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Subject :- Computer Network (401)

Semester :- IVth Sem.

Branch :- Computer Science & Engineering

Computer Network (401)

Progressive / Assignment

1. What is a network ? Explain a Node and Link ?

Network :- A network is a set of devices (often referred to as nodes) connected by media links. A node can be a 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.

We can say that :- "A network set up by connecting two or more computers and other supporting hardware devices through communication channels is called a computer network."
Internet is the best example of network, thousand's of devices are connected with Internet.

Node

In a computer network, a node is either a connection point, a redistribution point, or a communication point. In other words, a node refers to a point where a connection takes place.

It can be a computer or device that is part of a network. Generally, two or more nodes are needed in order to form a network connection. The definition of a node depends on the network and protocol layer referred to.

Different Types of Nodes

In Internet Network

In internet network, host computers are physical network nodes that are recognized with the help of an IP address. Some of the data link equipment such as WLAN access points do not include IP host address. There are considered as LAN nodes or physical network rather than hosts or internet nodes.

~~Data~~ In Data Communication

The physical network nodes in data communications mainly include data communication devices or equipment (that can be used to establish communication, such as modem, hub, bridge, switch etc.) or a data terminal equipment (that can be an end device, such as digital telephone, handset, printer, host computer) etc.

LANs & WANs

A network node in LANs & WANs is a device, used to perform an exact function. Every node requires a MAC address used to every NIC (network interface card).

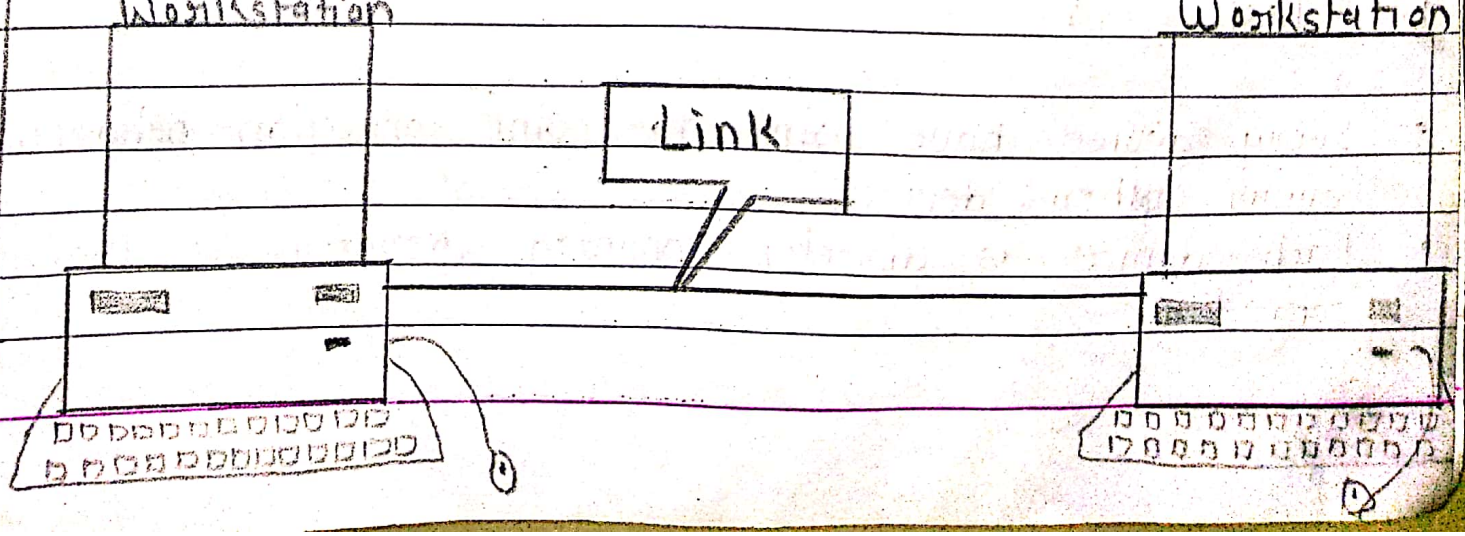
The examples of this mainly include computers, wireless LAN access points and modems using Ethernet interfaces etc.

In Cable TV system

Nodes in cable system are normally connected with fiber optic cable that connects to homes or businesses to serve a general fiber optic receiver in a geographic region. A fiber optic node in the cable system explains the number of businesses or homes can be served through a precise fiber node.

Link

- At the lowest level, a network can consist of two or more computers directly connected by some physical medium such as coaxial cable or optical fiber.
- Such a physical medium is called as Link.
- A link is the physical communication pathway that transfers data from one device to another.
- For the purposes of visualization, it is simplest to imagine any link as a line drawn between two points.



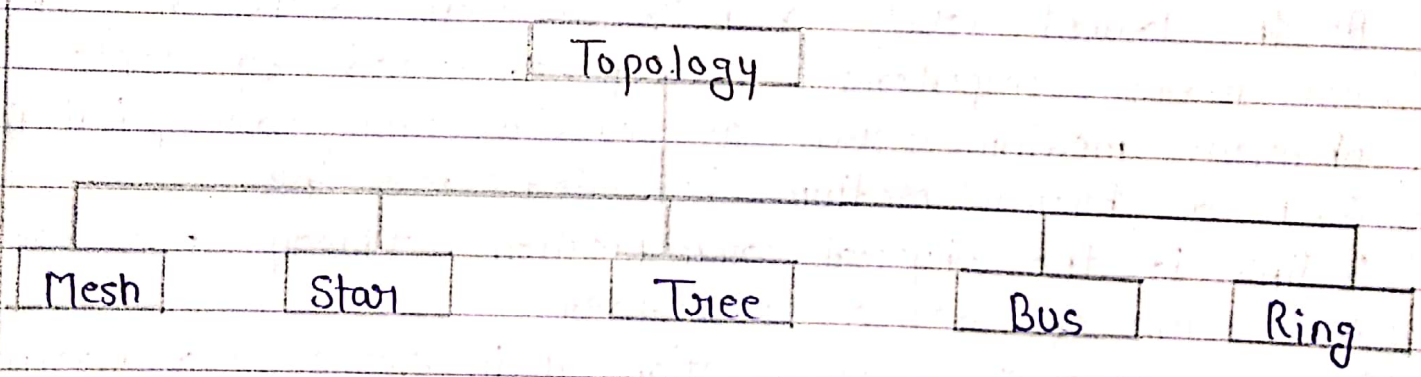
2. What is Network Topology ? Name the different types of network topologies and brief their advantage?

Answer of Q. No 2

Network Topology :-

The term topology refers to the way a network is laid out, either physically or logically. 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 links and linking devices (usually called nodes) to each other.

There are five basic topologies possible : mesh, star, tree, bus, and ring.



1. Mesh

- Every device have point-to-point connection between every other device.
- Each device is directly connected therefore no traffic congestion.

- The number of physical links increases with number of devices connected in the network.
- No need of centralised as in star topology.
- The number of duplex physical links can be calculated by $n(n-1)/2$. Also each device should have $n-1$ input-output ports.
- Each connection can carry its own data load.
- Provides security and privacy.

