



ECAP256

# COMPUTER NETWORK

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# Learning Outcome



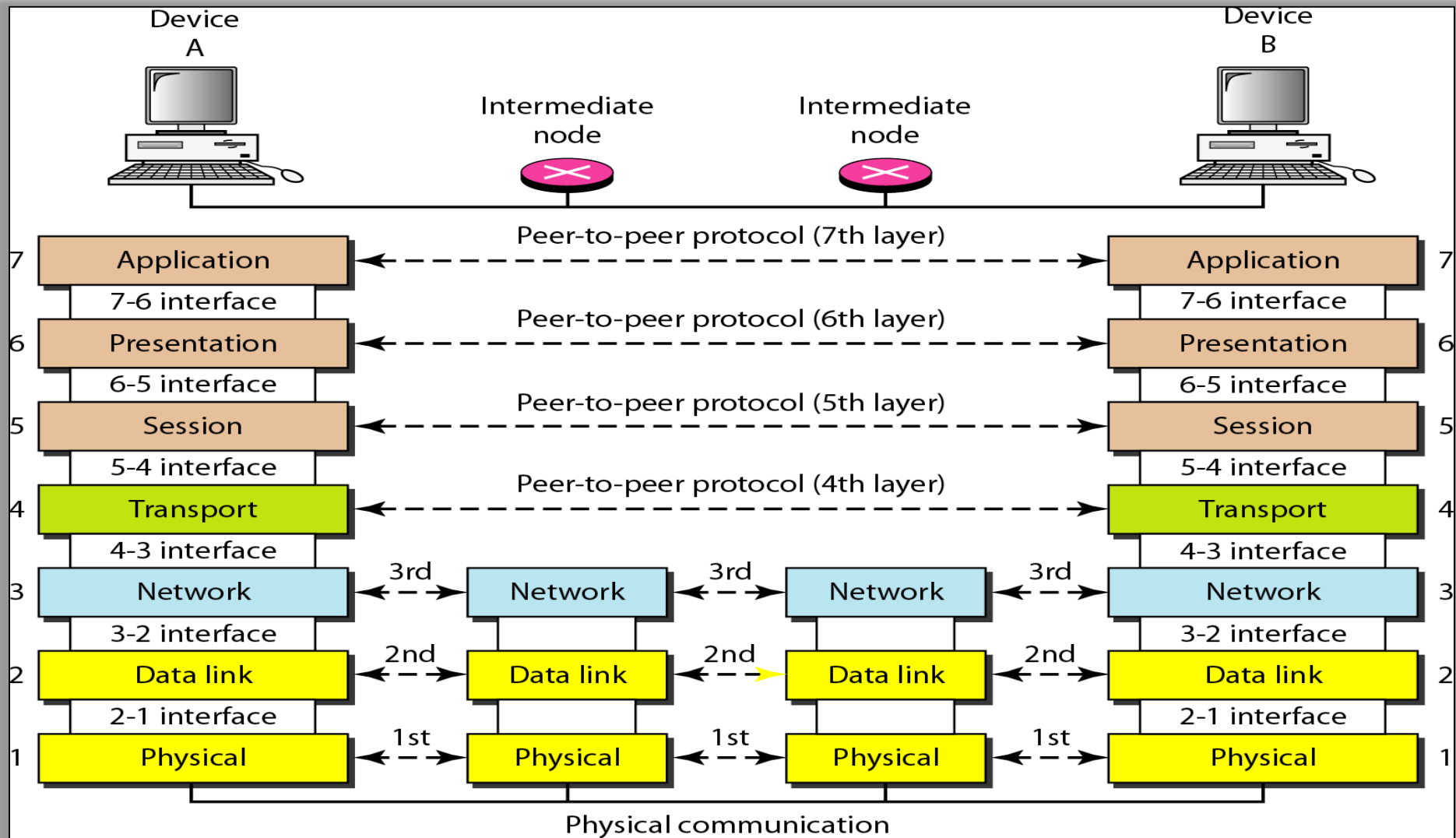
After this lecture you will be able to

- learn about the standard layer protocol suites adopted for data transmission in computer networks.

