

Is the facility to transfer data to remote locations quickly & conveniently, the data is transferred by means of a telecommunication network.

*Note*: Data communication is the transmission of electronic data over some media. The media may be cables, microwaves.

#### **Elements of Data Communication**

Four basic elements are needed for any communication system.

1. **Sender**. The computer or device that is used for sending data is called sender, source or transmitter. In modern digital communication system, the source is usually a computer.

2. **Medium**. The means through which data is sent from one location to another is called transmission medium. If the receiver and transmitter are within a building, a wire connects them. If they are located at different locations, they may be connected by telephone lines, fiber optics or microwaves.

3. **Receiver**. The device or computer that receives the data is called receiver. The receiver can be a computer, printer or a fax machine.

4. **Protocols**. There are rules under which data transmission takes place between sender and receiver. The data communication is used to transfer data from one computer to another. They follow same communication protocols can communicate and exchange data.

#### Data Transmission

Data may be transfer from one device to another by means of some communication media. The electromagnetic or light waves that transfer data from one device to another device in encoded form are called signals. Data transmissions across the network can occur in two forms i.e.:

(i) Analog signal.

(ii) Digital signal.

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Data Transmission

**Analog Signal**. The transfer of data in the form of electrical signals or continuous waves is called analog signal or analog data transmission. An analog signal is measured in volts and its frequency is in hertz (Hz

Advantages of Analog Signaling

- Allows multiple transmissions across the cable.
- Suffers less from attenuation.

Disadvantages of Analog Signaling

- Suffers from EMI.
- Can only be transmitted in one direction without sophisticated equipment.

#### **Digital Signal**

The transfer of data in the form of digit is called digital signal or digital data transmission. Digital signals consist of binary digits 0 & 1. Electrical pulses are used to represent binary digits. Data transmission between computers is in the form of digital signals.

#### **Advantages of Digital Signaling**

Equipment is cheaper and simpler than analog equipment.

Signals can be transmitted on a cable bidirectional.

Digital signals suffer less from EMI.

#### **Disadvantages Digital Signaling**

Only one signal can be sent at a time.

Digital signals suffer from attenuation.

# **Techniques of Data Communication**

There are two possible techniques of sending data from the sender to receiver, i.e:

# (1) Parallel transmission.

# (2) Serial transmission.

In parallel transmission each bit of character / data has a separate channel and all bits of a character are transmitted simultaneously. Here the transmission is parallel character by character.

# Sender Receiver

In serial transmission, the data is sent as one bit at a time having a signal channel for all the bit, i.e:

# Sender Receiver

# Modes of Data Communication.

The manner in which data is transmitted from one location to another location is called data transmission mode.

There are three ways or modes for transmitting data from one location to another. These are:

- (1) Simplex.
- (2) Half duplex.

(3) Full duplex.

# Simplex Mode

In simplex mode, data is transmitted in only one direction. A terminal can only send data and cannot receive it or it can only receive data but cannot send it. Simplex mode is usually used for a remote device that is meant only to receive data. It is not possible to confirm successful transmission of data in simplex mode.

This mode is not widely used. Speaker, radio and television broadcasting are examples of simplex transmission, on which the signal is send from the transmission to your TV antenna. There is no return signal.

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Advantages of Simplex

•Cheapest communication method.

Disadvantage of Simplex

•Only allows for communication in one direction.

#### Half Duplex.

In half duplex mode, data can be transmitted in both directions but only in one direction at a time. During any transmission, one is the transmitter and the other is receiver. So each time for sending or receiving data, direction of data communication is reversed, this slow down data transmission rate.In half duplex modes, transmission of data can be confirmed.

# Half Duplex Mode

Wireless communication is an example of half duplex.

Advantages of Half Duplex

- Costs less than full duplex.
- Enables for two way communications.

Disadvantages of Half Duplex

- Costs more than simplex.
- Only one device can transmit at a time.



# Full Duplex.

In full mode, data can be transmitted in both directions simultaneously. It is a faster mode for transmitting data because no time wastes in switching directions.

# **Full Duplex Mode**

Example of full duplex is telephone set in which both the users can talk and listen at the same time.

Advantage of Full Duplex.

• Enables two-way communication simultaneously.

Disadvantage of Full Duplex.

• The most expensive method in terms of equipment because of two bandwidth channels is required.

# What is Communication Speed?

The communication transfer rate is measured in a unit called band. In general band is identical to its bites e.g. at rate of 300 bounds is 300 bps. (bits per second). Different grades of channels provide...

