

# REFERENCE MODEL

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# OSI MODEL

- OSI stands for **Open System Interconnection** is a reference model that describes 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 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.

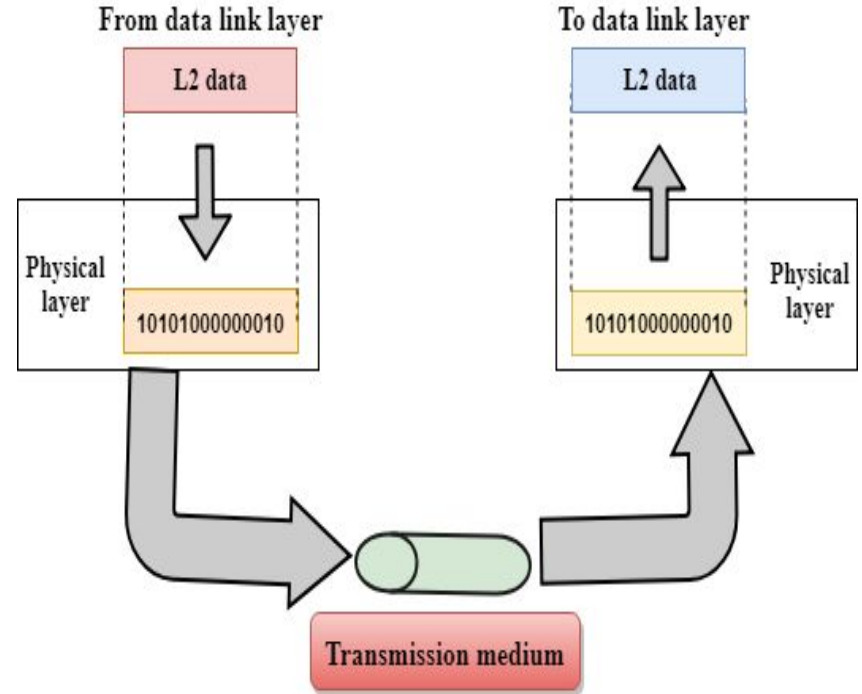
# FUNCTIONS OF THE OSI LAYERS

There are the seven OSI layers. Each layer has different functions. A list of seven layers are given below:

1. Physical Layer
2. Data-Link Layer
3. Network Layer
4. Transport Layer
5. Session Layer
6. Presentation Layer
7. Application Layer

# 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 establishes, maintains and deactivates the physical connection.

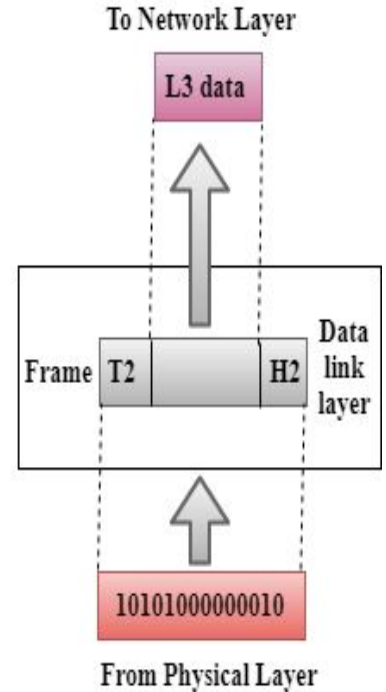
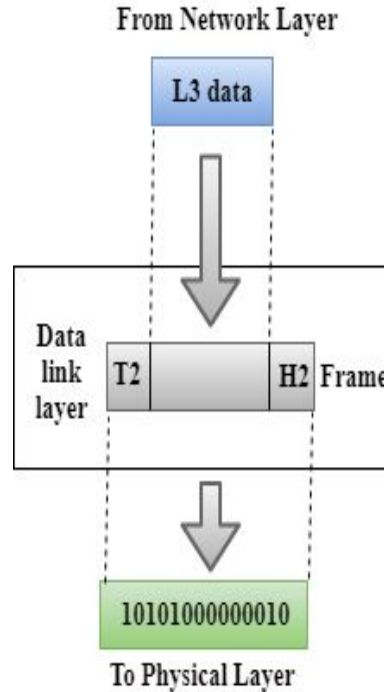


# FUNCTIONS OF PHYSICAL LAYER

- **Line Configuration:** It defines the way how two or more devices can be connected physically.
- **Data Transmission:** It defines the transmission mode whether it is simplex, half-duplex or full-duplex mode between the two devices on the network.
- **Topology:** It defines the way how network devices are arranged.
- **Signals:** It determines the type of the signal used for transmitting the information.

# DATA LINK LAYER

- This layer is responsible for the error-free transfer of data frames.
- 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.



