CHAPTER 3

# INFORMATION NETWORKS

Q1.   What are Information Networks?

Information Networks:

- Information networks or computer networks are the convergence of two technologies; Computing and Telecommunication.

- This convergence resulted in LAN (Local area Network), MAN (Metropolitan Area Network), WAN (Wide Area Network) and the Internet.

- The networks were used for research among computer scientists and telecommunication engineers.

- Information networks brought many useful benefits.

- It also has created some problems.

- The most popular information networks are the internet or World Wide Web.

- The users exchange information through internet.

- Internet is a large network through which information continuously flows.

- This circulation of information may flow rapidly or slowly.

Q2.   What is a Network? Discuss different types of networks.

NETWORK:

- When two or more than two computers are connected to each other through some communication media it is called a network.   OR

- A distributed data processing system in which multiple computers are linked together for the purpose of data communication and resource sharing.
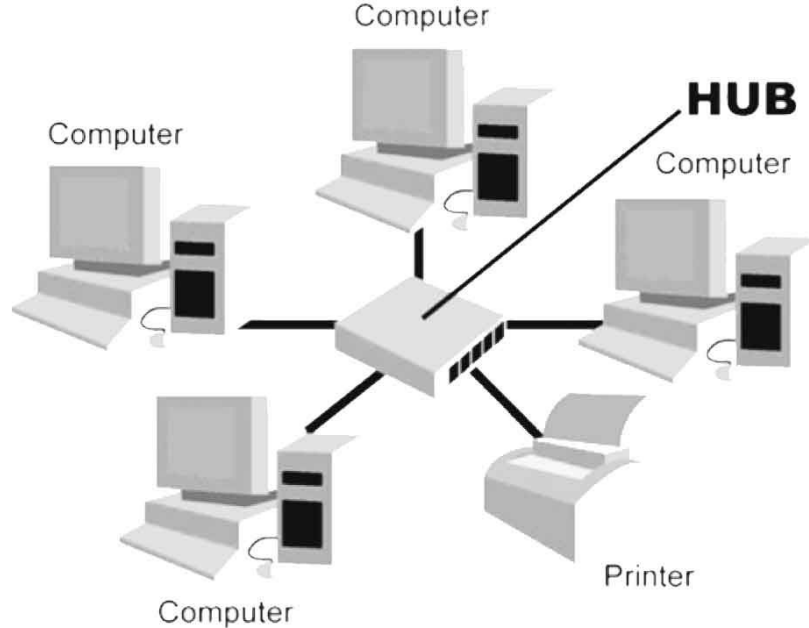
Uses of networks:

- Networks allow users to share programs and data at the same time.
- Networks allow users to share peripheral devices.
- Networks allow users to send email messages along with attachments (files).
- Some networks also provide tools for teleconferencing and videoconferencing.

TYPES OF NETWORKS:

- There are three types of Networks.
    - o LAN (Local area Network)
    - o MAN (Metropolitan Area Network)
    - o WAN (Wide Area Network)

LAN (Local area Network):

- It is a digital communication system capable of interconnecting a large number of computers, terminals and peripheral devices within a limited geographical area.
- It covers a small geographical area such as an office or a group of buildings e.g. College Lab etc.
- Its speed is faster than WAN.

MAN (Metropolitan Area Network):

- A MAN connects an area larger than LAN but less than WAN.
- A MAN covers the geographical boundaries of a city.
- The purpose of MAN is to bypass the local telephone companies when accessing long distance services.

WAN (Wide Area Network):

- It is a digital communication system, which interconnects different sites, terminals and also enables different LANs to communicate with each other.

- It covers a large geographical area such as among cities, countries or continents e.g. Internet. It is also known as long-haul network.

- The larger computer in WAN are hosts and hosts are the computers on the network which provides services to other computers on the network.

- **Terminal Emulation Software** is used to allow computer to appear as a terminal.

Difference Between LAN and WAN:

LAN	WAN
Area	
It is limited to small geographical area.	It covers a large geographical area.
Connection	
Computer and devices are physically connected.	Computers may or may not be physically connected.
Devices	
Ethernet Card is used in LAN.	Modem is used in WAN
Speed	
Data transmission speed is very high. 100 Mbps to 1000 Mbps.	Data transmission speed is low. 56Kbps to 56Mbps
Cost	
Its cost of installation is less than WAN.	Its cost is high.
Error	
Its error rate is negligible.	Its error rate is high.
Examples	
Computer lab of a college.	Internet

Q3. What is Internet? Discuss its History and Uses.