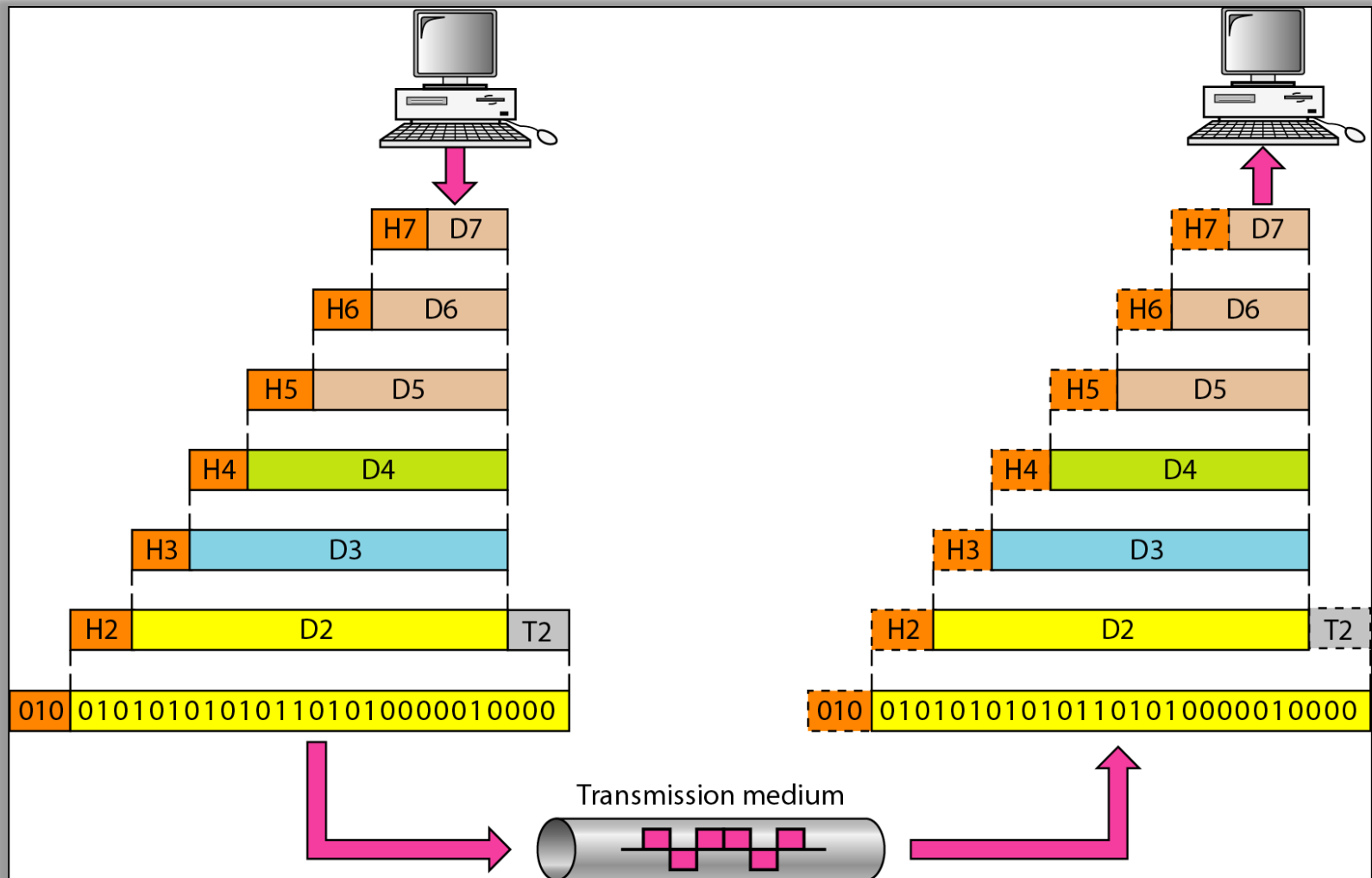
# The OSI Model

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.

