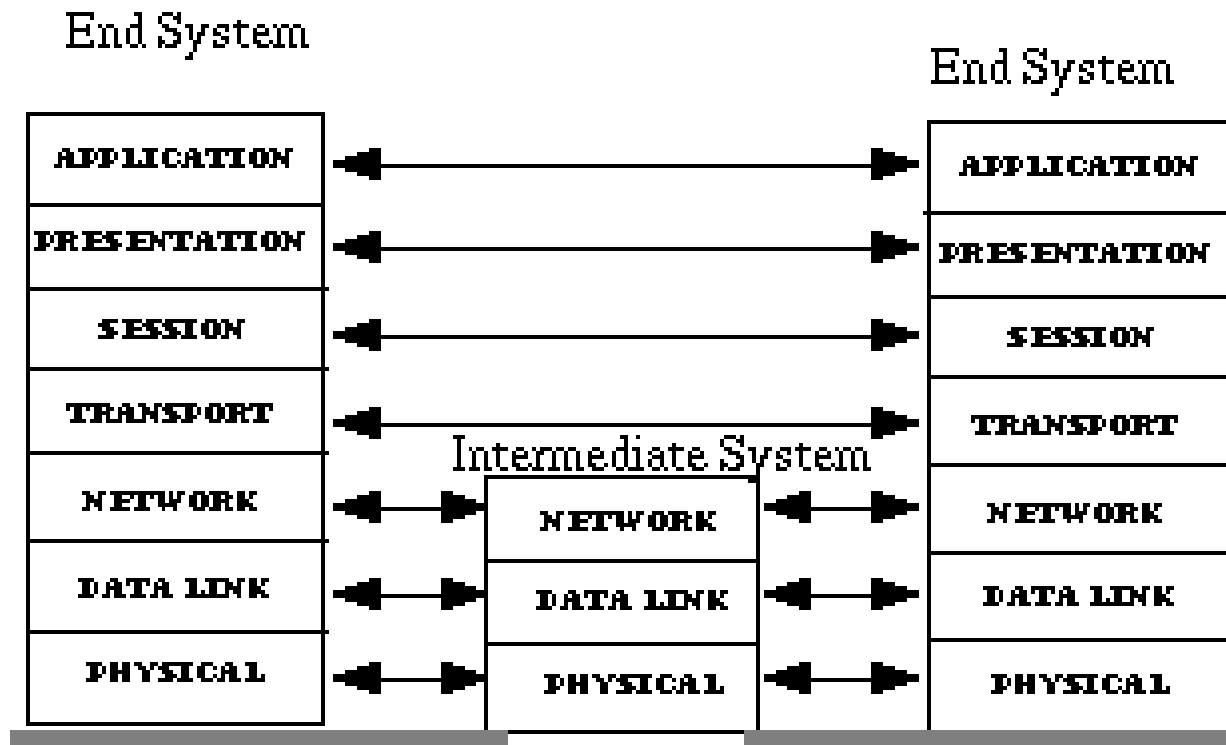


OSI RM

OSI RM has seven layers. Each layer builds upon the previous one so that each layer adds functionality to the services of the previous layer. Thus, outgoing data passes down through each layer, and incoming data passes up through each layer.



Physical layer

- The physical layer coordinates the functions required to transmit a bit stream over a physical medium. Physical layer corresponds to basic network hardware. For example, the specification of RS-232.
- The purpose of the physical layer is to deliver data from one computer to another. Specifically, the physical layer translates bits of data into a format suitable for transmission or receives a transmission and translates it back into bits. This layer sees all data as a stream of bits.
- It deals with the mechanical and electrical specifications of the interface and transmission media.
 - Electrical: what voltages and currents are used.
 - Mechanical: the physical shape and size of the connectors.
 - Functional: the significance of a connector pin and the voltage on that pin
 - Procedural: the sequence of functional changes that indicate event occurrences

Physical Layer

- The physical layer is concerned with the following:
- **Physical characteristics of interfaces and media:** The physical layer defines the characteristics of the interface between the devices and the transmission media. It also defines the type of transmission media.
- **Representation of bits:** The physical layer data consists of a stream of bits. In order to be transmitted, bits must be encoded into signals – electrical or optical. The physical layer defines the type of encoding.
- **Data rate:** The transmission rate is also defined by the physical layer.
- **Synchronization of bits:** The sender and the receiver clocks must be synchronized.

Physical Layer

- **Line configuration:** The physical layer is concerned with the connection of the devices to the media (link). In point-to-point configuration, two devices are connected together through a dedicated link. In multipoint configuration, a link is shared among several devices.
- **Physical topology:** Devices can be connected using mesh topology (full mesh : every device is connected to every other device), bus topology, ring topology, or star topology.
- **Transmission mode:** The physical layer defines the direction of transmission between two devices. In the simplex mode, there is only one transmitter, and the other devices are the receivers (space probe transfer data to an earth station). In half-duplex mode, two devices can send and receive, but not at the same time (user requesting data from a remote server and server returns data later). In full-duplex mode, two devices can send and receive at the same time (video telephone calls).

Physical layer

- A very important concept to remember is that the physical layer is not the same as the physical media (the wires that connect the computers are not part of the physical layer).
- Conceptually, they sit below the physical layer, and they aren't part of the physical layer specification.
- Physical layer is a network dependent layer
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Data Link layer

- Data link layer protocol specifies how to organize data into frames and how to transmit frames over a network. For example, frame formatting, bit or byte stuffing, and checksum computation are classified as layer 2 tasks.
- Responsible for reliable transfer of information across the physical link.
- Sends blocks of data (frames) with the necessary synchronization, flow control and error control.
- Synchronization can be done in 4 ways: time based, character counting, byte stuffing, and bit stuffing.
- It is a network dependent layer.
- Protocols at this layer are HDLC (High-level Data Link Control), LAPB (Link Access Procedure, Balanced), LLC (Logical Link Control), and LAPD (Link Access Procedure, D channel).