INTERNET:

- It is a large network of networks. Internet is a network of connected computers that provides us a facility of exchange data, messages and files with other computers that are connected to the Internet.

- Due to invention of Internet the Globe is referred as "Global Village". And Internet is an ocean of knowledge.

History of Internet:

- ARPANET was designed in 1960 by US-Defense department (DARPA-Defense Advance Research Project Agency) in collaboration with universities and research organizations.
- ARPANET (Advance Research Project Agency Network) was a wide area network connecting a small number of users. There were only four hosts.
- ARPANET was used for military purpose during 1970-1980.
- In 1989, NSF (National Science Foundation) established a network of five super computing centers that were available to researchers for academic purposes.
- This network of NSF was known as NSFnet.
- Internet became available for general public when in 1995 NSFnet moved the last restrictions on the use of the Internet for commercial traffic.
- NSF is still donating a lot of fund to it.

Uses of Internet:

WWW, E-mail, telnet, File-Transfer Facility, Gopher, Chat groups, Intranet, Extranet are the uses of Internet.

WWW:

- It stands for World Wide Web.
- It is a collection of millions of uploaded web pages or web sites.
- It organizes the Internet related resources so that we can easily access the information available on the Internet.
- Hyper text transfer protocol (**http**) protocol is used for WWW.

E-mail:

- It is a process of sending and receiving messages and files among the internet users.

Telnet:

- It is a software protocol that allows one computer to connect to another computer and make use of the other computer's information.

File-Transfer Facility:

- File Transfer Protocol (ftp) is used to transfer files from one computer to another.
- The process of transferring files from remote computers to our computer is called **downloading**.
- The process of transferring files from our computer to remote computer is called **uploading**.

Gopher:

- It is an access and retrieval system covering a wide range of information, from reference materials, to magazine articles, to government documents and speeches.

Chat Groups:

- The Internet users with similar interests form up their forums to have online real-time discussions over Internet.

Intranet:

- Intranet design to meet the internal need for sharing the information within single company.

- It is a privately owned secure, business network based on Internet technology (using TCP/IP) not necessarily connected to the Internet.

- Information is available to all employees, no matter where they were or what kind of hardware they were using.

- Information cannot be exchanged outside the organization-using intranet.

Extranet:

- It is a combination of multiple intranets.

- Intranets of different companies are connected to each other to share data and information.

- Each company on extranet provides selected information to one or more other companies.

Q4.   What is Email? Discuss its advantages.

E-MAIL AND ITS ADVANTAGES:

- It stands for electronic mail.

- It is a process of sending and receiving messages from one computer to another over the Internet.

- This facility is provided by some special websites called email servers.

- The sender and receiver may be in the same building or anywhere in the world.

- The sender and receiver both have an email address and email facility e.g. Yahoo, Hotmail Gmail etc.

- The same message can be sent to many people using email facility.

- We can send letters, notes, files, data and reports using the same technique.

- When email reaches at the destination it does not interrupt the working on the computer.

- Every Internet user has this facility.

- Email facility is cost effective. We can use it at the cost of using Internet.

- The receiver's system may be off when mails arrive and receiver can read after connecting to the internet.

- Emails are not anonymous. They always carry an address of originator.

- This facility is available round the clock.

- It reaches at the destination in a minute or seconds.

- There is no problem of distances in sending and receiving emails.

Q5.   What is Workgroup Computing? Define groupware.

WORKGROUP COMPUTING:

- When two or more than two people work on the same project using computer network, it is called work group. When people of a workgroup perform some processing is called workgroup computing. It is also known as collaborative computing.

- It enables the individuals and teams of certain projects to use computer networks for the purpose of cooperation, consultation and information sharing.

- The software that allows users to share the resources is called groupware.

Q6.   What are types of Network Model?

NETWORK MODELS:

- There are three types of network models.
  - Client-Server Modal/Dedicated Server Model
  - Peer-to-Peer Network Model
  - Hybrid Network Model

Client-Server Model/Dedicated Server Model:

- In this type of network model, one or more computers are dedicated servers and the remaining computers work as clients. The server cannot play the role of the client and vice-versa.

