VIVA

Introduction to Networking

Explain What is Network?

A network is a set of devices connected by physical media links. A network is recursively is a connection of two or more nodes by a physical link or two or more networks connected by one or more nodes.

Node :

A node is a point where a connection is established. It is a network component that is used to send, receive and forward the electronic information.

Feature of n/w:

- Communication speed
- File sharing
- Back up and roll back is easy
- Software and Hardware sharing
- Security
- Scalability
- Reliability

Application of n/w:

- Network Virtual terminal:
- File Transfer, Access, and Management (FTAM)
- Addressing
- Mail Service

What is Topology?

- Topology defines the structure of the network of how all the components are interconnected to each other.

BUS:

- The bus topology is designed in such a way that all the stations are connected through a single cable known as a backbone cable.
- Each node is either connected to the backbone cable by drop cable or directly connected to the backbone cable.

Advantages of Bus topology:

o **Low-cost cable:** In bus topology, nodes are directly connected to the cable without passing through a hub. Therefore, the initial cost of installation is low.

o **Moderate data speeds:** Coaxial or twisted pair cables are mainly used in bus-based networks that support upto 10 Mbps.

o **Familiar technology:** Bus topology is a familiar technology as the installation and troubleshooting techniques are well known, and hardware components are easily available.

o **Limited failure:** A failure in one node will not have any effect on other nodes.

Disadvantages of Bus topology:

o **Extensive cabling:** A bus topology is quite simpler, but still it requires a lot of cabling.

o **Difficult troubleshooting:** It requires specialized test equipment to determine the cable faults. If any fault occurs in the cable, then it would disrupt the communication for all the nodes.

o **Signal interference:** If two nodes send the messages simultaneously, then the signals of both the nodes collide with each other.

o **Reconfiguration difficult:** Adding new devices to the network would slow down the network.

o **Attenuation:** Attenuation is a loss of signal leads to communication issues. Repeaters are used to regenerate the signal.

RING:

- Ring topology is like a bus topology, but with connected ends.
- The node that receives the message from the previous computer will retransmit to the next node.
- The data flows in one direction, i.e., it is unidirectional.
- The data flows in a single loop continuously known as an endless loop.
- It has no terminated ends, i.e., each node is connected to other node and having no termination point.

Advantages of Ring topology:

o **Network Management:** Faulty devices can be removed from the network without bringing the network down.

o **Product availability:** Many hardware and software tools for network operation and monitoring are available.

o **Cost:** Twisted pair cabling is inexpensive and easily available. Therefore, the installation cost is very low.

o **Reliable:** It is a more reliable network because the communication system is not dependent on the single host computer.

Disadvantages of Ring topology:

o **Difficult troubleshooting:** It requires specialized test equipment to determine the cable faults. If any fault occurs in the cable, then it would disrupt the communication for all the nodes.

o **Failure:** The breakdown in one station leads to the failure of the overall network.

o **Reconfiguration difficult:** Adding new devices to the network would slow down the network.

o **Delay:** Communication delay is directly proportional to the number of nodes. Adding new devices increases the communication delay.

Star topology

- Star topology is an arrangement of the network in which every node is connected to the central hub, switch or a central computer.
- The central computer is known as a **server**, and the peripheral devices attached to the server are known as **clients**.
- Coaxial cable or RJ-45 cables are used to connect the computers.
- Hubs or Switches are mainly used as connection devices in a **physical star topology**.
- Star topology is the most popular topology in network implementation.

Advantages of Star topology

o **Efficient troubleshooting:** Troubleshooting is quite efficient in a star topology as compared to bus topology. In a bus topology, the manager has to inspect the kilometers of cable. In a star topology, all the stations are connected to the centralized network. Therefore, the network administrator has to go to the single station to troubleshoot the problem.

o **Network control:** Complex network control features can be easily implemented in the star topology. Any changes made in the star topology are automatically accommodated.

o **Limited failure:** As each station is connected to the central hub with its own cable, therefore failure in one cable will not affect the entire network.

o **Familiar technology:** Star topology is a familiar technology as its tools are cost-effective.

o **Easily expandable:** It is easily expandable as new stations can be added to the open ports on the hub.

o **Cost effective:** Star topology networks are cost-effective as it uses inexpensive coaxial cable.

o **High data speeds:** It supports a bandwidth of approx 100Mbps. Ethernet 100BaseT is one of the most popular Star topology networks.