# FUNCTIONS OF DATA LINK LAYER

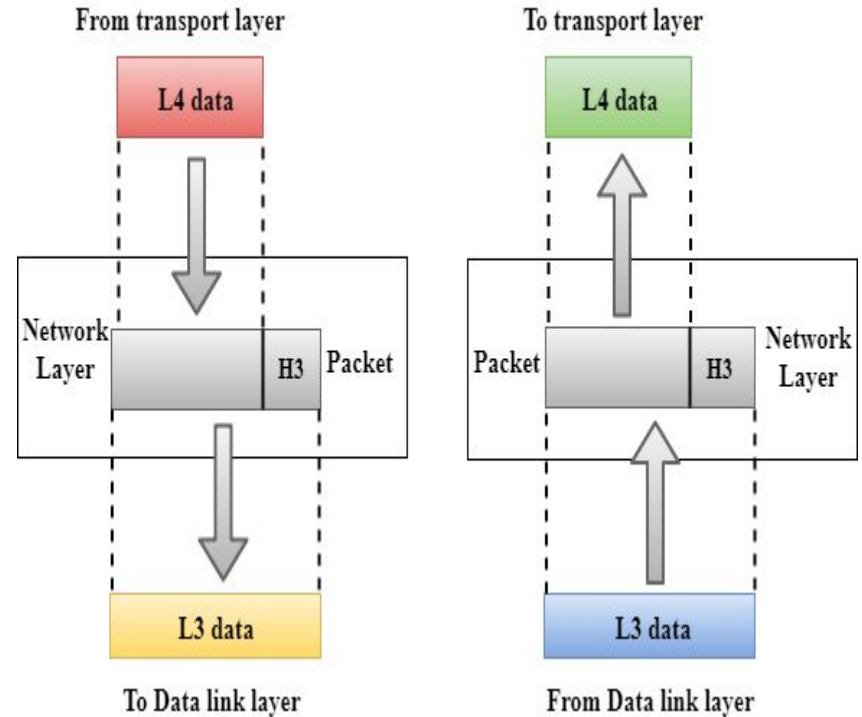
- **Framing:** The data link layer translates the physical's raw bit stream into packets known as Frames. The Data link layer adds the header and trailer to the frame. The header which is added to the frame contains the hardware destination and source addresses.



- **Physical Addressing:** The Data link layer adds a header to the frame that contains a destination address. The frame is transmitted to the destination address mentioned in the header.

# NETWORK LAYER

- It 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.



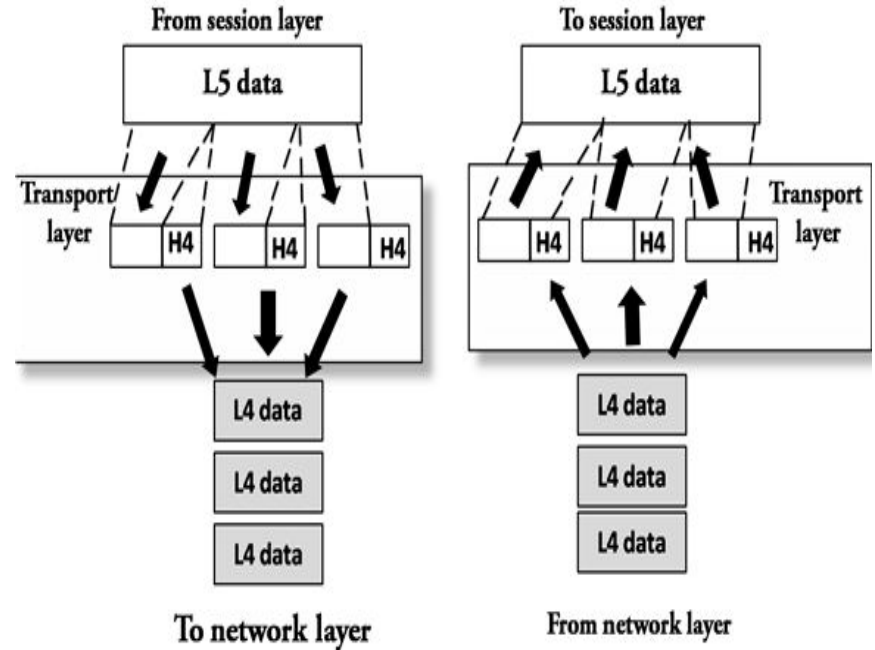


# FUNCTIONS OF NETWORK LAYER

- **Internetworking:** An internetworking is the main responsibility of the network layer. It provides a logical connection between different devices.
- **Addressing:** A Network layer adds the source and destination address to the header of the frame. Addressing is used to identify the device on the internet.
- **Routing:** Routing is the major component of the network layer, and it determines the best optimal path out of the multiple paths from source to the destination.
- **Packetizing:** A Network Layer receives the packets from the upper layer and converts them into packets. This process is known as Packetizing. It is achieved by internet protocol (IP).

