can be moved faster. |
| E. Coaxial cables | <u> F </u> | transmission media which use smooth, hair-like materials to conduct light. |
| F. Fiber optics | <u> E </u> | copper wires bundled into cable used as transmission media. |

TELECOMMUNICATIONS/NETWORKING

Test 4

1. Differentiate between (1) point-to-point and (2) multidrop or multipoint connections.

2. A _____ is a permanent circuit to connect a personal computer, terminal, or large computer with another computer. This line is also referred to as a _____ or a _____ line.

3. A _____ is established through the regular telephone system rather than through a direct connection.

4. A _____ is almost always used for multidrop line configurations.

5. Polling is performed by the _____ and the _____.

6. T F When a host computer addresses a terminal and sends a message to it, only the addressed terminal receives the message (even though there are many terminals on the same line).

7. How information is sent from one communication device to another is affected by: (Please circle the one best answer.)
 - a. frequency of transmission.
 - b. quantity of material to be sent.
 - c. rate at which it will be sent.
 - d. a and c above.
 - e. All of the above.

8. Which type of transmission is faster? (Please circle the one best answer.)
 - a. asynchronous
 - b. synchronous

Why?

9. What are the 3 terms used to describe the direction or directions that digital information is allowed to travel over the telephone lines:

10. Characters most commonly are made up of groups of 7 bits according to the _____

or groups of 8 bits according to the IBM-developed alphabet called _____

11. The speed at which information is sent over telephone lines is called its _____.

TELECOMMUNICATIONS/NETWORKING

Test 4 (Solutions)

1. Differentiate between (1) point-to-point and (2) multidrop or multipoint connections.

point-to-point: a direct line between two computers (any size) and a terminal and a computer.

multidrop or multipoint: a line that has more than one terminal, personal computer, or large computer connected to a host computer.

2. A (leased line) _____ is a permanent circuit to connect a personal computer, terminal, or large computer with another computer. This line is also referred to as a (dedicated) _____ or a (hard-wired) _____ line.
3. A (switched line) _____ is established through the regular telephone system rather than through a direct connection.
4. A (leased line) _____ is almost always used for multidrop line configurations.
5. Polling is performed by the (host computer) _____ and the (personal computer) _____.
6. T F When a host computer addresses a terminal and sends a message to it, only the addressed terminal receives the message (even though there are many terminals on the same line).
7. How information is sent from one communication device to another is affected by: (Please circle the one best answer.)
 - a. frequency of transmission.
 - b. quantity of material to be sent.
 - c. rate at which it will be sent.
 - d. a and c above.
 - e. All of the above.
8. Which type of transmission is faster? (Please circle the one best answer.)
 - a. asynchronous
 - b. synchronous

Why? Synchronous transmission allows characters to be sent and received in a continuous stream of bits without start or stop bits; with asynchronous transmission data are transmitted or received one character at a time.

9. What are the 3 terms used to describe the direction or directions that digital information is allowed to travel over the telephone lines:

_(simplex)_____ _(half duplex or duplex)____
_(full-duplex)_____

10. Characters most commonly are made up of groups of 7 bits according to the

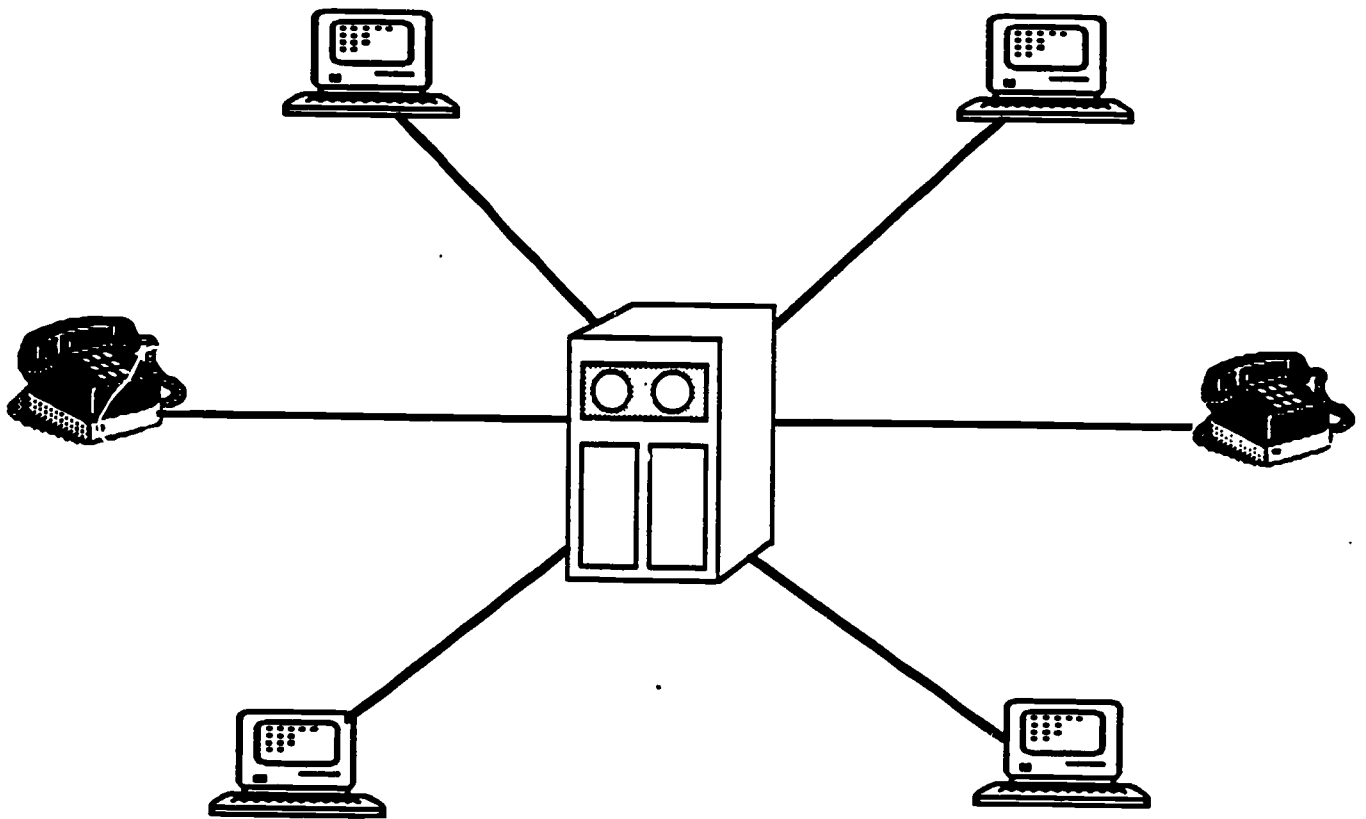
(American Standard Code for Information Exchange, ASCII)

