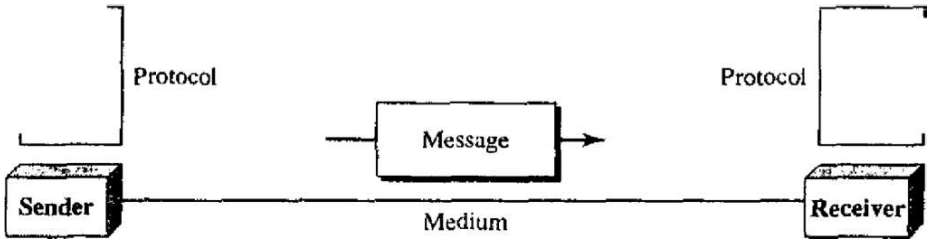
Data Communications

Data communications is the exchange of data between two devices via some form of transmission medium such as a wire cable. For data communications to occur, the communicating devices must be part of a communication system made up of a combination of hardware (physical equipment) and software (programs). The effectiveness of a data communications system depends on four fundamental characteristics: delivery, accuracy, timeliness, and jitter.

l. **Delivery:** The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.
2. **Accuracy:** The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable.
3. **Timeliness:** The system must deliver data in a timely manner. Data delivered late are useless. In the case of video and audio, timely delivery means delivering data as they are produced, in the same order that they are produced, and without significant delay. This kind of delivery is called *real-time* transmission.
4. **Jitter:** Jitter refers to the variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets. For example, let us assume that video packets are sent every 30 ms. If some of the packets arrive with 30-ms delay and others with 40- ms delay, an uneven quality in the video is the result.

Components

A data communications system has five components (see Figure 1.1).
Figure 1.1 *Five components of data communication*
Rule l. Rule 2: Rule n:



1. Message. The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.

2. Sender. The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.
3. Receiver. The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.
4. Transmission medium. The transmission medium is the path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiberoptic cable, and radio waves.
5. Protocol. A protocol is a set of rules that govern data communications. It sents an agreement between the communicating devices. Without a protocol, devices may be connected but not communicating, just as a person speaking Fr cannot be understood by a person who speaks only Japanese.

Data Representation

Information today comes in different forms such as text, numbers, images, audio, and video.

Text

In data communications, text is represented as a bit pattern, a sequence of bits (Is). Different sets of bit patterns have been designed to represent text symbols. Each is called a code, and the process of representing symbols is called coding. Today prevalent coding system is called Unicode, which uses 32 bits to represent a symbol character used in any language in the world. The American Standard Code for Information Interchange (ASCII), developed some decades ago in the United States, constitutes the first 127 characters in Unicode and is also referred to as Basic Latin.

Numbers

Numbers are also represented by bit patterns. However, a code such as ASCII is not *t* to represent numbers; the number is directly converted to a binary number to simple mathematical operations.

Images

Images are also represented by bit patterns. In its simplest form, an image is compound of a matrix of pixels (picture elements), where each pixel is a small dot. The size of pixel depends on the resolution. For example, an image can be divided into 1000 pi: or 10,000 pixels. In the second case, there is a better representation of the image (be resolution), but more memory is needed to store the image.

After an image is divided into pixels, each pixel is assigned a bit pattern. The value of the pattern depends on the image. For an image made of only black and-white dots (e.g., a chessboard), a 1-bit pattern is enough to represent a pixel.

If an image is not made of pure white and pure black pixels, you can increase size of the bit pattern to include gray scale. For example, to show four levels of g scale, you can use 2-bit patterns. A black pixel can be represented by 00, a dark g pixel by 01, a light gray pixel by 10, and a white pixel by 11.

There are several methods to represent color images. One method is called RGB so called because each color is made of a combination of three primary colors: red green, and blue. The intensity of each color is measured, and a bit pattern is assignee it. Another method is called YCM, in which a color is made of a combination of the other primary colors: yellow, cyan, and magenta.

Audio

Audio refers to the recording or broadcasting of sound or music. Audio is by nature different from text, numbers, or images. It is continuous, not discrete. Even when we use a microphone to change voice or music to an electric signal, we create a continuous signal.

