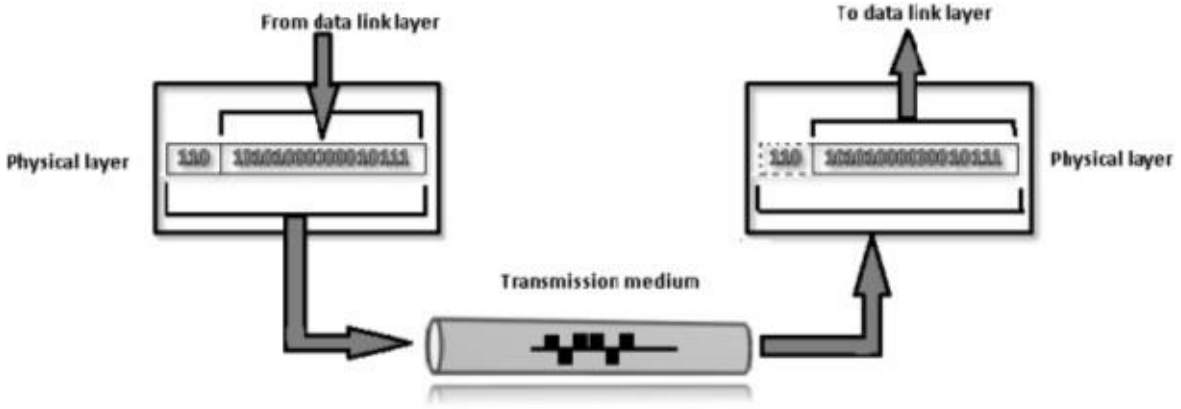
Describe the layers in the OSI Model. Give a brief description about the responsibilities of each layer.

A brief description of the functions of each layer in the OSI model is described as below:

Physical Layer

Primary responsibility: physical layer is responsible for movements of individual bits from one hop (node) to the next.

The physical layer coordinates the functions 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 interfaces have to perform fortransmission to Occur. Position of the physical layer with respect to the transmission medium and the data link layer is shown with the figure.



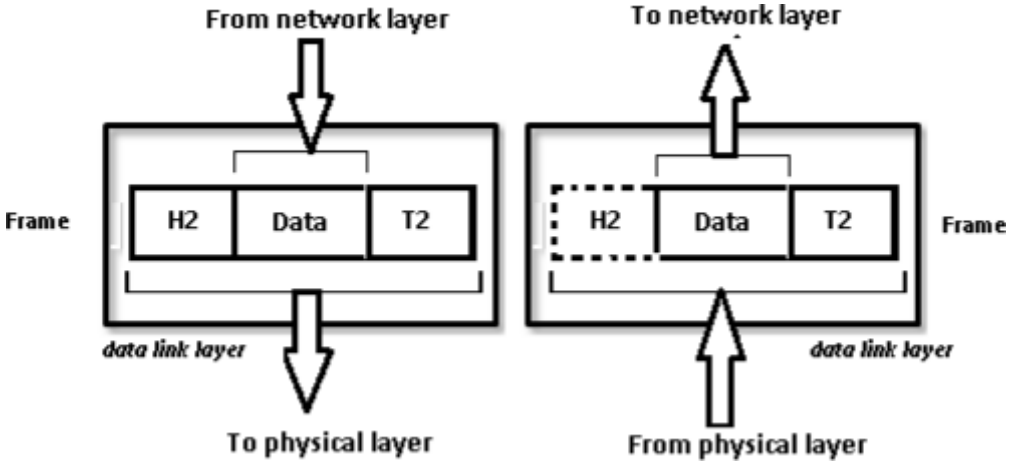
Other responsibilities of the physical layer include:

- Defines the characteristics of the interface between the devices and the transmission medium.
- The data in physical layer data consists of a stream of bits (0s and 1s) without interpretation, and defines the type of encoding for those streaming bits.
- The physical layer defines the duration of a bit, which is how long it lasts.
- All bits are synchronized (the sender and the receiver clocks must be synchronized)
- The physical layer is concerned with the connection of devices to the media.
  E.g. In a point-to-point configuration, two devices are connected through a dedicated link. Ina multipoint configuration, a link is shared among several devices.
- The physical topology defines how devices are connected to make a network.
  E.g. Devices can be connected by using a mesh topology (every device is connected to everyother device), a star topology (devices are connected through a central device), a ring topology (each device is connected to the next, forming a ring), a bus topology (every deviceis on a common link), or a hybrid topology (this is a combination of two or more topologies).