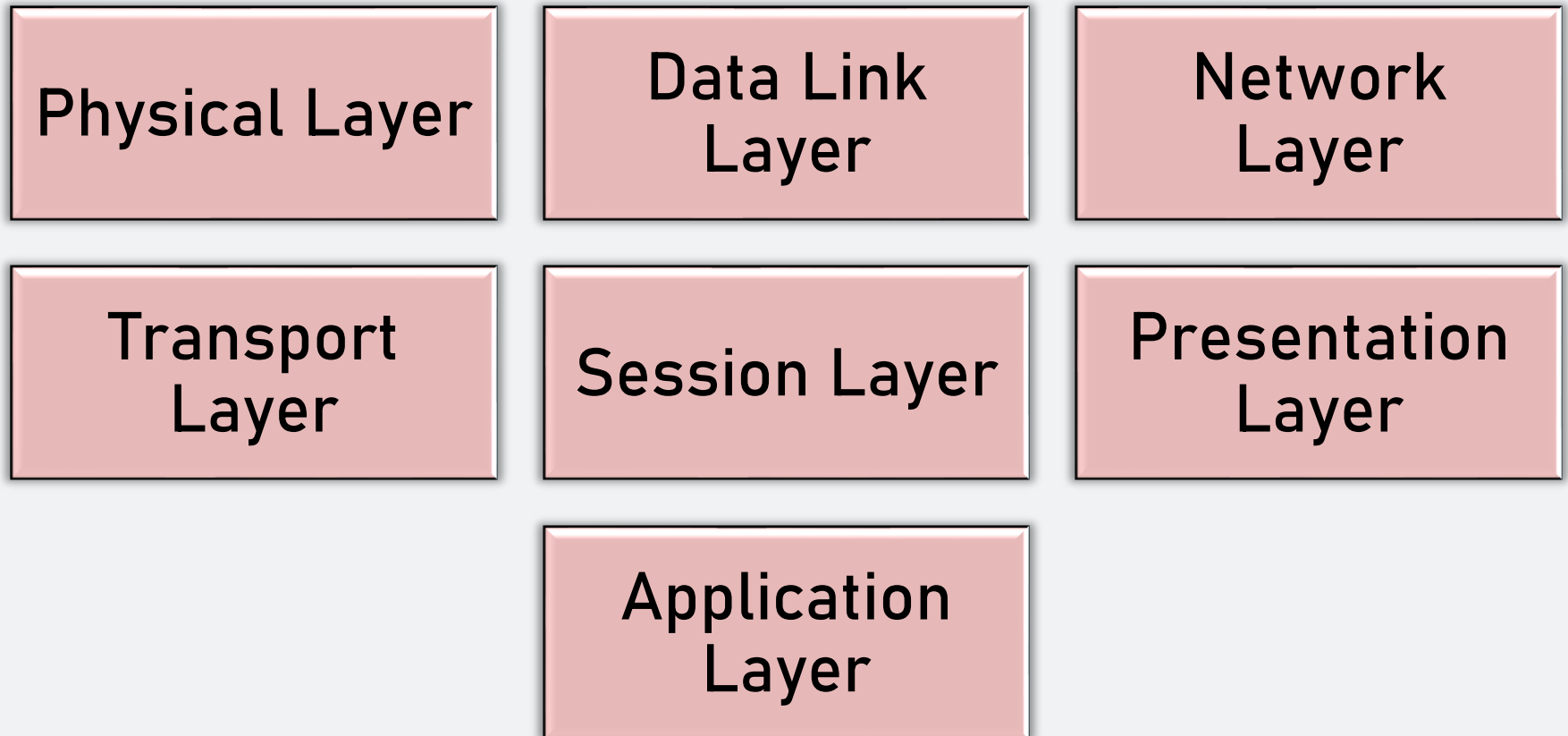
# The Interaction Between Layers in the OSI Model



# An Exchange Using the OSI Model



# Layers in the OSI Model



# OSI Reference Model

- OSI stands for **Open System Interconnection** is a reference model that describes how information from a software application in one computer moves through a physical medium to the software application in another computer.
- OSI consists of seven layers, and each layer performs a particular network function.

# OSI Reference Model

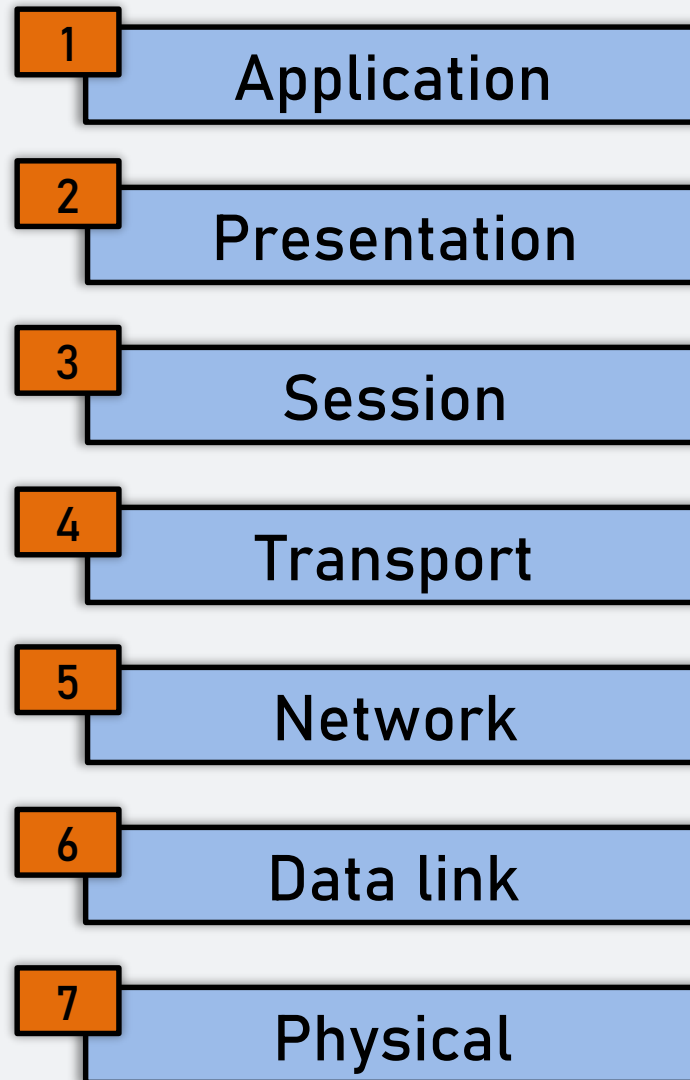
- OSI model was developed by the International Organization for Standardization (ISO) in 1984, and it is now considered as an architectural model for the inter-computer communications.
- OSI model divides the whole task into seven smaller and manageable tasks. Each layer is assigned a particular task.



