CO - 2

COURSE NAME : SYSTEM DESIGN AND INTRODUCTION TO CLOUD

COURSE CODE : 23AD2103A

TOPICS : NETWORK TOPOLOGIES REFERENCE MODELS- THE OSI REFERENCE MODEL- THE TCP/IP REFERENCE MODEL

SESSION DESCRIPTION

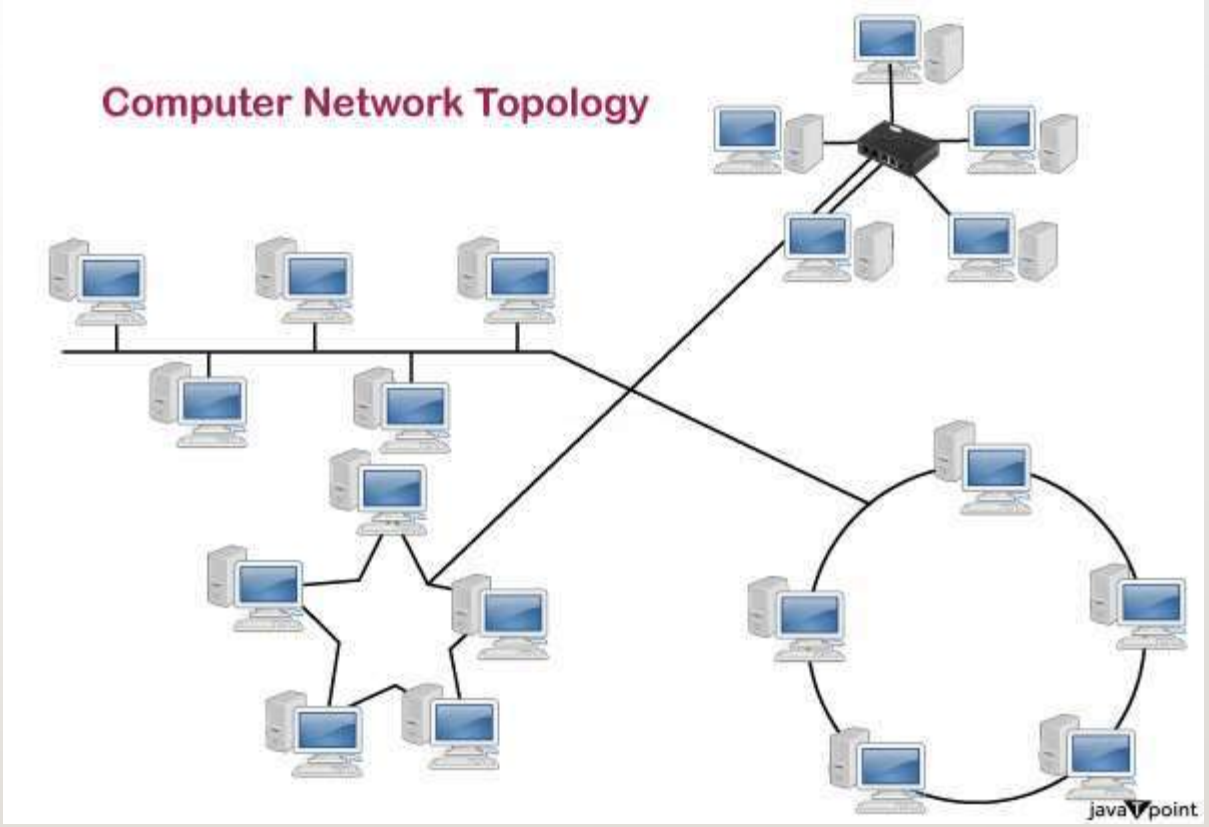
- Network Topologies Reference models-
- The OSI Reference Model-
- The TCP/IP Reference Model

WHAT IS NETWORK TOPOLOGY?

- Topology defines the structure of the network of how all the components are interconnected to each other. There are two types of topology: physical and logical topology.