Disadvantages of Star topology

- **A Central point of failure:** If the central hub or switch goes down, then all the connected nodes will not be able to communicate with each other.

- **Cable:** Sometimes cable routing becomes difficult when a significant amount of routing is required.

Mesh technology

o Mesh technology is an arrangement of the network in which computers are interconnected with each other through various redundant connections.

o There are multiple paths from one computer to another computer.

o It does not contain the switch, hub or any central computer which acts as a central point of communication.

o The Internet is an example of the mesh topology.

Advantages of Mesh topology:

- **Reliable:** The mesh topology networks are very reliable as if any link breakdown will not affect the communication between connected computers.
- **Fast Communication:** Communication is very fast between the nodes.
- **Easier Reconfiguration:** Adding new devices would not disrupt the communication between other devices.

Disadvantages of Mesh topology

- **Cost:** A mesh topology contains a large number of connected devices such as a router and more transmission media than other topologies.

- **Management:** Mesh topology networks are very large and very difficult to maintain and manage. If the network is not monitored carefully, then the communication link failure goes undetected.

- **Efficiency:** In this topology, redundant connections are high that reduces the efficiency of the network.

Transmission modes

- o The way in which data is transmitted from one device to another device is known as transmission mode.
- o The transmission mode is also known as the communication mode.

CATERGORY:

- o Simplex mode
- o Half-duplex mode
- o Full-duplex mode

Simplex mode

- o In Simplex mode, the communication is unidirectional, i.e., the data flow in one direction.
- o A device can only send the data but cannot receive it or it can receive the data but cannot send the data.
- o **radio**

Advantage of Simplex mode:

- o In simplex mode, the station can utilize the entire bandwidth of the communication channel, so that more data can be transmitted at a time.

Disadvantage of Simplex mode:

- o Communication is unidirectional, so it has no inter-communication between devices.

Half-duplex channel

- o In a Half-duplex channel, direction can be reversed, i.e., the station can transmit and receive the data as well.
- o Messages flow in both the directions, but not at the same time.
- o **Ex Walkie-talkie**

Advantage of Half-duplex mode:

- o In half-duplex mode, both the devices can send and receive the data and also can utilize the entire bandwidth of the communication channel during the transmission of data.

Disadvantage of Half-Duplex mode:

- o In half-duplex mode, when one device is sending the data, then another has to wait, this causes the delay in sending the data at the right time.

Full duplex:

- o In Full duplex mode, the communication is bi-directional, i.e., the data flow in both the directions.
- o Both the stations can send and receive the message simultaneously.
- o Ex. Telephone line

Advantage of Full-duplex mode:

- o Both the stations can send and receive the data at the same time.

Disadvantage of Full-duplex mode:

- o If there is no dedicated path exists between the devices, then the capacity of the communication channel is divided into two parts.

A computer network is a group of computers linked to each other that enables the computer to communicate with another computer and share their resources, data, and applications.