# OSI Reference Model

Each layer is self-contained, so that task assigned to each layer can be performed independently.

# Seven layers of the OSI model



# OSI Reference Model

The OSI model is divided into two layers:

1. Upper layers
2. Lower layers.

# OSI Reference Model

- The upper layer of the OSI model mainly deals with the application related issues, and they are implemented only in the software.
- The application layer is closest to the end user. Both the end user and the application layer interact with the software applications.

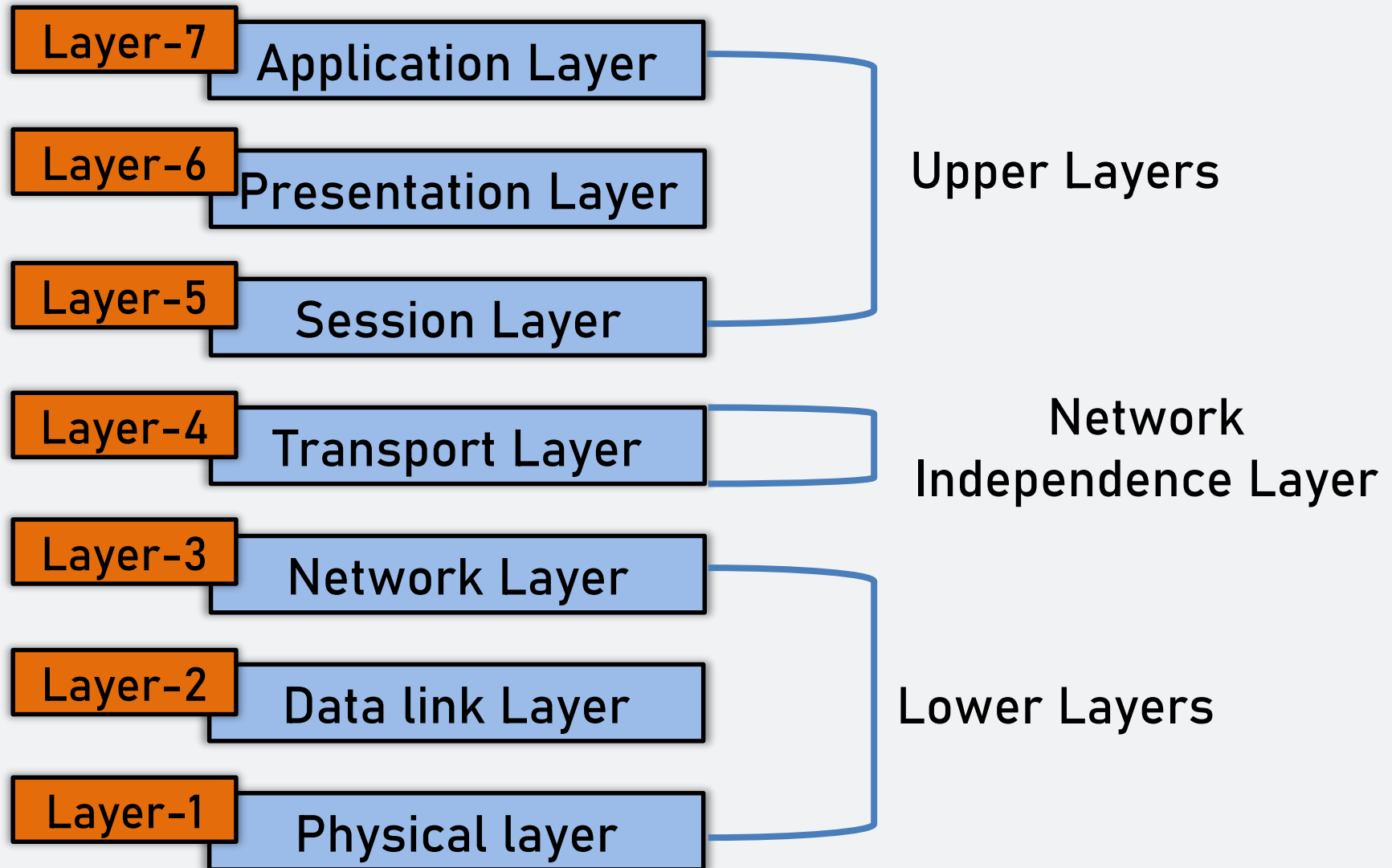
# OSI Reference Model

- The lower layer of the OSI model deals with the data transport issues.
- The data link layer and the physical layer are implemented in hardware and software.
- The physical layer is the lowest layer of the OSI model and is closest to the physical medium.

