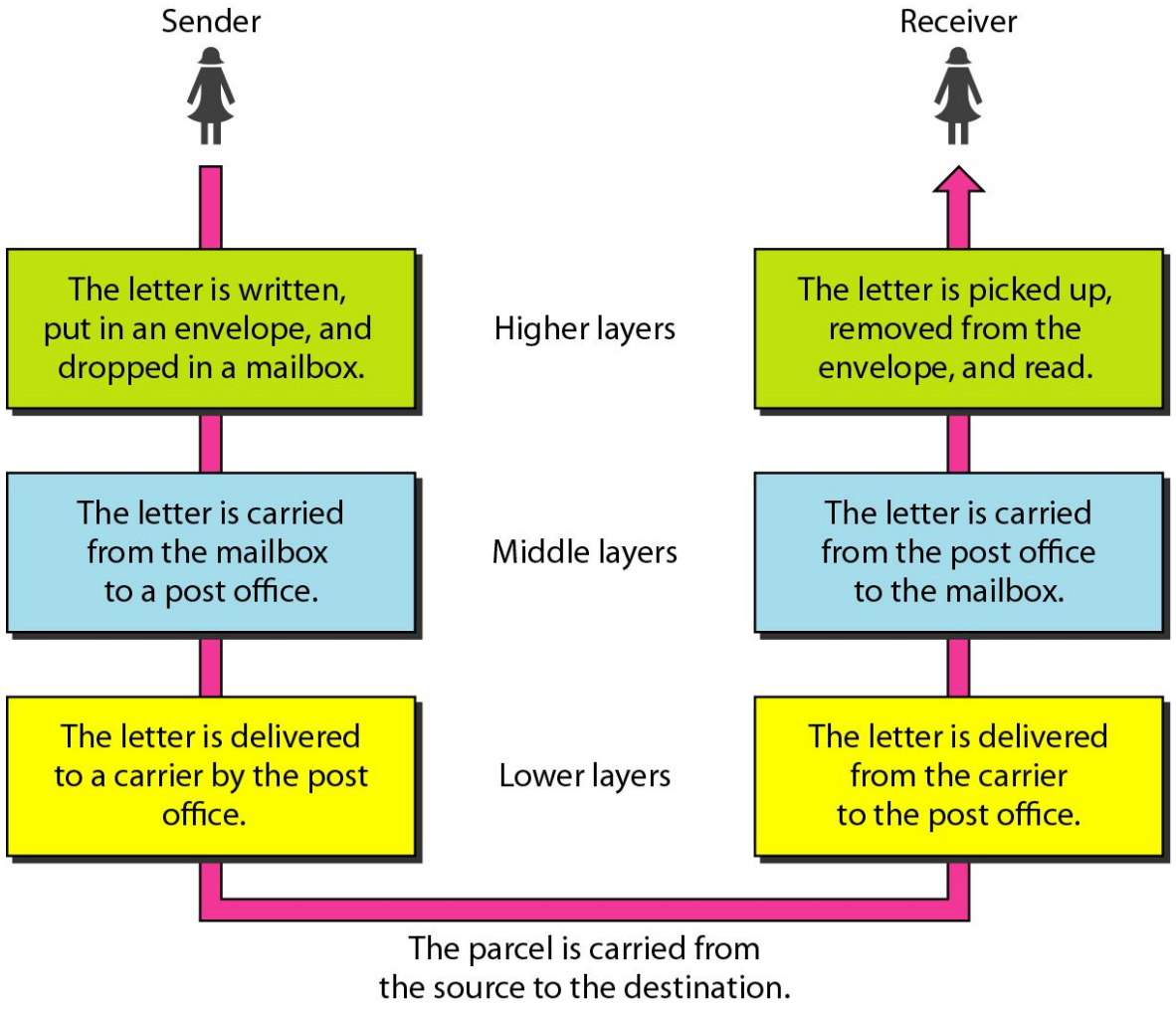
Network Models

LAYERED TASKS

- We use the concept of layers in our daily life. As an example, let us consider two friends who communicate through postal mail. The process of sending a letter to a friend would be complex if there were no services available from the post office.