# Working Computing

Means that the user at a network can use his own computer to do his tasks

# The benefits of this technique are: -

- 1. Sharing of files, documents, & resources.
- 2. Sending messages to all the people on the network at the same time.
- 3. Sharing software.
- 4. Sharing equipment's.

# Type of Network according to their Geographical distance

A **computer network** or **data network** is a telecommunications network that allows computers to exchange data. networked computing devices (network nodes) pass data to each other along data connections.

The connections (network links) between nodes are established using either cable media or wireless media. The best-known computer network is the Internet.

Network devices that originate, route and terminate the data are called network nodes. Nodes can include hosts such as servers and personal computers, as well as networking hardware. Two devices are said to be networked when a device is able to exchange information with another device. Computer networks support applications such as access to the *World Wide Web*, shared use of application and storage servers, printers, and fax machines, and use of email and instant messaging applications.

This article discusses computer network technologies and classifies them according to the following characteristics:

The physical media used to transmit signals, the communications protocols used to organize network traffic, along with the network's size, its topology and its organizational intent.

# 1. Local area network (LAN):

A number of computers linked together by cables in a limited area (same building). Is a computer network that interconnects computers in a limited area such as a home, school, computer laboratory, or office building using network media.



Fig: different shape of LAN

a. Server / clients network:

Computer called server store common data which it serves to other computers called clients.



**Client Server Network** 

**Fig: Client-server** 

A Client Machine usually manage the user-interface portion of the application, validate data entered by the user, dispatch requests to server programs. It is the front-end of the application that the user sees and interacts with. Besides, the Client Process also manages the local resources that the user interacts with such as the monitor, keyboard, workstation, CPU and other peripherals.

On the other hand, the Server Machine fulfills the client request by performing the service requested. After the server receives requests from clients, it executes database retrieval, updates and manages data integrity and dispatches responses to client requests. The server-based process may run on another machine on the network; the server is then provided both file system services and application services. Or in some cases, another desktop machine provides the application services. The server acts as software engine that manages shared resources such as databases, printers, communication links, or high powered-processors. The main aim of the Server Process is to perform the back-end tasks that are common to similar applications.

The simplest form of servers are disk servers and file servers. With a file server, the client passes requests for files or file records over a network to the file server. This form of data service requires large bandwidth and can slow a network with many users. The more advanced form of servers are Database servers, Transaction server and Application server

b. Peer – to – peer network:

Does not use server, individual computers share data directly with other computers.

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C- Wireless local area network (WLAN) links two or more devices using some wireless distribution method. And usually providing a connection through an access point to the wider Internet. This gives users the mobility to move around within a local coverage area and still be connected to the network. WLANs were once called LAWNs (for local area wireless network) by the Department of Defense.

Wireless LANs have become popular in the home due to ease of installation, and in commercial complexes offering wireless access to their customers; often for free.



Fig: An example of a Wi-Fi network.

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# 2. Wide Area Network (WAN):

Network that connect computers over large area by satellite communication, WAN is used to connect offices of an organization that are located in different cities in the same country or in different countries, also WAN used to connect the Bank machine, telephone system.

A **wide area network** (WAN) is a network that covers a broad area (i.e., any telecommunications network that links across metropolitan, regional, or national boundaries) using private or public network transports. Business and government entities utilize WANs to relay data among employees, clients, buyers, and suppliers from various geographical locations. The Internet can be considered a WAN as well, and is used by businesses, governments, organizations, and individuals for almost any purpose imaginable.



Fig: wide area network

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**Note:** Wide area network Private or public network spanning a large area (a region or country); it usually brings together several local area networks. the largest (WAN) is the Internet. Related terms for other types of networks are personal area networks (PANs), local area networks(LANs), campus area networks (CANs), or metropolitan area networks (MANs) which are usually limited to a room, building, campus or specific metropolitan area (e.g., a city) respectively.

# Internet

Global network consisting of thousands of public and private networks of varying sizes; it is linked by a set of standard communications protocols.

# WAN devices: -

HUB: a distributer that has a lot of port which connected to computer .OR. Unit that receives all messages sent by the devices connected to it and redistributes them to all users.

Switchers: like a HUB, but it transmits its packet to its destination. Unit establishing the connections needed to route data to intended users from one branch of a network to another; it also handles traffic between the various parts of a network.

Routers: choose the best path to transmit the packet. or Interconnecting devices ensuring transmission of data between two or more networks by determining the best path for them.