- Server is a computer that controls the network. It has the disks, containing database files and shared devices like printer, which can be used by other computers or nodes.

- The clients are all other computers on the network.

- It reduces the network traffic.
- The response of each node on client server network is very fast.
- In client server network terminals or clients are less expensive because mostly work is done by the server machine.

Peer-to-Peer Network Model:

- In this network model, every computer plays a role of server or client depending on the nature of communication. There is no clear distinction between the server and client machines.
- All computers have equal status.
- No one has the control over the others.
- Each computer is independent in terms of data storage and devices.
- The users can share data and resources when required.

Disadvantages:

    Lack of Speed: It becomes slow under heavy use.

    Lack of Security: In Peer to Peer Networks there is no security of data.

Hybrid Network Modal:

- It has the combined features of both client-server and peer-to-peer networks.
- The users take advantage of both models.

Q7.   **What are Network Standards? Describe types of Network Standards?**

NETWORK STANDARDS:

- The standards are the precise documents containing technical and physical specifications about the network being designed.
- Those standards are taken into considerations, which are worldwide, acceptable.

Types of Network Standards:

- De-Facto Standard
- De-Jure Standard

De-Facto Standard:

- De-Facto means "by tradition" or "by facts".
- These standards are developed informally and came into existence after historical development.
- These standards are used by organizations worldwide.

- SNA (system network architectures) an example of De-Facto standard.

De-Jure Standard:

- De-Jure means "According to Law or Regulation".

- These standards are properly researched, developed and approved by some networks governing bodies.

- These organizations are:

ANSI	American National Standard Institute.
IEEE	Institute of Electrical and Electronics Engineers.
ISO	The International Standard Organization.
ITU-T	The International Telecommunication union-Telecommunication Standards Sector (formally CCITT)
EIA	The Electronics Industries Association.
Telcordia	

Q8.   What are Network Topologies? Describe types of Network Topologies?

Network Topologies:

- Topology refers to the layout of connected devices on a network or
- The scheme of joining computers in a network is called topology or
- Arrangement of computer nodes in a computer network is called topology.

TYPES OF TOPOLOGIES:

- Bus
- Ring
- Star
- Tree
- Mesh

Bus Topology:

- In this topology all the computers are connected to a common communication medium.

- The communication medium is called BUS.

- A special device terminator is used at both ends of the series to absorb the signals.

- In bus topology, if a computer transmits data (broadcast message) on to the communication medium (bus) then all the nodes on the bus see this message and only the destination computer accepts and processes the message.

- Ethernet bus is mostly used in LAN because it is relatively easy to install.

- The number of computers in bus topology should be limited.

- 10 Base-2 ("ThinNet") and 10 Base-5 ("ThickNet") cables are used in bus topology.
- Problems are increased with the increase of number of computers in bus topology.
- The entire network fails if the backbone (bus/cable) fails.
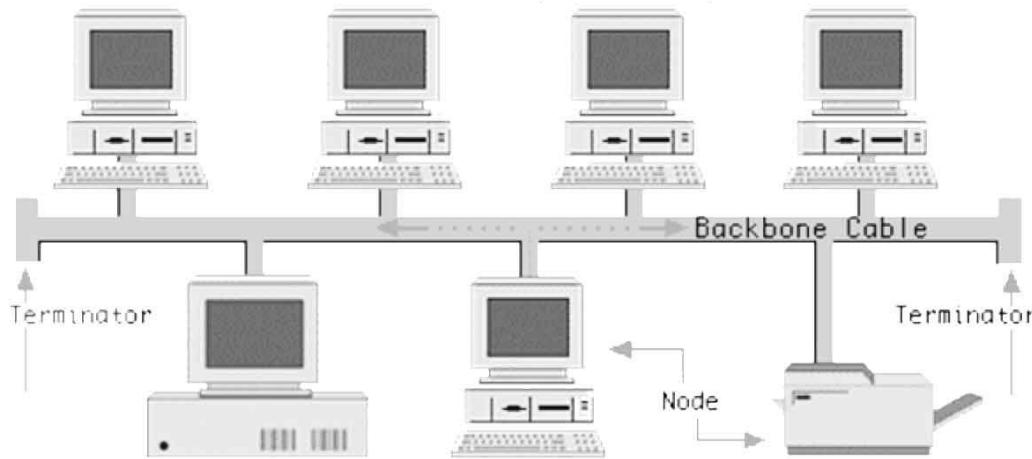
Advantages
- It is easy to understand
- It is easy to connect additional computers to this kind of network.
- This topology is best to connect computers close to each other.

