Data Communication

Data communication is the exchange of data (In the form 0's and 1's) between two devices via some form of transmission medium (such as wire cable). This communication is considered local (devices in the same building) or remote if the devices are farther apart.

The effectiveness of a data communication system depends on three ***fundamental characteristics***:-

1- 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 data accurately. Data that have been altered in transmission and left uncorrected are unusable.
3- Timeliness: The system must deliver data in timely manner. Data delivered late are useless.

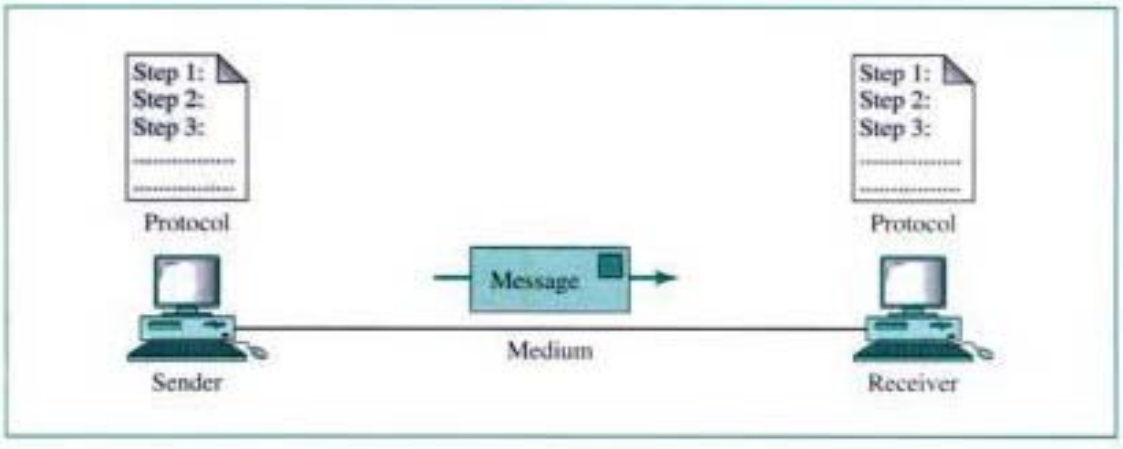
Real – time transmission: - delivery of data (video, audio, and voice data) as they are produced in the same order they are produced and without significant delay.

Components of a Data Communication System:

A data communication system is made up of 5 components:

A data communications system has five components (see Fig. 1.1).

Figure 1.1 *Five components of data communication*



1- ***Message:*** The message is the information (data) to be communicated. It can consist of text, numbers, sound, picture, or video, or any combination of these.
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- ***Medium:*** The transmission medium is the physical path by which a message travels from sender to receiver. It can consist of twisted pair wire, coaxial cable, fiber optic cable, laser, or radio waves.
5- ***Protocol:*** A protocol is a set of rules that govern data communication. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected, but not communicating, just as a person speaking French cannot be understood by a person who speaks only Japanese.

Uses of Computer Networks

Before we start to examine the technical issues in detail, it is worth devoting some time to pointing out why people are interested in computer networks and what they can be used for.

1-Business Applications

Many companies have a substantial number of computers. For example, a company may have separate computers to monitor production, keep track of inventories, and do the payroll. Initially, each of these computers may have worked in isolation from the others, but at some point, management may have decided to connect them to be able to extract and correlate information about the entire company.

the issue here is resource sharing, and the goal is to make all programs, equipment, and especially data available to anyone on the network without regard to the physical location of the resource and the user. An obvious and widespread example is having a group of office workers share a common printer However; probably even more important than

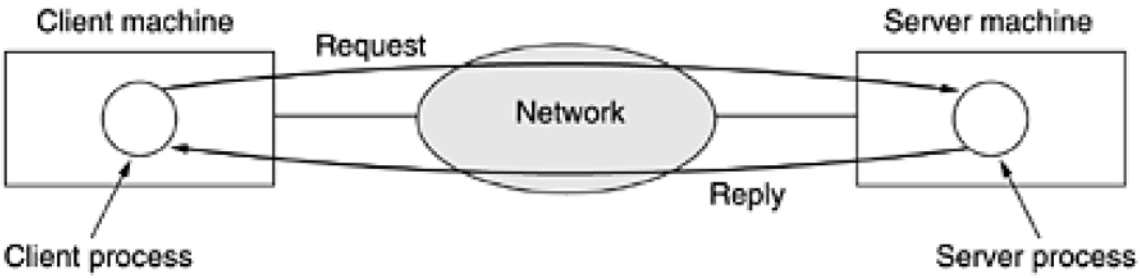
sharing physical resources such as printers, scanners, and CD burners, is sharing information. Every large and medium-sized company and many small companies are vitally dependent on computerized information.