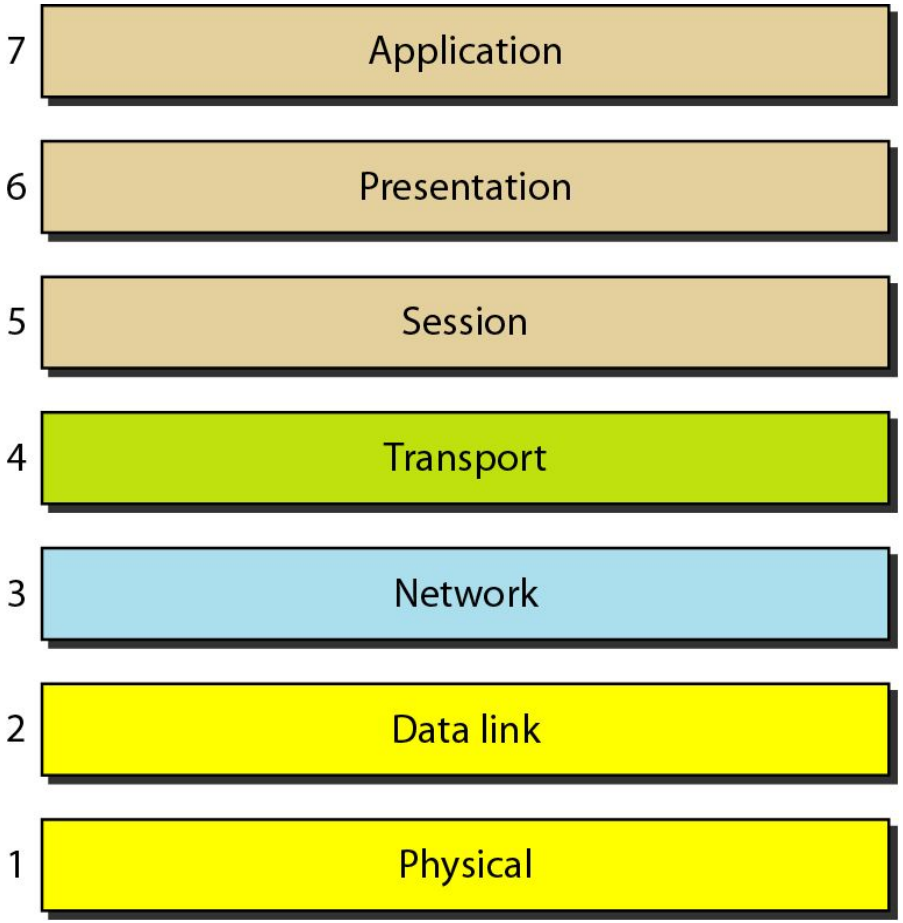
Layered Tasks, Example



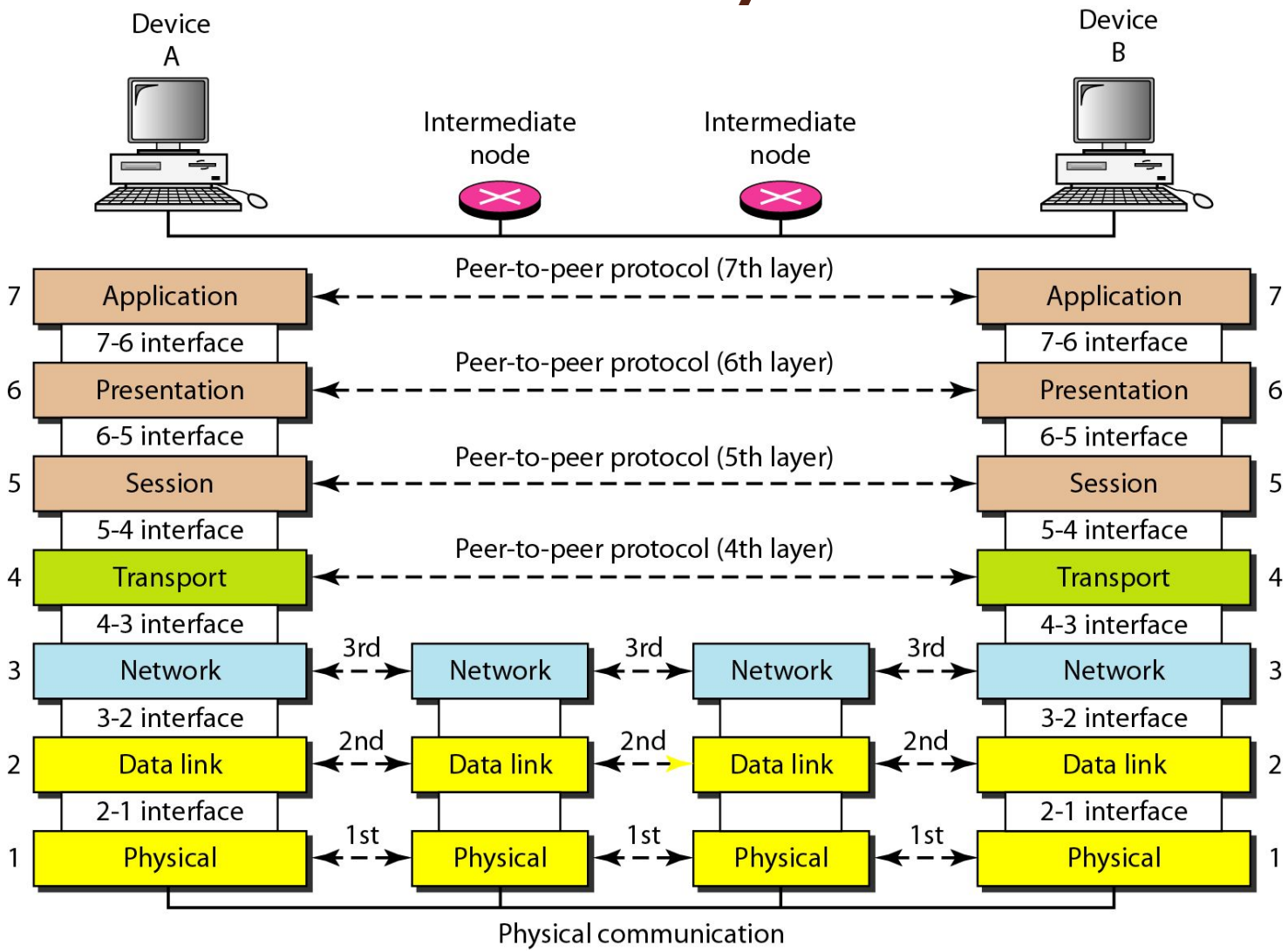
THE OSI MODEL

- Established in 1947, the International Standards Organization (ISO) is a multinational body dedicated to worldwide agreement on international standards. An ISO standard that covers all aspects of network communications is the Open Systems Interconnection (OSI) model. It was first introduced in the late 1970s.
- Note:
  - ISO is the organization.
  - OSI is the model.