or groups of 8 bits according to the IBM-developed alphabet called

(Extended Binary-Coded Decimal Interchange Code, EBCDIC).

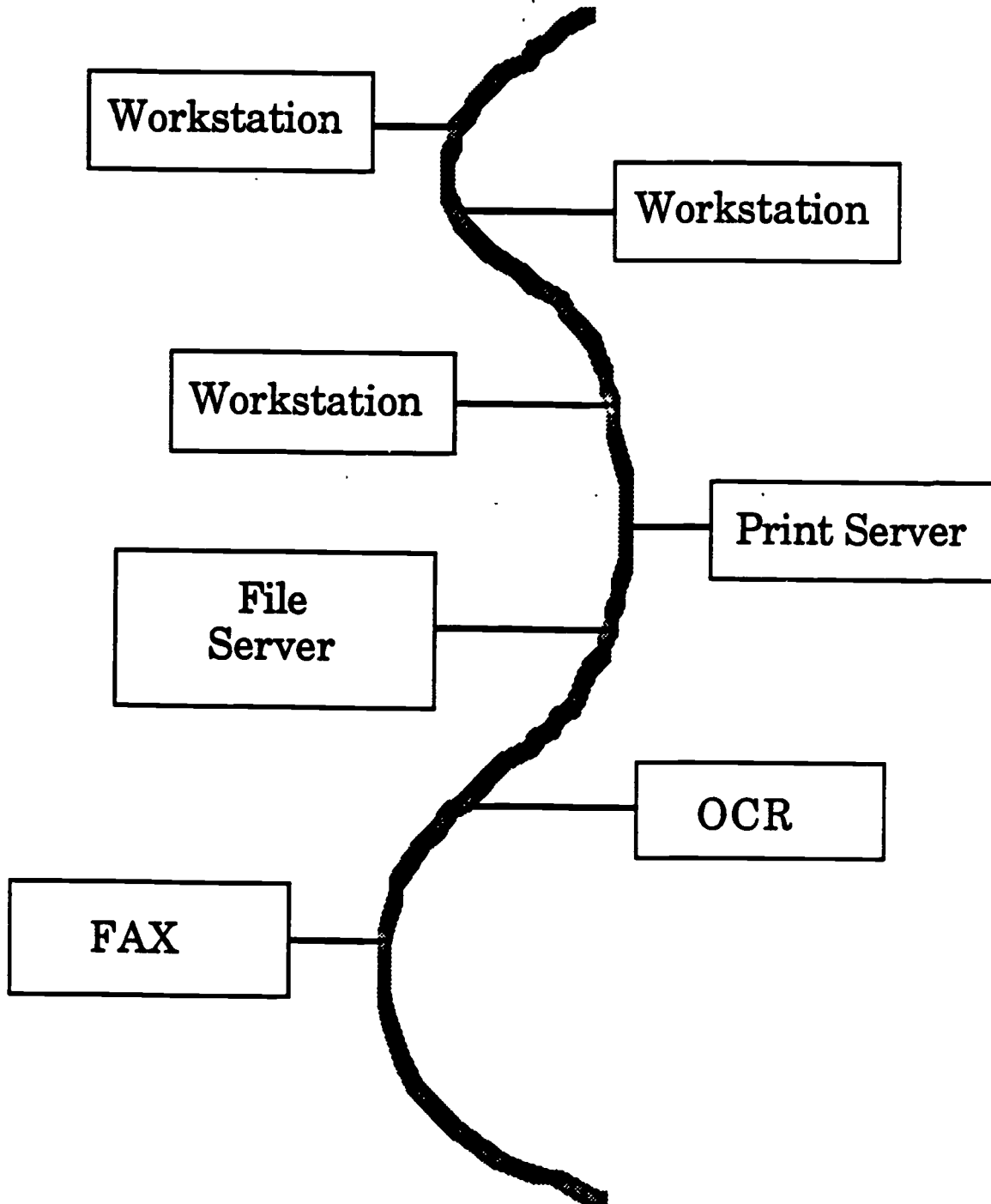
11. The speed at which information is sent over telephone lines is called its _(transmission speed)_____.

