Network Standards ,Protocols and Network Models

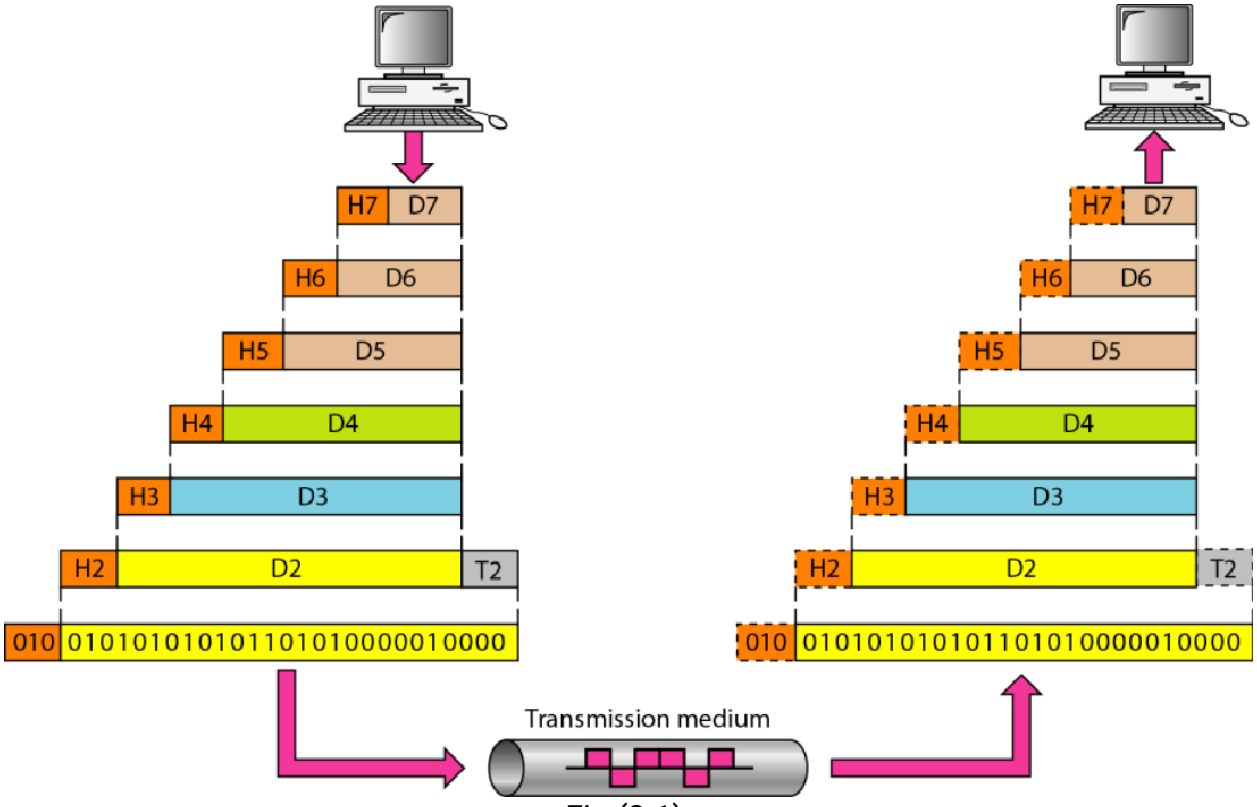


Fig (3-1)

- ## Network Criteria

A network must be able to meet a certain number of criteria. The most important of these are **performance, reliability, and security.**

a) Performance can be measured in many ways, including transit time and response time. Transit time is the **amount of time** required for a message to travel from one device to another. Response time is the **elapsed time** between an inquiry and a response.

The performance of a network depends on a number of factors:

1) Number of users.

2) Type of transmission medium.

3) Capabilities of the connected hardware.

4) Efficiency of the software.

Performance is often evaluated by two networking metrics: **throughput and delay**. We often need more throughput and less delay.

- throughput:

Indicate the level of successful packets (actual rate) delivery from one point on the network to another (measures in bit per second bps)

- Delay :

How long it takes for a bit of data to travel a cross the network from one communication end point to another.

b) Reliability network reliability is measured by the:

1) Accuracy of delivery.

2) Frequency of failure.

3) The time it takes a link to recover from a failure.

4) Network's robustness in a catastrophe.

c) Security Network security issues include:

1) Protecting data from unauthorized access

2) Protecting data from damage and change.