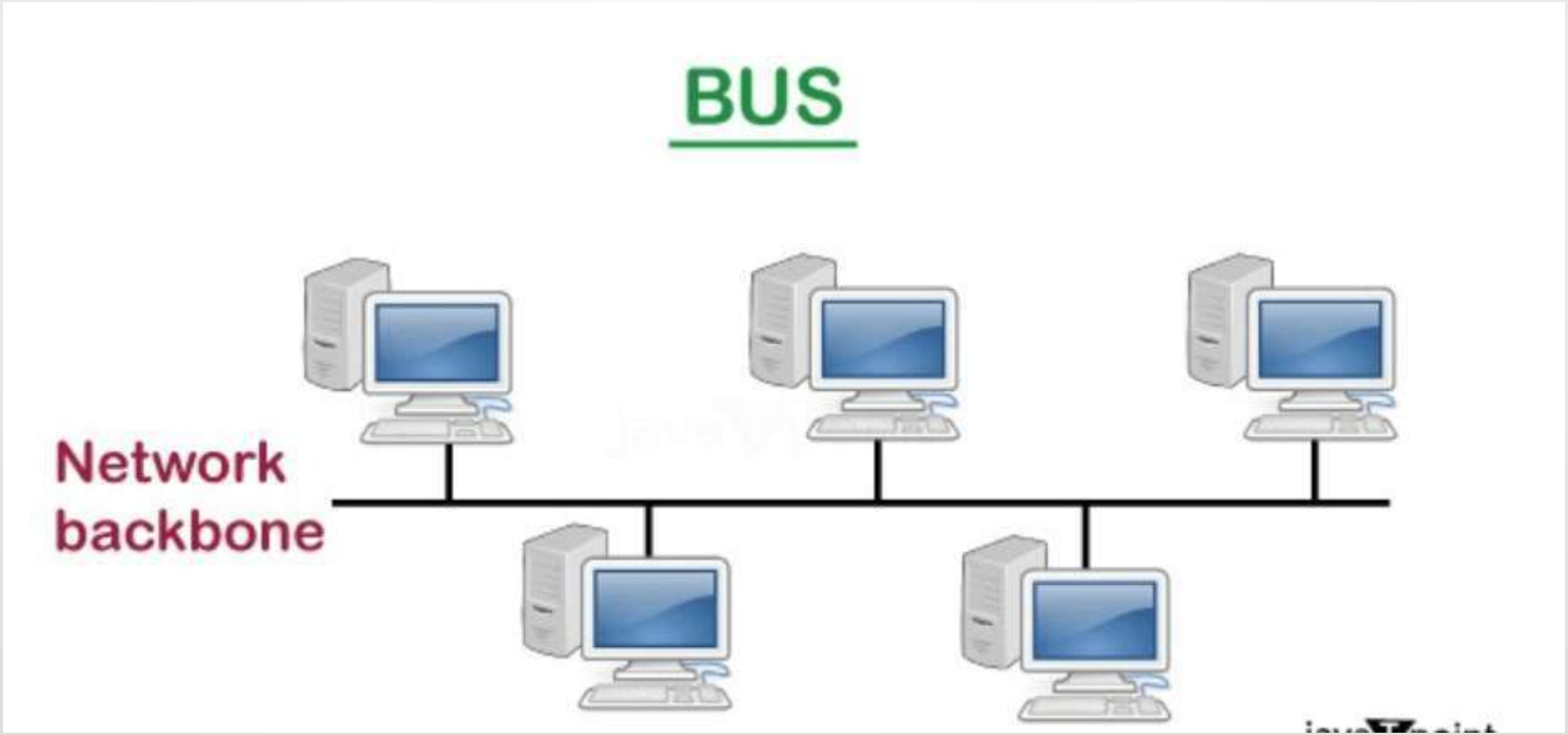
• Types of Network Topology

- Physical topology is the geometric representation of all the nodes in a network. There are six types of network topology which are Bus Topology, Ring Topology, Tree Topology, Star Topology, Mesh Topology, and Hybrid Topology.



BUS TOPOLOGY

- 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.
- When a node wants to send a message over the network, it puts a message over the network. All the stations available in the network will receive the message whether it has been addressed or not.
- The bus topology is mainly used in 802.3 (ethernet) and 802.4 standard networks.
- The configuration of a bus topology is quite simpler as compared to other topologies.
- The backbone cable is considered as a "single lane" through which the message is broadcast to all the stations.
- The most common access method of the bus topologies is CSMA (Carrier Sense Multiple Access).


BUS
Network backbone

ADVANTAGES OF BUS TOPOLOGY:

- **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.
- **Moderate data speeds:** Coaxial or twisted pair cables are mainly used in bus-based networks that support upto 10 Mbps.
- **Familiar technology:** Bus topology is a familiar technology as the installation and troubleshooting techniques are well known, and hardware components are easily available.
- **Limited failure:** A failure in one node will not have any effect on other nodes.

DISADVANTAGES OF BUS TOPOLOGY:

- **Extensive cabling:** A bus topology is quite simpler, but still it requires a lot of cabling.
- **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.
- **Signal interference:** If two nodes send the messages simultaneously, then the signals of both the nodes collide with each other.
- **Reconfiguration difficult:** Adding new devices to the network would slow down the network.
- **Attenuation:** Attenuation is a loss of signal leads to communication issues. Repeaters are used to regenerate the signal.

RING TOPOLOGY

- 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.
- The data in a ring topology flow in a clockwise direction.
- The most common access method of the ring topology is token passing.
- Token passing: It is a network access method in which token is passed from one node to another node.
- Token: It is a frame that circulates around the network.