A computer network can be categorized by their size. A **computer network** is mainly of **four types**:
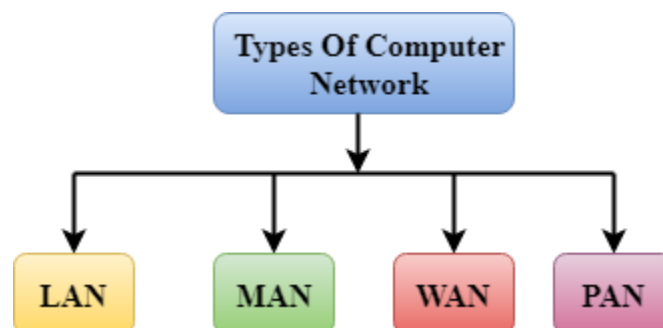
- o LAN(Local Area Network)
- o PAN(Personal Area Network)
- o MAN(Metropolitan Area Network)
- o WAN(Wide Area Network)

n/w device +component:

NIC

- NIC stands for network interface card.
- NIC is a hardware component used to connect a computer with another computer onto a network
- It can support a transfer rate of 10,100 to 1000 Mb/s.
- The MAC address or physical address is encoded on the network card chip which is assigned by the IEEE to identify a network card uniquely. The MAC address is stored in the PROM (Programmable read-only memory).

Hub

A Hub is a hardware device that divides the network connection among multiple devices. When computer requests for some information from a network, it first sends the request to the Hub through cable. Hub will broadcast this request to the entire network. All the devices will check whether the request belongs to them or not. If not, the request will be dropped.

Router

- A router is a hardware device which is used to connect a LAN with an internet connection. It is used to receive, analyze and forward the incoming packets to another network.
- A router works in a **Layer 3 (Network layer)** of the OSI Reference model.
- A router forwards the packet based on the information available in the routing table.
- It determines the best path from the available paths for the transmission of the packet.

Advantages Of Router:

- **Security:** The information which is transmitted to the network will traverse the entire cable, but the only specified device which has been addressed can read the data.
- **Reliability:** If the server has stopped functioning, the network goes down, but no other networks are affected that are served by the router.
- **Performance:** Router enhances the overall performance of the network. Suppose there are 24 workstations in a network generates a same amount of traffic. This increases the traffic load on the network. Router splits the single network into two networks of 12 workstations each, reduces the traffic load by half.
- **Network range**

Gateway is a network device used to connect two or more dissimilar networks. In networking parlance, networks that use different protocols are **dissimilar networks**. A gateway usually is a computer with multiple **NICs** connected to different networks.

A **switch** is a hardware device that connects multiple devices on a computer network. A Switch contains more advanced features than Hub. The Switch contains the updated table that decides where the data is transmitted or not. Switch delivers the message to the correct destination based on the physical address present in the incoming message. A Switch does not broadcast the message to the entire network like the Hub.

S.NO	Connection-oriented Service	Connection-less Service
1.	Connection-oriented service is related to the telephone system.	Connection-less service is related to the postal system.
2.	Connection-oriented service is preferred by long and steady communication.	Connection-less Service is preferred by bursty communication.
3.	Connection-oriented Service is necessary.	Connection-less Service is not compulsory.
4.	Connection-oriented Service is feasible.	Connection-less Service is not feasible.
5.	In connection-oriented Service, Congestion is not possible.	In connection-less Service, Congestion is possible.
6.	Connection-oriented Service gives the guarantee of reliability.	Connection-less Service does not give a guarantee of reliability.
7.	In connection-oriented Service, Packets follow the same route.	In connection-less Service, Packets do not follow the same route.
8.	Connection-oriented services require a bandwidth of a high range.	Connection-less Service requires a bandwidth of low range.
9.	Ex: TCP (Transmission Control Protocol)	Ex: UDP (User Datagram Protocol)
10.	Connection-oriented requires authentication.	Connection-less Service does not require authentication.

Data Link Layer

- In the OSI model, the data link layer is a 4ᵗʰ layer from the top and 2ⁿᵈ layer from the bottom.
- The communication channel that connects the adjacent nodes is known as links, and in order to move the datagram from source to the destination, the datagram must be moved across an individual link.
- The main responsibility of the Data Link Layer is to transfer the datagram across an individual link.
- The Data link layer protocol defines the format of the packet exchanged across the nodes as well as the actions such as Error detection, retransmission, flow control, and random access.
- The Data Link Layer protocols are Ethernet, token ring, FDDI and PPP.