# OSI Reference Model

The physical layer is mainly responsible for placing the information on the physical medium.

# The OSI Reference Model (Layer Categorization)

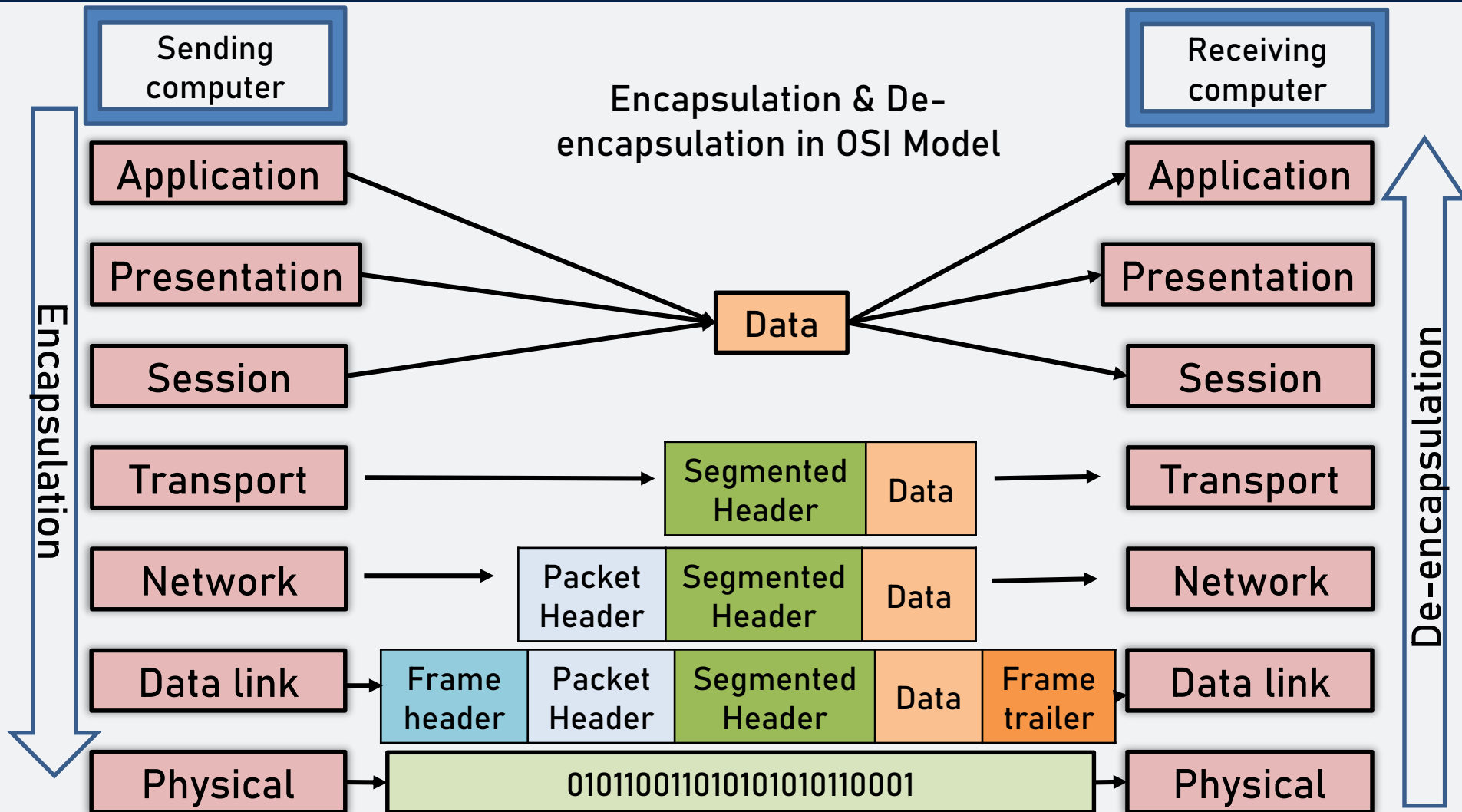


# Functions of the OSI Layers

Layer No.	Layer	Responsibility of	PDU (Protocol Data Unit)	Data Flow	Address Used
7	Application Layer	Host	Data		Specific Address
6	Presentation Layer	Host	Data		Specific Address
5	Session Layer	Host	Data		Specific Address
4	Transport Layer	Host	Segment	Process to Process	Port Address
3	Network Layer	Network	Packet	End to End	Logical Address
2	Data Link Layer	Network	Frame	Hop to Hop	Physical Address
1	Physical Layer	Network	Bits and Bytes		