# TRANSPORT LAYER

- The Transport layer 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.



# TRANSPORT LAYER

The two protocols used in this layer are:

- **Transmission Control Protocol**

- It is a standard protocol that allows the systems to communicate over the internet.
- It establishes and maintains a connection between hosts.
- When data is sent over the TCP connection, then the TCP protocol divides the data into smaller units known as segments. Each segment travels over the internet using multiple routes, and they arrive in different orders at the destination. The transmission control protocol reorders the packets in the correct order at the receiving end.

- **User Datagram Protocol**

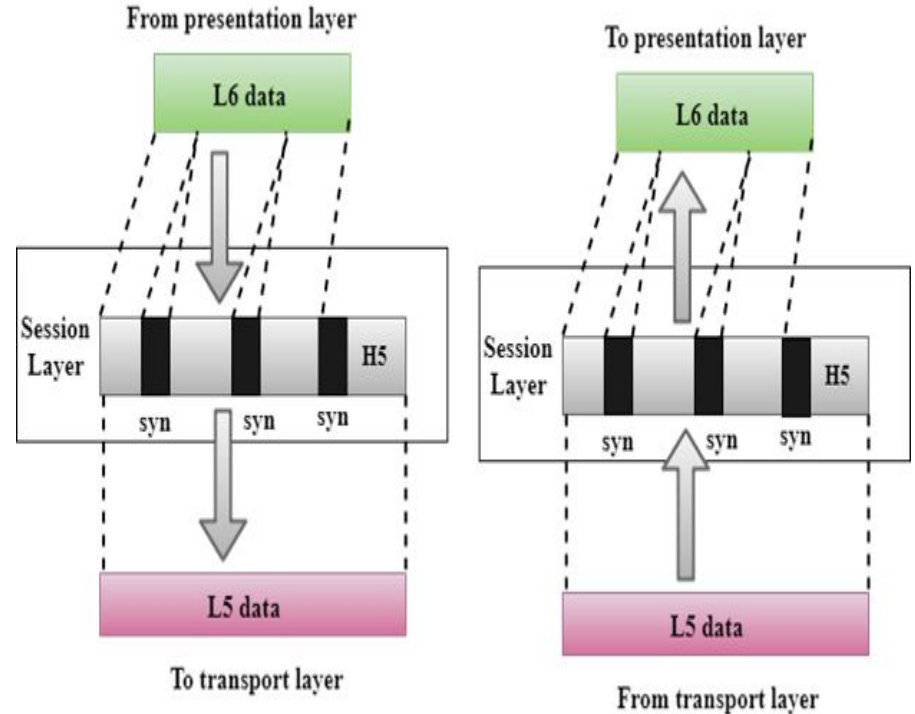
- User Datagram Protocol is a transport layer protocol.
- It is an unreliable transport protocol as in this case receiver does not send any acknowledgment when the packet is received, the sender does not wait for any acknowledgment. Therefore, this makes a protocol unreliable.

# FUNCTION OF TRANSPORT LAYER

- **Segmentation and reassembly:** When the transport layer receives the message from the upper layer, it divides the message into multiple segments, and each segment is assigned with a sequence number that uniquely identifies each segment. When the message has arrived at the destination, then the transport layer reassembles the message based on their sequence numbers.
- **Flow control:** The transport layer also responsible for flow control but it is performed end-to-end rather than across a single link.
- **Error control:** The transport layer is also responsible for Error control. Error control is performed end-to-end rather than across the single link. The sender transport layer ensures that message reach at the destination without any error.
- **Connection control:** Transport layer provides two services Connection-oriented service and connectionless service. A connectionless service treats each segment as an individual packet, and they all travel in different routes to reach the destination. A connection-oriented service makes a connection with the transport layer at the destination machine before delivering the packets. In connection-oriented service, all the packets travel in the single route.

# SESSION LAYER

- The Session layer is used to establish, maintain and synchronizes the interaction between communicating devices.