A Suggested Solution to the Case Study in Task IV

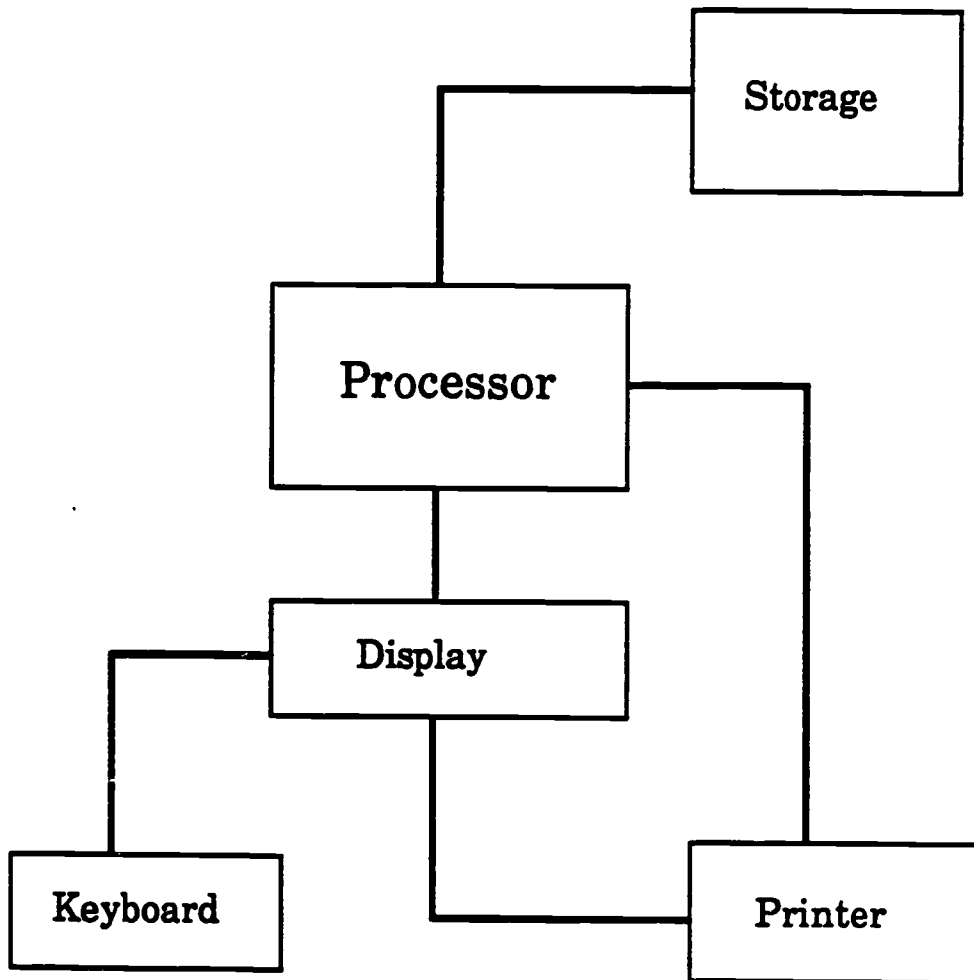


Local Area Network

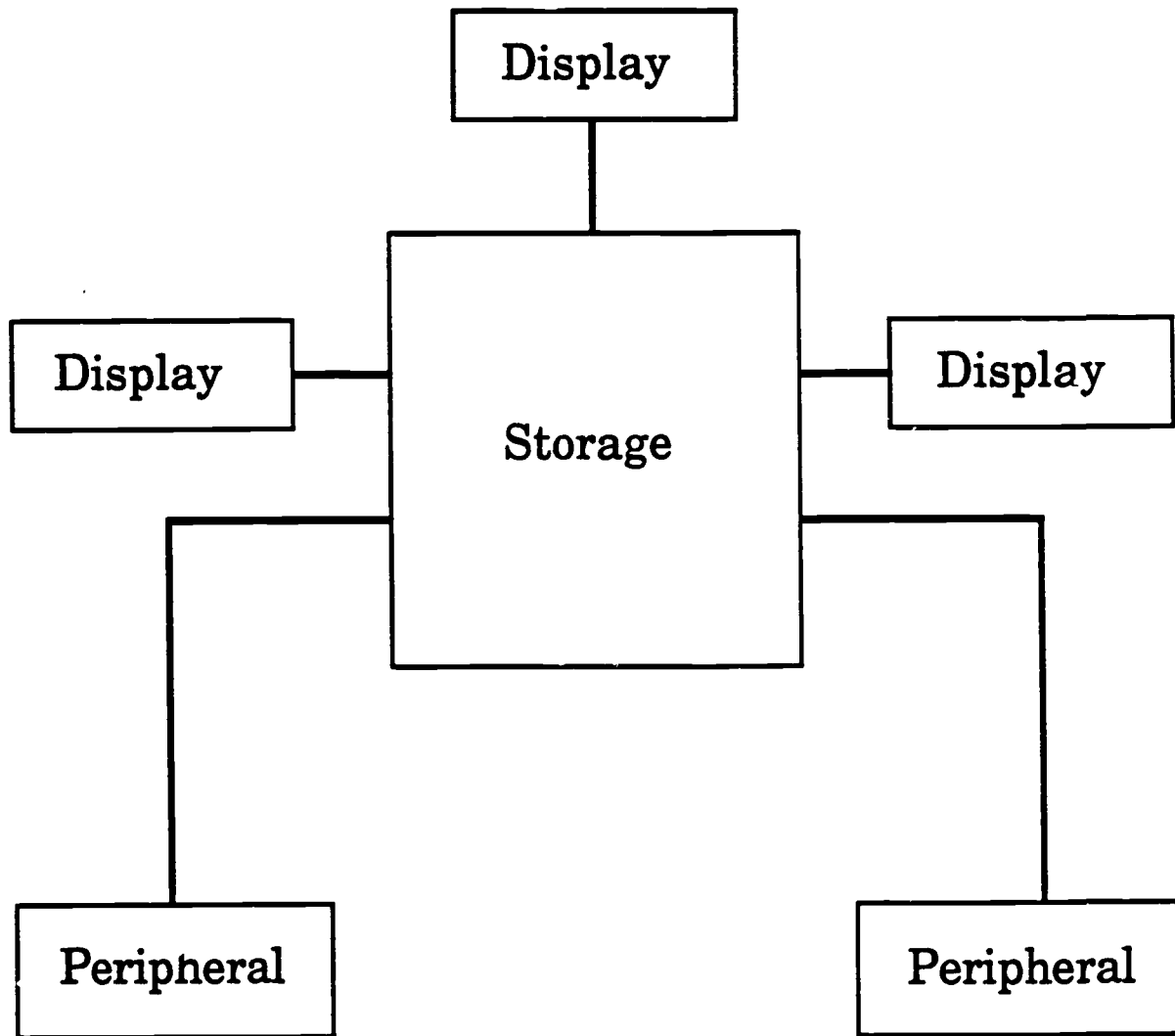
LOCAL AREA NETWORK



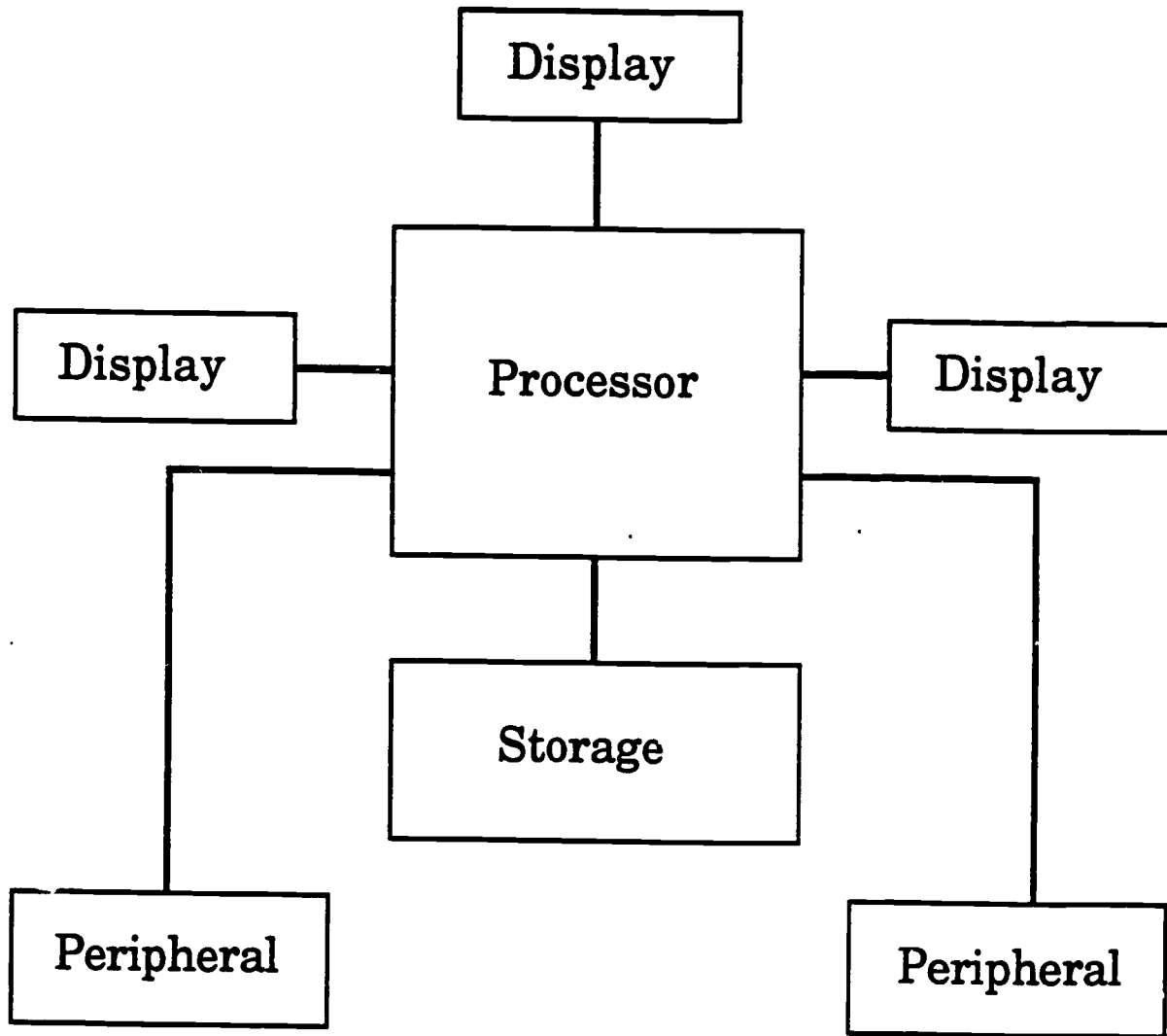
STANDALONE (OR DEDICATED) SYSTEM



MULTIUSER SHARED RESOURCE SYSTEM



MULTIUSER SHARED LOGIC SYSTEM



Telecommunications/ Networking

course four

References

TCP/IP: standards for communication

TCP/IP: standards for communication

Alan Pfeiffer-Traum, in the Technical Services group of Operations and Facilities, describes TCP/IP protocols as a set of rules by which two or more machines transfer data.

The rules are based on the desire for increased and enhanced telecommunication between machines running on different operating systems.