3) Implementing policies for recovery from data losses.

- ## Protocols and Standards

A) **Protocol** :.....is a set of rules followed by the network.

Protocols: are formal standards and policies made up of rules, procedures and formats that defines communication between two or more devices over a network. A protocol defines **what** is communicated, **how** it is communicated, and **when** it is communicated.

Protocols including both software and hardware.

Networking protocols describe many processes such as:

1. Format or Structure of the message.
2. How and when error and system message are passed between devices.
3. The setup and terminate of data transfer session.

B) Standards

Standards are essential in creating an open and competitive market for equipment manufacturers and in guaranteeing national and international telecommunications.

Standards Creation Committees

Most data telecommunications rely primarily on the standards published by the following committees:

International Organization for Standardization (ISO).

American National Standards Institute (ANSI).

Institute of Electrical and Electronics Engineers (IEEE).

Electronic Industries Association (EIA).

- ## Network Models

The layered modesl that dominated data communications and networking literature before 1990 was the Open Systems Interconnection (OSI) model. Everyone believed that the OSI model would become the ultimate standard for data communications, but this did not happen. The TCP/IP protocol suite became the dominant commercial architecture because it was used and tested extensively in the Internet; the OSI model was never fully implemented.

The Open Systems Interconnection (OSI) model is introduced in the late 1970s by the International Standards Organization (ISO).

(Note: ISO is the organization. OSI is the model.)

The OSI model is a layered model for the design and understands of network systems that allows communication between all types of computer systems.

OSI consists of seven separate but related layers, each of which defines a part of the process of moving information across a network (see Figure 3.2). When a message is sent for example from device A to device B. As the message travels from A to B, it may pass through many intermediate nodes, called routers. These intermediate nodes usually involve only the first three layers of the OSI model.