Disadvantages:
- Difficult to detect errors.
- Data collisions are very high due to shared medium of communication.
- Slow speed because of shared medium.

Ring Topology:
- In a ring network, every device has exactly two neighbors for communication purpose and the last computer is connected to the first computer i.e. all the computers are connected in a ring shape.
- All messages travel through a ring in the same direction (clock-wise or anti-clock-wise).
- A failure in any cable or a device breaks the loop and the entire network fails.
- Token passing scheme is used in ring topology.

RING Topology
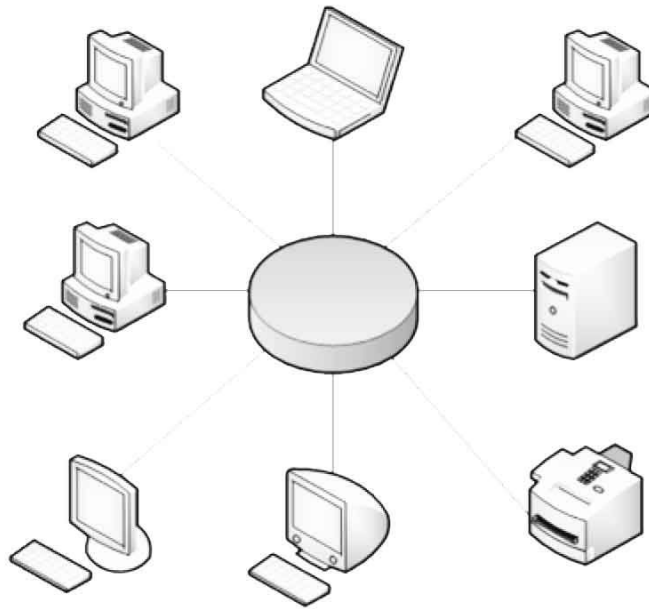
Advantages

- No chance of data collision.

Disadvantages:

- If one of the computers becomes defective, it affects the whole network.
- It is difficult to troubleshoot the ring topology.
- Speed of ring topology is very slow.

Star Topology:

- All the computers are connected through a central device (Hub or Switch).
- Twisted pair (UTP) cable is used in star topology. Star topology requires more cable. Therefore it is expensive.
- It is mostly used in LAN because it is easy to maintain and install.
- If any computer fails the network is not affected.
- If the HUB or Switch fails then the entire network also fails.
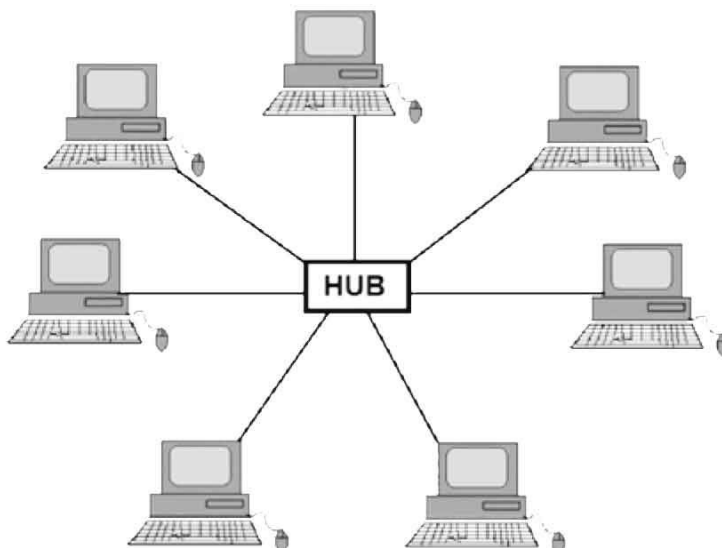
Advantages

- If any computer becomes defective, it does not affect any other terminal of this network.
- The central computer controls the flow of the data.
- There is no chance of data collision in star topology.

Disadvantages:

- This type of topology is expensive because of extra cabling cost.
- If the central device is shutdown, the whole network will be down.

Tree Topology:

- Tree topology integrates multiple star topologies together on to a bus i.e. all the computers are connected in such a way that forms a tree like structures.
- It has the combined features of star and bus topology.

