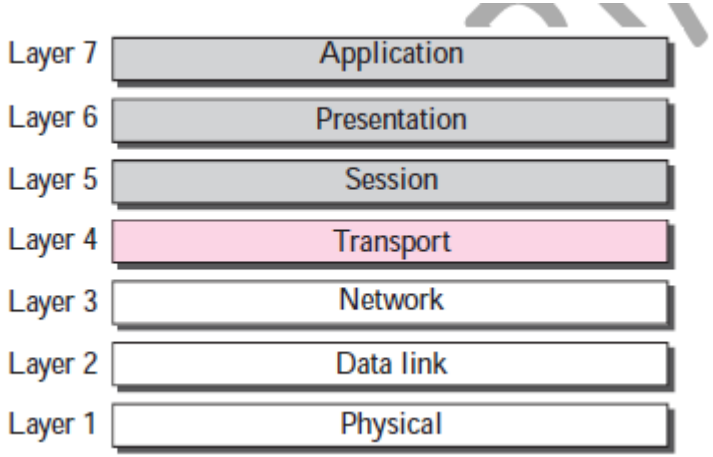
OSI Layer

Open Systems Interconnection Reference Model

• Developed in 1984 by the International Standards Organization (ISO)

• It is a way of sub-dividing a communications system into smaller parts called layers.

• A layer is a collection of conceptually similar functions that provide services to the layer above it and receives services from the layer below it.



Layered Architecture –

• The OSI model is composed of seven ordered layers: physical (layer 1), data link (layer 2), network (layer 3), transport (layer 4), session (layer 5), presentation (layer 6), and application (layer 7).

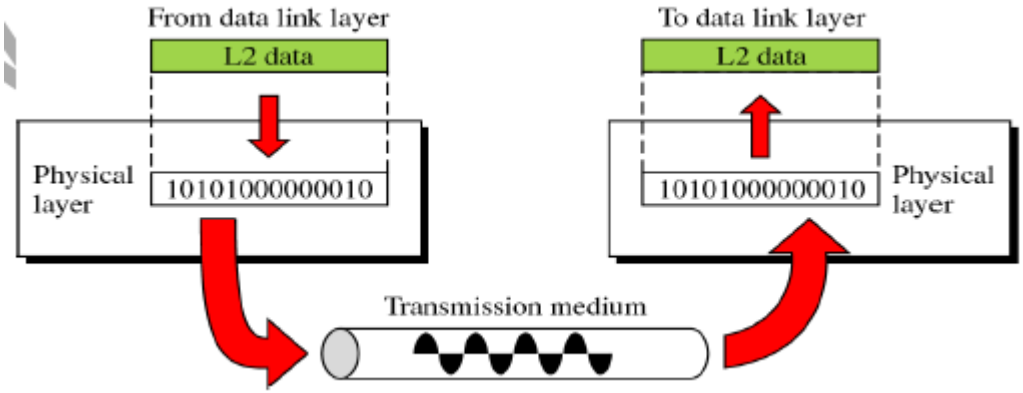
Physical Layer –

• The physical layer is responsible for the movement of individual bits from one node to another.

• The physical layer coordinates the function required to carry a bit stream over a physical medium.

• It deals with the mechanical and electrical specifications of the interface and transmission medium.

• It also defines the procedures and functions that physical devices and the interfaces have to perform for transmission to occur. The data here consists of a stream of bits (sequence of 0's and 1's).



Responsibilities of Physical Layer –

1. **Physical characteristics of interfaces and medium**: It defines the characteristics of the interface between the devices and the transmission medium.

2. **Representation of bits**: It consist of stream of bits (0;s and 1's) with no interpretation. The bits are represented in the form of signals i.e. in the encoded format.

3. **Data Rate**: The transmission rate i.e. the number of bits sent each second is also defined.

4. **Synchronization of bits**: The sender and receiver not only must use the same bit rate but also must be synchronized at the bit level. In other words, the sender and the receiver clocks must be synchronized.

5. **Line Configuration**: The physical Layer is concerned with the connection of devices to the media ie point to point and multi point configuration.