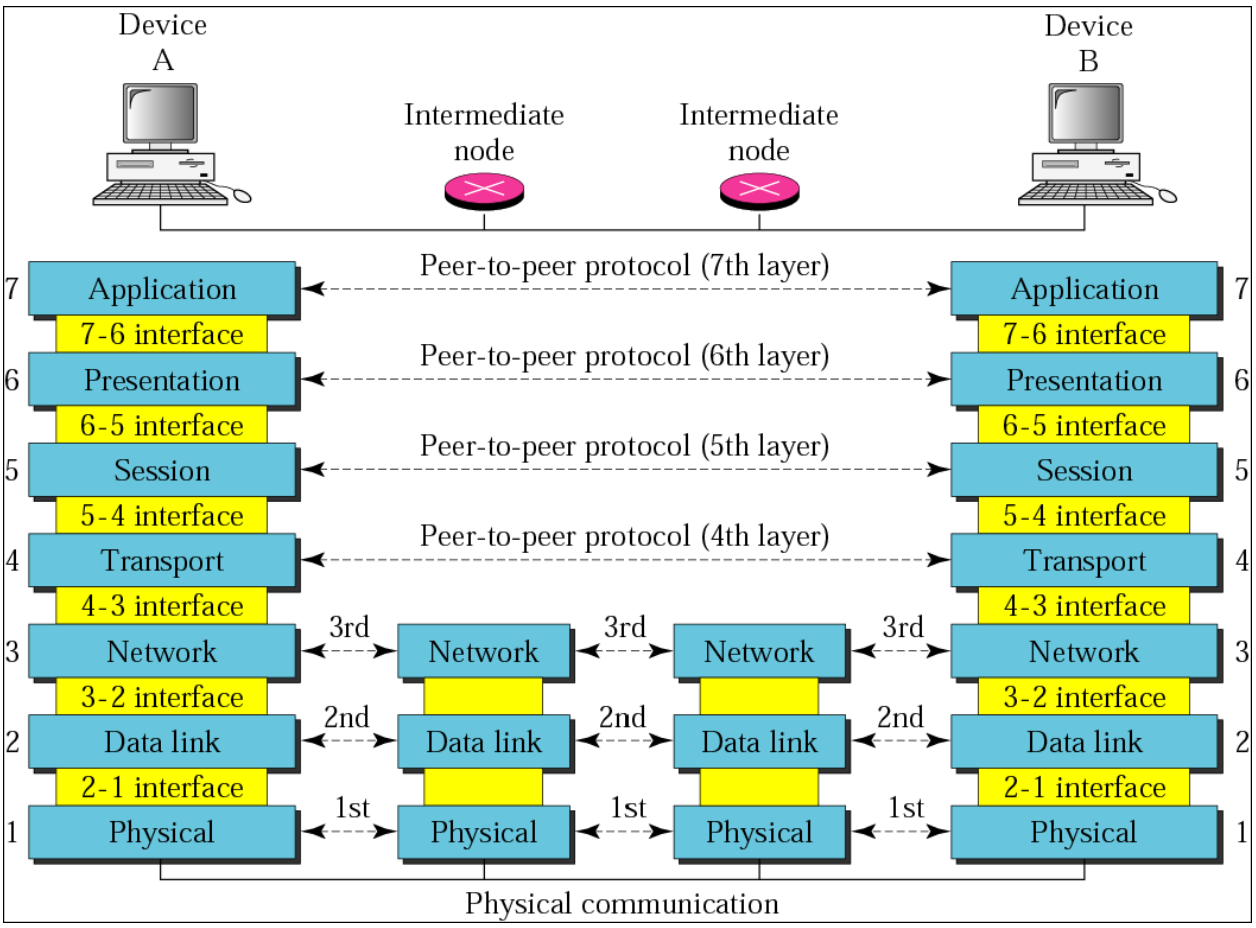


Fig (3.2) The interaction between layers in the OSI model

Each layer defines a family of functions distinct from those of the other layers. Each layer at the sending site uses the services of the layer immediately below it. The sender at the higher layer uses the services of the middle layer. The middle layer uses the services of the lower layer. The lower layer uses the services of the carrier. Layer 3, for example, uses the services provided by layer 2 and provides services for layer 4.

The processes on each machine that communicate at a given layer are called peer-to-peer processes. Communication between machines is therefore a peer-to-peer process using the protocols appropriate to a given layer.

The interfaces between layers are to define the information and services that each layer must provide for the layer above it.

The seven layers are belonging to three subgroups. **Layers 1, 2, and 3 are the network** support layers; they deal with the physical aspects of moving data from one device to another (such as electrical specifications, physical connections, and physical addressing). **Layers 5, 6, and 7** are the user support layers; they allow interoperability among unrelated software systems. Layer 4, the transport layer, links the two subgroups.

- ## Layers in the OSI Model

In the following we describe the functions of each layer in the OSI model.

1. Physical Layer: first and lowest layer(bit by bit delivery)

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

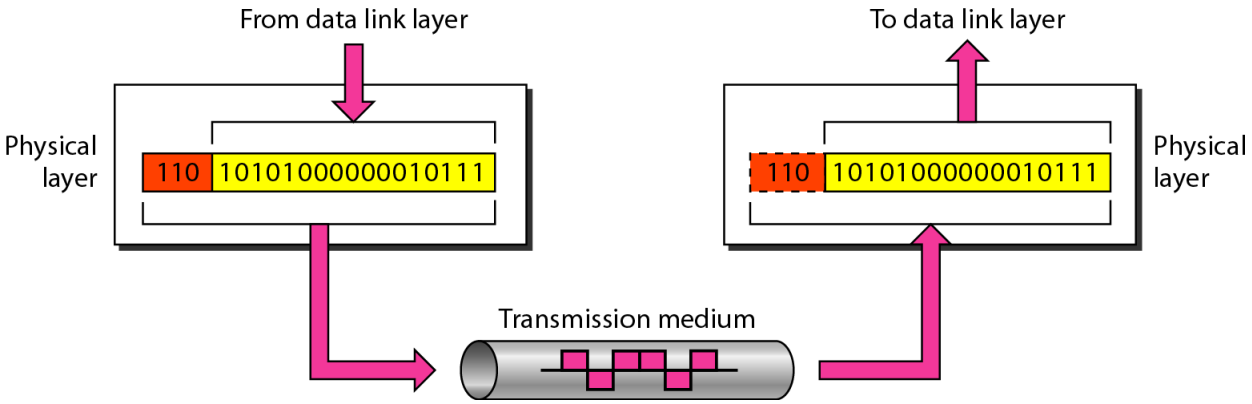


Fig (3-3) physical bit streem

The physical layer is concerned with the following:

- Physical characteristics of **interfaces and medium**.
- Representation of bits (sequence of 0s or 1s) with defining the type of **Encoding** (how 0s and 1s are changed to signals).
- Data rate or the **transmission rate** (the number of bits sent each second)
- **Synchronization of bits.** The sender and receiver not only must use the same bit rate but also must be synchronized at the bit level.