Service

- Framing
- Reliable delivery
- Flow control
- Error detection
- Error correction
- Haft -full duplex

Design issue

- Data control
- Flow control
- Frame syn
- Error control
- Addressing
- Link management

Framing method;

- Charater count
- Staring and ending charater stuffing
- Staring and ending charater bit stuffing

Physical Layer

Digital Transmission

Data can be represented either in Analog or digital form. The computers used the digital form to store the information. Therefore, the data needs to be converted in digital form so that it can be used by a computer.

- Transmission media is a communication channel that carries the information from the sender to the receiver. Data is transmitted through the electromagnetic signals.
- The electrical signals can be sent through the copper wire, fibre optics, atmosphere, water, and vacuum.
- Transmission media is of two types are wired media and wireless media. In wired media, medium characteristics are more important whereas, in wireless media, signal characteristics are more important.
- Different transmission media have different properties such as bandwidth, delay, cost and ease of installation and maintenance.
- The transmission media is available in the lowest layer of the OSI reference model, i.e., Physical layer.

Physical layer Function of the OSI model.

- **Representation of Bits:** Data in this layer consists of stream of bits. The bits must be encoded into signals for transmission. It defines the type of encoding i.e., how 0's and 1's are changed to signal.
- **Data Rate**: This layer defines the rate of transmission which is the number of bits per second.
- **Synchronization**: It deals with the synchronization of the transmitter and receiver. The sender and receiver are synchronized at bit level.
- **Interface**: The physical layer defines the transmission interface between devices and transmission medium.
- **Line Configuration**: This layer connects devices with the medium: Point to Point configuration and Multipoint configuration.
- **Topologies**: Devices must be connected using the following topologies: Mesh, Star, Ring and Bus.
- **Transmission Modes**: Physical Layer defines the direction of transmission between two devices: Simplex, Half Duplex, Full Duplex.
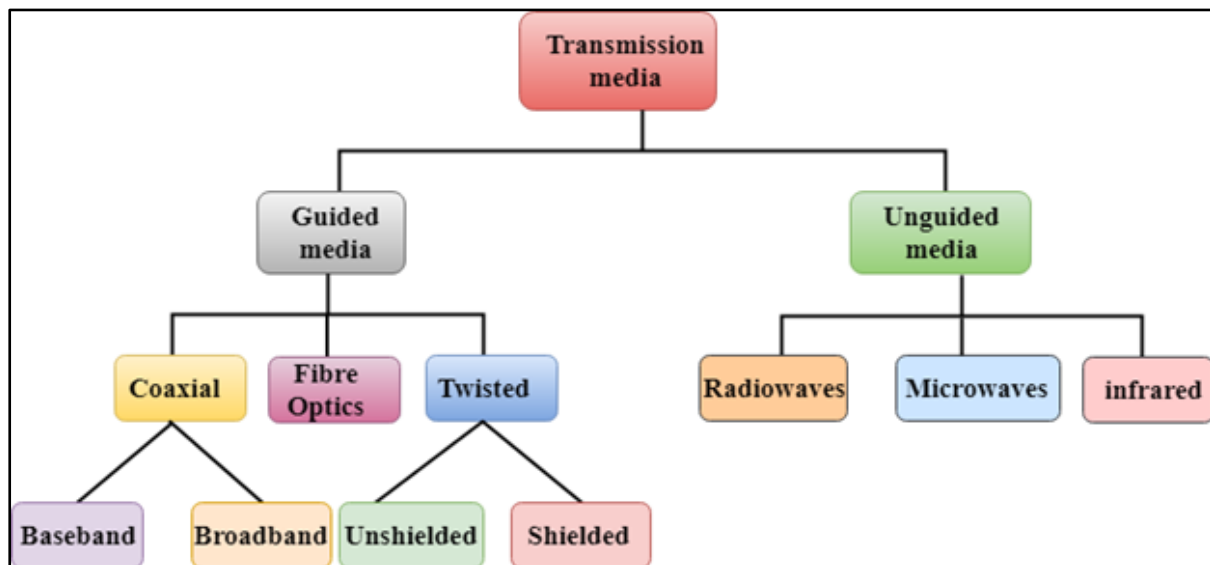
Guided transmission media

Guided transmission media consists of physical connection between source and destination through a wire or a cable.