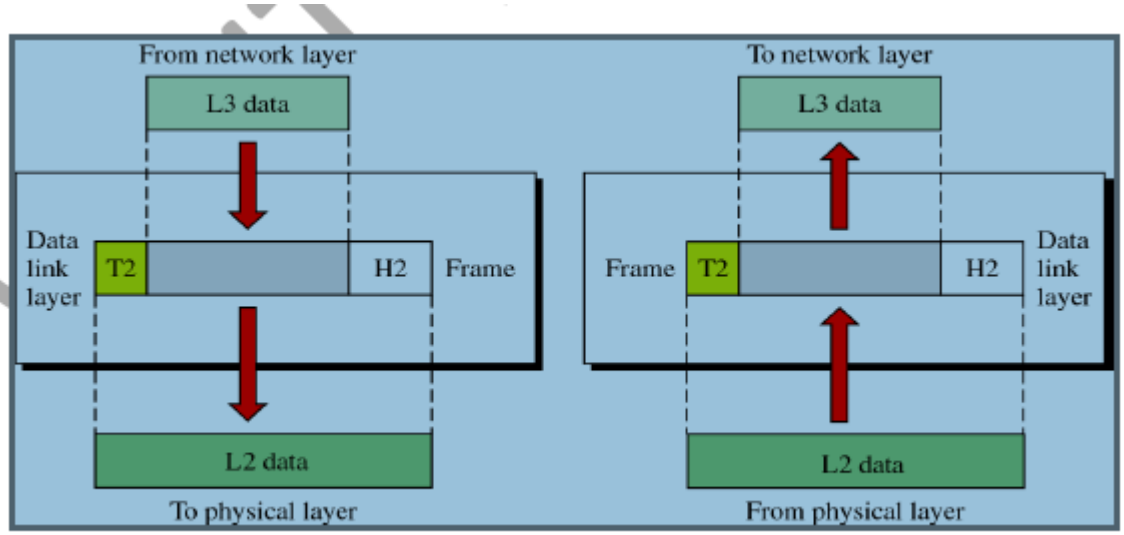
6. **Physical topology:** It defines how devices are connected to make a network. Devices can be connected by using a mesh topology, a star topology or any such kind of topologies.

7. **Transmission Mode**: It also defines the direction of transmission between devices : simplex, half duplex or full duplex.

Data Link Layer –

• The data link layer is responsible for moving frames from one node to the other. The data link layer divides the stream of bits received from the network layer into manageable data units called frames.

• The data link layer makes the physical layer reliable by adding mechanisms to detect and retransmit damaged or lost frames. It also controls the flow (i.e. the rate at which the data is sent or received) of data.

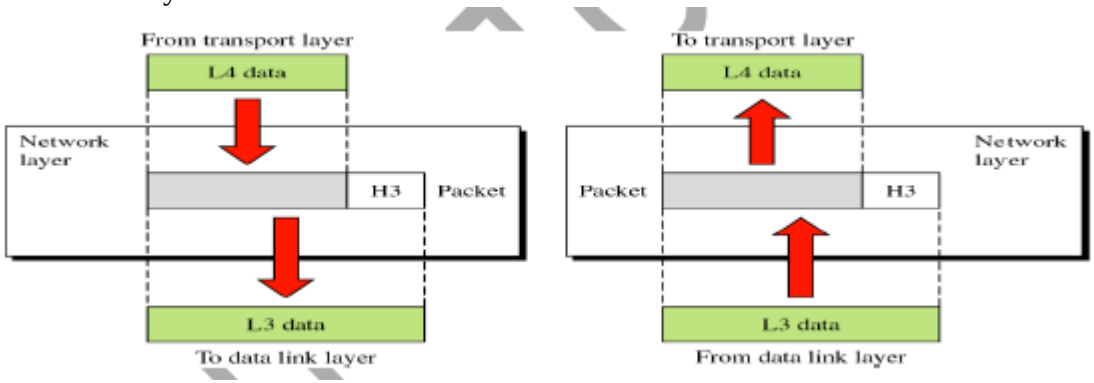


Responsibilities –

1. **Framing** The data link layer divides the stream of bits received from the network layer into manageable data units called **frames**.
2. **Physical addressing** If frames are to be distributed to different systems on the network, the data link layer adds a header to the frame to define the sender of receiver of the frame.
3. **Flow control** If the rate at which the data are absorbed by the receiver is less than the rate at which data are produced in the sender, the data link layer imposes a flow control mechanism to avoid overwhelming the receiver.
4. **Error control** The data link layer adds reliability to the physical layer by adding mechanisms to detect and retransmit damaged or lost frames.It also uses a mechanism to recognize duplicate frames
5. **Access Control** When two or more devices are connected to the same link, data link layer protocols are necessary to determine which device has control over link at any time.