- **Line configuration** (point-to-point or multipoint configuration).
- **Physical topology** (mesh, star, bus, etc.).
- **Transmission mode** (simplex, half-duplex, or full-duplex).

➢Kind of modulation

2. Data Link Layer

The data link layer makes the physical layer appear error-free to the upper layer (network layer). The figure shows the relationship of the data link layer to the network and physical layers.

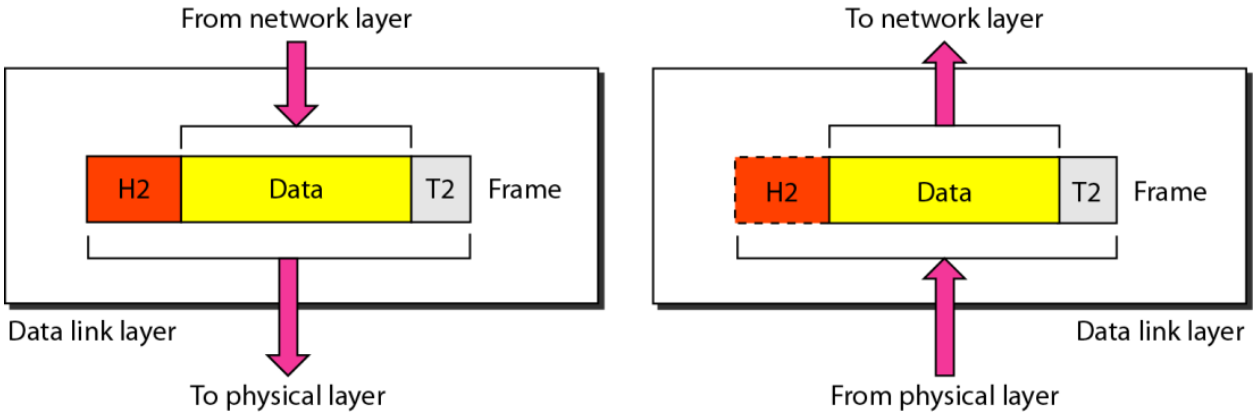


Fig (3-4) data link frame

The data link layer is responsible for moving frames from one hop (node) to the next. Other responsibilities of the data link layer include the following:

➢Node to Node delivery.

- Framing. The data link layer divides the stream of bits received from the network layer into manageable data units called **frames**.
- Physical addressing. The data link layer adds a header to the frame to define the sender and/or receiver devices of the frame. The devises are defined by the physical address (or MAC address).
- Flow control. The data link layer ensures the rate at which data are produced in the sender and arrived in the receiver.

- Error control. (error detection and correction).The data link layer adds mechanisms to detect and retransmit damaged or lost frames. Error control is normally achieved through a **trailer** added to the end of the frame (see the **T2** in Figure).
- Access control. The data link layer controls the access to the link when two or more devices are connected to the same link.

3. Network Layer

The network layer is responsible for the source-to-destination delivery of a packet (see Figure(3-6)), possibly across multiple networks (links). Whereas the data link layer oversees the delivery of the packet between two systems on the same network (links).

Other responsibilities of the network layer include the following:

- Source to Destination delivery.
- Logical addressing. The network layer adds a header to the packet coming from the upper layer that, among other things, includes the logical addresses (IP address) of the sender and receiver.
- Routing. When independent networks or links are connected to create internetworks, the connecting devices (called routers or switches) route or switch the packets to their final destination. One of the functions of the network layer is to provide this mechanism.
- Multiplexing.