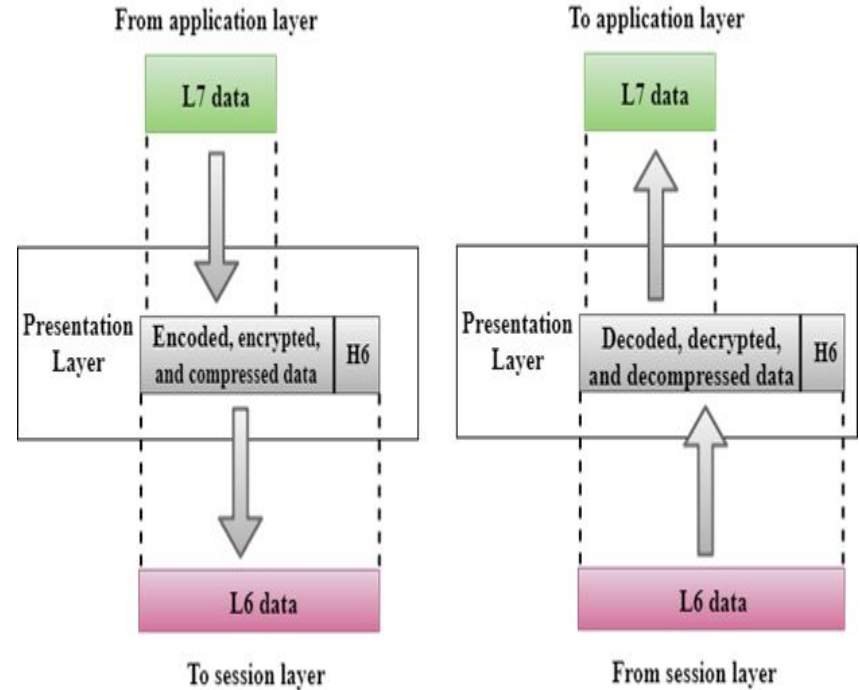


# FUNCTION OF SESSION LAYER

- **Dialog control:** Session layer acts as a dialog controller that creates a dialog between two processes or we can say that it allows the communication between two processes which can be either half-duplex or full-duplex.
- **Synchronization:** Session layer adds some checkpoints when transmitting the data in a sequence. If some error occurs in the middle of the transmission of data, then the transmission will take place again from the checkpoint. This process is known as Synchronization and recovery.

# 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.



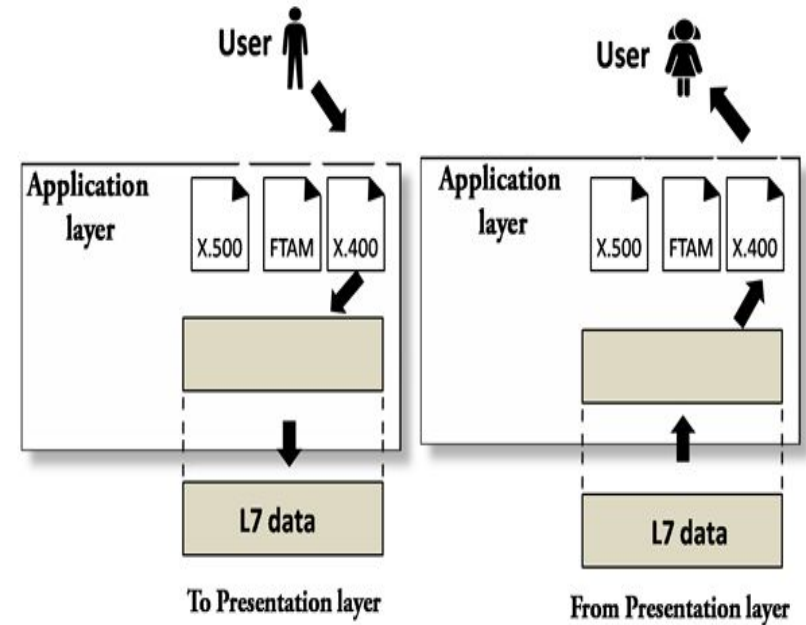
# FUNCTIONS OF PRESENTATION LAYER

- **Translation:** The processes in two systems exchange the information in the form of character strings, numbers and so on. Different computers use different encoding methods, the presentation layer handles the interoperability between the different encoding methods. It converts the data from sender-dependent format into a common format and changes the common format into receiver-dependent format at the receiving end.
- **Encryption:** Encryption is needed to maintain privacy. Encryption is a process of converting the sender-transmitted information into another form and sends the resulting message over the network.
- **Compression:** Data compression is a process of compressing the data, i.e., it reduces the number of bits to be transmitted. Data compression is very important in multimedia such as text, audio, video.