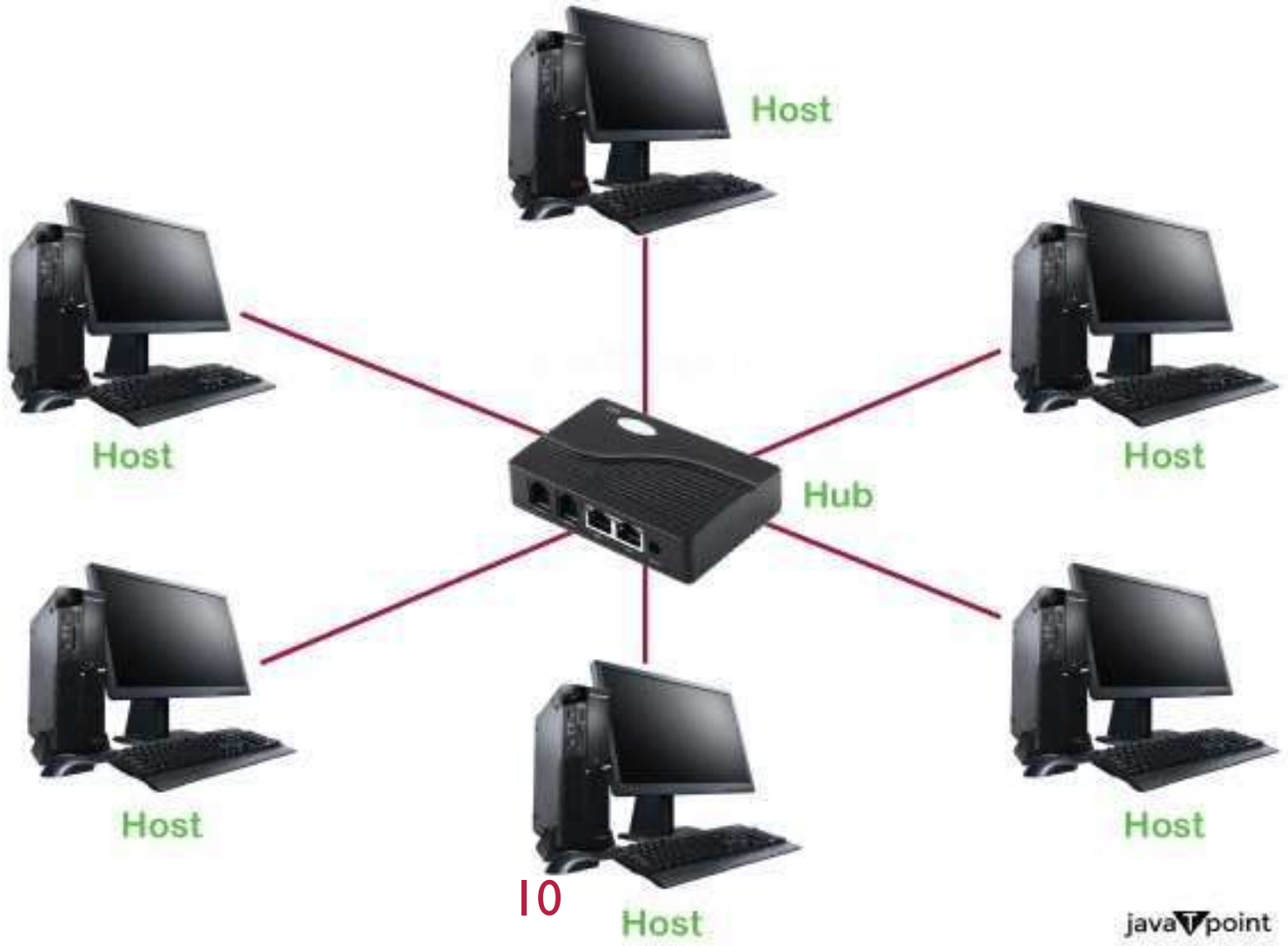
WORKING OF TOKEN PASSING

- A token moves around the network, and it is passed from computer to computer until it reaches the destination.
- The sender modifies the token by putting the address along with the data.
- The data is passed from one device to another device until the destination address matches. Once the token received by the destination device, then it sends the acknowledgment to the sender.
- In a ring topology, a token is used as a carrier.