- Only Hubs are connected directly to form tree and function of each hub as the root of tree devices.

Tree topology 'branch' with multiple nodes
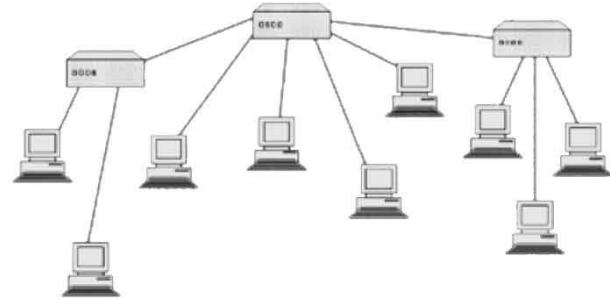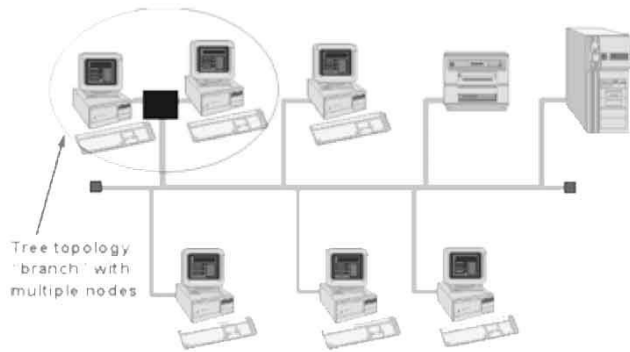
Advantages
- A lot of hardware and network vendors support this topology
- A point to point connection is not possible with tree networks.
- Best topology for branched out networks.

Disadvantages:
- Constraint of network length depends on cable type.
- Totally dependent on a trunk, if it fails the whole network fails.
- Because of large size difficult to manage.

Mesh Topology:
- In Mesh topology, every computer is directly connected to every other computer on the network.
- There are several possible paths from source to destination.
- Mesh topology is used in WAN or internet.
- It has high fault tolerance due to multiple links.
- Troubleshooting in mesh topology is easy as compared to other networks.
- The installation of mesh topology is difficult.
- Its performance is not affected with heavy load of data transmission.
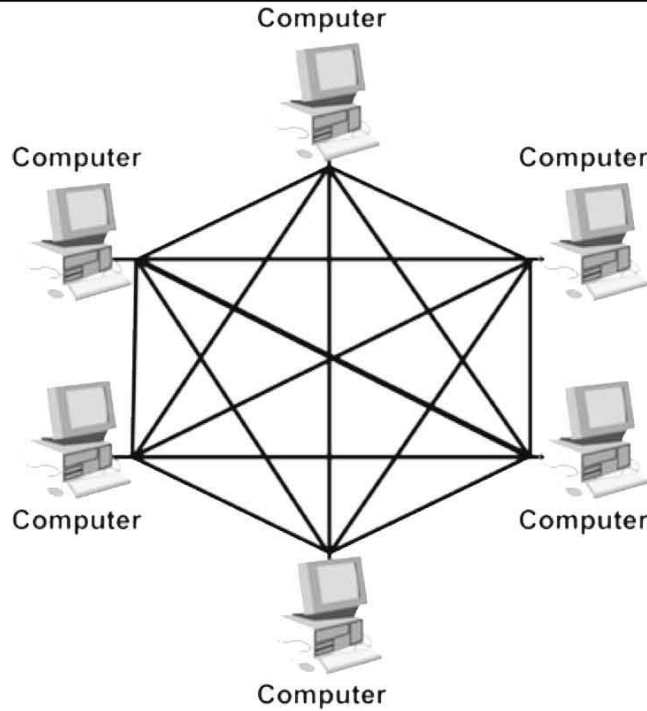
Advantages

- No traffic problem as there are dedicated links.
- Reliable because failure of one link does not affect the entire system.
- Security as data travels along a dedicated line.
- Point to point links makes fault identification easy.
- More fault tolerant.

Disadvantages:

- Expensive hardware is required for direct connections.
- Because of direct connections, more wire is required.
- Installation and maintenance is complex.

Q9.   What are Network Protocols? Describe different Network Protocols.