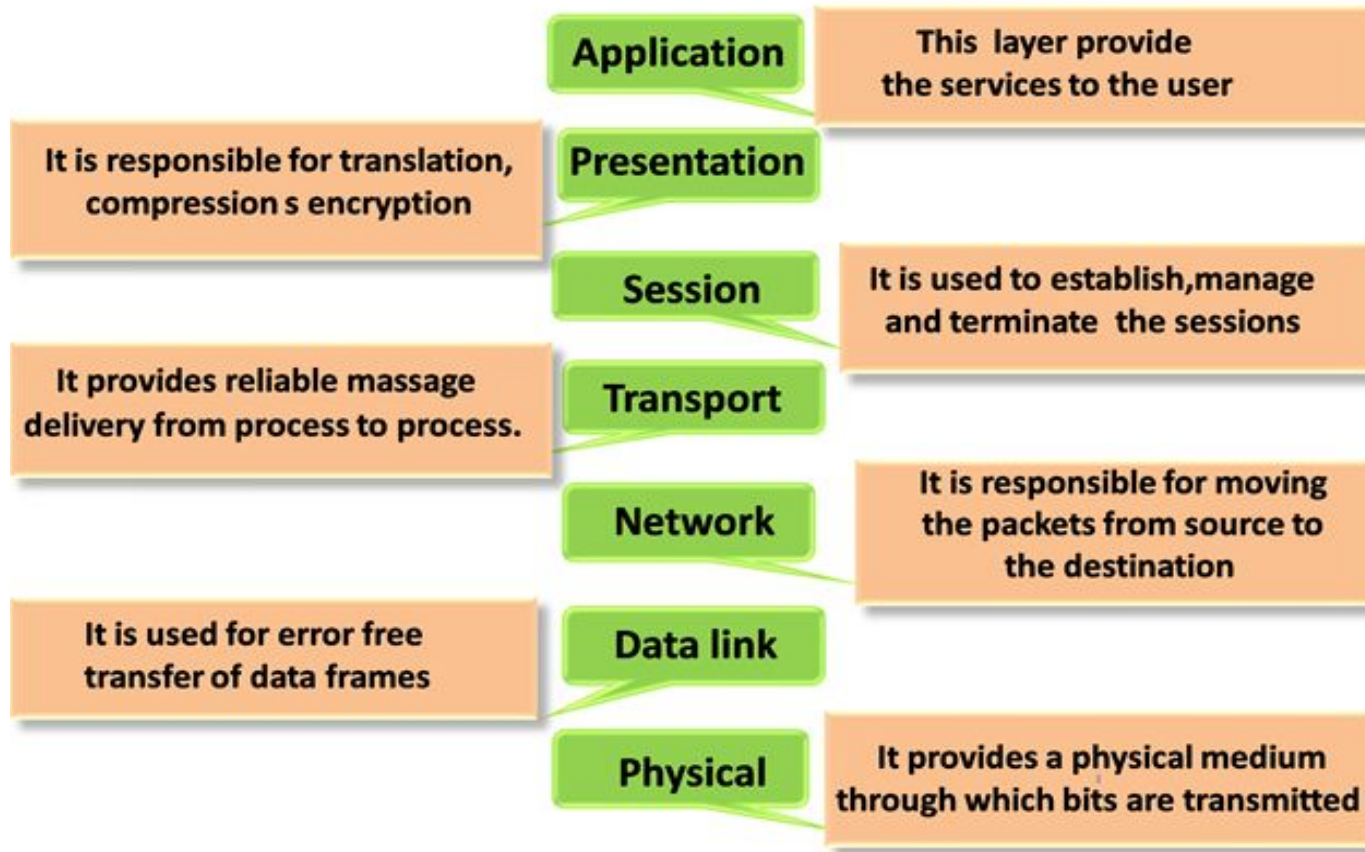
# APPLICATION LAYER

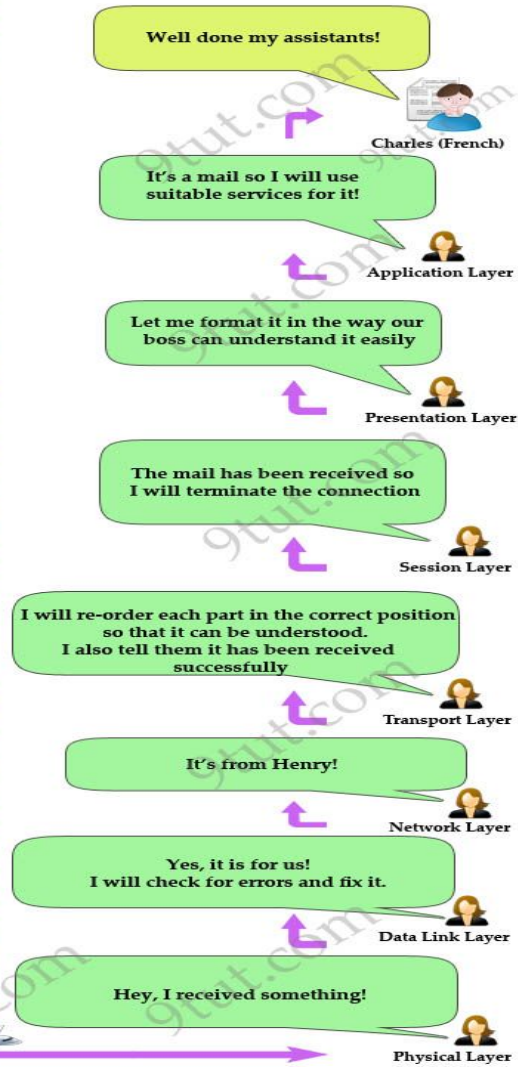
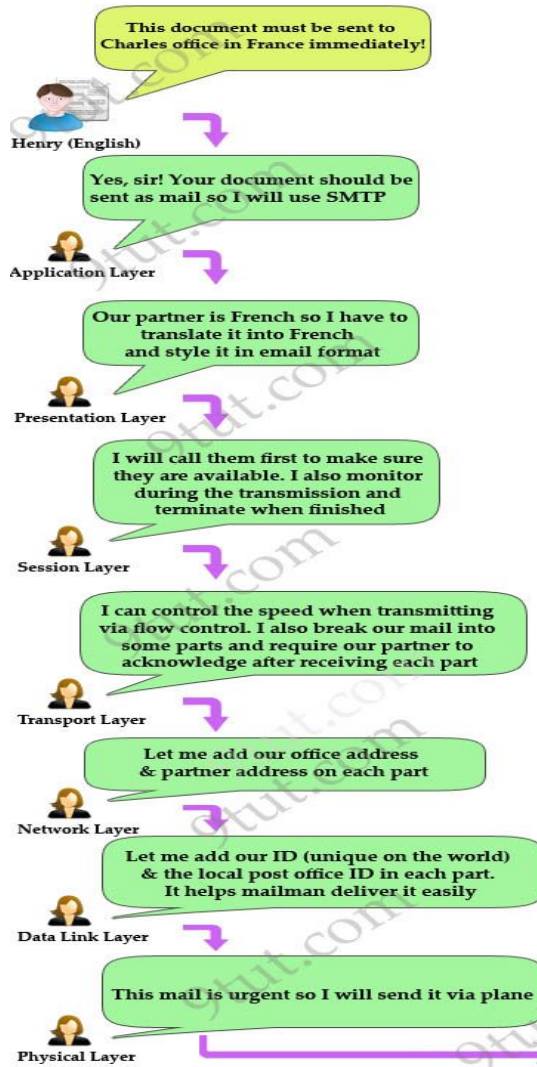
- An application layer serves as a window for users and application processes to access network service.
- It handles issues such as network transparency, resource allocation, etc.
- An application layer is not an application, but it performs the application layer functions.
- This layer provides the network services to the end-users.



# FUNCTION OF APPLICATION LAYER

- **File transfer, access, and management (FTAM):** An application layer allows a user to access the files in a remote computer, to retrieve the files from a computer and to manage the files in a remote computer.
- **Mail services:** An application layer provides the facility for email forwarding and storage.
- **Directory services:** An application provides the distributed database sources and is used to provide that global information about various objects.





# OSI Model & TCP/IP

## OSI

**Application**  
High-level API, resource sharing

**Presentation**  
Data formatting, encoding, encryption, compression

**Session**  
Authenticate, manage sessions and reconnections