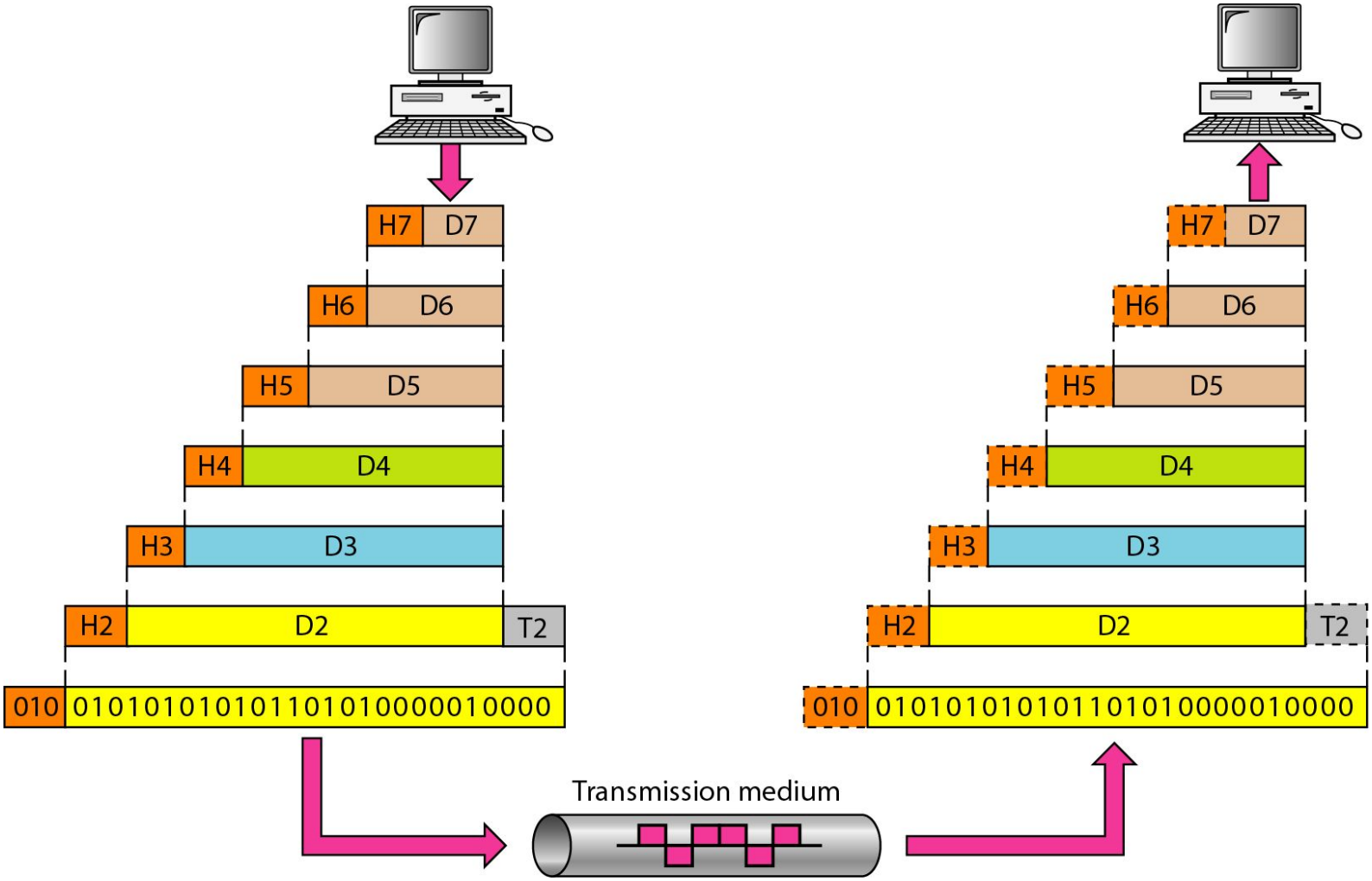
Seven layers of the OSI model



Interfaces b/w Layers



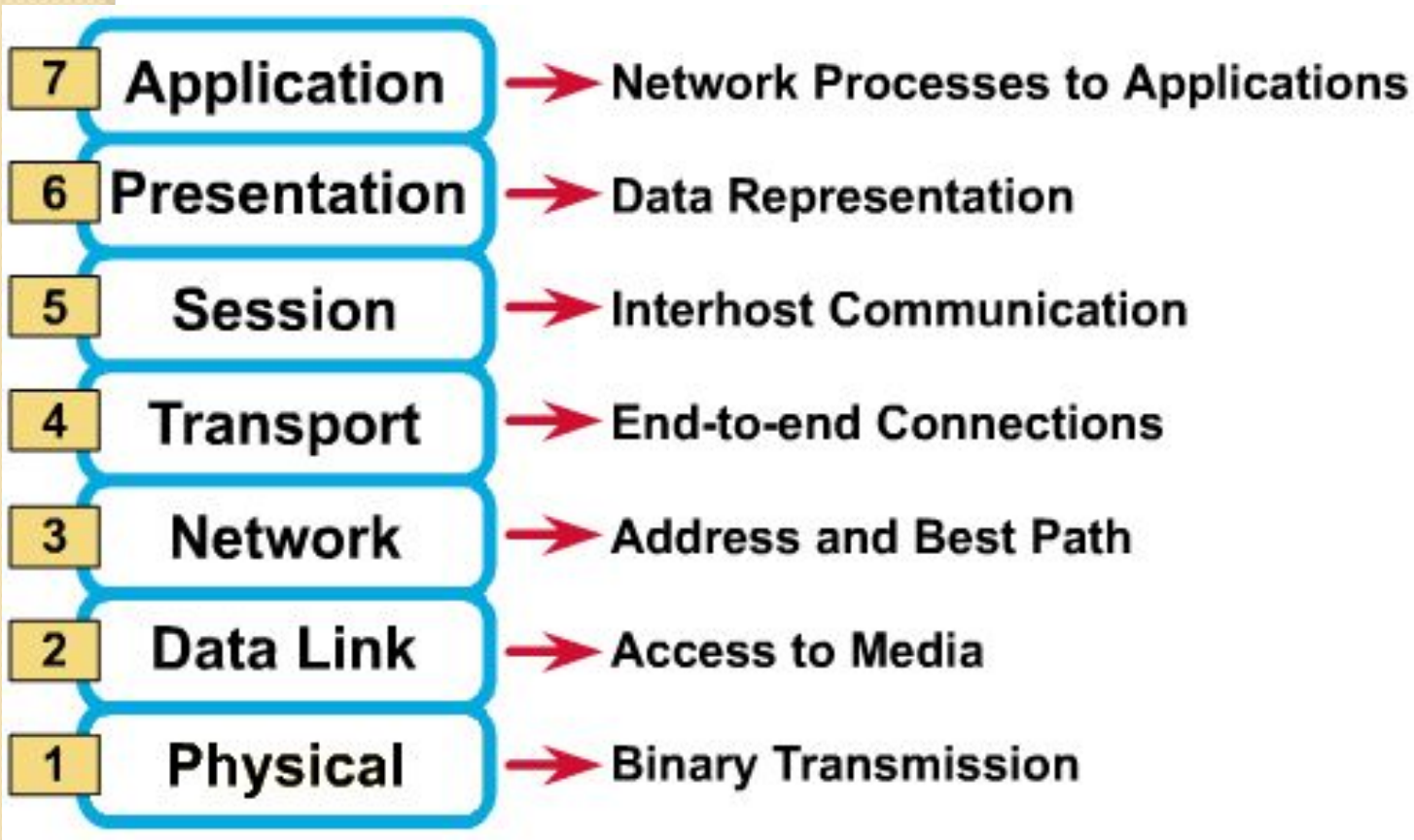
Exchange using the OSI Model



LAYERS IN THE OSI MODEL

- Physical Layer
- Data Link Layer
- Network Layer
- Transport Layer
- Session Layer
- Presentation Layer
- Application Layer

THE SEVEN OSI REFERENCE MODEL LAYERS



OSI: A Layered Network Model

- The process of breaking up the functions or tasks of networking into layers reduces complexity.
- Each layer provides a service to the layer above it in the protocol specification.
- Each layer communicates with the same layer's software or hardware on other computers.
- The lower 4 layers (transport, network, data link and physical —Layers 4, 3, 2, and 1) are concerned with the flow of data from end to end through the network.
- The upper four layers of the OSI model (application, presentation and session—Layers 7, 6 and 5) are orientated more toward services to the applications.
- Data is Encapsulated with the necessary protocol information as it moves down the layers before network transit.

