OSI (Open Systems Interconnections)

Application Layer	
Presentation Layer	Software Layers
Session Layer	
Transport Layer	Heart of OSI
Network Layer	
Data Link Layer	Hardware Layers
Physical Layer	

Sender

Receiver
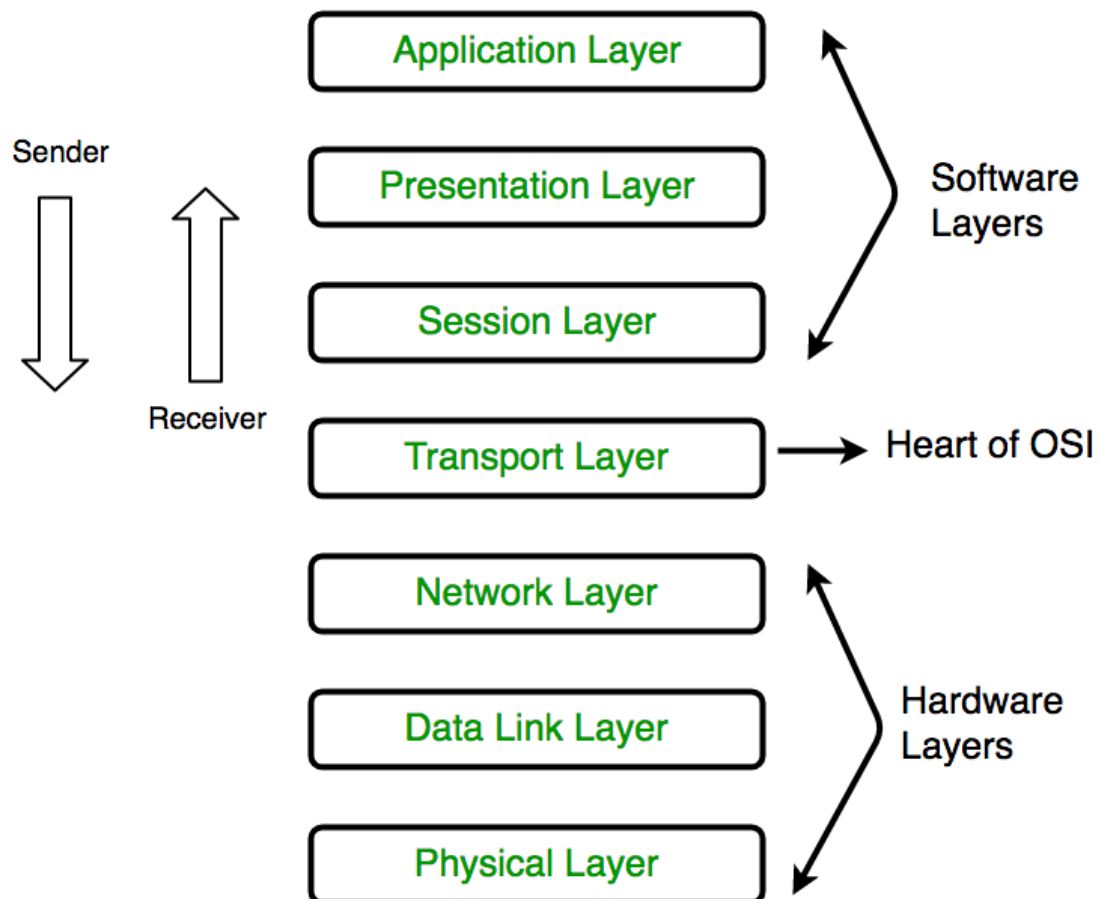
No.	Layer Name	Responsibility	Information Form (Data Unit)	Device
7	Application Layer	Helps in identifying the client and synchronize communication	Message	-
6	Presentation Layer (Translation Layer)	Data from application layer is extracted and manipulated as required format for transmission	Message	-
5	Session Layer	Establishes connection, maintenance, authentication and ensure security	Message	Gateway
4	Transport Layer (HEART of OSI)	Take service from network layer and provide it to application layer	Segment	Firewall
3	Network Layer	Transmission of data from one host to other. Located in different network	Packet	Router
2	Data Link Layer	Node to node delivery of messages	Frame	Switch, Bridge
1	Physical Layer	Establishing physical connection between devices	Bits	Hub, Repeater, Modem, Cables

1. Physical Layer :

The functions of the physical layer are as follows:

1   **Bit synchronisation:** The physical layer provides the synchronisation of the bits by providing a clock. This clock controls both sender and receiver thus providing synchronization at bit level.
2   **Bit rate control:** The Physical layer also defines the transmission rate i.e. the number of bits sent per second.
3   **Physical topologies:** Physical layer specifies the way in which the different, devices/nodes are arranged in a network i.e. bus, star, or mesh topology.
4   **Transmission mode:** Physical layer also defines the way in which the data flows between the two connected devices. The various transmission modes

possible are Simplex, half-duplex and full-duplex.
* Hub, Repeater, Modem, Cables are Physical Layer devices.
** Network Layer, Data Link Layer, and Physical Layer are also known as **Lower Layers** or **Hardware Layers.**