**Transport**  
Message segmentation, acknowledgement, reliable

**Network**  
Multi node routing and addressing

**Data link**  
Flow and error control on physical link

**Physical**  
Transmission of physical bit streams

## TCP/IP

**Application**

**Transport**

**Internet**

**Network  
Access**

# NIC

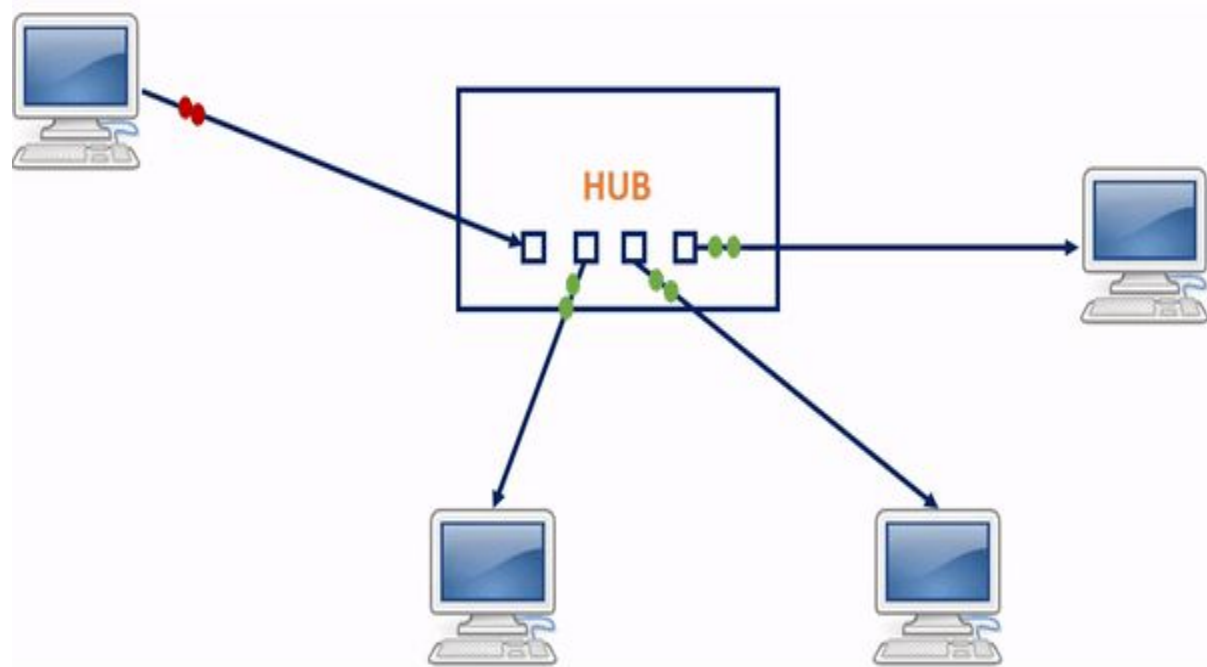
- Network interface card or NIC, is also known as Ethernet card, network card, LAN card, network adapter or network adapter card (NAC) or Network Interface Unit(NIU) or Terminal Access Point (TAP).
- It is a physical and data link layer device used by computers to connect to Ethernet LAN and communicate with other devices on the LAN.
- The earliest Ethernet cards were external to the system and needed to be installed manually. In modern computer systems, it is an internal hardware component.
- The NIC manufacturer assigns a unique physical address to each NIC card. This physical address is called as MAC address or Media Access Control Address.
- MAC address is a 6 byte unique hardware identification number that uniquely identifies each device on a network. Because there are millions of networkable devices in existence, MAC address helps to distinguish them on the network.