Physical Layer

- Provides physical interface for transmission of information.
- Defines rules by which bits are passed from one system to another on a physical communication medium.
- Covers all - mechanical, electrical, functional and procedural - aspects for physical communication.
- Such characteristics as voltage levels, timing of voltage changes, physical data rates, maximum transmission distances, physical connectors, and other similar attributes are defined by physical layer specifications.

Physical Layer

- The physical layer is responsible for movements of individual bits from one hop (node) to the next.
  - Physical characteristics of interface and medium: pin assignment, connector, cables
  - Representation of bits: encoding
  - Data rate
  - Synchronization of bits
  - Line configuration: point-to-point, multipoint
  - Physical topology
  - Transmission mode: simplex, half-duplex, full-duplex

Data Link Layer

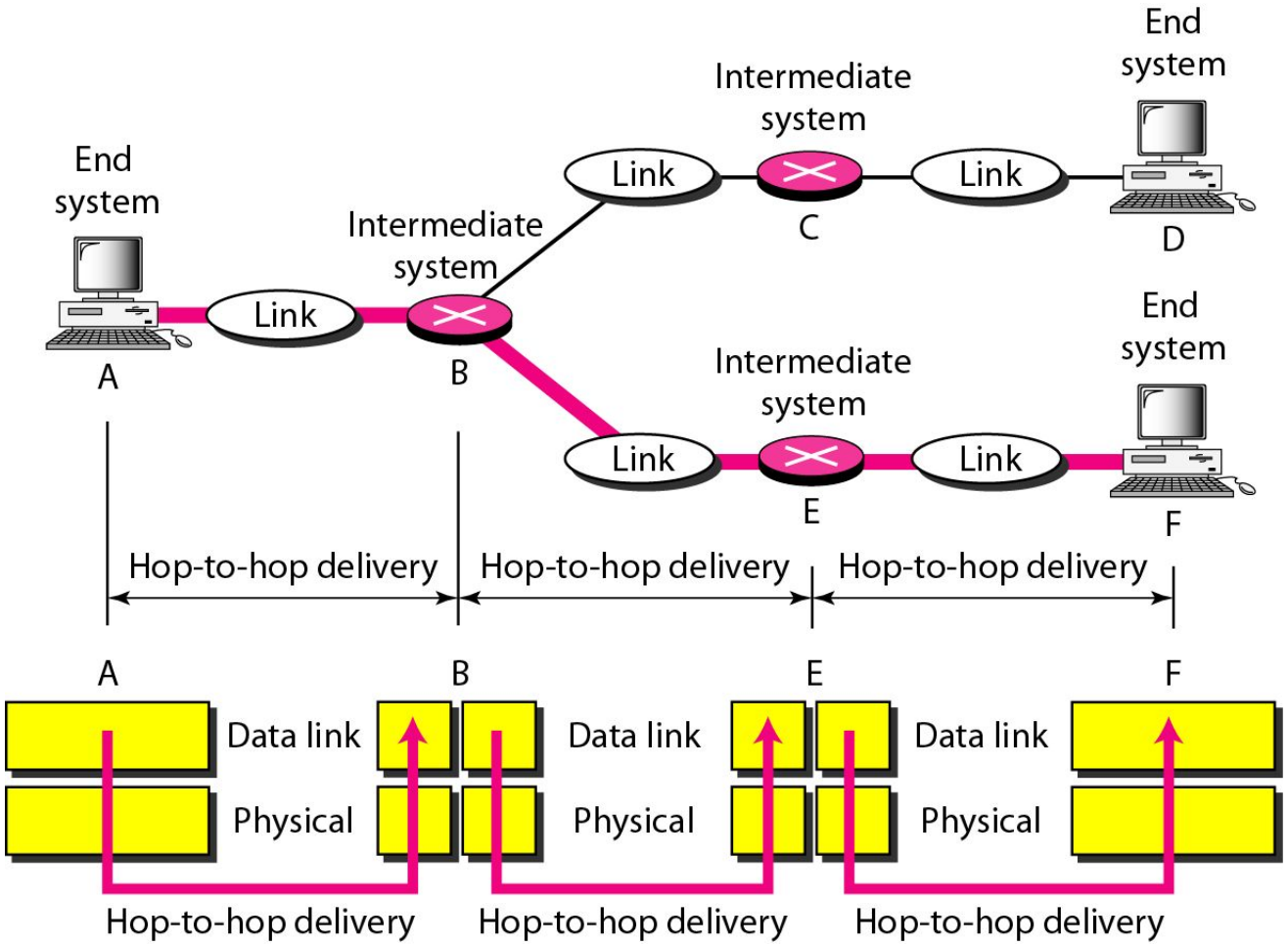
- Data link layer attempts to provide reliable communication over the physical layer interface.

- Breaks the outgoing data into frames and reassemble the received frames.
- Create and detect frame boundaries.
- Handle errors by implementing an acknowledgement and retransmission scheme.
- Implement flow control.
- Supports points-to-point as well as broadcast communication.
- Supports simplex, half-duplex or full-duplex communication.