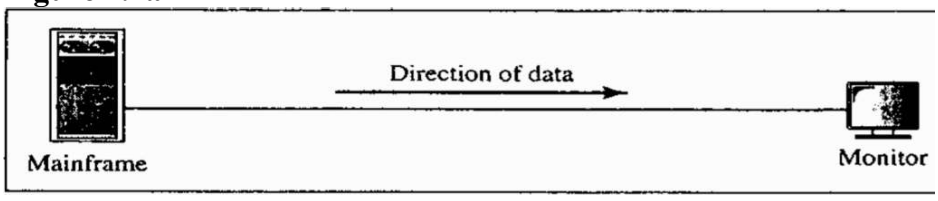
Video

Video refers to the recording or broadcasting of a picture or movie. Video can either be produced as a continuous entity (e.g., by a TV camera), or it can be a combination of images, each a discrete entity, arranged to convey the idea of motion.

Data Flow

Communication between two devices can be simplex, half-duplex, or full - duplex as shown in Figure 1.2. (a, b & c)

Figure 1.2a



Simplex

In simplex mode, the communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit; the other can only receive (see Figure 1.2a). Keyboards and traditional monitors are examples of simplex devices. The keyboard can only introduce input; the monitor can only accept output. The simplex mode can use the entire capacity of the channel to send data in one direction.

Half-Duplex

In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa.

The half-duplex mode is like a one-lane road with traffic allowed in both directions. When cars are traveling in one direction, cars going the other way must wait. half-duplex transmission, the entire capacity of a channel is taken over by whichever the two devices is transmitting at the time. Walkie-talkies and CB (citizens band) are both half-duplex systems.

The half-duplex mode is used in cases where there is no need for communicate, in both directions at the same time; the entire capacity of the channel can be utilized each direction.

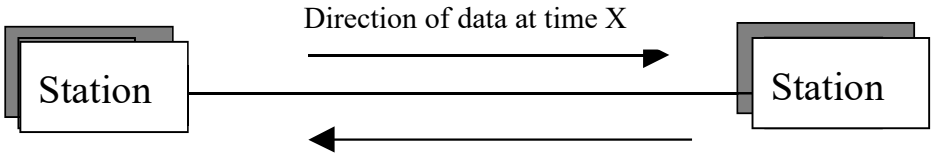


Figure 1.2 b

Full-Duplex

In full-duplex mode (also called duplex), both stations can transmit and receive simultaneously (see Figure 1.2c). The full-duplex mode is like a two-way street with traffic flowing in both directions at the same time. In full-duplex mode, signals going in one direction share capacity of the link with signals going in the other direction. This sharing can occur in two ways: Either the link must contain two physically separate transmission paths, for sending and the other for receiving; or the capacity of the channel is division between signals traveling in both directions.

One common example of full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at same time.

The full-duplex mode is used when communication in both directions is requires all the time. The capacity of the channel, however, must be divided between the t directions.

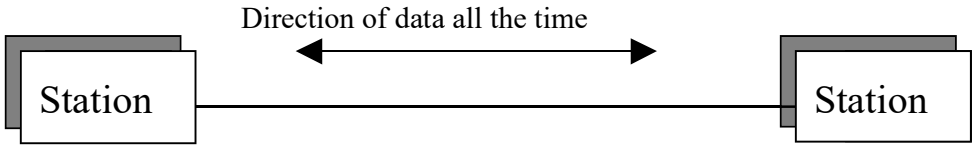


Figure 1.2 c

UNIT 2 NETWORKS
INTRODUCTION

A network is a set of devices (often referred to as *nodes)* connected by communication links. A node can be a computer, printer, or any other device capable of sending and, receiving data generated by other nodes on the network.

Distributed Processing

Most networks use distributed processing, in which a task is divided among multiple computers. Instead of one single large machine being responsible for all aspects of process, separate computers (usually a personal computer or workstation) handle subset.

Network Criteria

A network must be able to meet a certain number of criteria. The most important these are performance, reliability, and security.

Performance

Performance can be measured in many ways, including transit time and response time. Transmit time is the amount of time required for a message to travel from one device to another. Response time is the elapsed time between an inquiry and a response. The performance of a network depends on a number of factors, including the number of users, the type of transmission medium, the capabilities of the connected hardware, zinc) the efficiency of the software.

Performance is often evaluated by two networking metrics: throughput and delay. We often need more throughput and less delay. However, these two criteria are often contradictory, If we try to send more data to the network, we may increase throughput but we increase the delay because of traffic congestion in the network.

Reliability

In addition to accuracy of delivery, network reliability is measured by the frequency of failure, the time it takes a link to recover from a failure, and the network's robustness in a catastrophe.

Security

Network security issues include protecting data from unauthorized access, protecting data from damage and development, and implementing policies and procedures for recovery from breaches and data losses.

Type of Connection

A network is two or more devices connected through links. A link is a communications pathway that transfers data from one device to another. For visualization purposes, it is simplest to imagine any link as a line drawn between two points. For communication to occur, two devices must be connected in some way to the same link at the same time. There are two possible types of connections: point-to-point and multipoint.