The physical layer defines the direction of transmission between two devices. E.g. Simplex,half-duplex, and full-duplex. In simplex mode, only one device can send; the other can onlyreceive. The simplex mode is a one-way communication. In the half-duplex mode, two devices can send and receive, but not at the same time. In a full-duplex (or simply duplex) mode, two devices can send and receive at the same time.

Data Link Layer

Primary responsibility: The data link layer is responsible for moving frames from one hop (node)to the next.
The data link layer transforms 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). Figure as shown describes the relationship of the data link layer to the network and physical layers.



Other responsibility of the data link layer includes:

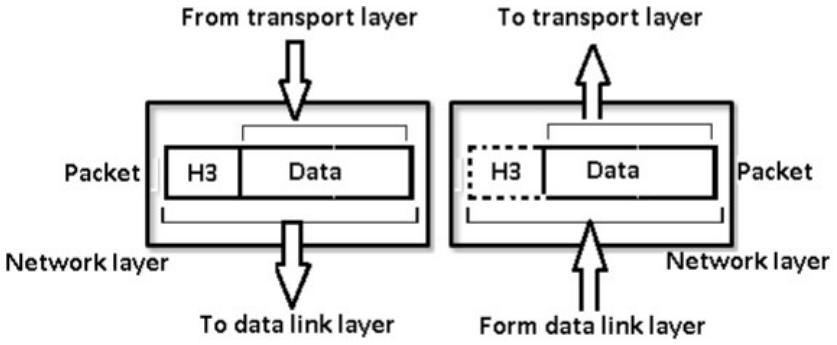
- The data link layer divides the stream of bits received from the network layer into manageable data units called frames.
- If those frames are to be distributed to different systems on the network, the data link layer
- adds a header (H2 in the figure) to the frame to define the sender and/or receiver of the frame.
- If the rate at which the data are absorbed by the receiver is less than the rate at which dataare produced in the sender, the data link layer imposes a flow control mechanism to avoid overwhelming the receiver.
- The data link layer adds reliability to the physical layer by adding mechanisms to detect andretransmit damaged or lost frames (Errors). It also uses a mechanism to recognize duplicate frames. Error control is normally achieved through a trailer added to the end of the frame (T2 in the figure).
- When two or more devices are connected to the same link, data link layer protocols are necessary to determine which device has control over the link at any given time, throughaccess control.

Network Layer

Primary responsibility: The network layer is responsible for the delivery of individual packets fromthe source host to the destination host.

The network layer is responsible for the source-to-destination delivery of a packet, possibly across multiple networks (links). Whereas the data link layer oversees the delivery of the packet between two systems on the same network (links), the network layer ensures that each packet gets from its point of origin to its final destination.

If two systems are connected to the same link, there is usually no need for a network layer. However, if the two systems are attached to different networks (links) with connecting devices between the networks (links), there is often a need for the network layer to accomplish source-to- destination delivery. Figure as depicted below describes the relationship of the network layer to thedata link and transport layers.



Other responsibility of the Network layer includes:

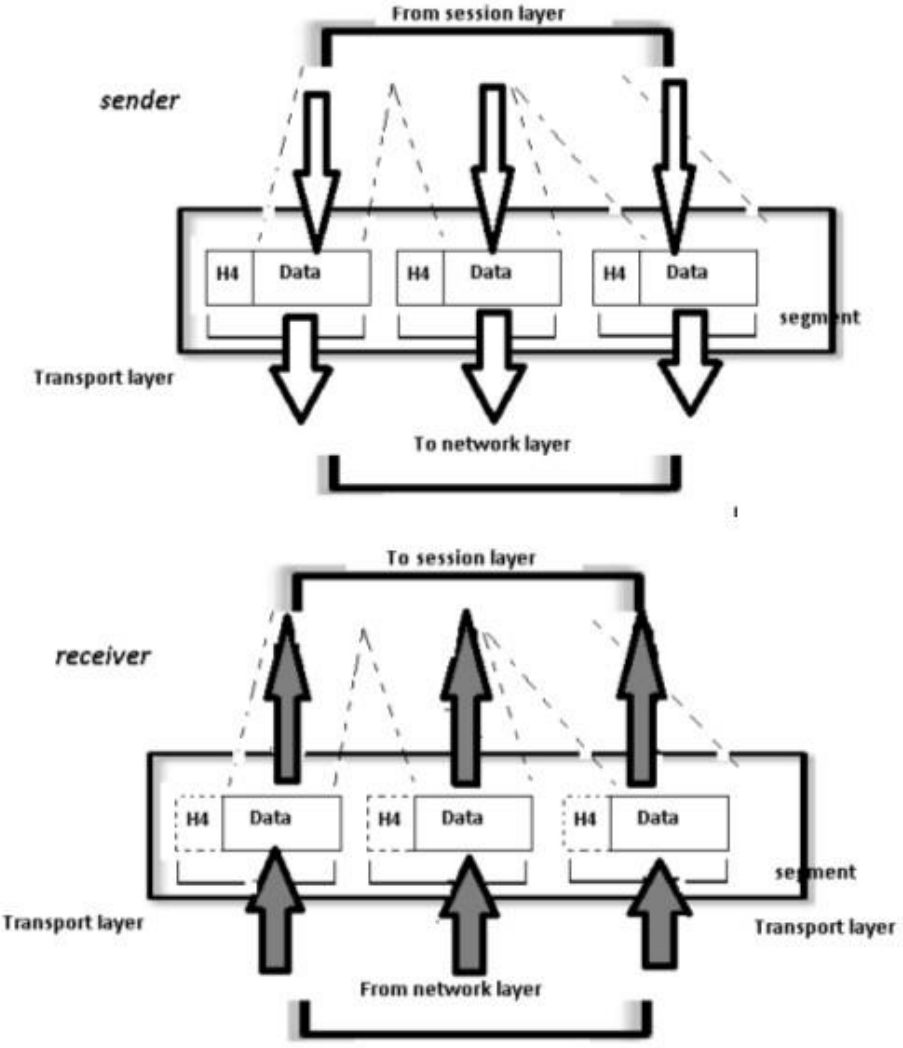
- The physical addressing implemented by the data link layer handles the addressing problemlocally. If a packet passes the network boundary, we need another addressing system calledlogical addressing to help distinguish the source and destination systems.
- The network layer adds a header to the packet coming from the upper layer that, amongother things, includes the logical addresses of the sender and receiver.
- When independent networks or links are connected to create internetworks (network of networks) or a large network, the connecting devices (called routers or switches) route orswitch the packets to their final destination.

Transport Layer

Primary responsibility: The transport layer is responsible for the delivery of a message from one process to another.

The transport layer is responsible for process-to-process delivery of the entire message. A process isan application program running on a host. Whereas the network layer oversees source- to destination delivery of individual packets, it does not recognize any relationship between those packets. It treats each one independently, as though each piece belonged to a separate message, whether or not it does. The transport layer, on the other hand, ensures that the whole message arrives intact and in order, overseeing both error control and flow control at the source-to destination level. Figure depicted below shows the relationship of the transport layer to the

networkand session layers.