Data Link Layer

- The data link layer is responsible for moving frames from one hop (node) to the next.
  - Framing
  - Physical addressing
  - Flow control
  - Error control
  - Access control

Hop-to-hop Delivery



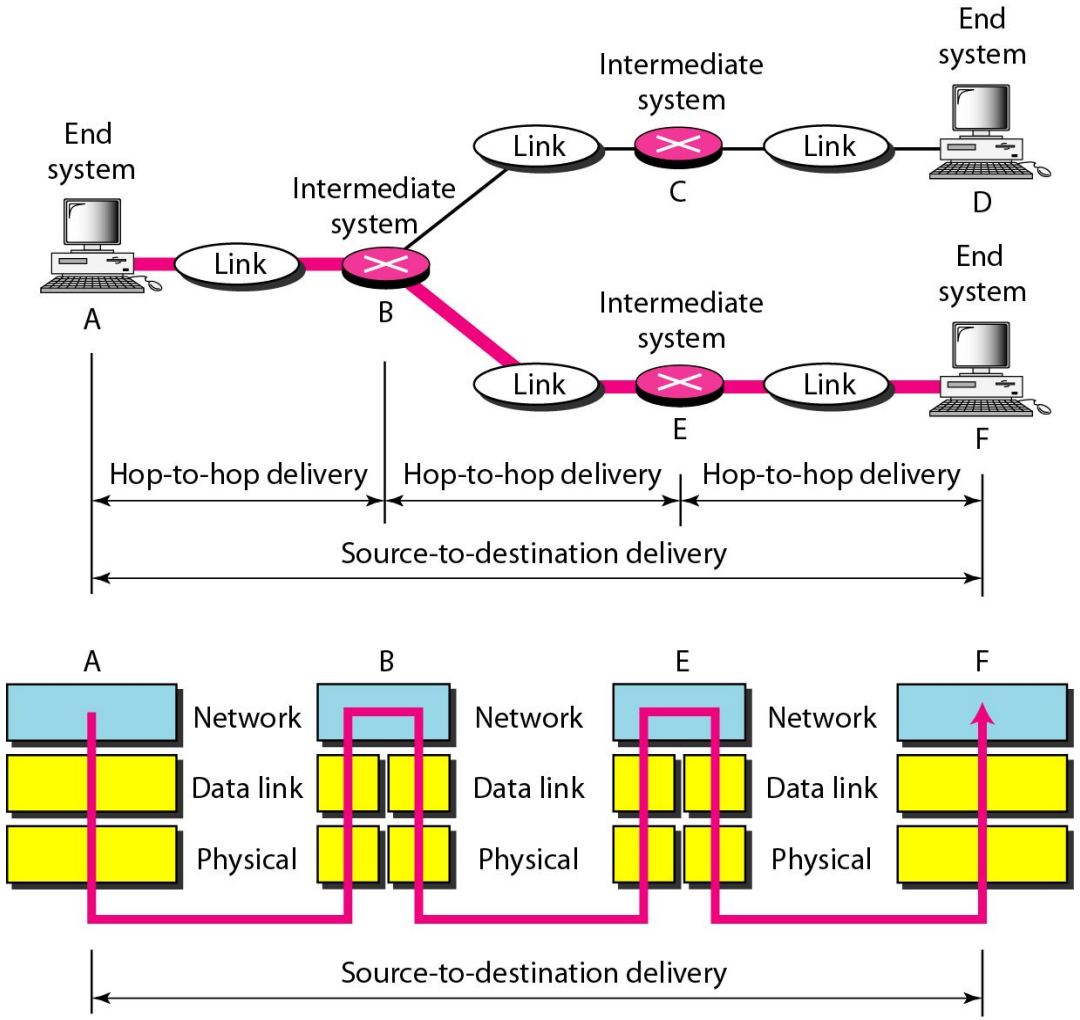
Network Layer

- Implements routing of frames (packets) through the network.
- Defines the most optimum path the packet should take from the source to the destination
- Defines logical addressing so that any endpoint can be identified.
- Handles congestion in the network.
- Facilitates interconnection between heterogeneous networks (Internetworking).
- The network layer also defines how to fragment a packet into smaller packets to accommodate different media.

Network Layer

- The network layer is responsible for the delivery of individual packets from the source host to the destination host.
  - Logical addressing
  - Routing

Source-to-destination delivery



Transport Layer

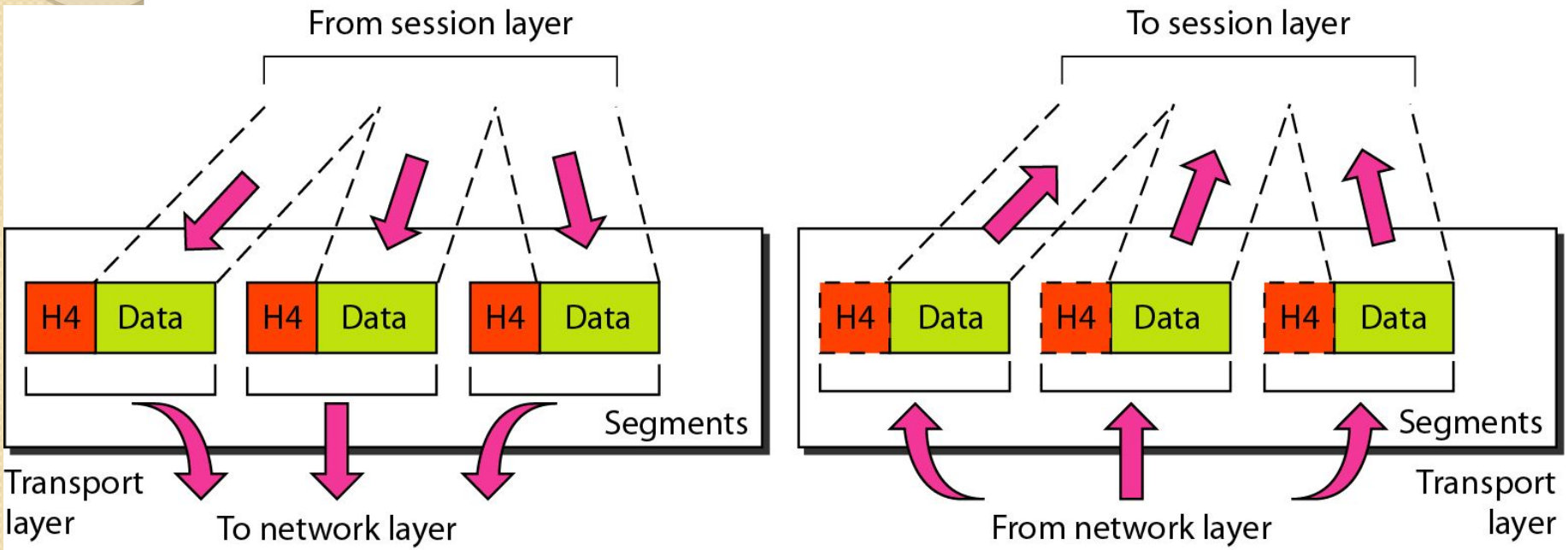
- Purpose of this layer is to provide a reliable mechanism for the exchange of data between two processes in different computers.