STAR TOPOLOGY

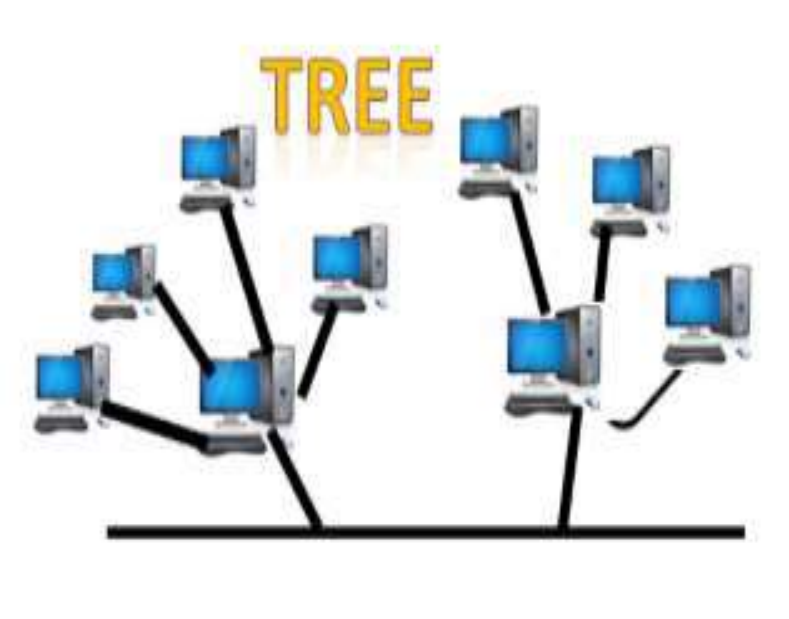
Star Topology

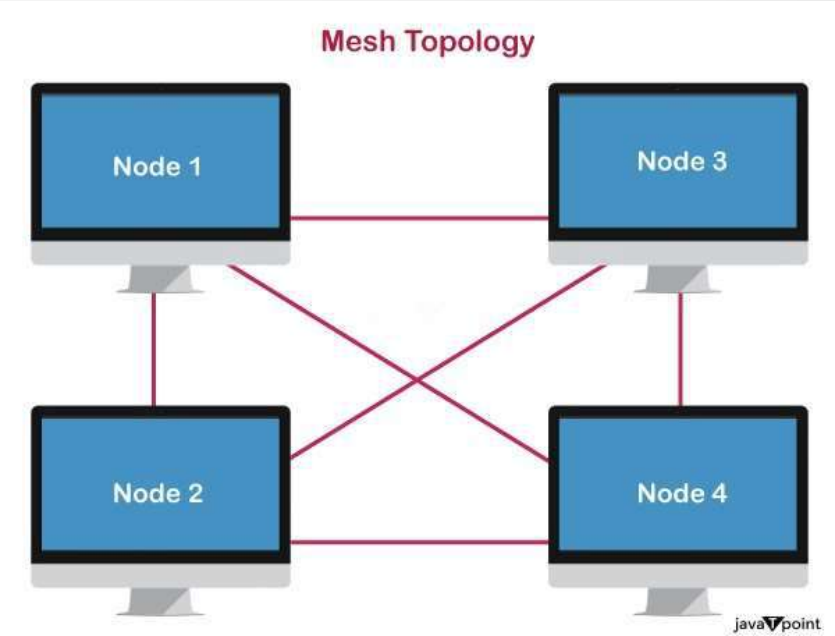
- All hosts in Star topology are connected to a central device, known as hub device, using a point-to-point connection.
- Point-to-point connection between hosts and hub.

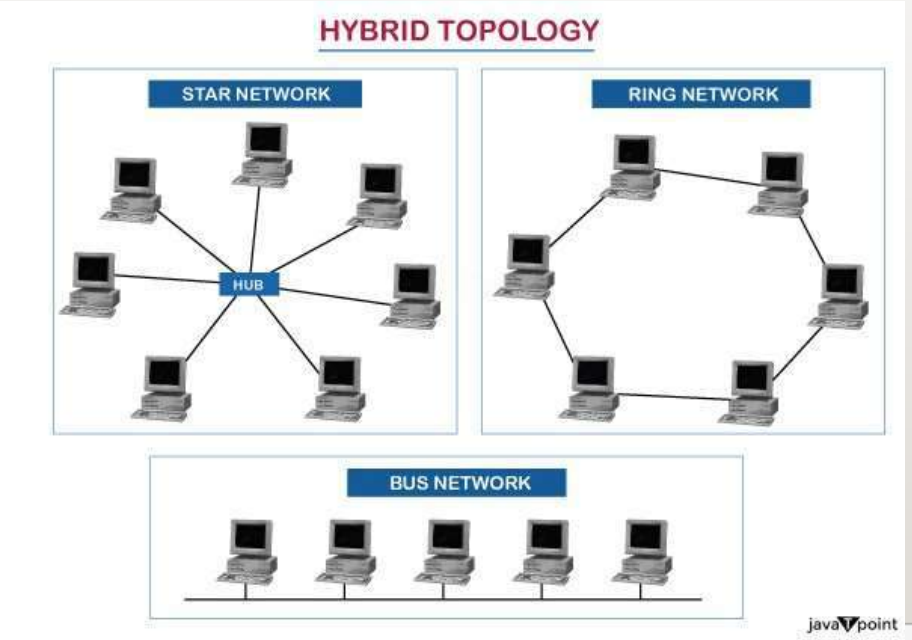


STAR TOPOLOGY

- 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.