2. Data Link Layer (DLL) :

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 DLL to transmit it to the Host using its MAC address.
Data Link Layer is divided into two sublayers:

1. Logical Link Control (LLC)
2. Media Access Control (MAC)

The functions of the Data Link layer are :

1. **Framing:** Framing is a function of the data link layer. It provides a way for a sender to transmit a set of bits that are meaningful to the receiver. This can be accomplished by attaching special bit patterns to the beginning and end of the frame.
2. **Physical addressing:** After creating frames, the Data link layer adds physical addresses (MAC address) of the sender and/or receiver in the header of each frame.
3. **Error control:** Data link layer provides the mechanism of error control in which it detects and retransmits damaged or lost frames.
4. **Flow Control:** The data rate must be constant on both sides else the data may get corrupted thus, flow

control coordinates the amount of data that can be sent before receiving acknowledgement.

5   **Access control:** When a single communication channel is shared by multiple devices, the MAC sub-layer of the data link layer helps to determine which device has control over the channel at a given time.

** Packet in Data Link layer is referred to as **Frame.***

** Data Link layer is handled by the NIC (Network Interface Card) and device drivers of host machines.

*** Switch & Bridge are Data Link Layer devices.

3. Network Layer :

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.

The functions of the Network layer are :

1   **Routing:** The network layer protocols determine which route is suitable from source to destination. This function of the network layer is known as routing.

2   **Logical Addressing:** In order to identify each device on internetwork uniquely, the network layer defines an addressing scheme. The sender & receiver's IP addresses are placed in the header by the network layer. Such an address distinguishes each device uniquely and universally.

** Segment in Network layer is referred to as

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Packet.
** Network layer is implemented by networking
devices such as routers.
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4. Transport Layer :

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 acknowledgement of the successful data transmission and re-transmits the data if an error is found.

At sender's side: Transport layer receives the formatted data from the upper layers, performs **Segmentation**, and also implements **Flow & 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.

Note: The sender needs to know the port number associated with the receiver's application.

Generally, this destination port number is configured, either by default or manually. For example, when a web application makes a request to a web server, it typically uses port number 80, because this is the default port assigned to web applications. Many applications have default ports assigned.

At 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.

The functions of the transport layer are as follows:

1. **Segmentation and Reassembly:** This layer accepts the message from the (session) layer, and breaks the message into smaller units. Each of the segments produced has a header associated with it. The transport layer at the destination station reassembles the message.

2. **Service Point Addressing:** In order to deliver the message to the correct process, the transport layer header includes a type of address called service point address or port address. Thus by specifying this address, the transport layer makes sure that the message is delivered to the correct process.

The services provided by the transport layer :

A. Connection-Oriented Service: It is a three-phase process that includes

– Connection Establishment
– Data Transfer
– Termination / disconnection

In this type of transmission, the receiving device sends an acknowledgement, back to the source after a packet or group of packets is received. This type of transmission is reliable and secure.

B. Connectionless service: It is a one-phase process and includes Data Transfer. In this type of transmission, the receiver does not acknowledge receipt of a packet. This approach allows for much faster communication between devices. Connection-oriented service is more reliable than connectionless Service.

* Data in the Transport Layer is called as **Segments**.
** Transport layer is operated by the Operating System. It is a part of the OS and communicates with the Application

Layer by making system calls.
Transport Layer is called as **Heart of OSI** model.

5. Session Layer :

This layer is responsible for the establishment of connection, maintenance of sessions, authentication, and also ensures security.
The functions of the session layer are :

1 **Session establishment, maintenance, and termination:** The layer allows the two processes to establish, use and terminate a connection.
2 **Synchronization:** This layer allows a process to add checkpoints which are considered synchronization points into the data. These synchronization points help to identify the error so that the data is re-synchronised properly, and ends of the messages are not cut prematurely and data loss is avoided.
3 **Dialog Controller:** The session layer allows two systems to start communication with each other in half-duplex or full-duplex.

**All the below 3 layers(including Session Layer) are integrated as a single layer in the TCP/IP model as "Application Layer".
Implementation of these 3 layers is done by the network application itself. These are also known as **Upper Layers or **Software Layers**.

6. Presentation Layer :

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.

The functions of the presentation layer are :

- **Translation:** For example, ASCII to EBCDIC.
- **Encryption/ Decryption:** Data encryption translates the data into another form or code. The encrypted data is known as the ciphertext and the decrypted data is known as plain text. A key value is used for encrypting as well as decrypting data.
- **Compression:** Reduces the number of bits that need to be transmitted on the network.

7. Application Layer :

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, which has 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.

Example: Application – Browsers, Skype Messenger, etc.

`**Application Layer is also called Desktop Layer.`

The functions of the Application layer are :

1 Network Virtual Terminal
2 FTAM-File transfer access and management
3 Mail Services
4 Directory Services