- Ensures that the data units are delivered error free.
- Ensures that data units are delivered in sequence.
- Ensures that there is no loss or duplication of data units.
- Provides connectionless or connection oriented service.
- Provides for the connection management.
- Multiplex multiple connection over a single channel.

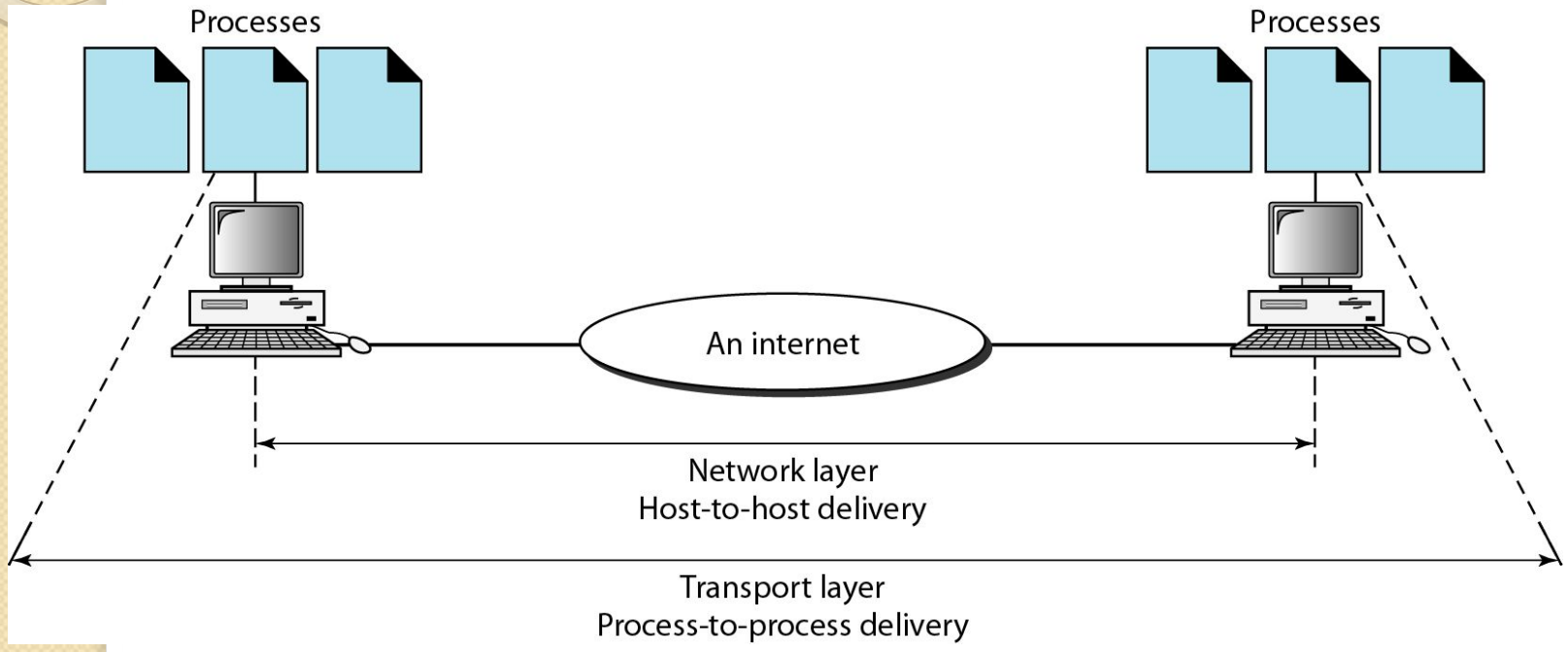
Transport layer

- The transport layer is responsible for the delivery of a message from one process to another.
  - Service-point addressing
  - Segmentation and reassembly
  - Connection control
  - Flow control
  - Error control