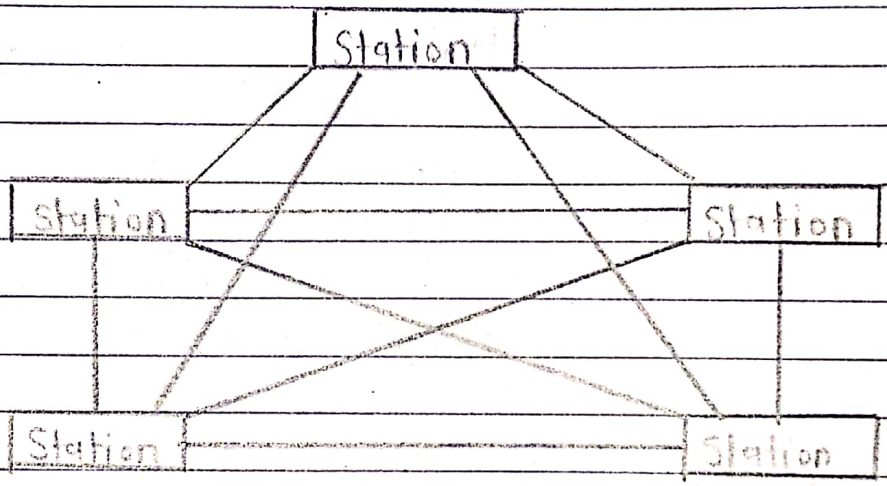


fig 2.11: Mesh Topology

2. Star

- In a star topology the devices are connected point-to-point to the centralised hub.
- This hub is controller which acts as the exchange: If one device wants to send data to another, it sends to the hub which then relays the data to the destination device connected to the other side of the hub.
- Every node has its own dedicated connection to the hub.
- Fast performance with few nodes and low network traffic.
- It is easy to set up and modify.

- Only that node is affected which has failed, rest of the nodes can work smoothly.

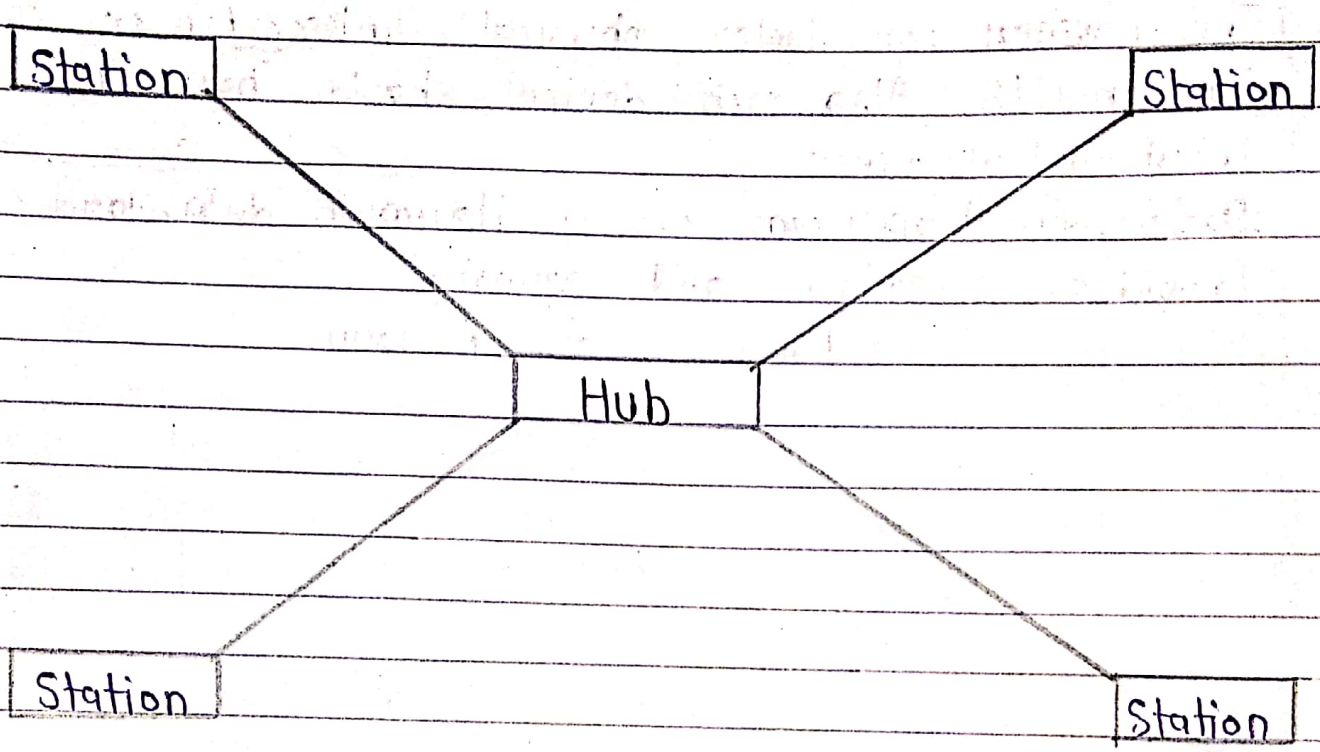


fig 2 (ii): Star Topology

3. Tree

- It has a root node and all other nodes are connected to it forming a hierarchy.
- It is also called hierarchical topology.
- It should at least have three levels to the hierarchy.
- It used in wide area network.
- Extension of bus and star topologies.
- Easily managed and maintained.
- Error detection is easily done.

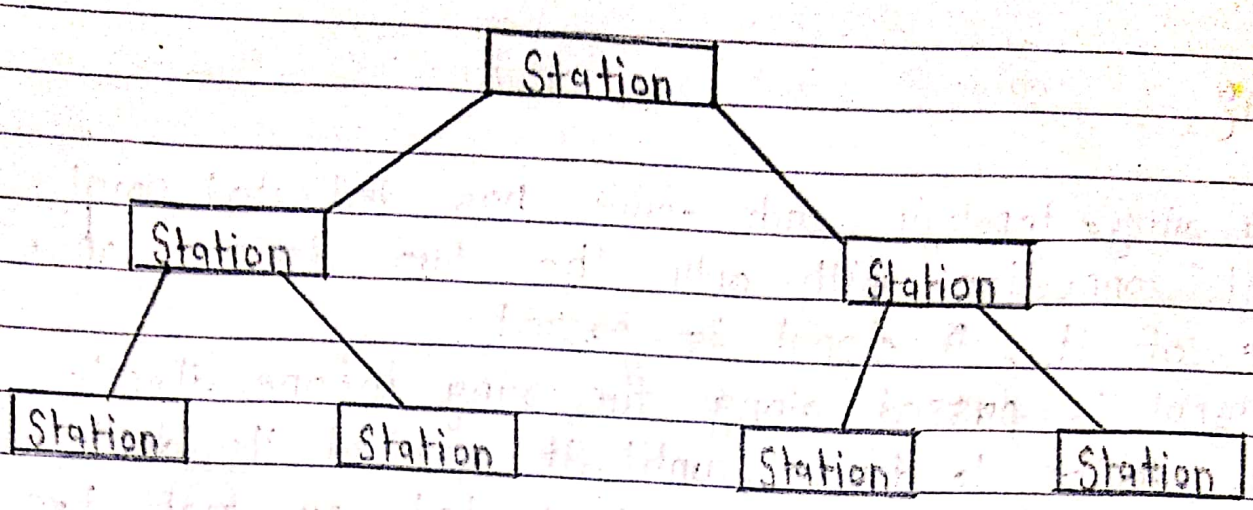


fig 3.(iii) : Tree Topology

4. Bus

- A bus topology is multipoint.
- One long cable act as the back bone to link all the device in a network.
- Nodes are connected to this backbone lines and taps.
- A drop line is the connection between the node and the main cable.
- A tap is a connector that either splices into the main cable or punctures the sheathing of a cable to touch the metallic core of main cable.
- It is cost effective.
- It is used in small networks.
- Easy to expand joining two cables together.