Gateway: it is used to connect to different LAN<sub>s</sub>.

Bridge: it is used to connect two similar LAN<sub>s</sub>.

Repeaters: repeat signals that travel via long distance. Device running the length of a cable that receives amplifies and resends signals to transmit them over long distances.

Multipliers: combines messages of several devices and sends them a long a single high speed path.

Firewall: Device controlling data that circulate between a public network (such as the Internet) and a private network; it prevents unauthorized access to the latter.

File server: Server hosting a set of data files that are at the disposal of all computers connected to the network.

Server: Computer that hosts various resources (including files, applications and databases) and places them at the disposal of all the devices connected to the network.

Backbone: Main artery of a network characterized by a high throughput; it transmits data between secondary networks.

Dedicated line: Telephone or cable communications link reserved for one use or for a specific user.

Desktop computer: Small workstation or microcomputer designed for stationary use.

telephone/cable/satellite line : Linking of off-site devices by telephone network, cable network or telecommunications satellite.

# Network topologies

There are three main topologies for computers: -

**1**. Star network: star network- Network in which all devices are connected to a central unit (here, a hub) in the shape of a star.

#### desktop computer

Small workstation or microcomputer designed for stationary use. **hub** 

Unit that receives all messages sent by the devices connected to it and redistributes them to all users.

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#### server

Computer that hosts various resources (including files, applications and databases) and places them at the disposal of all the devices connected to the network.



2. Ring network: Network in which all devices are connected to a ring; messages travel from one device to another in a set direction until they reach the intended receiver.

#### ring

One-way transmission of data between network components. desktop computer

Small workstation or microcomputer designed for stationary use. server

Computer that hosts various resources (including files, applications and databases) and places them at the disposal of all the devices connected to the network.



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3. Bus network: Network in which all devices are connected to a common bus; the same message is sent to all of them but only one receives and registers it.

#### Terminator

Device attached to the endpoint of a bus; it absorbs signals reaching it to prevent reflections.

#### **Desktop computer**

Small workstation or microcomputer designed for stationary use.

#### Bus

Linear cable ensuring two-way transmission of data between network components.

#### **T-connector**

Device used to connect the network interface card of a computer or peripheral to the bus.



# Data communication hardware

1. Modem "Modulate / Demodulate"

An equipment converts analogue format (voice) to digital format and vice versa, this technique in data communication is slow.

**2.** Network interface card.

a. wireless network interface card

Expansion card with an integrated antenna; it links a computer to a network access point transceiver via radio waves.

b. network interface card

Expansion card that connects a computer to a computer network.

c. network access point transceiver

Device that links a computer network linked by cable and a computer fitted with a wireless network interface card.



Fig show: *Communication devices*. Electronic devices allowing computers to exchange data.

**3.** Transmission media.

# a. Wired media

*Cables:* Protective sheaths covering one or several usually insulated wires; they transmit data between network components.



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Cable that contains one or several pairs of twin wires twisted around one another; it transmits signals in the form of electric pulses.

2. Fiber optic cable

Cable that holds thin glass filaments or optical fibers that transmit signals in the form of light pulses at high speed.

3. Coaxial cable

Cable that holds two insulated concentric conductors; it transmits signals in the form of electric pulses without loss of quality.

#### b. Wireless media:

Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor.

The most common wireless technologies use electromagnetic wireless telecommunications, such as radio. With radio waves distances can be short, such as a few meters for television or as far as thousands or even millions of kilometers for deep-space radio communications. It encompasses various types of fixed, mobile, and portable applications, including two-way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking. Less common methods of achieving wireless communications include the use of light, sound, magnetic, or electric fields.



Fig: Wireless Media

#### Wireless Media

Transmission of waves take place in the electromagnetic (EM) spectrum. The carrier frequency of the data is expressed in cycles per second called hertz(Hz). Low frequency signals can travel for long distances through many obstacles but cannot carry a high bandwidth of date while high frequency signals can travel for shorter distances through few obstacles and carry a narrow bandwidth. Also the noise effect on the signal is inversely proportional to the power of the radio transmitter.

The three broad categories of wireless media are:

1. Radio - 10 Khz to 1 Ghz. It is broken into many bands including AM, FM, and VHF bands.

#### 2. Microwave

Terrestrial - Used to link networks over long distances but the two microwave towers must have a line of sight between them. The frequency is usually 4-6GHz or 21-23GHz. Speed is often 1-10Mbps. The signal is normally encrypted for privacy. Two nodes may exist.