Segmentation and Reassembly



Reliable process-to-process delivery of a message

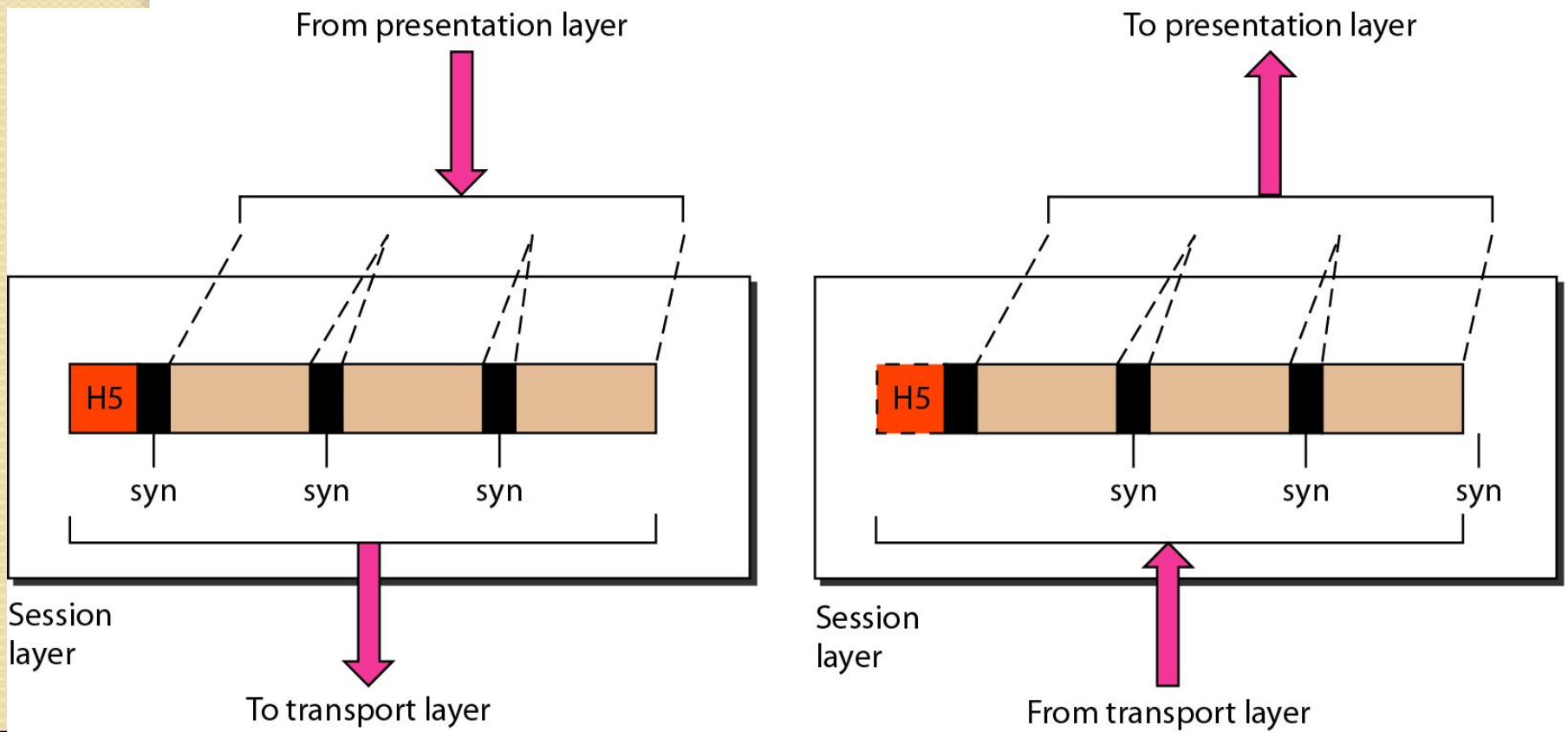


Session Layer

- Session layer provides mechanism for controlling the dialogue between the two end systems. It defines how to start, control and end conversations (called sessions) between applications.
- This layer requests for a logical connection to be established on an end-user's request.
- Any necessary log-on or password validation is also handled by this layer.
- Session layer is also responsible for terminating the connection.
- This layer provides services like dialogue discipline which can be full duplex or half duplex.
- Session layer can also provide check-pointing mechanism such that if a failure of some sort occurs between checkpoints, all data can be retransmitted from the last checkpoint.

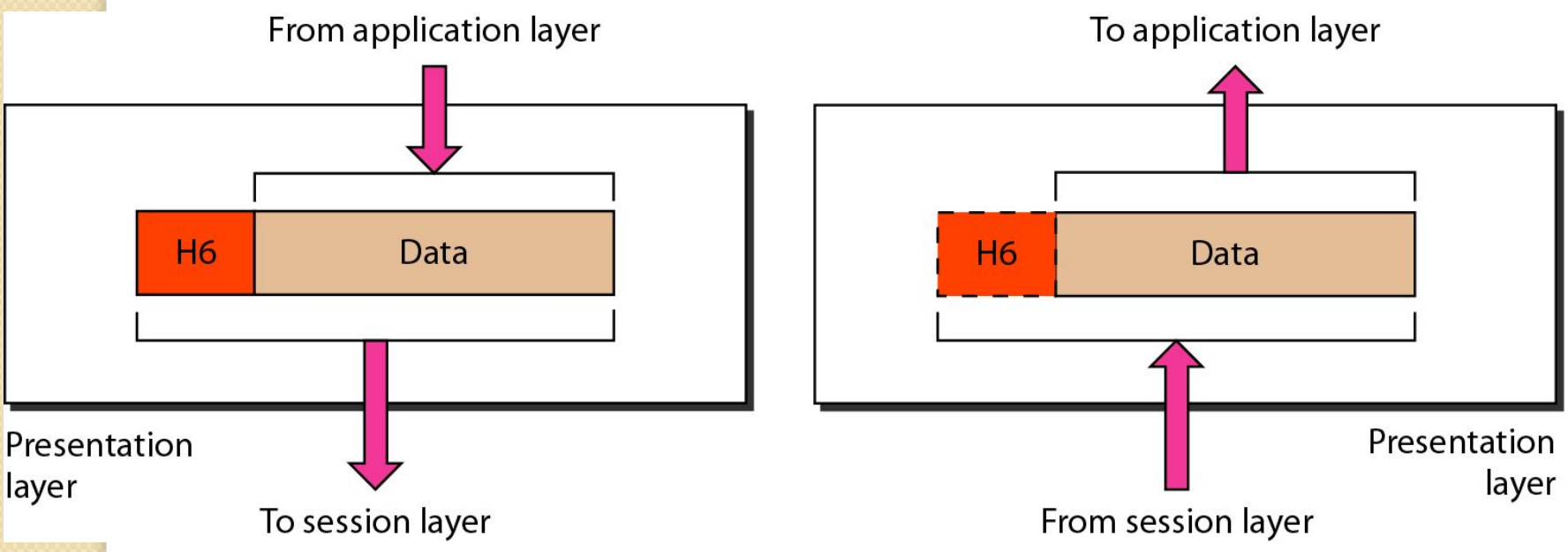
Session layer

- The session layer is responsible for dialog control and synchronization.



Presentation layer

- **Presentation layer defines the format in which the data is to be exchanged between the two communicating entities.**
- **Also handles data compression and data encryption (cryptography).**