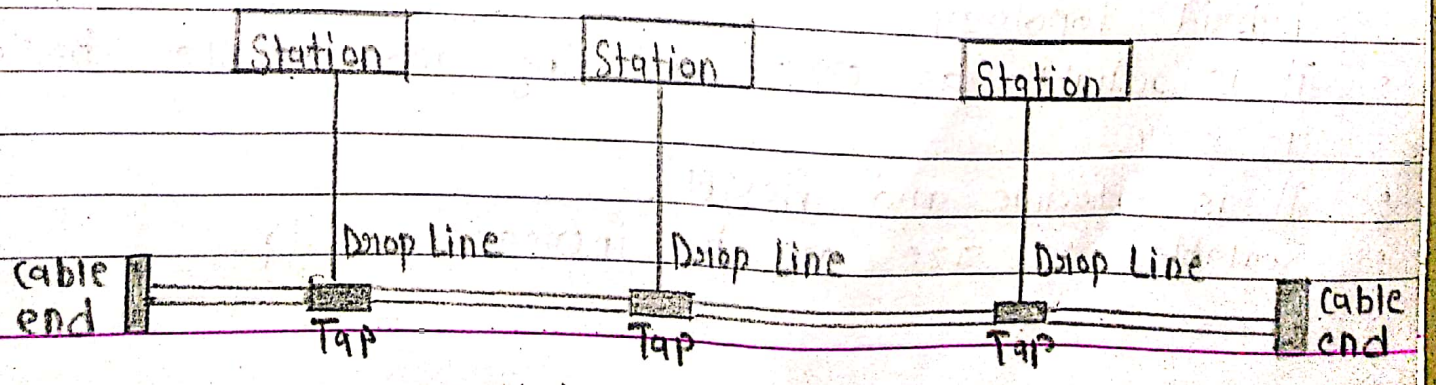


fig 2.(iv) : Bus Topology

5 Ring

- In a ring topology, each device has dedicated point-to-point connection with only the two devices on either side of it. ~~A signal is passed~~
- A signal is passed along the ring in one direction, from device to device, until it reached its destination.
- Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having tokens can transmit data.
- Cheap to install and expand.

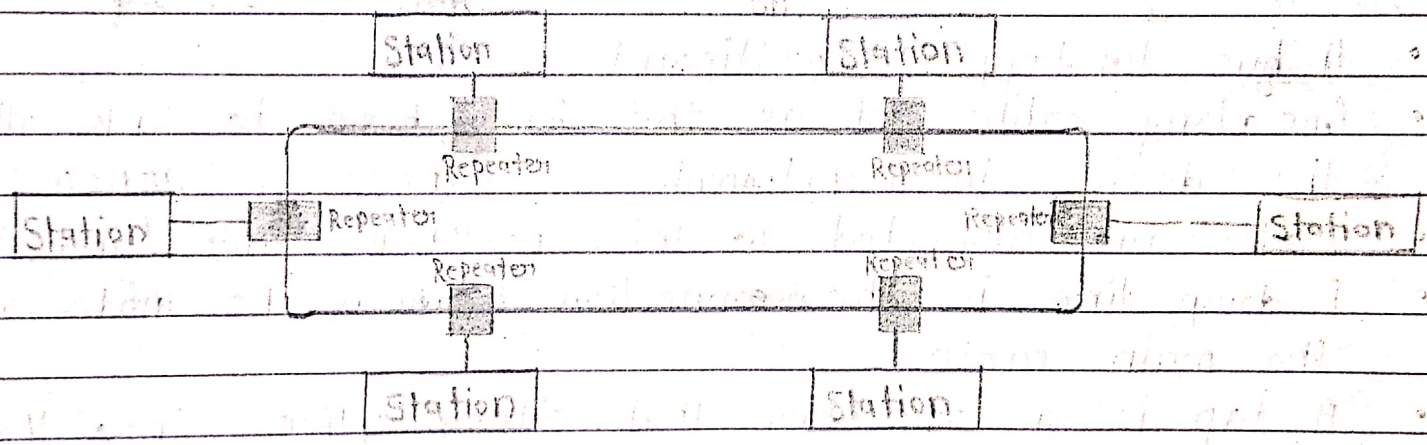


Fig 2:(v) : Ring Topology

6. Hybrid

- Combination of one or more topologies is called hybrid topology.
- It is reliable as error detecting and trouble shooting is easy.
- It is effective and flexible.
- Scalable as size can be increase easily.

- In the below diagram the main topology is star and the remaining part is bus topology.

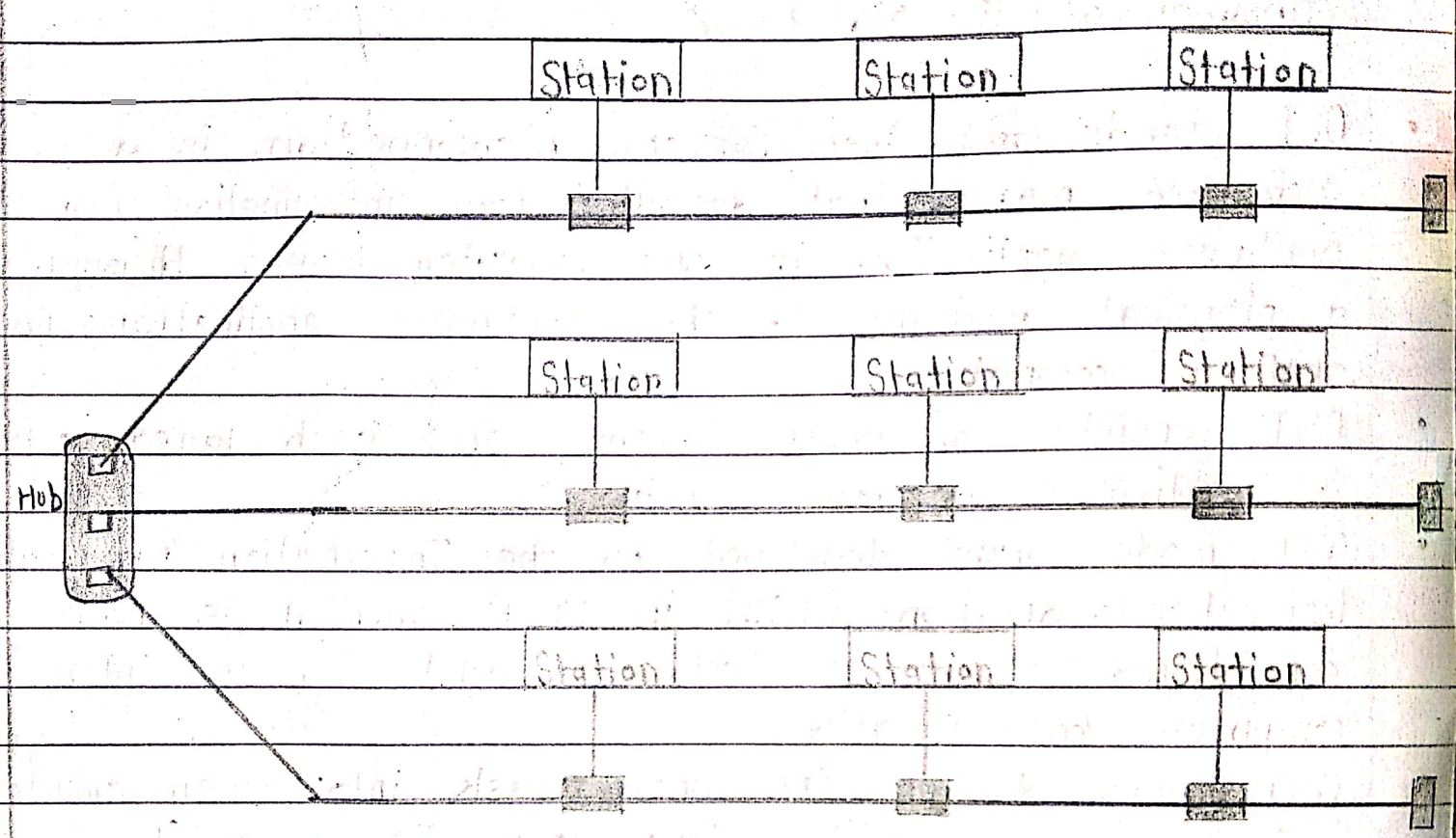


Fig 2.(vi) : Hybrid Topology

3. What are the layers in OSI reference models? Describe each layer briefly.

Answer of Q. No 3

- OSI stands for Open System Interconnection is a reference model that describe how information from a software application in one computer moves through a physical medium to the software application in another computer.
- OSI consists of seven layers, and each layer performs a particular network function.
- OSI model was developed by the Internation Organization for Standardization (ISO) in 1984, and it is now considered as an architectural model for the inter-computer communications.
- OSI model divides the whole task into seven smaller and manageable tasks. Each layer is assigned a particular task.
- Each layer is self-contained, so that task assigned to each layer can be performed independently.