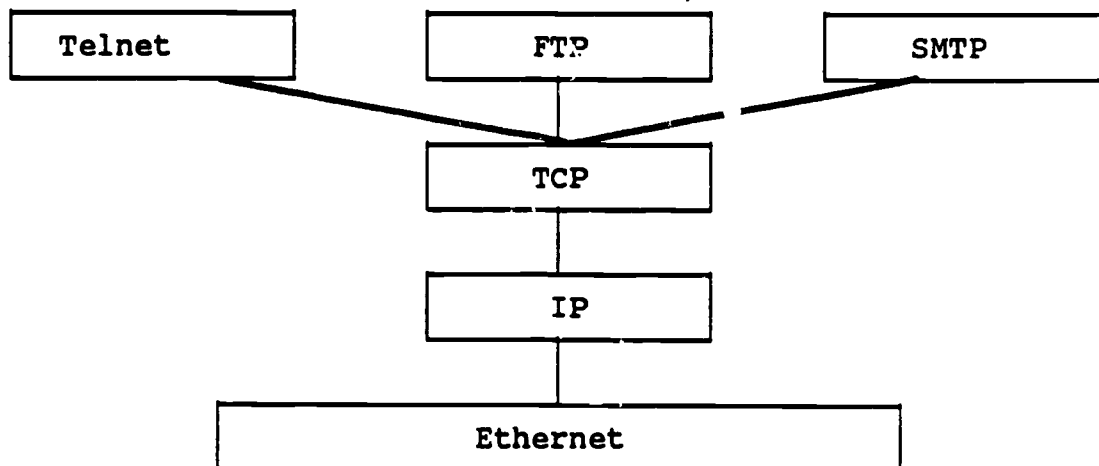
Set of Standards

TCP/IP, or Transmission Control Protocol and Internet Protocol, was originally developed by the Department of Defense as a set of standards for communication between machines. (See the example of protocols in this section, also.)

Pfeiffer-Traum said that several years ago the National Science Foundation "addressed the need they saw for providing a computer network between research institutions across the country." They decided that TCP/IP would be the standard.

Since then, universities across the country and around the world [as well as other public and private institutions] have purchased the software and connective hardware necessary to build networks using TCP and IP...

ILLUSTRATION OF TCP/IP



Building blocks

Protocols work like building blocks. Each protocol performs a different and specific role. IP is a low-layer protocol running on top of protocols used by a local network, such as Ethernet in this instance. TCP, the Transmission Control Protocol, takes the services that IP gives---an addressing scheme and transport mechanism---and adds a reliable stream protocol.

TCP provides an ordered connection between hosts so users know that data will arrive or be sent intact or they will be told otherwise. In turn, TCP provides enhanced service to another protocol or application. TCP, with the services of IP, provides a reliable means of transporting information for applications such as remote login, file transfer, and electronic mail.

Applications of TCP/IP

"We are hooking into a national network, and connecting our academic institution to others across the country and around the world by installing TCP/IP," said Jeff Hayward, also of Technical Services.

Pfeiffer-Traum describes TCP/IP as "a flexible and rich protocol, with a depth of utility which would make it useful if an individual had only one node and one machine."

TCP/IP is used by many users on different machines. Literally, thousands of hosts are using the TCP/IP protocol at any given time.

"You can't beat TCP/IP for its connectivity and universality," he added. "I can't think of a single machine on campus that could not run the software necessary to the TCP/IP protocol."

TCP/IP allows individuals on machines with different operating systems to transfer files, send mail, login from remote locations and do much more.

For the academic community, the protocols also mean access to the Internet, which in turn means researchers can get to National Science Foundation supercomputers, each other, and their own accounts across the country without ever leaving their terminals.

This means researchers at UH can access their supercomputer account in Minnesota from their IBM PC here on campus. A researcher with a VAX account at UH and a UNIX

account at MIT can transfer files back and forth between these two accounts.

Higher levels of protocols

Telnet is the protocol used to provide terminal access to machines. Pfeiffer-Traum compared using Telnet to using Set Host on the DECnet protocol.

"For example, if you're on George (a UH VAX running the VMS operating system) and want to get on VAX 750 (running Berkeley UNIX operating system) at the University of Chicago, you simply type Telnet [system name] and receive a login prompt and proceed from there."

FTP, the File Transfer Protocol, provides a means for transferring files between hosts on the Internet. FTP will also perform translation between different types of hosts, freeing the user from worrying about the specifics of character codes.

FTP can also require IDs and passwords in order for users to access files. Pfeiffer-Traum said there are some "anonymous" FTPs that allow general access to a restricted set of files.

SMTP, the Simple Mail Transfer Protocol, provides a means for exchanging electronic mail between dissimilar hosts.

Pfeiffer-Traum pointed out that SMTP may or may not be the protocol for sending mail to other Internet hosts.