TREE

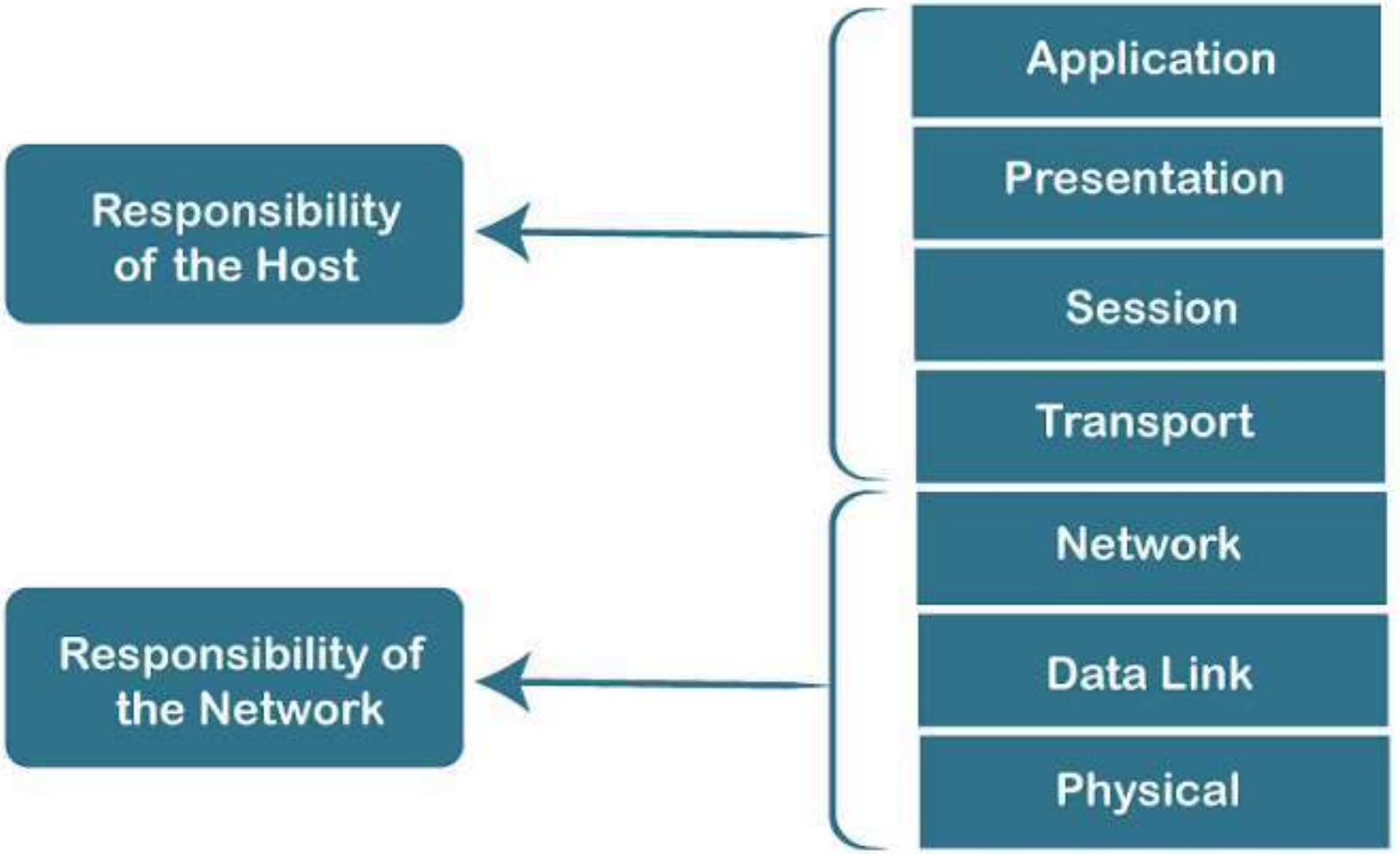

Mesh Topology
Node 1
Node 3
Node 2
Node 4
javaTpoint


HYBRID TOPOLOGY
STAR NETWORK
HUB
RING NETWORK
BUS NETWORK
javaTpoint

OSI REFERENCE MODEL

- OSI stands for Open Systems Interconnection, where open stands to say non-proprietary.
- It is a 7-layer architecture with each layer having specific functionality to perform.
- All these 7 layers work collaboratively to transmit the data from one person to another across the globe.
- The OSI reference model was developed by ISO – 'International Organization for Standardization', in the year 1984.
- The OSI model provides a theoretical foundation for understanding network communication.