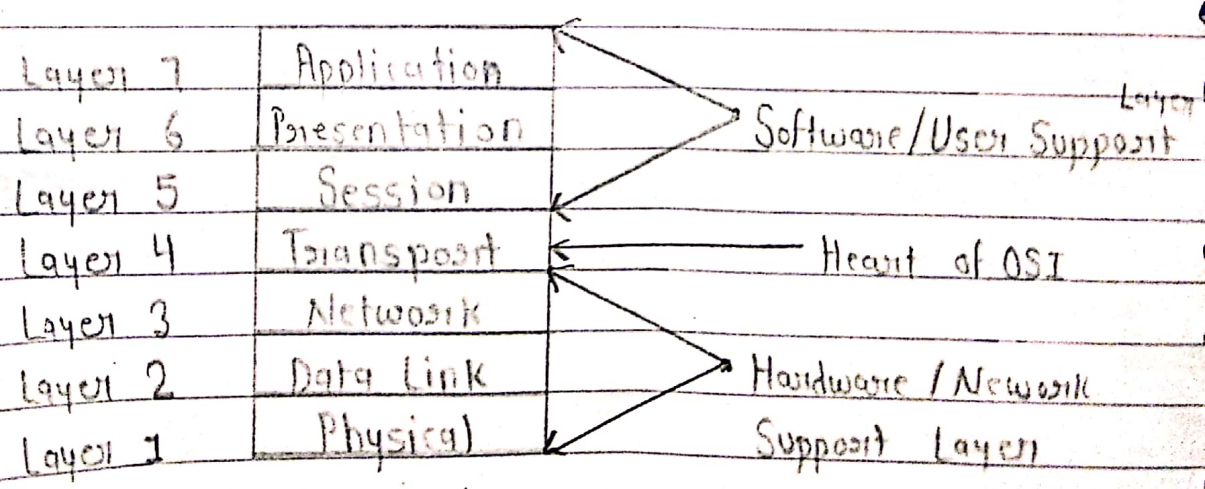


Fig 3.(i): OSI Model

1. Physical layer

- The main functionality of the physical layer is to transmit the individual bits from one node to another node.
- It is the lowest layer of the OSI model.
- It is establishes, maintains and deactivates the physical connection.
- It specifies the mechnical, electrical and procedual network interface specifications.

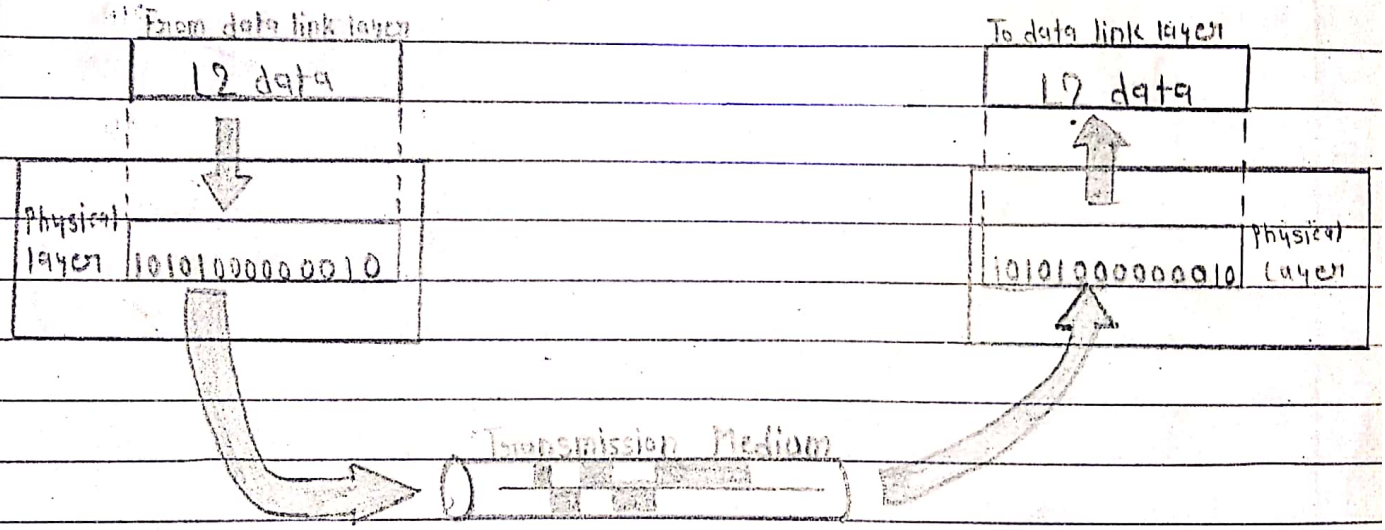


Fig 3.1 : Physical layer

2. Data - Link layer

- The data link layer transform the physical layer, a raw transmission facility, to a reliable link.
- It makes the physical layer appear error-free to the upper layer (network layer).
- The data link-layer is responsible for moving frames from one hop (node) to the next.

- It defines the format of the data on the network.
- It provides a reliable and efficient communication between two or more devices.
- It is mainly responsible for the unique identification of each device that resides on a local network.
- ~~It contai~~

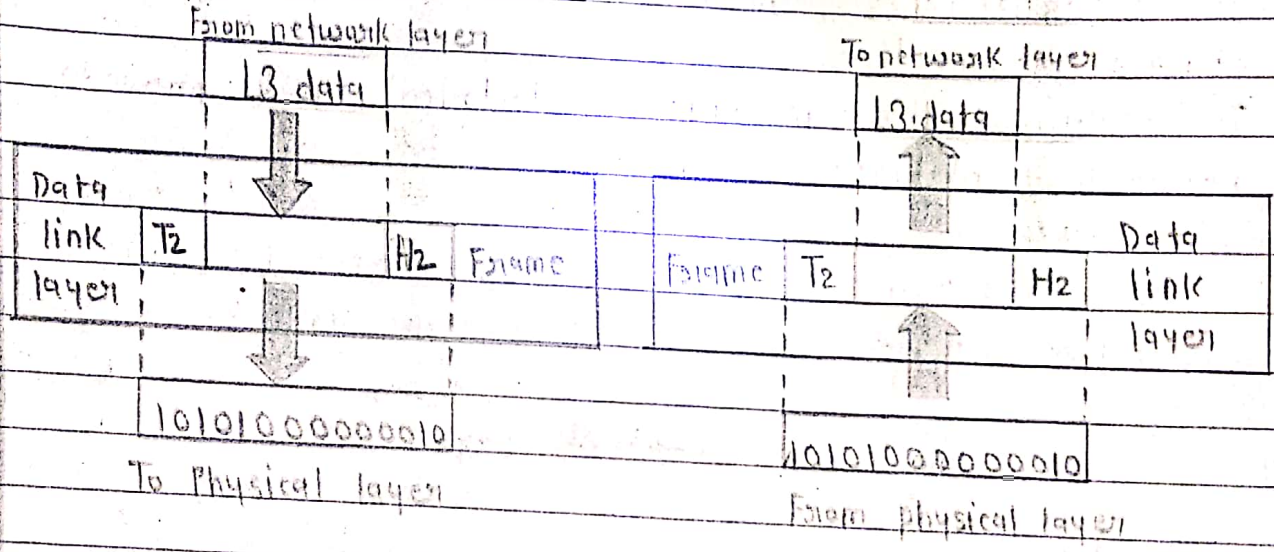


Fig 2.2 : Data Link Layer

3. Network Layer

- It is a layer 3 that manages device addressing, tracks the location of devices on the network.
- It determines the best path to move data from source to the destination based on the network conditions, the priority of service, and other factors.
- The data link layer is responsible for routing and forwarding the packets.
- Routers ~~and~~ are the layer 3 devices, they are specified in this layer and used to provide the routing services within an internetwork.