Network Layer :

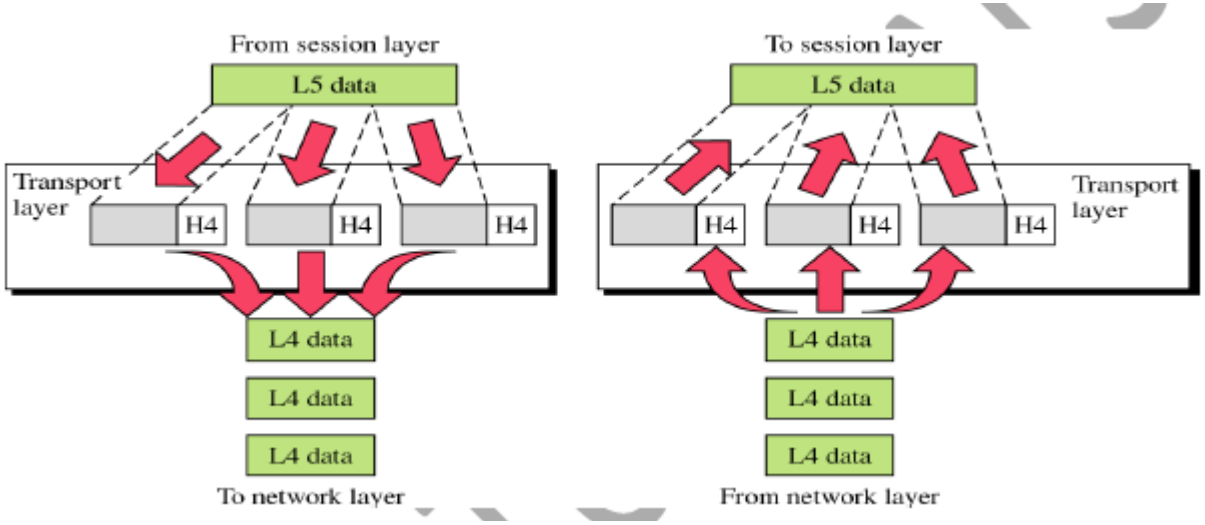
• The network layer is responsible for the source to destination delivery of a packet, possibly across multiple networks (links).
• When the links are connected to the large network than there is a need to route a packet. This routing process is done by routers which exist at the network layer.



Responsibilities –
1. **logical addressing** – The physical addressing implemented by the data link layer handles the addressing problem locally. If a packet passes the network boundary we need another addressing system to help distinguish the source and Destination systems. The network layer adds a header to the packet coming from the upper layer that among other things, includes the logical address of the sender and receiver.
2. **Routing** – When independent networks or links are connected to create internetworks or large network , the connecting devices route or switch the packets to their final destination.

Transport Layer –
• The transport layer is responsible for process to process delivery of the entire message. A process is an application program running on a host. Like the data link layer, the transport layer is responsible for error control and flow control.

• A message is divided into segments, than it is the responsibility of the transport layer to reassemble the segments at the destination point and identify and replace the segments that were lost in transmission. This layer can either be connectionless or connection oriented.
Responsibilities –
1. Service point addressing – The transport layer header must include a type of address called service point address to check the network layer gets each packet to the correct computer and the transport layer gets the entire message to the correct process on that computer.