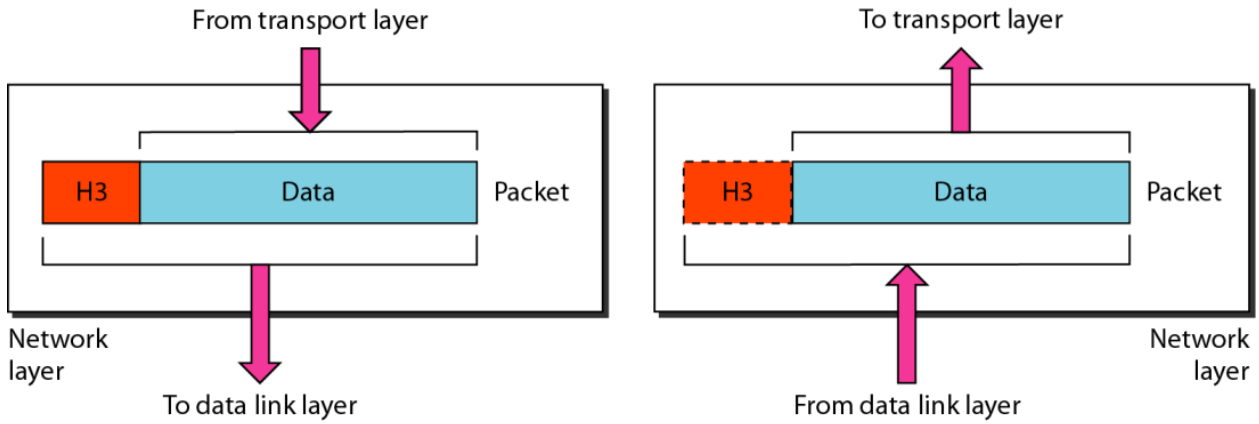


Fig (3-5) network layer

4. 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. Whereas the network layer over sees source-to-destination delivery of individual packets.

Other responsibilities of the transport layer include the following:

- End to end message delivery.
- Service-point addressing. Computers often run several programs at the same time. The transport layer header includes a type of address called a service-point address (or port address) in order to deliver the entire message to the correct process on that computer.
- 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 at the destination.
- 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.
- Error control. Like the data link layer, the transport layer is responsible for error control. However, error control at this layer is performed process-to-process rather than across a single link.