- The protocols used to route the network traffic are known as Network layer protocols.
Example of protocols are IP and Ipv6.

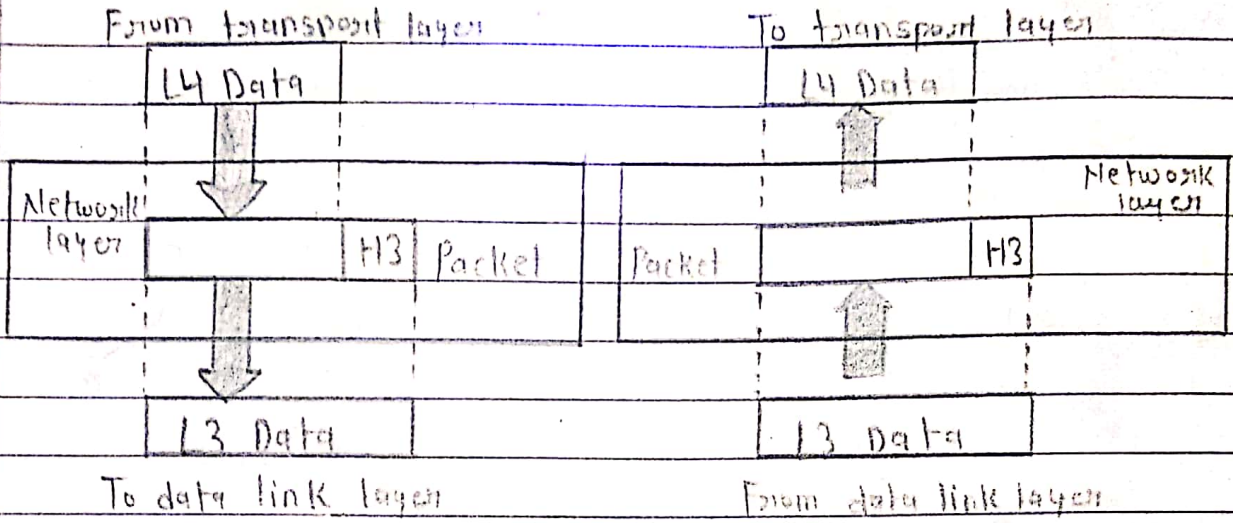


Fig 3.3 : Network Layer

4. Transport Layer

- The transport layer is a layer 4 ensures that messages are transmitted in the order in which they are sent and there is no duplication of data.
- The main responsibility of the transport layer is to transfer the data completely.
- It receives the data from the upper layer and converts them into smaller units known as segments.
- This layer can be termed as an end-to-end layer as it provides a point-to-point connection between source and destination to deliver the data reliably.

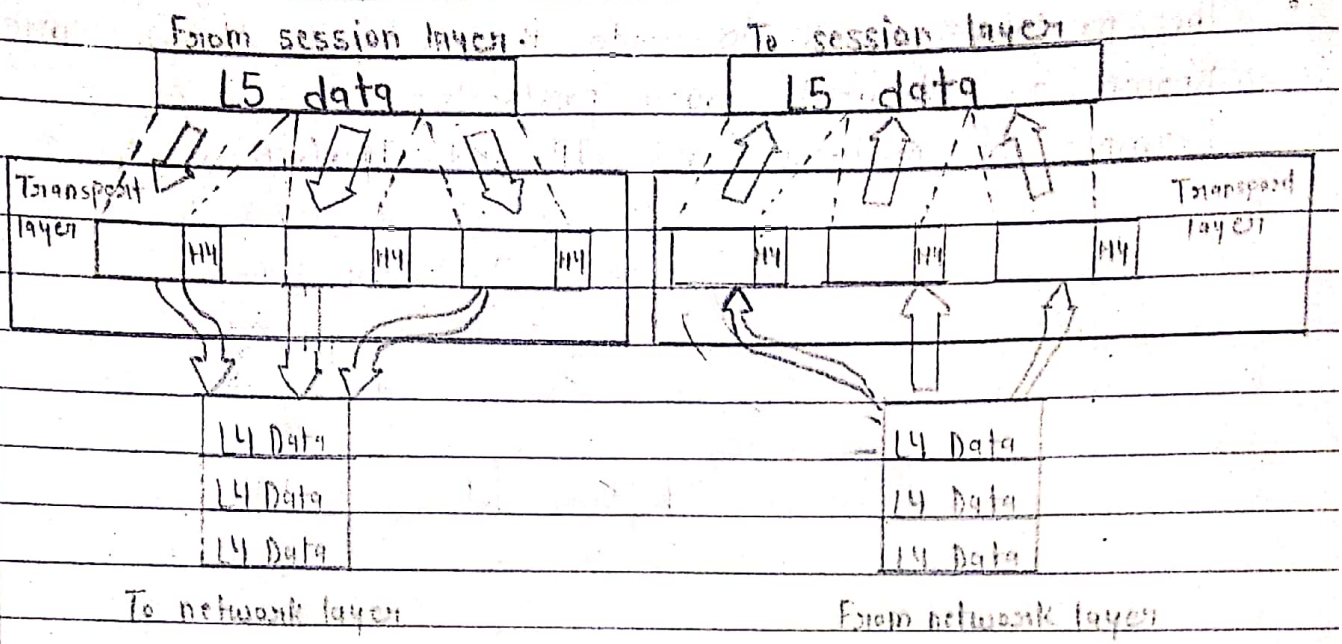
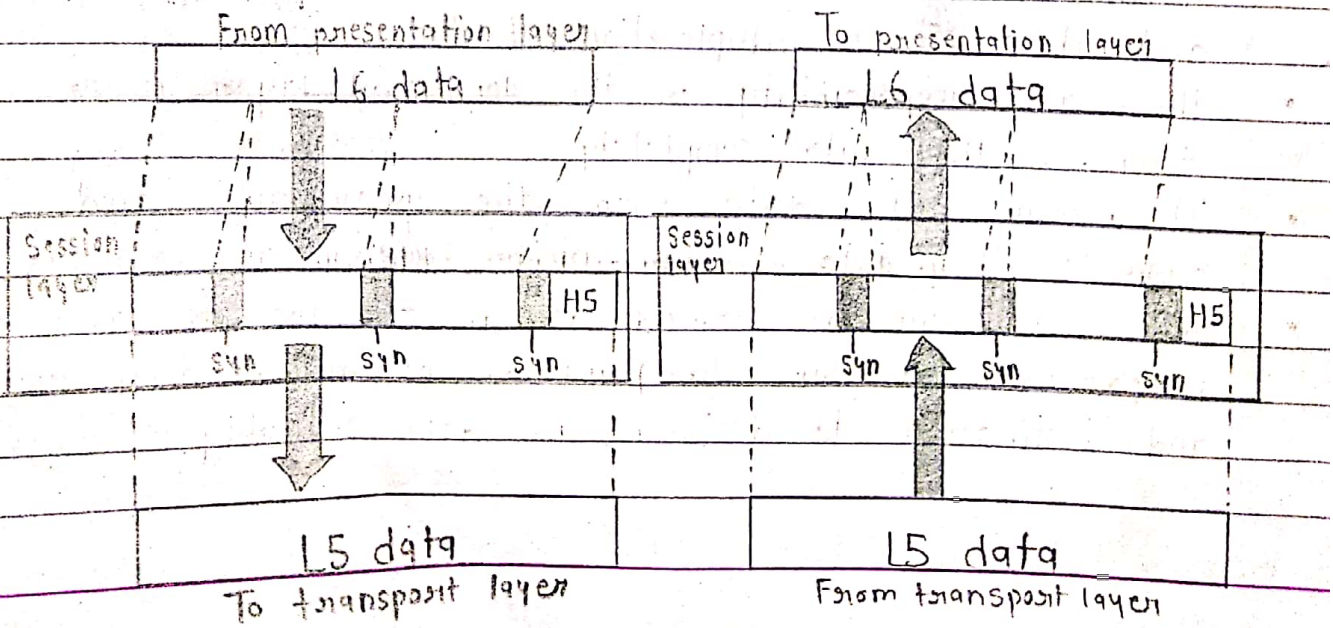