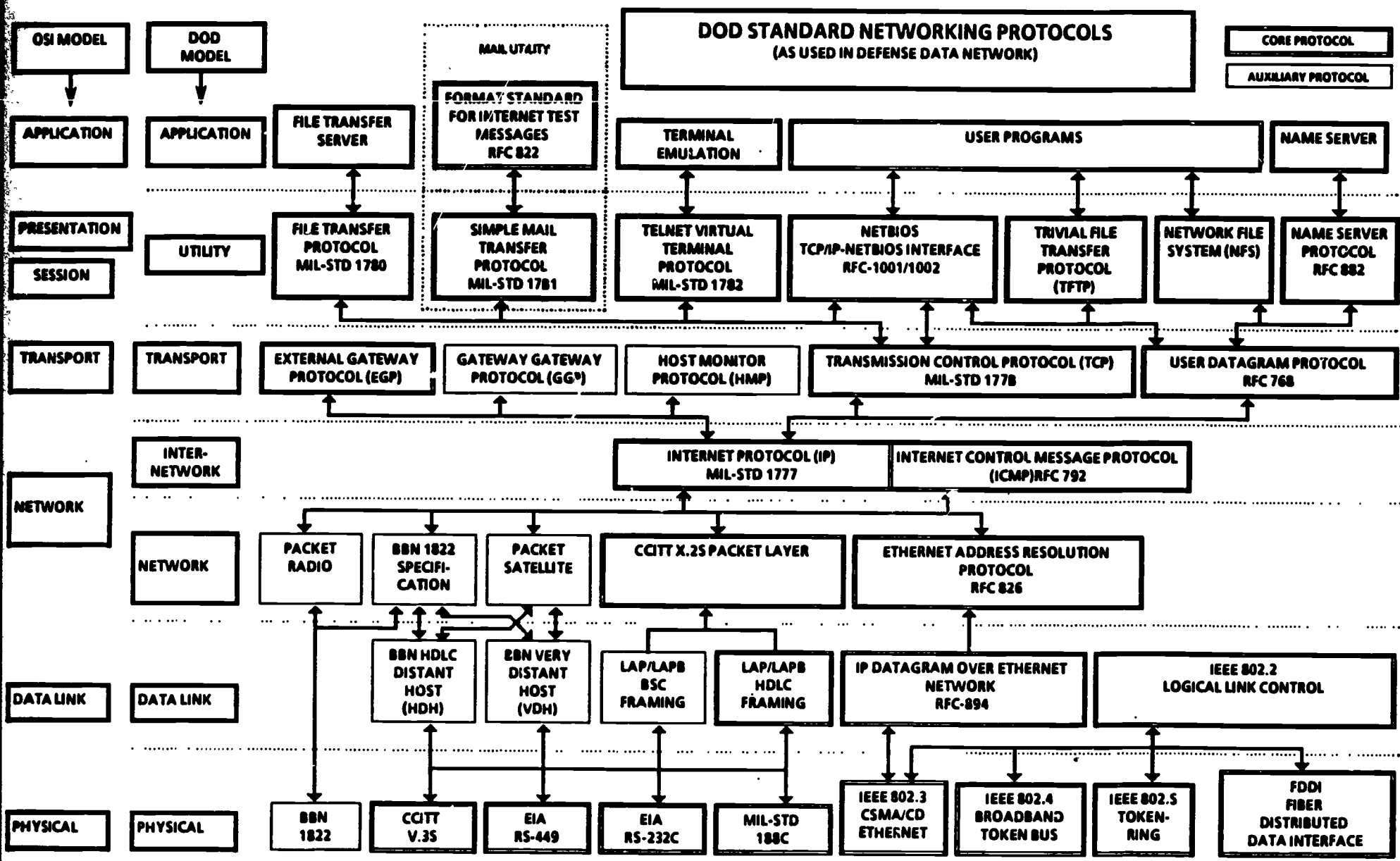
"You'll use Telnet to login or FTP to transfer files," he said, "but when you send mail, you may not always be using a mailer that uses the SMTP protocol." Often there is an SMTP implementation grafted onto the native mail system.

TCP/IP at UH

Researchers at UH commonly take advantage of the TCP/IP protocols to login, transfer files, and send mail to the supercomputer facilities. NSF has promoted TCP/IP as an academic networking protocol for some time now.

By making TCP/IP available on many of the academic VAXs and AT&T 3Bs, UH is keeping up with academic computing across the nation and around the world.

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BE WARY OF VIRUS PROGRAMS

Computer virus programs can attack any type of computer system. They are passed from one disk to another through contaminated software. These viruses can be programmed to destroy hard disks or floppy ones; they can damage specific data, cause wholesale destruction, or fall somewhere in between.

Most viruses are programmed to copy themselves to other disks, thereby spreading the contamination.

Even more bugs

In addition to viruses, three other programs damage computer data. A Trojan horse--generally disguised as an interesting type of software such as games or graphics or which promises confidential data--will steal data from your computer or disk while the software is being executed. Trojan horses can be used to change password combinations or to alter computer accounts.

Time bombs wait for a specific time to perform a task, such as sending the user a message or damaging data. A worm, on the other hand, will attach itself to a specific utility and gradually gnaw at files whenever the utility is used.

Avoiding damage

To avoid possible damage, users should exercise caution. First of all, be wary of software that has been downloaded from a bulletin board.

Bulletin board system operators (sysops) try to eradicate all contaminated software, but it doesn't hurt to double-check. Use a duplicate of your system as a start-up disk to load unknown software.

It's always a good idea to have all your data backed up and removed from your computer system. Further, you shouldn't have your backed-up data on the same disk that contains copies of your operating system. If the system is infected, the contamination could spread to the rest of the data on the disk.

If you think your system has become infected, substitute a clean copy of the operating system and, before using it again, turn off the machine.

It's a good idea to turn off a personal computer in a public area before you use it, since there is no way to tell

It's a good idea to turn off a personal computer in a public area before you use it, since there is no way to tell what type of software was used by the person before you.

Frequently check the dates which tell when you've updated your operating system disks and your files. These dates should be consistent with your computer use.

Vaccination

As one last precautionary measure, you can use a vaccine-type program on your computer. This software doesn't guarantee that it will destroy a virus, but it should alert you to the existence of one. Such software is available for various operating systems.

Above all else, you should exercise caution, but don't become overly concerned when your system crashes. The crash may have nothing to do with a virus, Trojan horse, or time bomb.

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Other articles in public journals have been written regarding viruses. Check the following:

- Time
- At
- Byte
- Personal Computing
- MacWorld
- etc.

Viruses Threatening Era of Computer Freedom

By Christine Winter

At George Washington University, students were complaining about data disappearing from their floppy disks. One day it was there; the next it wasn't.

Computer programmers in the lab took one of the damaged disks and delved into the complex lines of computer code used to write the programs on it. Translated, the message read: "Welcome to the Dungeon . . . Beware of this VIRUS. Contact us for vaccination. . . ." Included were two names, an address and three telephone numbers in Lahore, Pakistan.

Six months ago, a half dozen small businesses in California started using an accounting software package they got free from an electronic bulletin board sponsored by a local computer store. Everything went smoothly until each of them hit a certain total in accounts receivable; at that point, all their hard disk drives mysteriously erased all their accounting records.

In recent weeks in Silicon Valley, several employees at a small company reportedly had their video monitors catch fire while they worked at their PCs. Investigators speculate that the diskettes they were using contained buried commands that changed the cycle speed of certain video functions, causing the monitors to overheat and ignite.

Behold the arrival of the computer virus—an electronic scourge that could have the same chilling effect on

the free flow of data that AIDS has had on the sexual revolution.