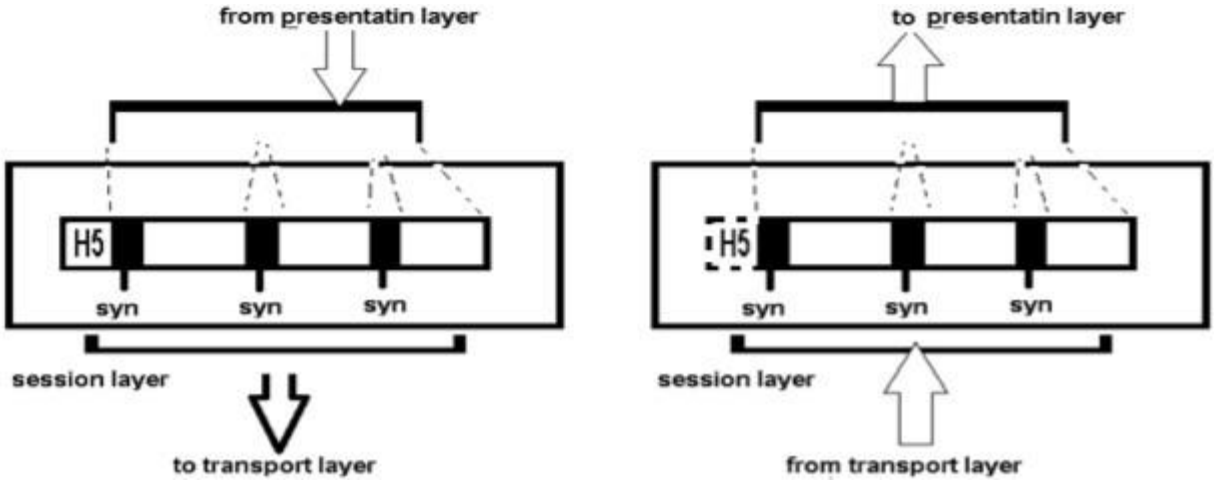


- Service-point addressing. Computers often run several programs at the same time. For this reason, source-to-destination delivery means delivery not only from one computer to the next but also from a specific process (running program) on one computer to a specific process (running program) on the other. The transport layer header must therefore include atype of address called a service-point address (or port address).
- Segmentation and reassembly. A message is divided into transmittable segments, with eachsegment containing a sequence number. These numbers enable the transport layer to reassemble the message correctly upon arriving at the destination
- Connection control. The transport layer can be either connectionless or connection oriented.
- A connectionless transport layer treats each segment as an independent packetand delivers it to the transport layer at the destination machine.
- Flow control. Like the data link layer, the transport layer is responsible for flow control.

- Error control. Like the data link layer, the transport layer is responsible for error control.

Session Layer

Primary responsibility: The session layer is responsible for dialog control and synchronization. Theservices provided by the first three layers (physical, data link, and network) are not sufficient for some processes. The session layer is the network dialog controller. It establishes, maintains, and synchronizes the interaction among communicating systems.



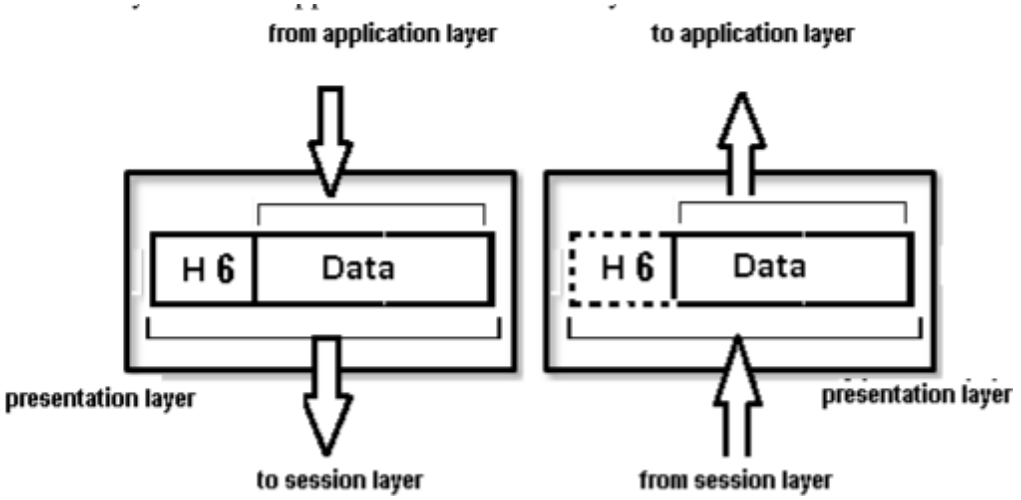
Other responsibility includes:

- Dialog control. The session layer allows two systems to enter into a dialog. It allows thecommunication between two processes to take place in either half duplex (One way at atime) or full-duplex (two ways at a time) mode.
- Synchronization. The session layer allows a process to add checkpoints, or synchronizationpoints, to a stream of data.