Fig 3.4 : Transport layer

5. Session Layer

- The session layer is the network dialog controller.
- It establishes, maintains, and synchronize the interaction among communicating system.
- The session layer is responsible for dialog control and synchronization.



6. Presentation Layer

- A presentation layer is mainly concerned with the syntax and semantics of the information exchanged between the two systems.
- It acts as a data translator for a network.
- This layer is a part of the operating system that converts the data from one presentation format to another format.
- The presentation layer is also known as the syntax layer.

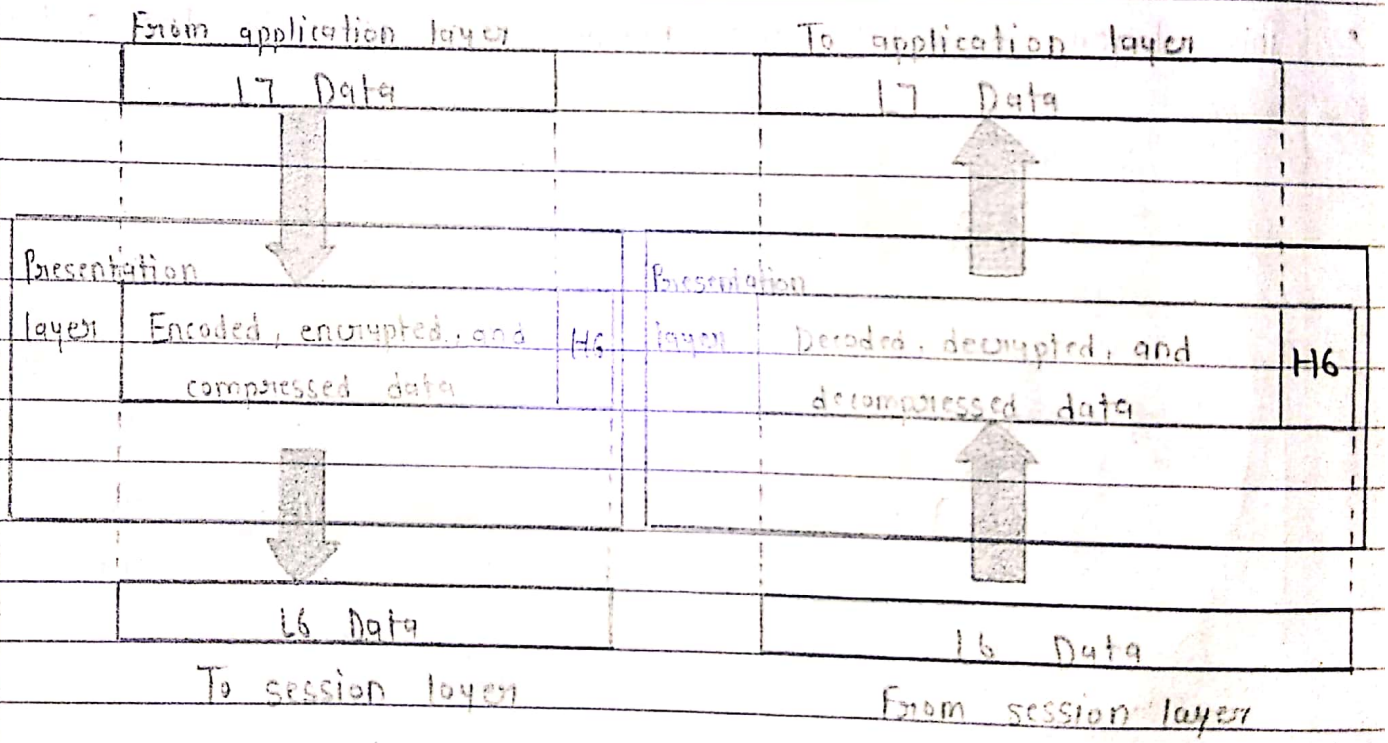


Fig 3.6 : Presentation Layer

7. Application Layer

- An application layer serves as a window for users and application processes to access network services.
- It provides user interfaces and support for services such as electronic mail, remote file access and transfer, shared database management and other types of distributed information services.
- It handles issues such as network transparency, resource allocation etc.
- An application layer is not an application, but it performs the application layer functions.
- This layer provides the network services to the end-users.