A computer virus is simply a small computer program. However, it is designed not to process words or crunch numbers, but to do some kind of damage: to delete data, alter information or destroy hardware. Viruses are written in a computer programming language, a type of code made up of numbers and symbols that gives instructions to the computer "behind the screen."

What differentiates a computer virus from any other program, or even any other form of computer sabotage, is this: It gives instructions to attach itself to other, innocent programs and to reproduce itself.

The average user would not see these few extra characters or lines of programming code on the screen, or understand them if he did. Even a sophisticated programmer would have to go looking for a virus to find it.

Another devious feature of a virus is that it is a time bomb. It is designed to do its dirty work later, when some date or event triggers it.

A virus recently found at Hebrew University in Jerusalem, for example, was designed to delete all files on the university's massive network, which included government and military installations, on May 13. It has been decoded and dismantled. Because of these delayed "logic bombs" that are built into most viruses, they are like-

ly to spread among a given user group before they do anything to make their presence known.

Today's trend toward connecting computers and sharing information over electronic bulletin boards makes viruses more contagious. These electronic bulletin boards are forums where computer users can communicate and trade "public domain" or free software via telephone linkups to commercial public networks.

One of the biggest threats to corporations comes from the trend to bring computer work home — where diskettes could be infected by programs that children bring home from school or get from bulletin boards.

A virus spreads by burying itself deep within the computer's operating system, which is the set of instructions that tells the computer how to do specific housekeeping tasks. This system must run every time the computer is turned on.

The virus then gives commands to make room for a copy of itself on every data diskette, or every program stored on the hard disk in the infected computer. Every time a new diskette is used to store data or copy a program the virus goes along. When that diskette is introduced into a clean computer, it spreads the virus to its operating system. When data from that newly infected computer is stored on a clean diskette, the virus spreads there, too, and so on. Just like a com-

mon cold or the flu.

There seems to be no such thing as a harmless virus. The virus that hit George Washington University and at least four other East Coast schools is generally described as passive. It was apparently intended to do nothing more harmful than keep duplicating itself, said Michael Peckman, a programmer-analyst there. But it wreaked unintentional havoc by delet-



A computer programmer creates a virus, which is a disruptive computer code that is able to duplicate itself and attach to other programs and data files.



A floppy disk that contains the virus will infect the memory, hard disk and other floppy disks in the computer. The virus remains, even when the original disk is removed.



Even if a computer is shut off and the memory wiped clean, the virus remains on the hard disk, storage disks or backup tapes.



Each time the virus comes into contact with a program, it duplicates and attaches itself, making it possible to infect a 'clean' disk or to infect programs that are shared on a network or sent to another computer via a modem.



The virus carries out the instructions written by the programmer. Those instructions can be as benign as a message that flashes on the screen at a specified time or date or as destructive as a command to delete or alter files on a certain date,

ing or damaging data when it made room for itself on student diskettes.

"The people who write these programs are not pranksters, they're vandals," said Dennis Director, president of Evanston, Ill.-based Director Technologies Inc. His Disk Defender is one of several security products, originally designed to prevent accidental data loss, that are being seen in a different light today.

There are some who think the viruses have been overdramatized by the media. Phillip McKinney, a manager at Oak Brook, Ill.-based Thumbscan Inc., a security products company, said there are probably only seven or eight viruses in active circulation in this country.

"There's never really been a documented case of industrial sabotage," he said. "This isn't something that is a serious threat for the average corporation on a yearly basis."

Fred Cohen, a University of Cincinnati professor of computer science, does not agree that the recent media hype has blown the problem out of proportion.

The best known virus episodes have a lot of flash but not much substance, he said. The more successful a virus is, the less likely anyone is to know about it.

Cohen, who is generally credited with developing the first computer virus as part of research on computer security for his doctoral thesis in 1983, suspects we are only seeing the tip of the phenomenon. There could be viruses at work in corporate America that may never be discovered, he said. These viruses are much more subtle and dangerous than "the gross and vulgar ones" that give themselves away by destroying everything.

"Suppose that a rival introduces a virus that would infiltrate the computers controlling the manufacturing process in a steel or semiconductor plant and just slows down production for a couple of months, or reduces the quality of the product being made," he suggested.

"If someone wrote a virus that would instruct a corporate computer to leak information, they would do it

slowly and selectively, so it could go on undetected for a long time," he said.

Cohen admits he did not make the decision to turn computer viruses loose on the world lightly when he decided to publish his early findings. He concluded that somebody would discover how to create them soon enough, and it was better to warn the world about what was coming.

Although it may not seem so to those uninitiated in the mysteries of computers, Cohen said viruses are so easy to write that "anybody can do it." He said that in some programming languages, he could write a simple virus in as few as 11 characters; many of those circulating today are about 100 to 200 characters—perhaps 10 to 20 lines of code."

Most documented cases of viruses in corporations have been in high-tech companies.

But the latest epidemic has been in the university systems around the world and has attacked personal computers. It is possible, although more difficult, to make a virus that can migrate up through larger systems.

"The academic world is especially vulnerable," although Northwestern and most Midwestern universities have not been victims of an outbreak yet, Roll said. "Our computers are easy to get into and we have fairly little security. After all, the whole purpose is to make the system fairly open so students can use it and learn it."

At Lehigh University in Bethlehem, Pa., students can sign out publicly usable software like library books. Last fall, the students who run the service noticed that a lot of diskettes were coming back faulty.

A virus was on the move that destroyed all the files on the parent disk after it had made four copies of itself. Each of those four "children" would make four copies of itself, and the parent files would self-destruct.

Kenneth van Wyk, a user consultant at Lehigh's computing center, said that once computer experts suspected mischief, it wasn't hard to find the virus, and even less difficult to write an antidote—a short program that simply deleted the 10ⁿ or so characters of machine language code

that made up the virus.