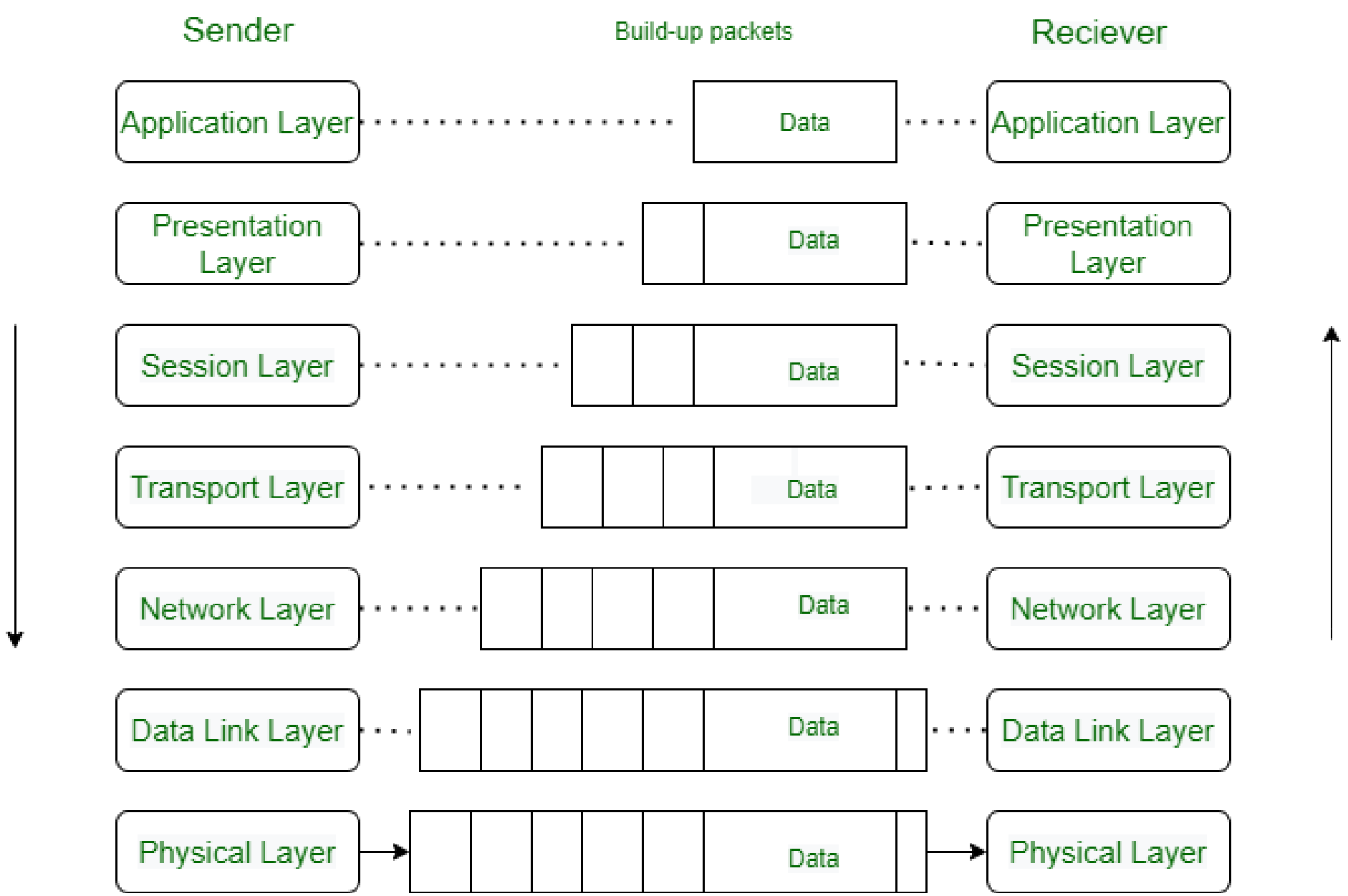
Characteristics of OSI Model



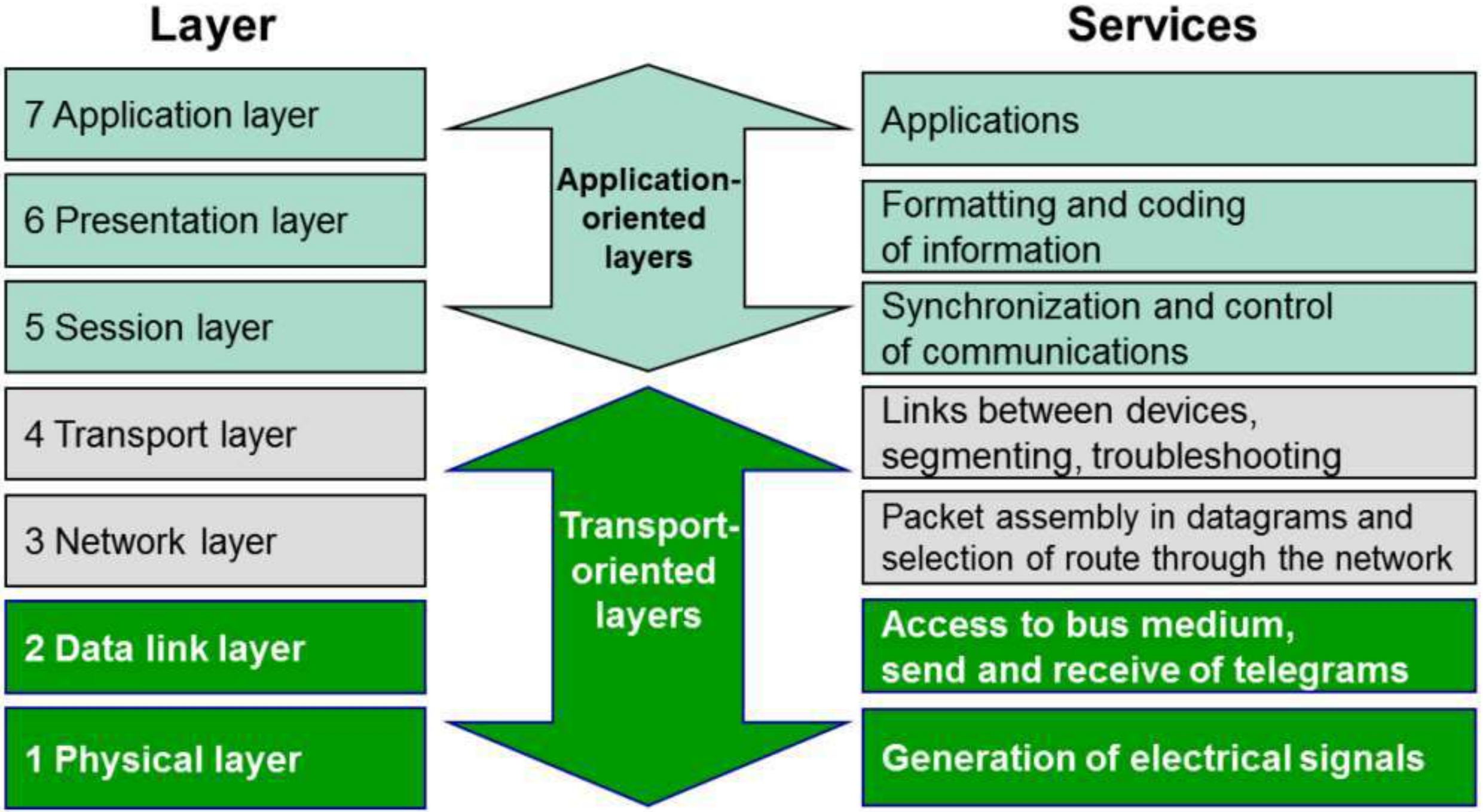
Application Layer	Responsible for providing services to the user.
Presentation Layer	Take care of syntax and semantics of the information exchange between two communication system.
Session Layer	It stablish, maintain, synchronize, and terminate the interaction between sender and receiver.
Transport Layer	Responsible for process to process delivery.
Network Layer	Responsible for delivery of individual packet from source to destination.
Data Link Layer	Responsible for moving frame from one hop to next hop.
Physical Layer	Responsible for moving individual bits from one device to the next device.

DATA FLOW IN OSI MODEL

- When we transfer information from one device to another, it travels through 7 layers of OSI model. First data travels down through 7 layers from the sender's end and then climbs back 7 layers on the receiver's end.
- **Data flows through the OSI model in a step-by-step process:**
- Application Layer: Applications create the data.
- Presentation Layer: Data is formatted and encrypted.
- Session Layer: Connections are established and managed.
- Transport Layer: Data is broken into segments for reliable delivery.
- Network Layer: Segments are packaged into packets and routed.
- Data Link Layer: Packets are framed and sent to the next device.
- Physical Layer: Frames are converted into bits and transmitted physically.



Each layer adds specific information to ensure the data reaches its destination correctly, and these steps are reversed upon arrival.