Most companies have customer records, inventories, accounts receivable, financial statements, tax information, and much more online.

If all of its computers went down, a bank could not last more than five minutes. A modern manufacturing plant, with a computer-controlled assembly line, would not last even that long. In the simplest of terms, one can imagine a company's information system as consisting of one or more databases and some number of employees who need to access them remotely. In this model, the data are stored on powerful computers called servers. Often these are centrally housed and maintained by a system administrator. In contrast, the employees have simpler machines, called clients, on their desks, with which they access remote data, for example, to include in spreadsheets they are constructing.

This whole arrangement is called the client-server model. It is widely used and forms the basis of much network usage. It is applicable when the client and server are both in the same building (e.g., belong to the same company), but also when they are far apart. For example, when a person at home accesses a page on the World Wide Web, the same model is employed, with the remote Web server being the server and the user's personal computer being the client. Under most conditions, one server can handle a large number of clients.

If we look at the client-server model in detail, we see that two processes are involved, one on the client machine and one on the server machine. Communication takes the form of the client process sending a message over the network to the server process. The client process then waits for a reply message. When the server process gets the request, it performs the requested work or looks up the requested data and sends back a reply. These messages are shown in figure below.



A second goal of setting up a computer network has to do with people rather than information or even computers. A computer network can provide a powerful communication medium among employees. Virtually every company that has two or more computers now has e-mail (electronic mail), which employees generally use for a great deal of daily communication.

A third goal for increasingly many companies is doing business electronically with other companies, especially suppliers and customers. For example, manufacturers of automobiles, aircraft, and computers, among others, buy subsystems from a variety of suppliers and then assemble the parts. Using computer networks, manufacturers can place orders electronically as needed. Being able to place orders in real time (i.e., as needed) reduces the need for large inventories and enhances efficiency. A fourth goal that is starting to become more important is doing business with consumers over the Internet. Airlines, bookstores, and music vendors have discovered that many customers like the convenience of shopping from home. Consequently, many companies provide catalogs of their goods and services online and take orders on-line. This sector is expected to grow quickly in the future. It is called e-commerce (electronic commerce).

2- Home Applications

Some of the more popular uses of the Internet for home users are as follows:

1. Access to remote information.

2. Person-to-person communication.

3. Interactive entertainment.

4. Electronic commerce.

3-Mobile Users

Mobile computers, such as notebook computers and personal digital assistants (PDAs), are one of the fastest-growing segments of the computer industry.

Although wireless networking and mobile computing are often related, they are not identical, as shown in figure below. Here we see a distinction between fixed wireless and mobile wireless.

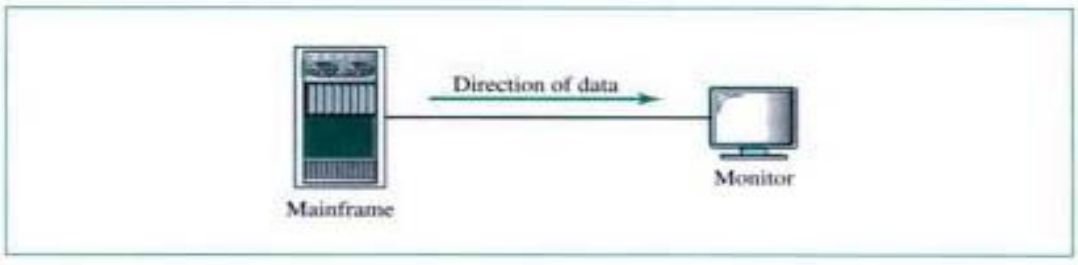
Wireless	Mobile	Applications
No	No	Desktop computers in offices
No	Yes	A notebook computer used in a hotel room
Yes	No	Networks in older, unwired buildings
Yes	Yes	Portable office; PDA for store inventory

Data Flow

Communication between two devices can be simplex, half-duplex, or full-duplex as shown in Figure below .