Thumbscan is looking into developing "secure software." These programs would detect any attachments or changes to a given program, then alert the operator or shut the program down.

"You can't prevent viruses," McKinney said. "The direction for security designers today is detection. What we need is virus alarms, ways of detecting viruses before they do damage, while backup copies are still secure."

Users are advised to be leery of public domain software, and of sharing software — and access to their computers — with anyone they don't know.

Computer magazines are urging everyone to put their operating systems on a separate disk and use "write protect tabs," which prevent anything from being added to the disk. Products like Director's Disk Defender perform similar functions for hard disk drives, while Thumbscan's PCBoot restricts those who can turn on the operating system for a PC or network.

Many public bulletin boards are becoming more private, opening access only to members and trying to verify the software distributed.

Backup copies of programs should be made when the system is known to be "clean" and put away for safekeeping.

There is no across-the-board test for viruses. A few give themselves away with various error messages or labels, but these are weaknesses that are quickly corrected by their creators in later versions.

"The most important thing is to recognize that you are at risk," said Cohen, who insists that computer users should not become terrorized by the threat.

"We can't give up all we've gained from the use of computers because of paranoia about these dangers," he said. "They're just part of life, like the flu."

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This is an example of written documentation for an E-Mail system on a VAX. Use this for illustration purposes for Task Area 5.

E-MAIL SYSTEM FOR XYZ COMPANY

Guidelines for Using the Mail Utility

To invoke the Mail Utility:

Type MAIL at the \$ prompt. The computer will respond with a mail prompt: MAIL>. The computer is now ready to accept any valid MAIL command.

```
$ MAIL  
MAIL>
```

To exit the Mail Utility:

Type the word EXIT or EX at the mail prompt (or CTRL Z). This will bring you back to the DCL level.

```
MAIL> EXIT (or EX) or (CTRL Z)
```

To read your new mail messages:

All new mail messages are placed in the NEWMAIL folder automatically. The NEWMAIL folder disappears once you have read all your new messages and have exited from the Mail Utility. Your new mail is then placed in a file called MAIL.MAI which is automatically created when you receive your first mail message. To read the mail in the NEWMAIL folder, simply give the computer a RETURN <ret> at the mail prompt. If there are no new messages to be read, and you type a <ret> at the mail prompt, the Mail Utility will automatically go to the MAIL folder and start displaying the messages that you have read.

```
MAIL> <ret>
```

To forward a message being read:

To forward a copy of the message that you are reading or have just finished reading, type FORWARD at the mail prompt. The Mail Utility will prompt you for the new header (address) information.

MAIL> FORWARD

TO: ORES::U123456
SUBJ: MEETING NOTICE

To reply to a message being read:

To reply to a message being read or have just finished reading, type REPLY at the mail prompt. The Mail Utility will automatically set up the header information and prompt you to type in your reply.

MAIL> REPLY

USER, THIS IS A REPLY TO YOUR MESSAGE. (CTRL Z)

To save a copy of the message in a file:

To save a copy of the mail message being read or just have finished reading in a file, type EXTRACT FILENAME.TXT at the mail prompt where FILENAME.TXT is a filename you want to call your file, such as MEETING.TXT. A file by that name is then saved in your account.

MAIL> EXTRACT FILENAME.TXT

To display the contents of your MAIL folder:

To display a list of all the messages in your MAIL folder, type DIR for a directory at the mail prompt. You may then read a specific mail message on the list by typing the number of that message after the mail prompt.

MAIL> DIR

To send a mail message:

To send a mail message, type SEND after the mail prompt. The Mail Utility will prompt you for the header information and ask you to type in your message and then press (CTRL Z) to send the message.

MAIL> SEND

To send a file using the Mail Utility:

To send a file using the Mail Utility, type SEND FILENAME.TXT (where filename.txt is the name of the file you want to send) after the mail prompt. The computer will then prompt you for the header information of where to send the file.

MAIL> SEND FILENAME.TXT

Global Mail Utility:

To send a message or a file to someone and you don't know the mail address, type # when the computer asks for TO in the header information. You will then be in the Global Directory where you can look up a person's name and mail address. When you exit the Global Mail Utility, you are back at your header information point in the Mail Utility.

MAIL> SEND

TO: #
SUBJ: NEW MAIL MESSAGE

To send mail using a distribution list:

If you frequently send mail to the same group of users, you can set up a distribution list. A distribution list is a file containing the user names of the people to whom you want to send messages. To set up a distribution list, you can either use the EDT/EDITOR at the DCL prompt to create the distribution list file with a DIS extension, or go into GLOBDIR (the Global Mail Utility) to have it build your distribution list. The distribution list file must have nodename::username for each entry.

VAXMAIL GETTING STARTED COMMANDS

Command	Description
Mail	Invokes mail at \$ prompt.
Help	Displays online help for VAXMAIL commands.
Dir	Displays your mail directory.
Send	To send an interactive message.
Read	To read a mail message.
Forward	To forward the message being read.
Reply	To reply to a message being read.
Exit	To exit the Mail Utility.

A keypad diagram for this particular VAX mail system looks like this:

MAIL Keypad Diagram

By default, the keypad keys on the VT200 and VT100 series terminals are defined to execute the following MAIL commands:

PF1 GO	PF2 HELP SHOW/DIR	PF3 EXTRACT/MAIL EXTRACT	PF4 ERASE SELECT/MAIL
F SEND SEND/DIR	R REPLY REPLY/DIR	F FORWARD FORWARD/DIR	PF5 REVIEW SHOW/DIR
C CURRENT CURRENT/DIR	F FIRST FIRST/DIR	L LAST LAST/DIR	D DIR/MAIL DIR MAIL
S SAC SAC/DIR	P PRINT PRINT/DIR	DIR DIR/DIR	ENTER SELECT
N NEXT NEXT/DIR		DEL DELETE	

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