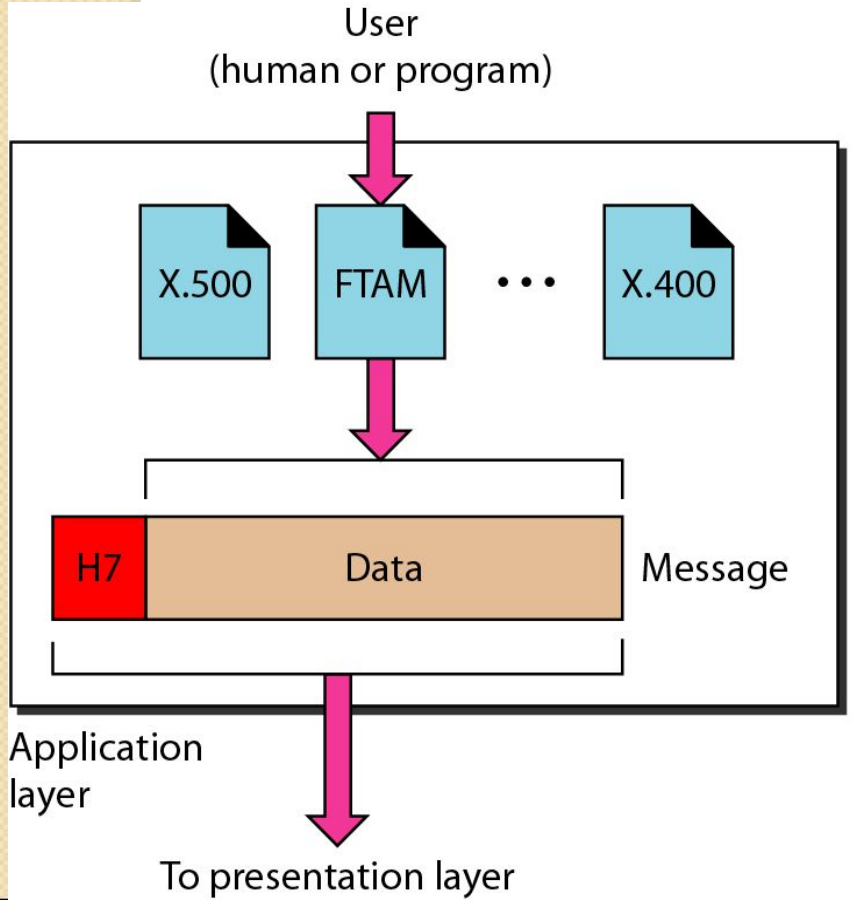


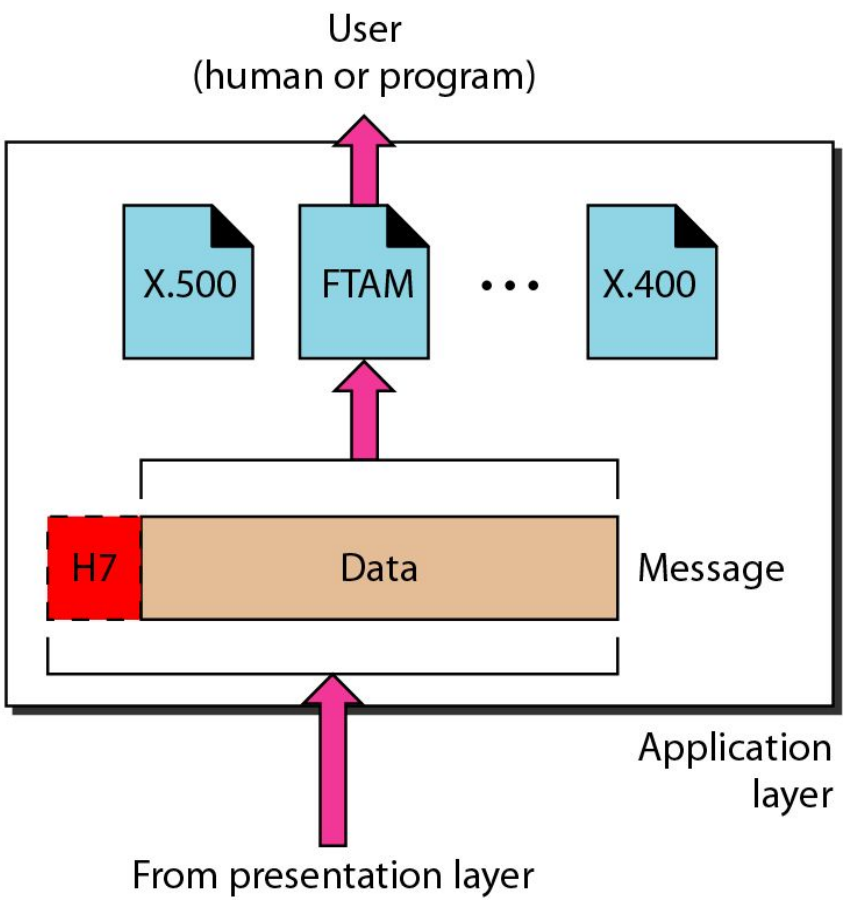
Application Layer

- Application layer interacts with application programs and is the highest level of OSI model.
- Application layer contains management functions to support distributed applications.
- Examples of application layer are applications such as file transfer, electronic mail, remote login etc.

Application layer

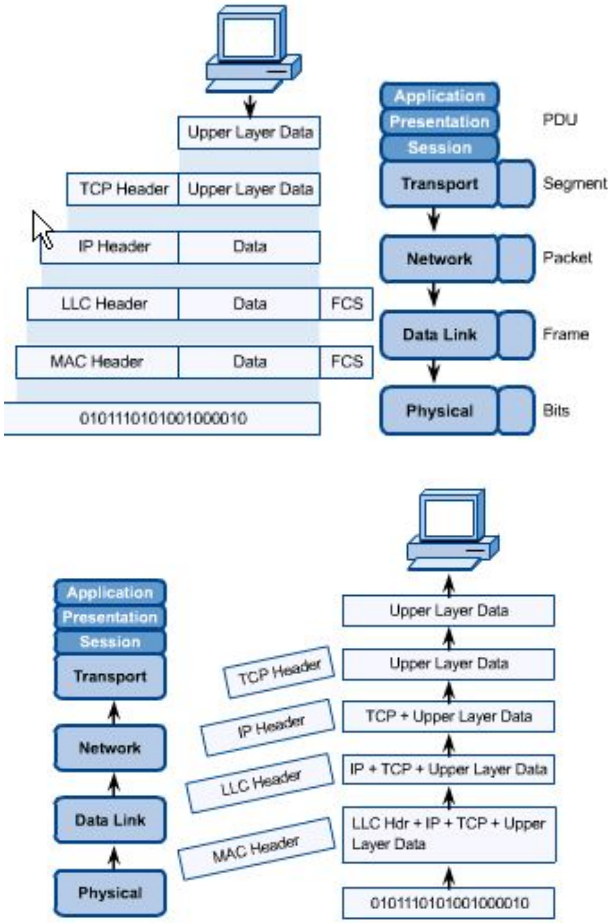
- The application layer is responsible for providing services to the user.





OSI in Action

- A message begins at the top application layer and moves down the OSI layers to the bottom physical layer.
- As the message descends, each successive OSI model layer adds a header to it.
- A header is layer-specific information that basically explains what functions the layer carried out.
- Conversely, at the receiving end, headers are striped from the message as it travels up the corresponding layers.



Summary of layers