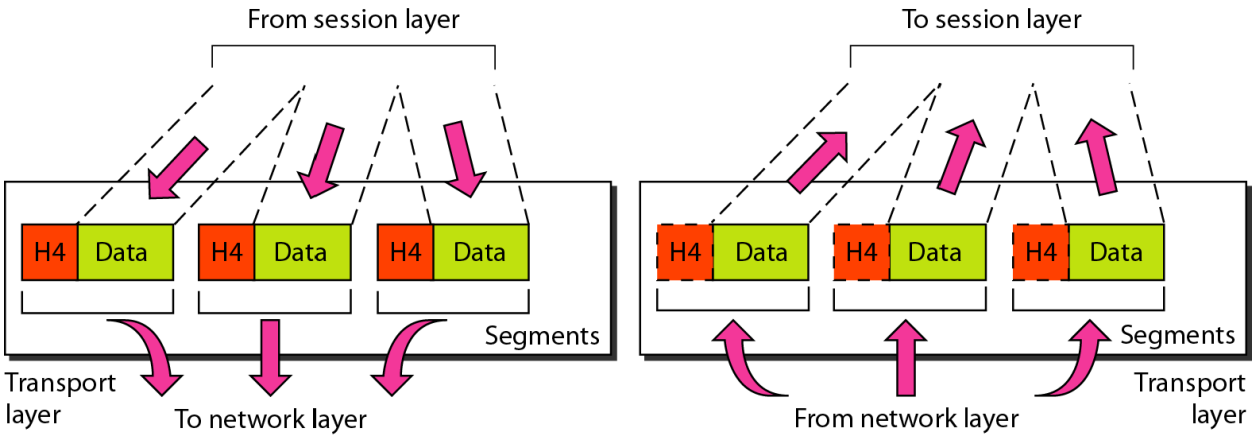


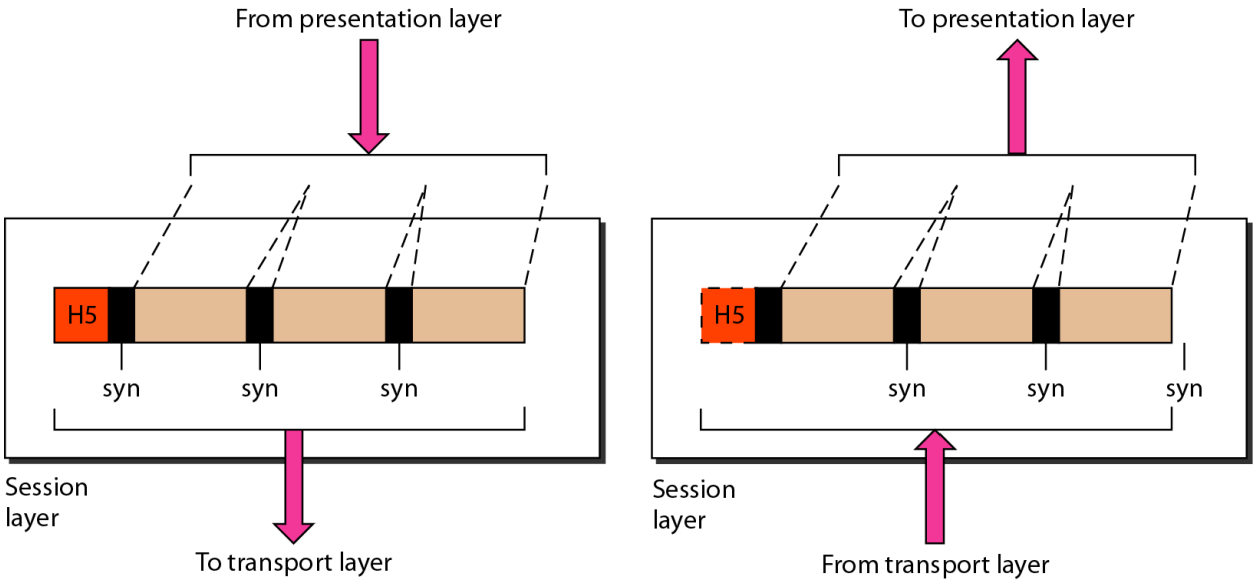
Fig (3-6) transport layer

5. Session Layer

The services provided by the first three layers (physical, data link, and network) are not sufficient for some processes. The session layer is responsible for dialog control and synchronization.

Specific responsibilities of the session layer include the following:

- Dialog control. The session layer allows the communication between two processes to take place in either half-duplex (one way at a time) or full-duplex (two ways at a time) mode.
- Synchronization. The session layer allows a process to add checkpoints, or synchronization points, to a stream of data (see Figure). For example, if a system is sending a file of 2000 pages, it is advisable to insert checkpoints after every 100 pages.

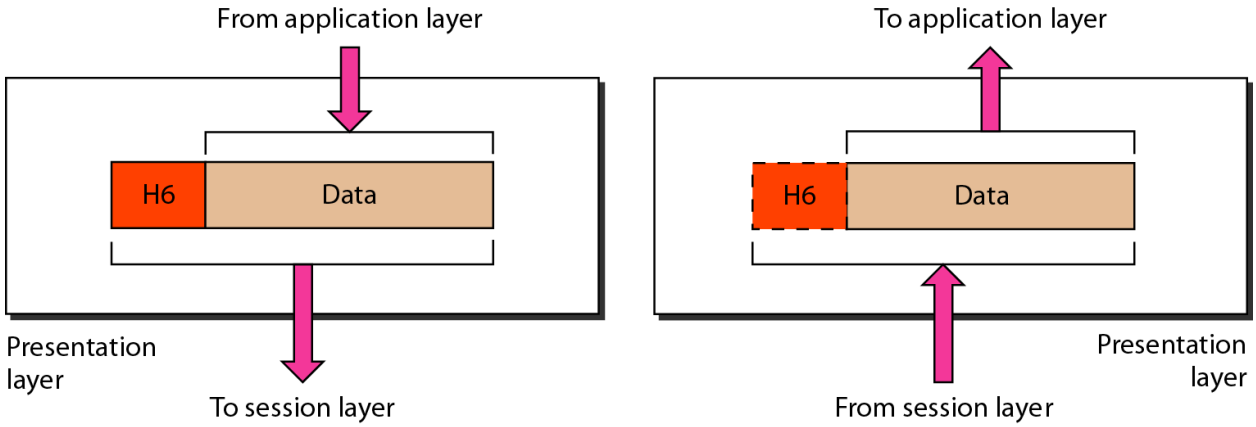

From presentation layer
H5
syn
syn
syn
Session layer
To transport layer
To presentation layer
H5
syn
syn
syn
Session layer
From transport layer