PROTOCOLS:

- Protocols are the rules to exchange data between two devices.
- These protocols are defined in the network software.
- Protocols are: Ethernet, Token Ring, ARCnet, TCP/IP, ISDN, and DSL.

LAN Protocols:

Ethernet:

- It is most commonly used LAN protocol.
- Ethernet is used in bus topology with high-speed network cable.
- It is relatively simple and cheaper.

- As all computers share the same transmission media therefore the computers must follow certain rules for communication with each other otherwise it may cause a loss of data.
- Before transmitting data, a station listens to the network to determine whether it is already in use. If it is, then it must wait. If the network is not in use, the station transmits.
- When two stations transmit data at the same time then the data collision occurs; a special message is sent to the network to indicate that it is jammed. Each node stops transmitting, waits a random period of time and then start transmitting again.
- The access method that allows only one station to transmit at a time on a shared medium is called CSMA/CD (Carrier Sense Multiple Access with Collision Detection).

Token Ring:
- Token ring protocol is used in ring topology.
- A token is an electronic signal.
- Only one token is available in a network.
- When a node wants to transmit data, first it captures the token and then transmits the data. After the transmission, it releases the token back to the network.
- As one token is available to the network and the one node with token can transmits data at a time, therefore the transmission rate of token ring is very slow and there is no data collision.
- Token ring was developed by IBM (International Business Machines).
- The method of controlling access to the shared network cable is called token passing.

ARCnet:
- It stands for Attached Resource Computer Network and was introduced in 1977.
- It uses either twisted pair or co-axial cable.
- The original ARCnet protocol was very slow.
- ARCnet is inexpensive, reliable, easy to setup and easy to expand.
- Fast ARCnet increased the transmission rate to 100Mbps and it can also use fiber optic cable.

WAN Protocols:

TCP/IP:
- It stands for **Transmission Control Protocol/Internet Protocol**.
- It is a WAN protocol.
- Every computer is identified separately over internet using TCP/IP protocol.
- TCP/IP ensures the reliable connection between the computers over internet.

- TCP/IP software differs for different computers but it always present the same interface to the network.

ISDN:

- It stands for **integrated services digital network**.
- It transmits data voice and video simultaneously at a very high speed over telephone lines.
- It provides better transmission rate.
- It provides reliable digital connection at higher speeds than those offered by analog connection.

DSL:

- It stands for **digital subscriber line**.
- It provides high-speed digital data transmission over telephone lines.
- Modems are necessary with DSL technology because lines are analog while data is digital.
- It is an alternative to ISDN.

Q10.   What are the different Components of a Network?

COMPONENTS OF A NETWORK:

- All networks require some components for interconnection. These components are: Communication Media, NIC, Repeater, Hub, Bridge, Switch, Gateway, Router

Communication Media:

- It is a pathway that is used for transmitting data from sender to receiver. These pathways are also called communication channels.
- There are two kinds of transmission media.
  - Guided media
  - Unguided media

Guided media:

- It refers to those channels that allow the transmission of data through a physical media.
- All the devices are connected directly with each other through physical media such as cables.
- These are also called bounded media e.g. Twisted pair, Coaxial, Fiber optic.

Unguided media:

- It refers to those channels that transmit data and information in the form of wave.
- These are the communication channels in which data is transmitted through the air instead of cables.
- There is no physical path between two devices for the transmission of data.

- Data signals are not bounded to cabling media therefore it is also known as unbounded media.
- Wireless LANs are easy to setup and reconfigure.
- The transmission rate is slower than the physical medium e.g. Microwave Transmission, Satellites, Mobile communication.

NIC:

- It is a printed circuit board that inserted into expansion slots.
- Some computers have built-in NIC.
- It provides a port to connect to the network.
- It provides network communication capabilities to and from a computer.
- It is also called LAN adapter.

Repeater:

- The maximum length for a UTP cable in a network is 100 meters. If you need to extend the network limit, you must add a device. This is called repeater.
- A repeater cleans, amplifies and resends the signal that is weakened by a long cable length.

Hub:

- Hub is used in star topology as central device.

- It is a multi-port repeater.

- Hub is used instead of repeater i.e. the purpose of hub is to regenerate and retime the network signals.

Bridge:

- It is used to connect similar types of network.

- It recognizes the message on the network and passes on the data to computer in other networks.

- It filters the network traffic and divides the network into segments.

Switch:

- It is a multi-port bridge.