# HUB

- A hub is a networking device that is used to connect multiple devices or segments on a local network. It is a physical layer (layer-1) device that simply broadcasts all incoming data to all other output ports. means if a hub has eight pods, then any input data that arrives on pod 1 will be transmitted on all ports 2 to 8.
- It is not an intelligent device because it does not have any memory to store device information. If a computer wants to send information to another computer, the hub broadcasts information to all the other computers, connected to the hub, that's why it is not an intelligent device.
- So there is a lot of traffic on the network and network performance is also very poor, only one device transmits information at a particular time.

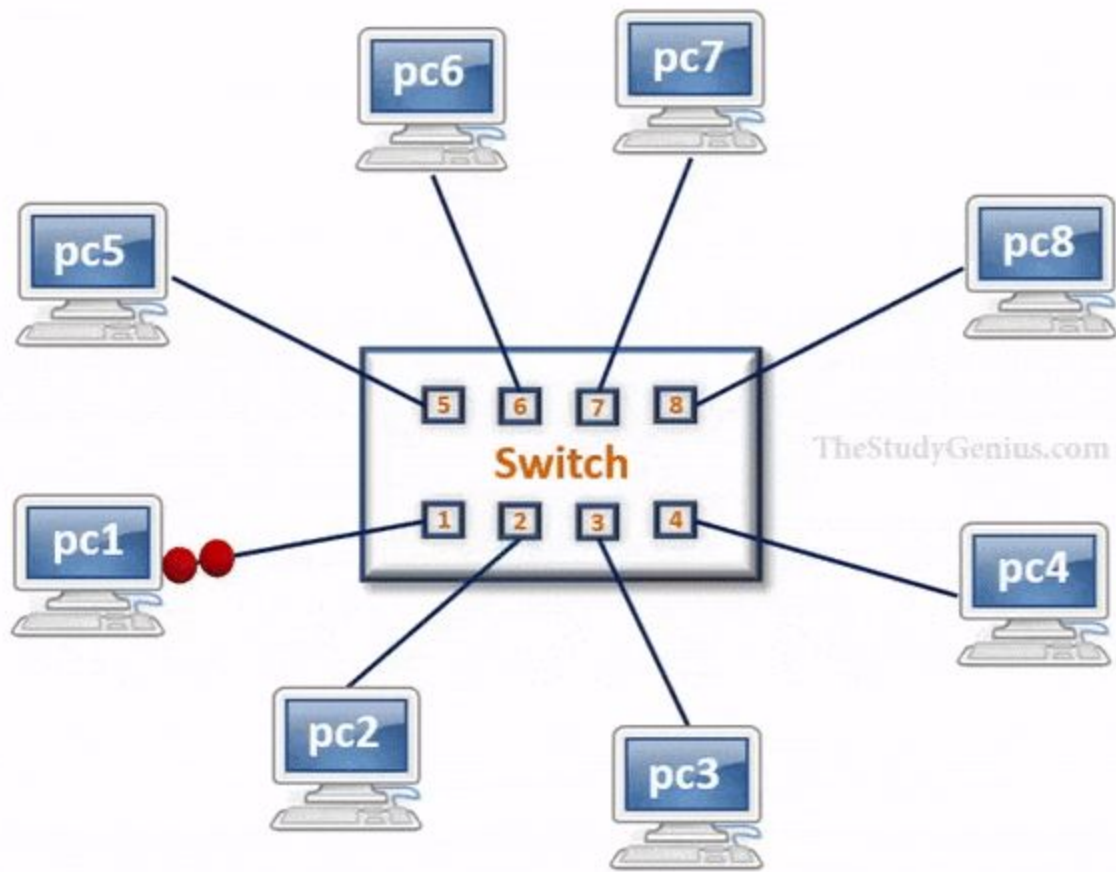






# SWITCH

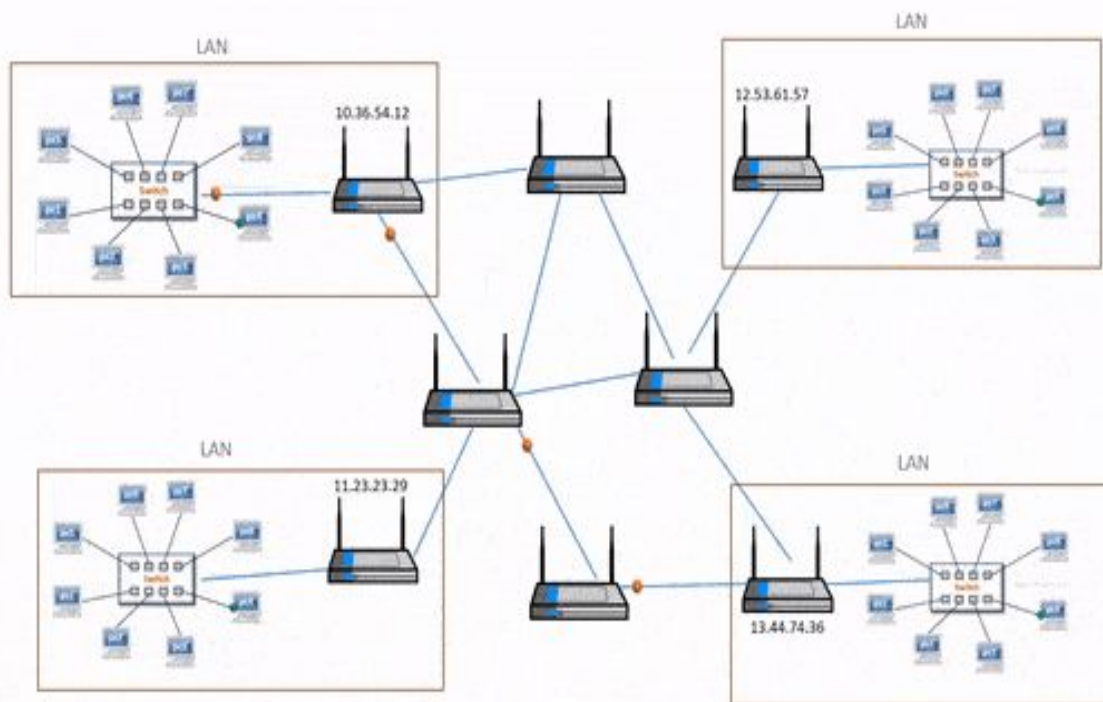
- Switch is a network device that has multiple ports, used to connect computer devices and create a network. It works on layer 2 (data-link layer) of the OSI model and has multiple switching ports, whichever PC connects to its ports connects that computer to the network.
- A switch can actually learn the physical addresses of the devices that are connected to it, store these physical addresses (called MAC addresses) in its table.
- It's an intelligent device because it has a memory where it maintains a table called CAM table (Content Accessible Memory), and stores the port number and MAC addresses of all devices, which helps to identify every device on a network.



# ROUTER

- A router is an internetworking device, that receives IP packets from one computer network and forwards it to another computer network.
- It is used to establish connections between two or more different computer networks.
- It can be a physical or virtual networking device, which is designed to receive the data packets from one network, analyze it, and forward it to another computer network.
- It is an intelligent device because it maintains a routing table, decides the packet's next route, and also helps to find the best route to transmit the IP packets from source to destination.

## Router Device



# BRIDGE

- A bridge is the network device that established a connection between various LANs thus forming a larger LAN.
- This scenario of grouping networks is termed network bridging.
- As various components are connected in a single line through the bridge, they appear to be a single network.
- The functionality of bridges is at the data link layer of the OSI model and so these network devices are also called Layer 2 switches.

# REPEATER

- As signals travel along a network cable (or any other medium of transmission), they degrade and become distorted in a process that is called attenuation. If a cable is long enough, the attenuation will finally make a signal unrecognizable by the receiver.
- A Repeater enables signals to travel longer distances over a network. Repeaters work at the OSI's Physical layer. A repeater regenerates the received signals and then retransmits the regenerated (or conditioned) signals on other segments.

# TASK

- Differentiate between
  - Peer-to-peer network and client server network
  - LAN and MAN
  - Hub and Switch
  - Switch and Router