There are three basic types of guided media which are as follows –

- Twisted pair cable
- Co-axial cable
- Fiber-optic cable

Twisted pair

- Twisted pair is a physical media made up of a pair of cables twisted with each other.
- A twisted pair cable is cheap as compared to other transmission media.
- Installation of the twisted pair cable is easy, and it is a lightweight cable. The frequency range for twisted pair cable is from 0 to 3.5KHz.
- A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern.
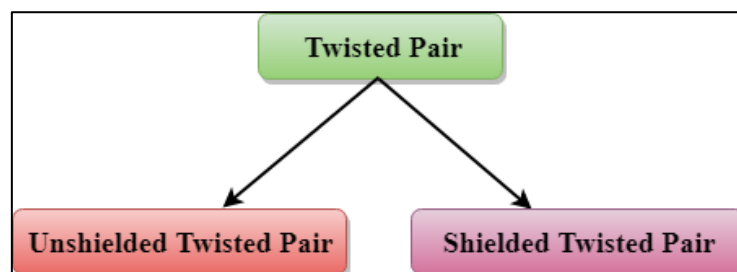
Advantages Of ~~Unshielded~~ Twisted Pair:

- It is cheap.
- Installation of the unshielded twisted pair is easy.
- It can be used for high-speed LAN.

Disadvantage:

- This cable can only be used for shorter distances because of attenuation.

Coaxial Cable

- Coaxial cable is very commonly used transmission media, for example, TV wire is usually a coaxial cable.
- The name of the cable is coaxial as it contains two conductors parallel to each other.
- It has a higher frequency as compared to Twisted pair cable.
- The inner conductor of the coaxial cable is made up of copper, and the outer conductor is made up of copper mesh. The middle core is made up of non-conductive cover that separates the inner conductor from the outer conductor.

Advantages Of Coaxial cable:

- The data can be transmitted at high speed.
- It has better shielding as compared to twisted pair cable.
- It provides higher bandwidth.

Disadvantages Of Coaxial cable:

- It is more expensive as compared to twisted pair cable.
- If any fault occurs in the cable causes the failure in the entire network.

Fibre Optic

- Fibre optic cable is a cable that uses electrical signals for communication.
- Fibre optic is a cable that holds the optical fibres coated in plastic that are used to send the data by pulses of light.
- The plastic coating protects the optical fibres from heat, cold, electromagnetic interference from other types of wiring.
- Fibre optics provide faster data transmission than copper wires.

Basic elements of Fibre optic cable:

Core: The optical fibre consists of a narrow strand of glass or plastic known as a core. A core is a light transmission area of the fibre. The more the area of the core, the more light will be transmitted into the fibre.

Cladding: The concentric layer of glass is known as cladding. The main functionality of the cladding is to provide the lower refractive index at the core interface as to cause the reflection within the core so that the light waves are transmitted through the fibre.

Jacket: The protective coating consisting of plastic is known as a jacket. The main purpose of a jacket is to preserve the fibre strength, absorb shock and extra fibre protection.