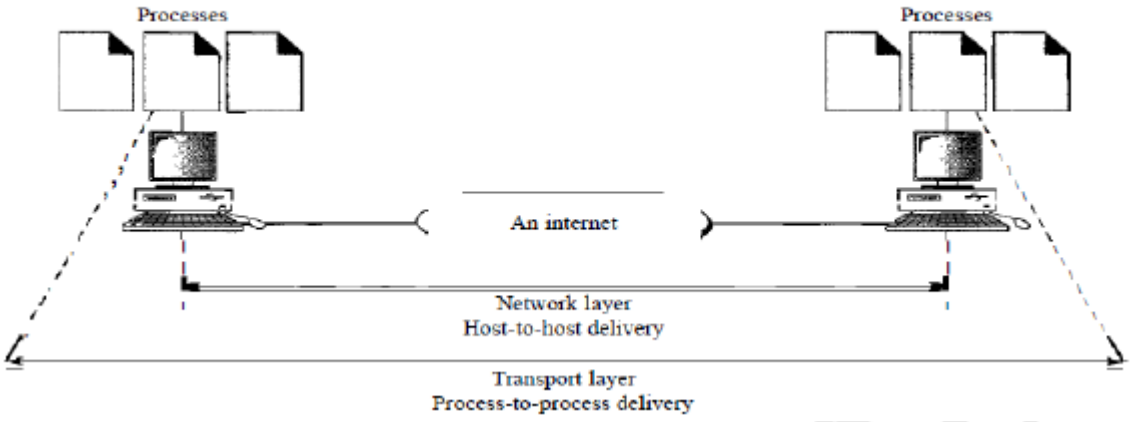
2. Segmentation and reassembly – A message is divided into transmittable segments with each segment containing a sequence number. These numbers enable the transport layer to reassemble the message correctly upon arriving at the destination and to identify and replace packets that were lost in transmission.

3. Flow Control – Like the data link layer , the transport layer is responsible for flow control. However,flow control at this layer is performed end to end rather than across a single link.

4. Error Control – Here the sending transport layer makes sure that the entire message arrives at the receiving transport layer without error. Error correction is usually achieved through retransmission.

5. Connection control – The transport layer can be either connectionless or connection oriented. A connectionless transport layer treats each segment as an independent packet and delivers it to the transport layer at the destination machine. A connection oriented transport layer makes a connection with the transport layer at the destination machine first before delivering the packets. After all the data are transferred, the connection is terminated.

Figure – illustrates process-to-process delivery by the transport layer.



Session Layer:

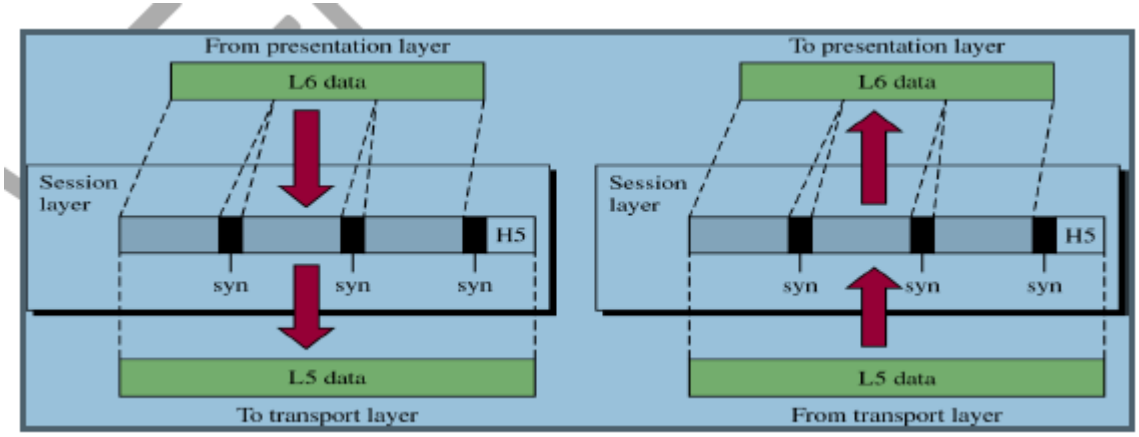
• The services provided by the first 3 layers (physical, data link, network) are sometimes not sufficient for some processes. At this point, the session layer acts as a dialog controller in the network.

• It establishes, maintains and synchronizes the interaction among communicating systems. The session layer allows a process to add checkpoints to a stream of data.

Responsibilities –

1. **Dialog control –** The session layer allows two systems to enter into dialog. It allows the communication between two processes to take place in either half duplex or full duplex.
2. **Synchronization –** The session Layer allows a process to add checkpoints or synchronization points to a stream of data.