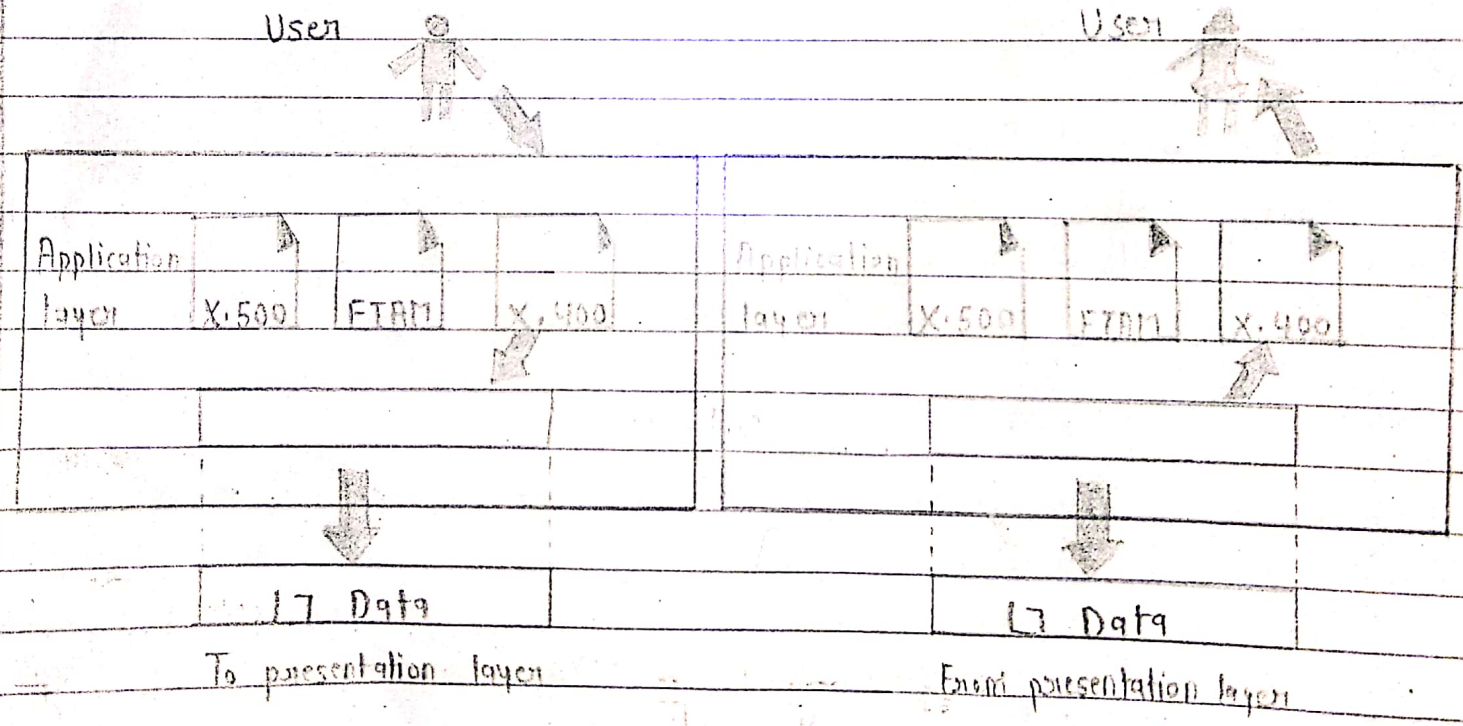


Fig 3.7 : Application Layer

4. Explain different types of Ethernet ?

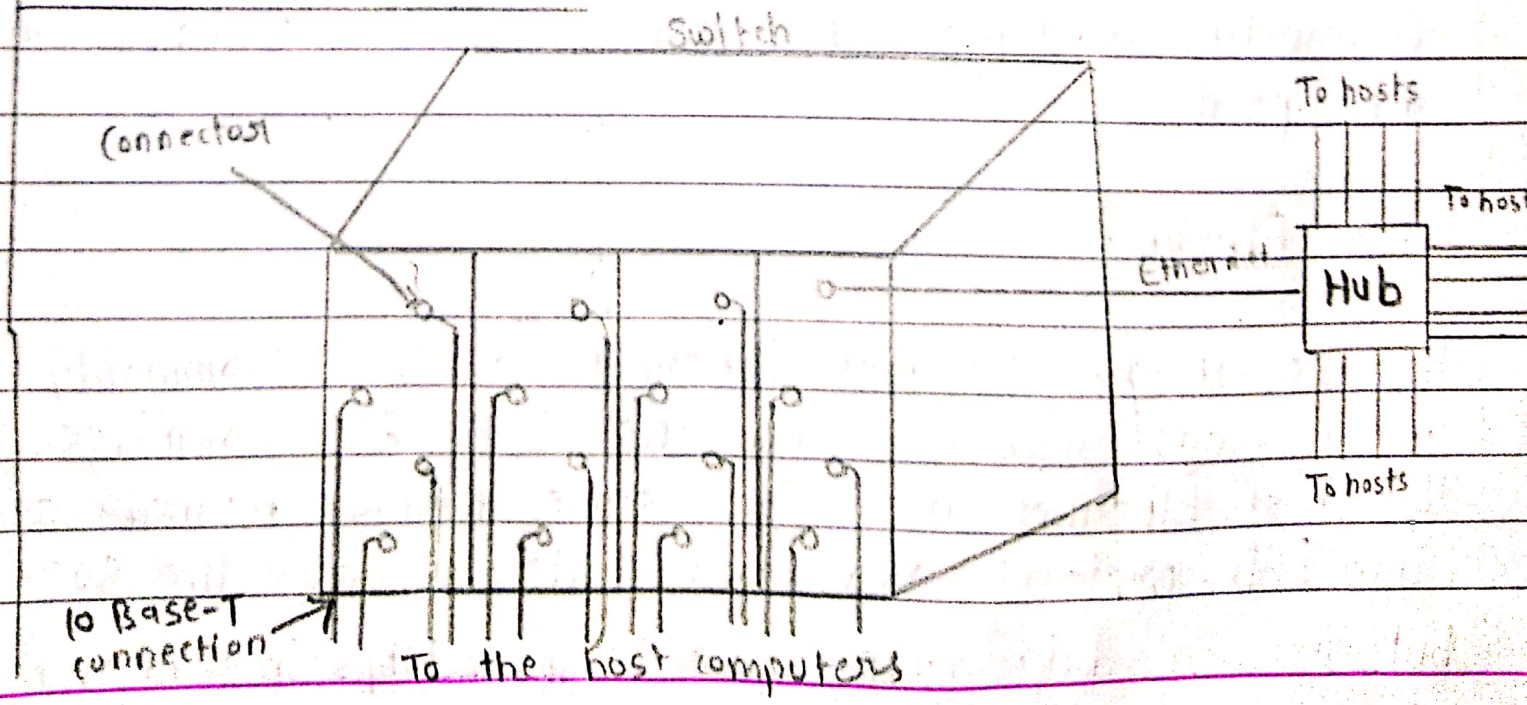
Answer of Q. No 4.

Ethernet

- Ethernet is the most widely used local area network protocol.
- The original Ethernet was created in 1976 at Xerox's Palo Alto Research Center (PARC) with a data rate of 10 Mbps and a bus topology and later extended by a joint venture between Digital Equipment Corporation, Intel Corporation and Xerox.
- Today it has a data rate of 100 Mbps and 100 Mbps (1 gigbit per second).
- Ethernet is formally defined by the IEEE 802.3 standard.

Types of Ethernet

1. Switched Ethernet



- Switched Ethernet gives dedicated 10 Mbps bandwidth on each of its ports.
- On each of the ports one can connect either a thick/thin segment or a computer.
- In switched Ethernet, the collision domain is separated.
- The hub is replaced by a switch, which function as a fast bridge.
- It can recognize the destination address of the received frame and can forward the frame to the port to which the destination station is connected.
- The other ports are not involved in the transmission process.
- The switch can receive another frame from another station at the same time and can route this frame to its own final destination.
- In this case, both the physical and logical topologies are star.
- The throughput can be further increased on switched
- Ethernet by using full-duplex technique, which uses separate wire pairs for transmitting and receiving.
- Thus a station can transmit and receive simultaneously, effectively doubling the throughput to 20 Mbps on each port.

Fast Ethernet

- The 802.u or the fast Ethernet, as it is commonly known, was approved by the IEEE 802 Committee.
- The fast Ethernet uses the same frame format, same CSMA/CD protocol and same interface as the 802.3 but uses a data transfer rate of 100 Mbps instead of 10 Mbps.

- However, fast Ethernet is based entirely on 10-Base-T, because of its advantages (Although technically 10-Base-5 and 10-Base-2 can be used with shorter segment length).
- IEEE has designed two categories of Fast Ethernet: 100Base-X and 100Base-T4.
- 100Base-X uses two wire interface between a hub and a station while 100-Base-T4 uses four-wire interface.
- 100-Base-X itself is divided into two: 100Base-TX and 100base-FX.

Name	Cable	Max. Segment	Advantages
100Base-T4	Twisted pair	100m	Uses category 3 UTP
100Base-TX	Twisted pair	100m	Full duplex at 100 Mbps
100Base-FX	Fiber optics	2000m	Full duplex at 100Mbps; long runs

- Upgrade the data rate to 100 Mbps.
- Make it compatible with Standard Ethernet.
- Keep the same 48-bit address.
- Keep the same frame format.
- Keep the same minimum and maximum frame lengths.