# Functions of the OSI Layers



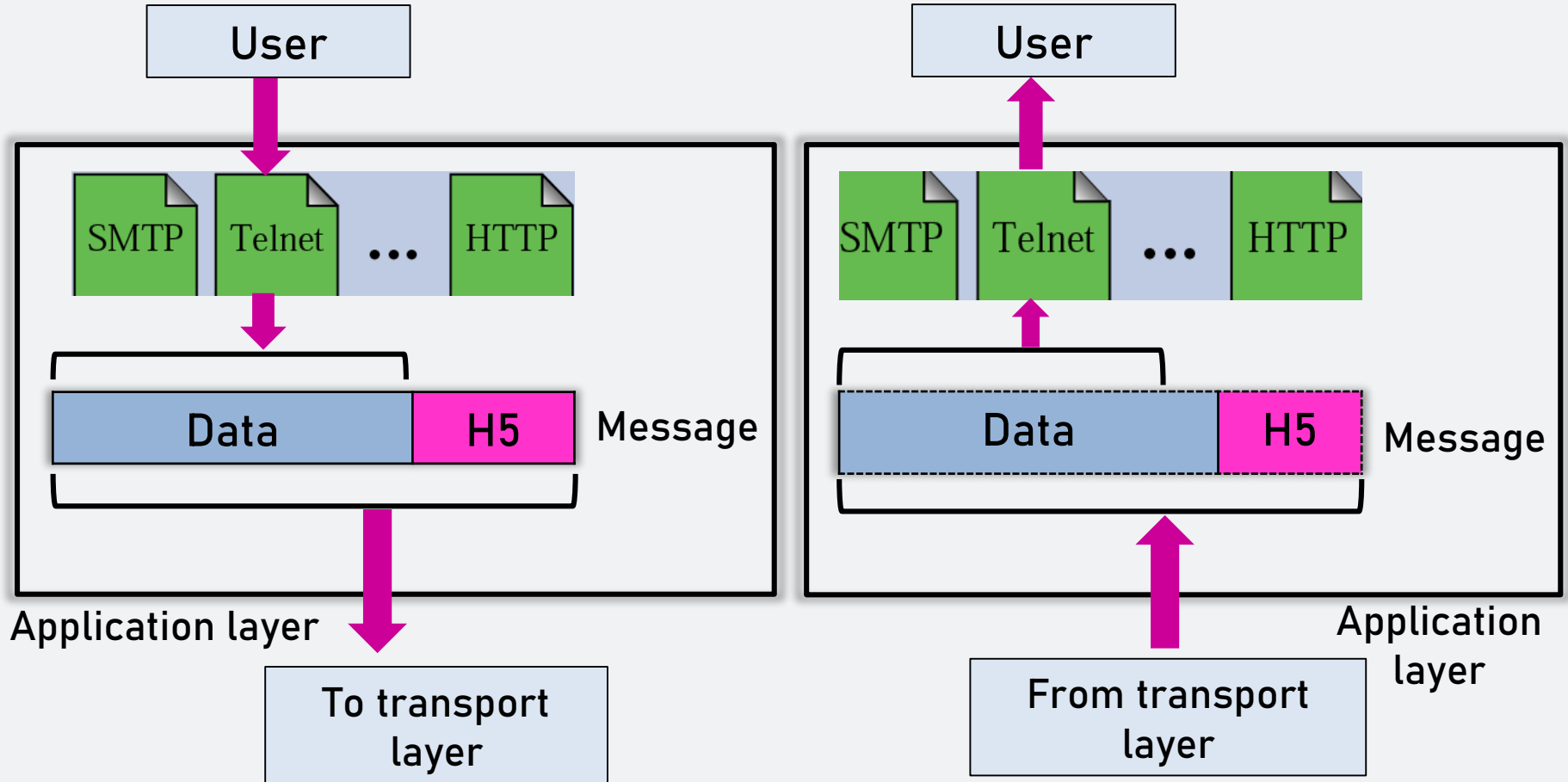
# Functions of the OSI Layers

**Application Layer:** This layer is responsible for providing interface to the application user. This layer encompasses protocols which directly interact with the user.