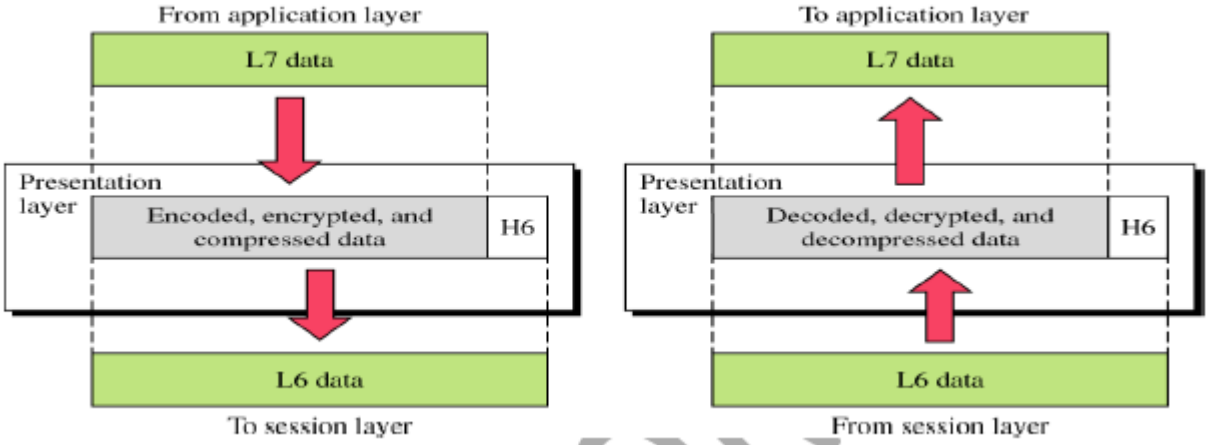
Figure – illustrates the relationship of the session layer to the transport and presentation layers.



Presentation Layer:

• The presentation layer is concerned with the syntax and semantics of the information exchanged between two systems.

• The presentation layer is responsible for translation, compression and encryption.



Responsibilities –

1. Translation – The processes in two systems are usually exchanging information in the form of character strings, numbers and so on.The information must be changed to bit streams before being transmitted.

2. Encryption – To carry sensitive data, a system must be able to ensure privacy. Encryption means that the sender transforms the original information to another from and sends the resulting message out over the network. Decryption reverses the original process.

3. Compression – Data compression reduces the number of bits contained in the information.

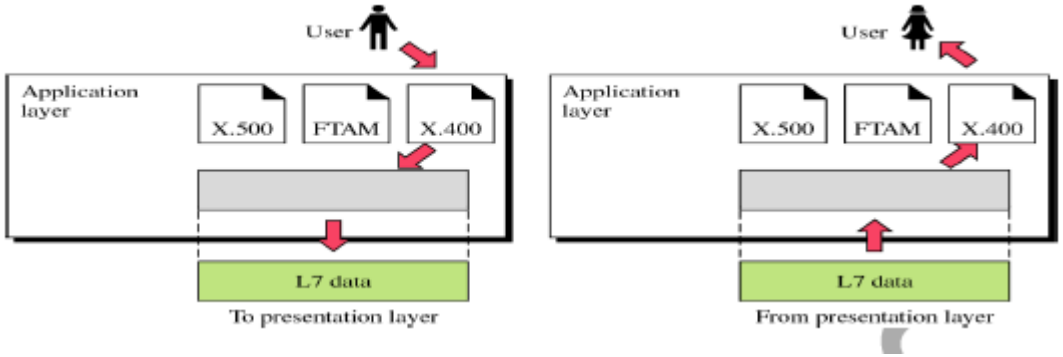
Application Layer:

• The application layer enables the user, whether human or software, to access the network.

• 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.

• Figure – shows the relationship of the application layer to the user and the presentation layer. Of the many application services available, the figure shows only three: *XAOO* (message-handling services), X.500 (directory services), and file transfer, access, and management (FTAM).

• The user in this example employs *XAOO* to send an e-mail message.



The application layer is responsible for providing services to the user.

1. Network virtual Terminal – It is a software version of a physical terminal, and it allows a user to log on to a remote host. To do so the application creates a software emulation of a terminal at the remote host.The user computer talks to the software emulation of a terminal which in turn talks to the host and vice versa.

2. File transfer, access a nd management – The application allowas a user to access files in a remote host, to retrieve files from a remote computer for use in the local computer, and to manage a control files in a remote computer locally.

3. Mail service – The application provides the basis for email forwarding and storage.

4. Directory services – This application provides distributed database sources and access for global information about various objects and services.