Avd
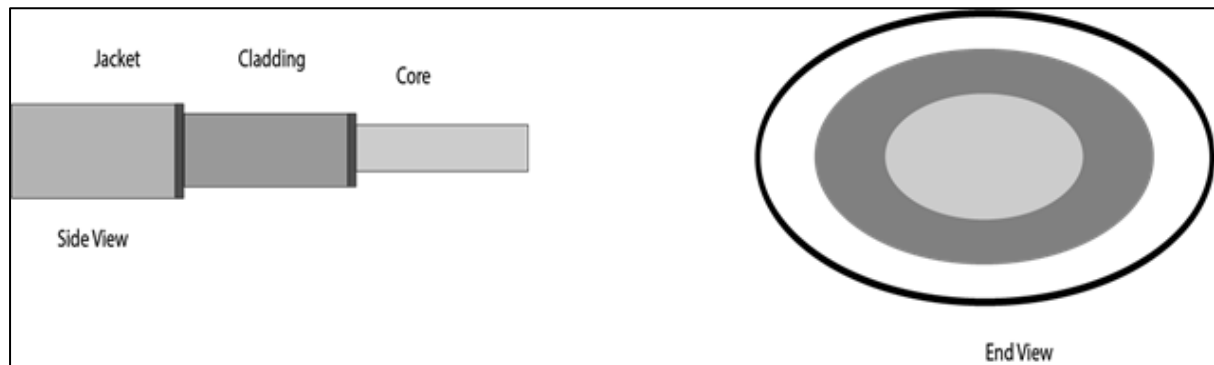
- Fiber cable is sized as 4.5 times which is best than copper wires
- As cable are lighter, thinner, in order that they use less area as compared to copper wires
- Installation is extremely easy thanks to less weight.
- Optical fiber cable is extremely hard to tap because they don't produce electromagnetic energy. These optical fiber cables are very secure for transmitting data.
- This cable opposes most acidic elements that hit copper wired also are flexible in nature.
- Optical fiber cable are often made cheaper than equivalent lengths of copper wire.
- Light has fastest speed within universe, such a lot faster signals
- Fiber optic cables allow much more cable than copper twisted pair cables.
- Fiber optic cables have how more bandwidth than copper twisted pair cables.

Dis

- Installation of those cables is cost-effective. they're not as robust because wires. Special equipment is typically required to optical fiber.
- These cable are highly vulnerable while fitting
- These cables are more delicate than copper wires.

Unguided transmission media

In Unguided transmission media there is no physical connection between source and destination, instead they use air itself.

- **Microwaves ex BT**
- **Satellite EX Mobile**
- **Radio wave ex fm**
- **Infrared ex remote**

S.No.	Guided Media	Unguided Media
1.	In guided media, the signal energy communicates via wires.	In unguided media, the signal energy communicates through the air.
2.	Guided media is generally preferred when we want to execute direct communication.	Unguided media is generally preferred for radio broadcasting in all directions.
3.	The guided media formed the different network topologies.	The unguided media formed the continuous network topologies.
4.	Here, the signals are in the state of current and voltage.	Here, the signals are in the state of electromagnetic waves.
5.	In the case of guided media, the transmission capacity can be boosted by counting more wires.	In the case of unguided media, it is not feasible to acquire more capacity.
6.	Open Wire, Twisted Pair, Coaxial Cable, and Optical Fibre are the different kinds of guided media.	Microwave Transmission, Radio Transmission, and Infrared Transmission are the types of unguided media.
7.	It is cost-effective.	It is expensive.

Application Layer

- Application layer is the top most layer in OSI and TCP/IP layered model.
- The **application layer in the** OSI model is the closest layer to the end user which means that the application layer and end user can interact directly with the software application.
- The application layer programs are based on client and servers.

Functions of Application Layer

- **Mail Services**: This layer provides the basis for E-mail forwarding and storage.
- **Network Virtual Terminal**: It allows a user to log on to a remote host. The application creates software emulation of a terminal at the remote host. User's computer talks to the software terminal which in turn talks to the host and vice versa. Then the remote host believes it is communicating with one of its own terminals and allows user to log on.
- **Directory Services**: This layer provides access for global information about various services.
- **File Transfer, Access and Management** (FTAM): It is a standard mechanism to access files and manages it. Users can access files in a remote computer and manage it. They can also retrieve files from a remote computer.

Name Space

Name Space basically maps each address to a unique name. The names assigned to the machines must be unique because addresses are unique.