- It is more intelligent device than a hub.

- Its purpose is to concentrate connectivity.

Gateway:

- It is a collection of hardware and software resources that enable a computer to communicate with a computer on a different network.

- It receives data from one network and transfer it according to the protocol of other network.

Router:

- Router is a combination of hardware and software resources and it connects two or more networks.

- High-speed routers serve as Internet backbone and handling the excessive data traffic.

- Its purpose is to examine incoming packets, choose the best path and sends them to the proper outgoing port.

- It uses the routing protocols, operating system and management software.

Q11. What are CSMA/CD, CSMA/CS and CSMA/CR?

CSMA/CD-Carrier Sense Multiple Access with Collision Detection:

- It is a local area network access method in which contention between two or more station is resolved by collision or it is an access method that allows only one station to transmit at a time on a shared medium.

- CSMA/CD LAN can access the network at any time. Before transmitting data, CSMA/CD station listens to the network to determine whether it is already in use. If it is, then it must wait. If the network is not in use, the station transmits.

- When two stations transmit data simultaneously then the data collision occurs; CSMA/CD station can detect collision, a special message is sent to the network to indicate that it is jammed.

- Each node stops transmitting, waits a random period of time so they know when they must retransmit and then transmitting again.

- To make sure that the collision is recognized, Ethernet requires that a station must continue transmitting until the 50 micro second has ended. If the station has less than 64 bytes of data to send, then it must pad the data by adding zeros at the end.

CSMA/CS-Carrier Sense Multiple Access with Carrier Sense:

A node or a computer listens to the bus for a predetermined amount of time before transmitting and waits until the talking node has completed the transmission.

CSMA/CR-Carrier Sense Multiple Access with Collision Resolution:

It allows multiple devices to communicate at once; a protocol determines which device receives priority.

Q12.   What is an OSI Model? Describe its different Layers.

OSI (Open System Interconnection) Model:

- It is known as OSI networking **reference model**.
- It was presented by **ISO** (International Standard Organization).
- **It provides a logical framework how data communication processes should take place across networks.**
- There are **seven layers in OSI model** and each layer has a particular function.
- These layers are: Application Layer, Presentation Layer, Session Layer, Transport Layer, Network Layer, Data Link Layer and Physical Layer.
- There are **two groups of OSI layers**.

    Upper layers

    Lower layers

Upper layers focus on user applications and how files are represented on computers before transmission.

Lower layers concentrates on how communication occurs across the network.
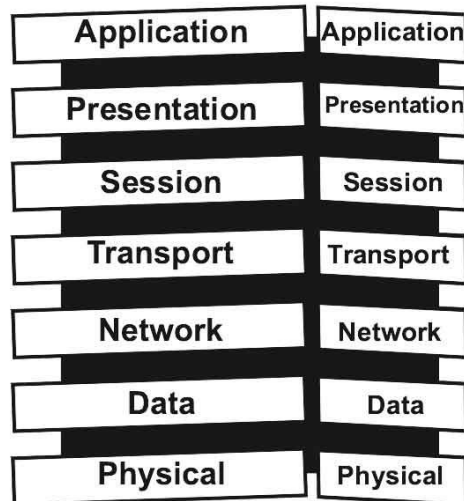
Application Layer:
- It provides network services to user application.
- It is responsible for exchanging information between programs running on the computer.

Presentation Layer:
- It is concerned with how data is converted and formatted for data transfer.
- This layer performs code conversion, data translation, compression and encryption.

Session Layer:
- It determines how two devices establish, maintain and manage connection.
- It determines how two devices talk to each other.
- These connections are called sessions.

Transport Layer:
- It is responsible for breaking the data into segments.
- It establishes a logical connection between two devices and provides error handling.
- It also controls the message flow between the systems.

Network Layer:
- It is responsible for determining the address on the network.
- It will determine the route from source to destination.
- It will manage the network traffic.
- Segments at this level are converted into packets.

Data Link Layer:
- It is responsible for the reliability of the physical connection established at physical layer.
- It provides an error free transmission of data from one computer to another.
- Packets are converted into frames at this level.

Physical Layer:
- It determines how data is converted into bits.
- It defines the physical characteristics of the network such as connections, voltage levels, timing and physical medium.
- It deals with the physical transmission of bits over transmission medium.
- It is responsible for activating and maintaining the physical link between systems.