Gigabyte Ethernet

- The technology is based on fiber optic cable. Multi-mode fiber is able to transmit at gigabit rate to at least 580 meters and with single-mode runs exceeding 3 km.
- Fiber optic cabling is costly. In order to reduce the cost of cabling, the 802.3z working group also proposed the use of twisted pair or cable or coxial cable for distances up to 30 meters.

- At gigabit speed, two stations 200 meters apart will not detect a collision, when both simultaneously send 64-byte frames.
- This inability to detect collision leads to network instability.
- A mechanism known as carrier extension has been proposed for frames shorter than 512 bytes.
- The number of repeater hops is also restricted to only one in place of two for 100 Base-T.

Name	Cable	Max. segment	Advantages
1000 Base-SX	Fiber optics	500m	Multimode fiber (50, 62.5 microns)
1000 Base-LX	Fiber optics	5000m	Single (10μ) or multimode (50, 62.5μ)
1000 Base-CX	2 Pairs of STP	25m	Shielded twisted pair
1000 Base-T	4 Pairs of UTP	100m	Standard category 5 UTP

- Upgrade the data rate to 1 gbps.
- Make it compatible with Standard or Fast Ethernet.
- Use the same 48-bit address.
- Use the same frame format.
- Keep the same minimum and maximum frame lengths.
- To support auto-negotiation as defined in Fast Ethernet.

5 Explain TCP/IP Model ?

Answer of Q. No 5.

- The TCP/IP model was developed prior to the OSI mode
- The TCP/IP model is not exactly similar to the OSI model
- The TCP/IP model consists of five layers : the application layer, transport layer, network layer, data link layer and physical layer.
- The first four layer provide physical standards, network interface, internetworking and transport functions that correspond to the first four layers of the OSI model and these four layers are represented in TCP/IP model by a single layer called the application layer
- TCP/IP is a hierarchical protocol made up of interactive modules, and each of them provides specific functionality.

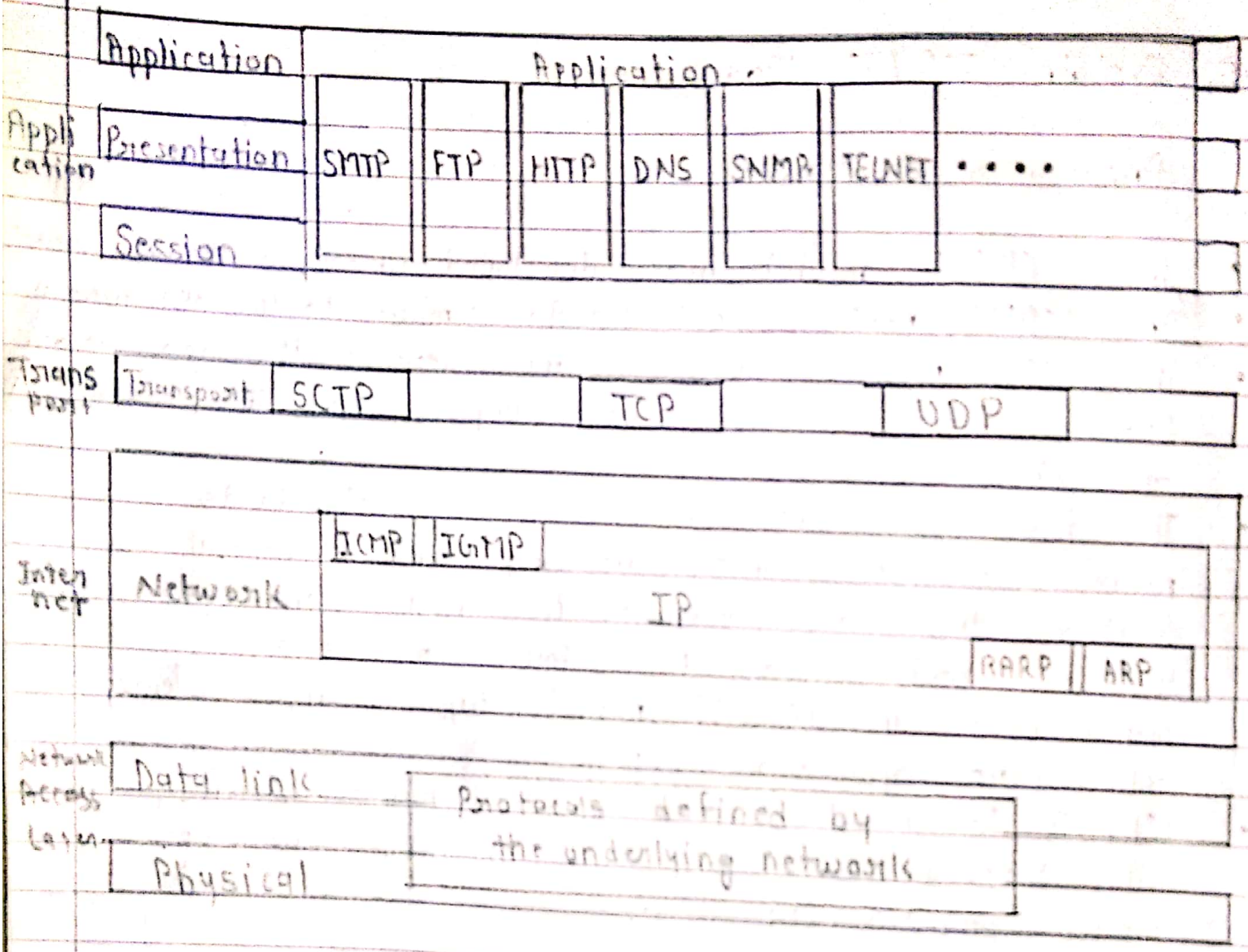


fig 5.1 : TCP/IP model

Network Layer

- A network layer is the lowest layer of the TCP/IP model.
- A network layer is the combination of the Physical layer and Data Link layer defined in the OSI reference model.

- It defines how the data should be sent physically through the network.
- The layer is mainly responsible for the transmission of the data between two devices on the same network.
- The functions carried out by this layer are encapsulating the IP datagram into frames transmitted by the network and mapping of IP addresses into physical addresses.
- The protocols used by this layer are ethernet, token ring, FDDI, X.25, frame relay.

Internet Layer

- An internet layer is the second layer of the TCP / IP model.
- An internet layer is also known as the network layer.
- The main responsibility of the internet layer is to send the packets from any network, and they arrive at the destination irrespective of the route they take.

Following are the protocols used in this layer are:

(i) IP Protocol
(ii) ARP Protocol
(iii) ICMP Protocol

Transport Layer

- The transport layer is responsible for the reliability, flow control, and correction of data which is being sent over the network.

- It decides if data transmission should be on parallel path or single path.
- Functions such as multiplexing, segmenting or splitting on the data is done by transport layer.
- The application can read and write to the transport layer.
- Transport layer adds header information to the data.
- Transport layer also arrange the packets to be sent in sequence.
- The two protocols used in the transport layer are:

(i) User Datagram Protocol (UDP)
(ii) Transmission Control Protocol (TCP)

Application Layer

- An application layer is the topmost layer in the TCP/IP model.
- It is responsible for handling high-level protocols issue of representation.
- This layer allows the user to interact with the application.
- When one application layer protocol wants to communicate with another application layer, it forwards its data to the transport layer.
- There is an ambiguity occurs in the application layer. Every application cannot be placed inside the application layer except those who interact with the communication system.
- For example: text editor cannot be considered in application layer while web

browsen ~~as~~ using HTTP protocol is interact with the network where HTTP protocol is an application layer protocol.

- Following are the main protocols used in the application layer.

(i) HTTP
(ii) SNMP
(iii) SMTP
(iv) DNS
(v) TELNET
(vi) FTP.