6. Presentation Layer

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

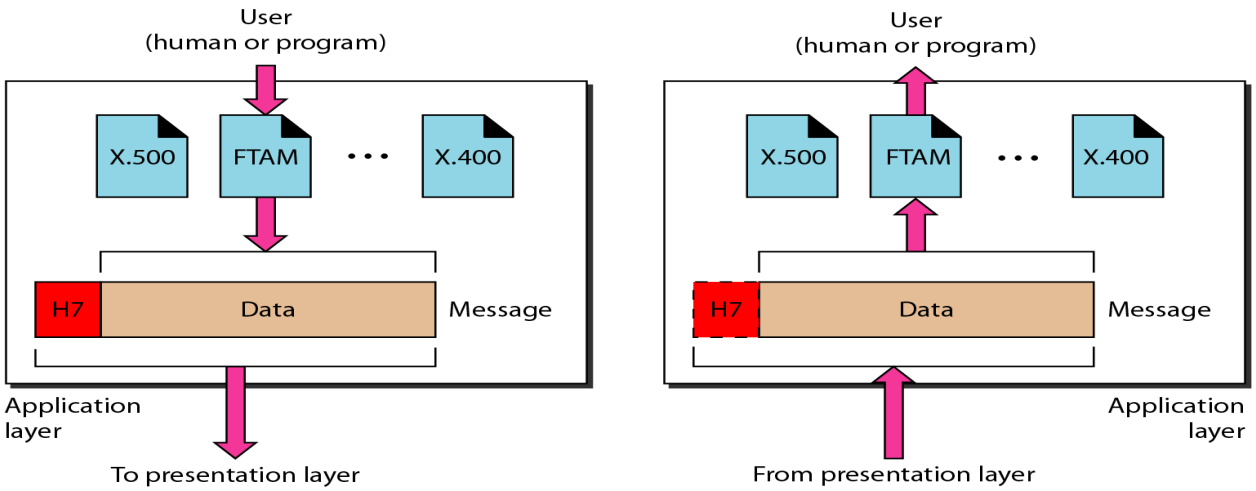
Specific responsibilities of the presentation layer include the following:

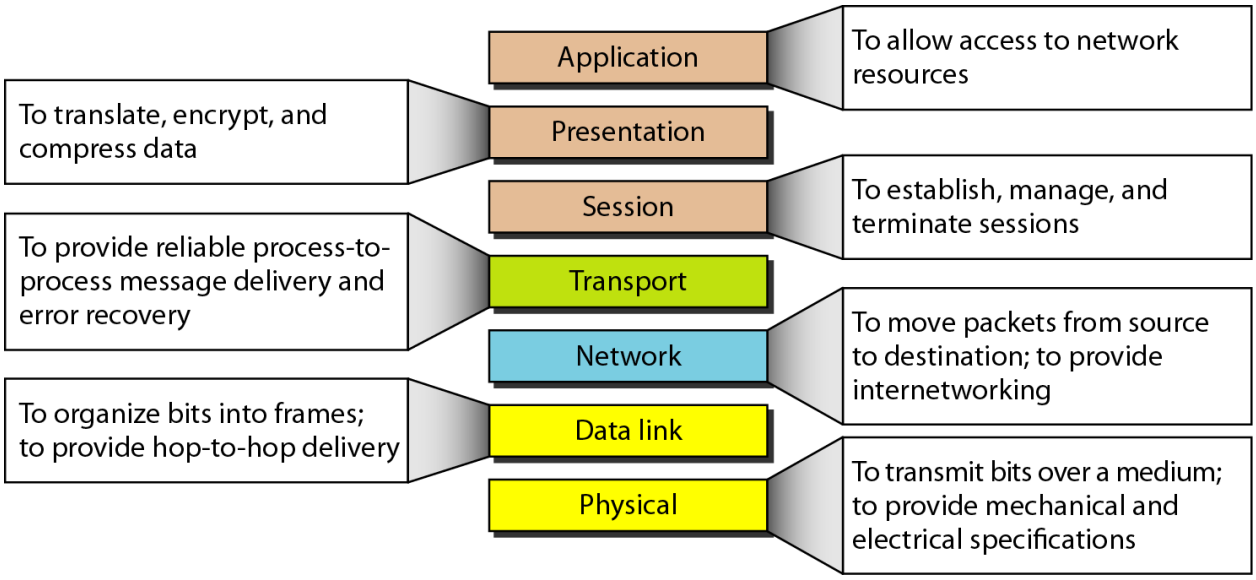
- Translation. Because different computers use different encoding systems, the presentation layer is responsible for interoperability between these different encoding methods.
- Encryption. To carry sensitive information, a system must be able to ensure privacy.
- Compression. Data compression reduces the number of bits contained in the information. Data compression becomes particularly important in the data transmission.



7. Application Layer

The application layer is responsible for providing services to the user. It 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, and other types of distributed information services.





Summary of OSI layers