# Application Layer

- An application layer serves as a window for users and application processes to access network service.
- It handles issues such as network transparency, resource allocation, etc.
- An application layer is not an application, but it performs the application layer functions.
- This layer provides the network services to the end-users.

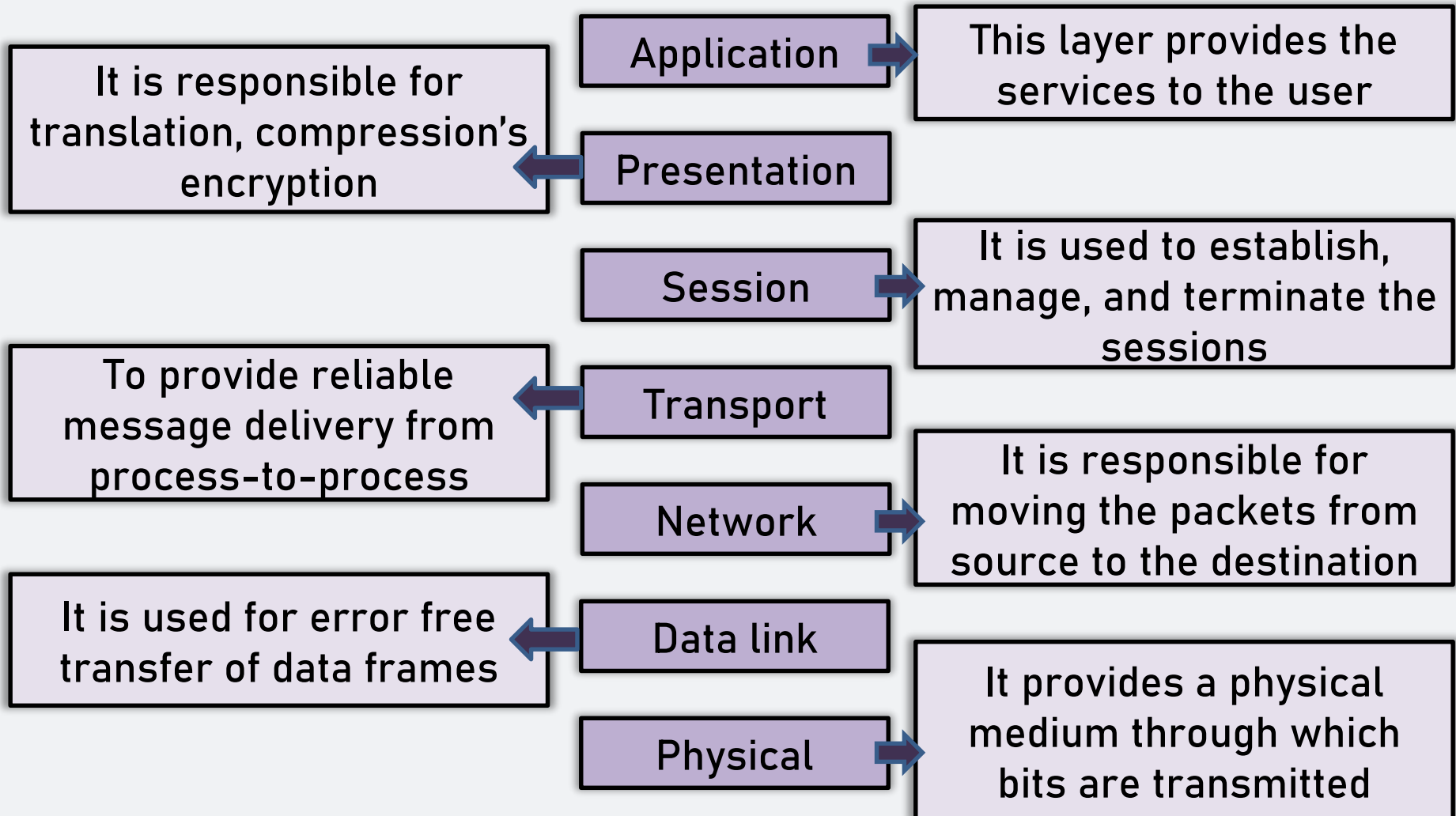
# Application Layer



# Functions of Application layer

- **File transfer, access, and management (FTAM):** An application layer allows a user to access the files in a remote computer, to retrieve the files from a computer and to manage the files in a remote computer.
- **Mail services:** An application layer provides the facility for email forwarding and storage.
- **Directory services:** An application provides the distributed database sources and is used to provide that global information about various objects.