DNS

- An application layer protocol defines how the application processes running on different systems, pass the messages to each other.
- DNS stands for Domain Name System.
- DNS is a directory service that provides a mapping between the name of a host on the network and its numerical address.
- DNS is required for the functioning of the internet.
- Each node in a tree has a domain name, and a full domain name is a sequence of symbols specified by dots.
- DNS is a service that translates the domain name into IP addresses. This allows the users of networks to utilize user-friendly names when looking for other hosts instead of remembering the IP addresses.
- For example, suppose the FTP site at EduSoft had an IP address of 132.147.165.50, most people would reach this site by specifying ftp.EduSoft.com. Therefore, the domain name is more reliable than IP address.

It is further categorized into two:

- Flat Name Space
- Hierarchical Name Space.

FTP

- FTP stands for File transfer protocol.
- FTP is a standard internet protocol provided by TCP/IP used for transmitting the files from one host to another.
- It is mainly used for transferring the web page files from their creator to the computer that acts as a server for other computers on the internet.
- It is also used for downloading the files to computer from other servers.
- The File Transfer Protocol makes the use **of two protocols; Port 21 for the Control connection and Port 20 is used for Data connection.**

Objectives of FTP

- It provides the sharing of files.
- It is used to encourage the use of remote computers.
- It transfers the data more reliably and efficiently.

Advantages of FTP:

- **Speed**: One of the biggest advantages of FTP is speed. The FTP is one of the fastest way to transfer the files from one computer to another computer.
- **Efficient**: It is more efficient as we do not need to complete all the operations to get the entire file.
- **Security**: To access the FTP server, we need to login with the username and password. Therefore, we can say that FTP is more secure.
- **Back & forth movement:** FTP allows us to transfer the files back and forth. Suppose you are a manager of the company, you send some information to all the employees, and they all send information back on the same server.

SMTP

SMTP mainly stands for Simple Mail Transfer Protocol. Basically, the actual transfer of mail is done through the message transfer agents(MTA). Thus in order to send the mail, the system must have the **client MTA** and in order to receive the mail, the system must have a server MTA.

- In order to define the MTA client and server on the Internet, there is a formal way and it is known as Simple Mail Transfer Protocol(SMTP).
- SMTP also makes the use of TCP/IP for sending and receiving e-mail.
- SMTP is based on the client/server model.
- The original standard port for SMTP is Port 25.

TELNET

TELNET is basically the short form for Terminal Network. It is basically a TCP/IP protocol that is used for virtual terminal services and was mainly proposed by International Organization for Standards(ISO).

- It is a general-purpose client/server application program.
- This program enables the establishment of the connection to the remote system in such a way that the local system starts to appear as a terminal at the remote system.

Adva

- One of the major benefits of TELNET is that it allows remote access to someone else's computer system
- As TELNET makes the use of Plain text. Thus this allows the user for more access with fewer problems in data transmission.
- TELNET saves a lot of time.

Dis

- It can be very difficult for beginners.
- As there is no concept of encryption because data is sent in the form of plain text. Thus it is not a secure me.

HTTP:

HTTP stands for Hypertext Transfer Protocol and is mainly used to access the data on the world wide web i.e (WWW). The HTTP mainly functions as the combination of FTP(File Transfer Protocol) and SMTP(Simple Mail Transfer Protocol).

- HTTP is one of the protocols used at the Application Layer.
- The HTTP is similar to FTP because HTTP is used to transfer the files and it mainly uses the services of TCP.
- Also, HTTP is much simpler than FTP because there is only one TCP connection.
- In HTTP, there is no separate control connection, as only data is transferred between the client and the server.

ADV

1. There is no runtime support required to run properly.
2. HTTP is usable over the firewalls and global application is possible.
3. HTTP is platform-independent.
4. HTTP reports the errors without closing the TCP connection.
5. Offers Reduced Network congestions.

DIS:

- HTTP is not optimized for mobile.
- HTTP is too verbose.
- It can be only used for point-to-point connections.
- This protocol does not have push capabilities.