Presentation Layer

Primary responsibility: The presentation layer is responsible for translation, compression, and encryption.

The presentation layer is concerned with the syntax and semantics of the information exchanged between two systems. Figure as depicted below describes the relationship between the presentation layer and the application and session layers.

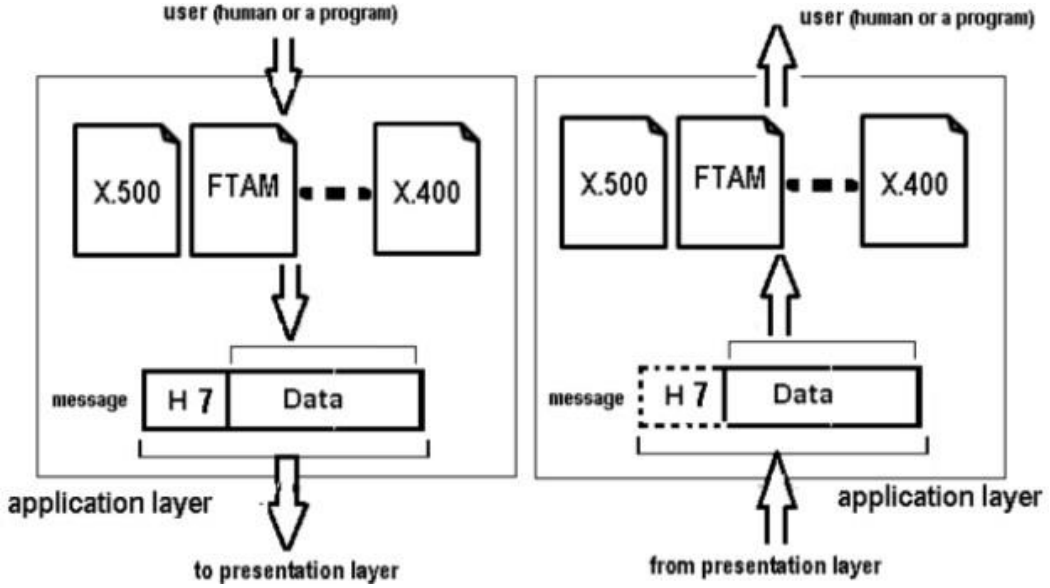


Other responsibility includes:

- Translation. The processes (running programs) in two systems are usually exchanging information in the form of character strings, numbers, and so on. The information must bechanged to bit streams before being transmitted. Because different computers use differentencoding systems, the presentation layer is responsible for interoperability between these different encoding methods.
- Encryption. To carry sensitive information, a system must be able to ensure privacy. Encryption means that the sender transforms the original information to another form and sends the resulting message out over the network. Decryption reverses the original processto transform the message back to its original form.
- Compression. Data compression reduces the number of bits contained in the information. Data compression becomes particularly important in the transmission of multimedia such astext, audio, and video.

Application Layer

Primary responsibility: The application layer is responsible for providing services to the user. Theapplication 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 as depicted below 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 of them as:
X.400 (message-handling services), X.500 (directory services), and file transfer, access, andmanagement (FTAM). The user in this example employs X.400 to send an e-mail message.



- Network virtual terminal. A network virtual terminal 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 asoftware emulation of a terminal at the remote host. The user's computer talks to the software terminal which, in turn, talks to the host, and vice versa.
- File transfer, access, and management. This application allows a user to access files in a remote host (to make changes or read data), to retrieve files from a remote computer for usein the local computer.
- Mail services. This application provides the basis for e-mail forwarding and storage.
- Directory services. This application provides distributed database sources and access forglobal information about various objects and services.