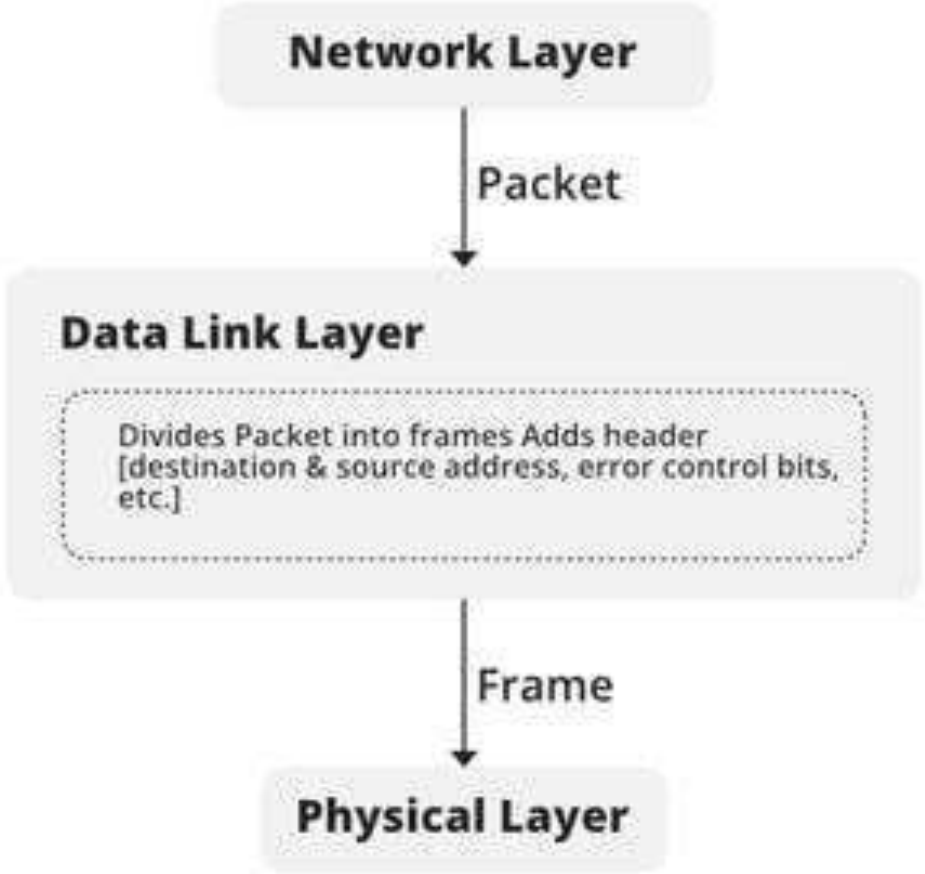

Layer
Services
7 Application layer
6 Presentation layer
5 Session layer
4 Transport layer
3 Network layer
2 Data link layer
1 Physical layer
Application-oriented layers
Transport-oriented layers
Applications
Formatting and coding of information
Synchronization and control of communications
Links between devices, segmenting, troubleshooting
Packet assembly in datagrams and selection of route through the network
Access to bus medium, send and receive of telegrams
Generation of electrical signals

PHYSICAL LAYER

- The lowest layer of the OSI reference model is the physical layer. It is responsible for the actual physical connection between the devices.
- The physical layer contains information in the form of bits. It is responsible for transmitting individual bits from one node to the next.
- When receiving data, this layer will get the signal received and convert it into 0s and 1s and send them to the Data Link layer, which will put the frame back together.

DATA LINK LAYER (DLL) – LAYER 2

- The data link layer is responsible for the node-to-node delivery of the message. The main function of this layer is to make sure data transfer is error-free from one node to another, over the physical layer. When a packet arrives in a network, it is the responsibility of the DLL to transmit it to the Host using its MAC address.
- The Data Link Layer is divided into two sublayers:
- Logical Link Control (LLC)
- Media Access Control (MAC)


Network Layer
Packet
Data Link Layer
Divides Packet into frames Adds header [destination & source address, error control bits, etc.]
Frame
Physical Layer

NETWORK LAYER – LAYER 3

- The network layer works for the transmission of data from one host to the other located in different networks.
- It also takes care of packet routing i.e. selection of the shortest path to transmit the packet, from the number of routes available.
- The sender & receiver's IP addresses are placed in the header by the network layer.

TRANSPORT LAYER – LAYER 4

- The transport layer provides services to the application layer and takes services from the network layer. The data in the transport layer is referred to as Segments. It is responsible for the end-to-end delivery of the complete message. The transport layer also provides the acknowledgment of the successful data transmission and re-transmits the data if an error is found.
- **At the sender's side:** The transport layer receives the formatted data from the upper layers, performs Segmentation, and also implements Flow and error control to ensure proper data transmission. It also adds Source and Destination port numbers in its header and forwards the segmented data to the Network Layer.
- **At the receiver's side:** Transport Layer reads the port number from its header and forwards the Data which it has received to the respective application. It also performs sequencing and reassembling of the segmented data.

SESSION LAYER – LAYER 5, PRESENTATION LAYER – LAYER 6, APPLICATION LAYER – LAYER 7

- This layer is responsible for the establishment of connection, maintenance of sessions, and authentication, and also ensures security.
- The **presentation layer** is also called the Translation layer. The data from the application layer is extracted here and manipulated as per the required format to transmit over the network.
- At the very top of the OSI Reference Model stack of layers, we find the **Application layer** which is implemented by the network applications. These applications produce the data to be transferred over the network. This layer also serves as a window for the application services to access the network and for displaying the received information to the user.

THANK YOU

Team – System Design & Introduction to Cloud