1. **Simplex:-** The communication is unidirectional as on, one way street, only one of the two stations on the link can transmit, the other can only receive. Ex: [keyboard can only introduce input, monitor can only accept output].

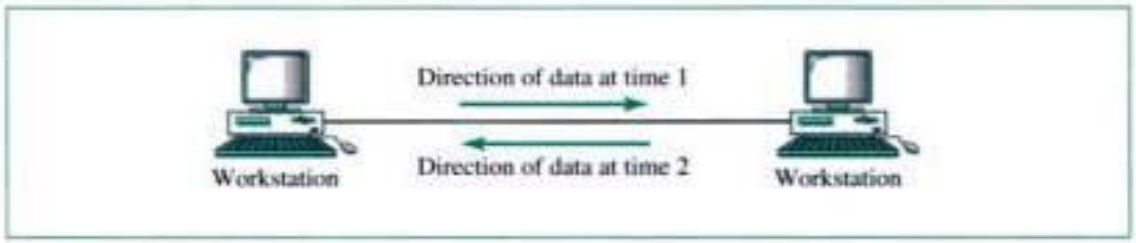
Figure 1.2 *Simplex*



2. **Half Duplex:-** in this mode, each station can both transmit and receive, but not at the same time. When one device sending, the other can only receive, and vice

versa. The entire capacity of the channel is taken over by whichever of the two devices is transmitting at the time. Walkie – talkies is an example of half – duplex system.

Figure 1.3 *Half-duplex*



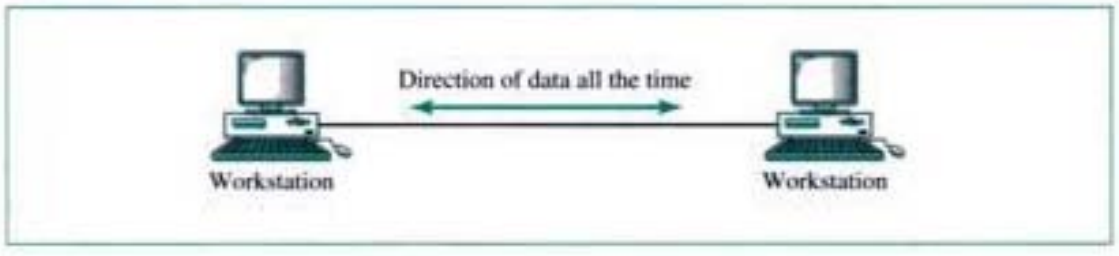
3-Full – Duplex: in full duplex mode, (also called duplex), both stations can transmit and receive simultaneously. Signals going in either direction share the capacity of the link. This sharing can occur in two ways:
- The link must contain two physically separate transmission path, one for sending and other for receiving.

Or:

- The capacity of the channel is divided 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 the same time.

Figure 1.4 *Full-duplex*



Networks:

A networks is a set of devices (often retired to as nodes) connected by media links. A node can be computer, printer, or any other device capable of sending

and/or receiving data generated by other nodes on the network. The links connecting the devices are often called communication channels.

Distributed processing:

Network use distributed processing, in which a task is divided among multiple computers, Instead of a single large machine being responsible for all aspects of a process, each separate computer handles a subset.

Network Criteria:

To be considered effective and efficient, a N.W must meet a number of criteria:

1- ***Performance:*** Performance can be measured in many ways, including transit time and response time.

Transit 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 response.

The performance of N.W depends on a number of factors including:

Number of users: Having a large number of concurrent users can slow response time in a N.W not designed to coordinate heavy traffic load. How a N.W response to loading is a measure of it's performance.

- Type of transmission medium: The medium defines the speed at which data can travel through a connection (data rate).
- Hardware.
- Software.

2- ***Reliability:*** In addition to accuracy of delivery, network reliability is measured by:

- Frequency of failure
- Recovery time of a network after a failure.
- Catastrophe.

3- ***Security:*** Network security issues include protecting data from unauthorized access and viruses.