*Satellite* : A satellite orbits at 22,300 miles above the earth which is an altitude that will cause it to stay in a fixed position relative to the rotation of the earth. This is called a geosynchronous orbit. A station on the ground will send and receive signals from the satellite. The signal can have propagation delays between 0.5 to 5 seconds due to the distances involved. The transmission frequency is normally 11-14GHz with a transmission speed in the range of 1-10Mbps.

#### 3. Infrared

Infrared is just below the visible range of light between 100Ghz and 1000Thz. A light emitting diode (LED) or laser is used to transmit the signal. The signal cannot travel through objects. Light may interfere with the signal. The types of infrared are:

*Point to point* - Transmission frequencies are 100GHz-1,000THz . Transmission is between two points and is limited to line of sight range. It is difficult to eavesdrop on the transmission. The speed is 100Kbps to 16Mbps

*Broadcast* - The signal is dispersed so several units may receive the signal. The unit used to disperse the signal may be reflective material or a transmitter that amplifies and retransmits the signal. Normally the speed is limited to 1Mbps. The transmission frequency is normally 100GHz-

1,000THz with transmission distance in 10's of meters. Installation is easy and cost is relatively inexpensive for wireless.

Note: wireless bridge - Microwave or infrared is used between two lines of site points where it is difficult to run wire.

CDPD - Cellular Digital Packet Data will allow network connections for mobile users using satellites.

*Satellite*. Telecommunications by satellite Transmission of data such as images, sound and computer data using radio waves relayed by satellites.



# Network protocol

Set of instruction and procedures that maintain and control transmission in network, it decides number of computers that can be connected, how error can be fixed and how the transmission will be occurred.



#### fig: wide area network

#### **EXAMPLE:** Explain the fig WAN:

#### Hub :

Unit that receives all messages sent by the devices connected to it and redistributes them to all users.

Uninterruptible power supply (UPS):

Device used to regulate the power supply to the computer and its peripherals by limiting the effects of cuts, surges or dips in the electric circuit voltage.



Input receptacle: used to connect the UPS to the electric grid.

Surge protection receptacle: designed to protect equipment connected to it from damage caused by too high voltage.

Computer interface port: Connector attaching the UPS to the computer; software can then turn the computer off before the battery runs out completely.

Battery backup/surge protection receptacles: Ant surge attached to a battery so that equipment connected to them have electric power in the event of a power outage.

Telephone surge protection: designed to protect communications equipment (such as telephones, fax machines and modems) from damage caused by too high voltage.

**Control lights: Signal lights indicating the operating mode (main power or battery power) or certain problems (weak battery, overload).** 

On/off/test button: Button that turns on the UPS and begins the procedure of checking the status of the battery.

Laptop computer:

Small stand-alone microcomputer with a screen and integrated keyboard; it is powered by an internal battery.

Modem:

Device that converts digital signals into analog signals so that computers can communicate with each other over telephone lines.

Telephone/cable/satellite line:

Linking of off-site devices by telephone network, cable network or telecommunications satellite. Telecommunications by satellite Bridge:

Interconnecting device linking similar networks.

**Backup storage unit:** 

Storage peripheral used to copy data onto a removable medium to facilitate retrieval in the event of loss.

**Printer:** 

Output peripheral allowing computer-generated characters, images and graphics to be reproduced on paper.

Internet:

Global network consisting of thousands of public and private networks of varying sizes; it is linked by a set of standard communications protocols.

Firewall:

Device controlling data that circulate between a public network (such as the Internet) and a private network; it prevents unauthorized access to the latter. File server:

Server hosting a set of data files that are at the disposal of all computers connected to the network.

Gateway:

Interconnecting device linking different networks.

switch :

Unit establishing the connections needed to route data to intended users from one branch of a network to another; it also handles traffic between the various parts of a network.

backbone:

Main artery of a network characterized by a high throughput; it transmits data between secondary networks.

dedicated line :

Telephone or cable communications link reserved for one use or for a specific user. desktop computer :

Small workstation or microcomputer designed for stationary use. routers :

Interconnecting devices ensuring transmission of data between two or more networks by determining the best path for them. server :

Computer that hosts various resources (including files, applications and databases) and places them at the disposal of all the devices connected to the network. hub :

Unit that receives all messages sent by the devices connected to it and redistributes them to all users

#### **H.W:**

1. What does the term LAN stand for?

- 2. What does the term WAN stand for?
- 3. Compare between LANs, & WANs.
- 4. What is a workgroup computing?
- 5. Explain the term Modem?

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