Point-to-Point

A point-to-point connection provides a dedicated link between two devices. The entire capacity of the link is reserved for transmission between those two devices. Most point-to-point connections use an actual length of wire or cable to connect the two ends, but other options, such as microwave or satellite links, are also possible (see Figure 1,3a). When you change television channels by infrared remote control, you are establishing a point-to-point connection between the remote control and the television's control system.

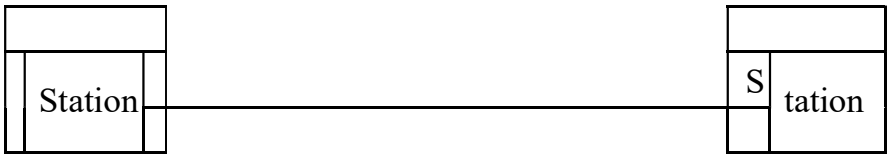
Multipoint

A multipoint (also called multidrop) connection is one in which more than two specific devices share a single link (see Figure 1.36).

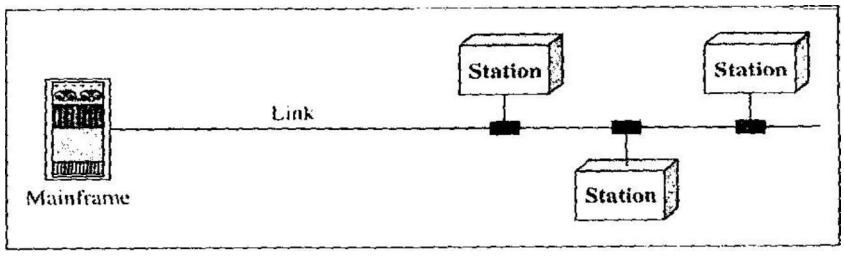
In a multipoint environment, the capacity of the channel is shared, either spatially or temporally. It' sever al devices can use the link simultaneously; it is a *spatially shared* connection. If users must take turns, it is a timeshared connection.

Physical Topology

The term physical topology refers to the way in which a network is laid out physically. Two or more devices connect to a link: two or more links form a topology. The topology of a network is the geometric representation of the relationship of all the line linking devices (usually called nodes) to one another. There are four basic tope possible: mesh, star, bus, and ring (see Figure 1.4). *Figure 1.3 Types of connections: point-to-point and multipoint*



a. point-to-point



b. Multipoint

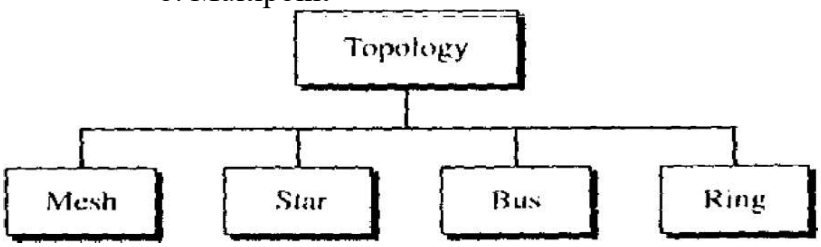


Figure 1.4 Categories of topology

UNIT 3 PROTOCOLS

INTRODUCTION

In this unit, we define two widely used terms: protocols and standards. First we define protocol, which is synonymous with rule. Then we discuss standards, with agreed-upon rules.

OBJECTIVES

At the end of this unit, you should be able to:

- understand Protocols

Protocols

In computer networks, communication occur between entities in different system entity is anything capable of sending or receiving information. However, two entities not simply send bit streams to each other and expect to be understood. For communicate to occur, the entities must agree on a protocol. A protocol is a set of rules that govern communications. A protocol defines what is communicated, how it is communicate when it is communicated. The key elements of a protocol are syntax, semantics, and timing.

- **Syntax:** The term *syntax* refers to the structure or format of the data, meaning order in which they are presented. For example, a simple protocol might expect first 8 bits of data to be the address of the sender, the second 8 bits to be the at of the receiver, and the rest of the stream to be the message itself.
- **Semantics:** The word *semantics* refers to the meaning of each section o How is a particular pattern to be interpreted, and what action is to be taken on that interpretation? For example, does an address identify the route to be or the final destination of the message?
- **Timing:** The term *timing* refers to two characteristics: when data should b and how fast they can be sent. For example, if a sender produces data at 100 but the receiver can process data at only I Mbps, the transmission will overload receiver and some data will be lost.