Data Link Layer

The responsibilities of this layer:

- **Framing:** The data link layer divides the stream of bits received from the network layer into manageable data units called frames.
- **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 and/or receiver of the frame. If the frame is intended for a system outside the sender's network, the receiver address is the address of the connecting device that connects the network to the next one.
- **Flow control:** If the rate in which the data is transmitted is greater than the rate in which it is absorbed by the receiver, the data link layer imposes a flow control to prevent the consequences (e.g. packet drop). It can be achieved by stop-and-wait or sliding window technique.

Data Link Layer

The responsibilities of this layer:

- **Error control:** The data link layer provides error detection and retransmission of damaged or lost frames. It also provides the mechanism to prevent duplication of frames. Error control is normally achieved through a trailer added left to the end of the frame.
- **Access control:** When two or more devices are connected to the same link, data link layer protocols are necessary to determine which device will access when.

Network Layer

- The network layer is responsible for the source-to-destination delivery of a packet possibly across multiple networks.
- Whereas the data link layer oversees the delivery of the packets between two systems on the same network.
- 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 (network), there is usually no need for a network layer.
- However, if the two systems are attached to different networks with connecting devices between the networks, there is often a need for the network layer to accomplish source-to-destination delivery.

Network Layer

The specific responsibilities of the network layer:

- **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. The network layer adds a header to the packet coming from the upper layer that includes the logical address of the sender and receiver.
- **Routing:** When independent networks are connected together to create internetworks, the connecting devices (router or switches) route or switch the packets to their final destination

Transport layer

- Network independent layer.
- The transport layer is responsible for source-to-destination (end-to-end) delivery of the entire message.
- Whereas the network layer oversees end-to-end delivery of individual packets, it does not recognize any relationship between those packets. It treats each one independently.
- Transport layer ensures that the whole message arrives intact and in order, overseeing both error control and flow control at the source-to-destination level.

Transport layer

- The responsibilities of the transport layer:
- **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 a type of address called a service-point address (or port address). The network layer gets each packet to the correct computer, the transport layer gets the entire message to the correct process on that computer.

Transport layer

- The responsibilities of the transport layer:
- **Segmentation and reassembly:** a message is divided into small manageable segments/packets. Each segment contains a sequence number that enables the transport layer to reassemble the message correctly upon arriving at the destination and to identify and replace segments that were lost during transmission.
- **Connection control:** Transport layer can be 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. A connection-oriented transport layer makes a connection with the transport layer at the destination first before delivering the packets. After the transmission of all data, the connection is terminated.

Transport layer

- The responsibilities of the transport layer:
- **Flow control:** Like the data link layer, the transport layer is responsible for the flow control. However, flow control at this layer is performed end to end rather than across a single link.
- **Error control:** Like the data link layer, the transport layer is responsible for the error control. However, error control at this layer is performed end to end rather than across a single link. Error correction is generally achieved through retransmission.

Session Layer

- Session layer is the network dialog controller.
- It establishes, maintains, and synchronizes the interaction between communicating systems.
- The responsibilities are:
- **Dialog control:** The session layer specifies how to establish a communication session with a remote systems (e.g. how to login to a remote timesharing computer). Specifications for security details such as authentication using passwords belong to this layer. The session layer provides the mechanism for controlling the dialog between the two end systems in half-duplex or full-duplex mode.

For example:

FTP session with half-duplex mode, TALK is Full-duplex.

Session Layer

Responsibilities are:

- **Synchronization:** The session layer allows a process to add checkpoints (synchronization points) into a stream of data. For example, if a system is sending a file of 2000 pages, it is advisable to insert checkpoint after every 100 pages to ensure that each 100-page unit is received and acknowledged independently. In this case, if a crash happens during the transmission of page 523, the only pages that need to be resent after system recovery are pages 501 to 523. Pages previous to 501 need not be resent.

Presentation Layer

- The presentation layer is concerned with the syntax and semantics of the information exchanged between two systems.
- The responsibilities are:
- **Translation:** The processes in two systems are usually exchanging information in the form of character string, numbers, and so on. Because different computers use different encoding systems, the presentation layer is responsible for interoperability between these different encoding systems. The presentation layer at the sender changes the information from its sender-dependent format into a common format. The presentation layer at the receiver changes the common format to its receiver-dependent format.

Presentation Layer

- The responsibilities are:
- **Encryption:** To carry sensitive information a system must be able to assure privacy. Encryption transforms the original information to another form. Then the encrypted message will be transmitted over the network. Decryption reverses the original process to transform the message back to its original form.
- **Compression:** Data compression reduces the number of bits contained in the information. Data compression is very important in the transmission of multimedia such as, text, audio, and video.

Application Layer

- The application layer enables the user (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, other types of distributed information services.
- No header or trailer is added at this layer.
- The responsibilities are:
- **Network virtual terminal:** a network virtual terminal is a software version of a physical terminal and allows a user to log in to a remote host. To do so, the application creates a software 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. The remote host believes it is communicating with one of its own terminals and allows you to log in.

Application Layer

- The responsibilities are:
- **File transfer, access, and management:** This application allows a user to access files in a remote host, to retrieve files from a remote computer for use in local computer, and to manage or control files in a remote computer locally.
- **Mail services:** This application provides the basis for email forwarding and storage
- **Directory services:** This application provides distributed database sources and access for global information about various objects and services.