# Functions of layers



# Functions of the OSI Layers

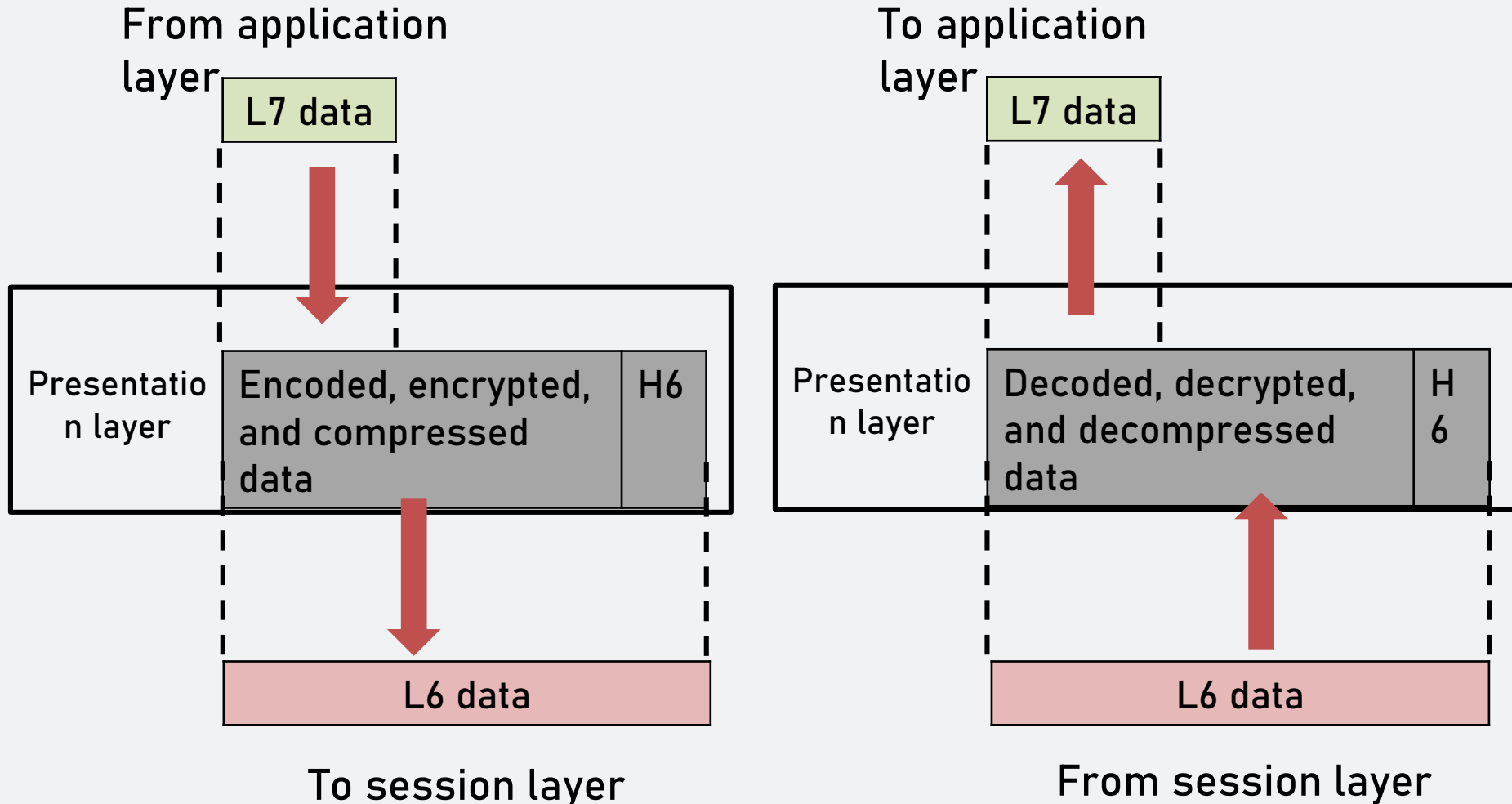
**Presentation Layer:** This layer defines how data in the native format of remote host should be presented in the native format of host.

# Presentation Layer

- A Presentation layer is mainly concerned with the syntax and semantics of the information exchanged between the two systems.
- It acts as a data translator for a network.
- This layer is a part of the operating system that converts the data from one presentation format to another format.
- The Presentation layer is also known as the syntax layer.



# Presentation Layer



# Functions of Presentation layer

**Translation:** The processes in two systems exchange the information in the form of character strings, numbers and so on. Different computers use different encoding methods, the presentation layer handles the interoperability between the different encoding methods. It converts the data from sender-dependent format into a common format and changes the common format into receiver-dependent format at the receiving end.

# Functions of Presentation layer

- **Encryption:** Encryption is needed to maintain privacy. Encryption is a process of converting the sender-transmitted information into another form and sends the resulting message over the network.
- **Compression:** Data compression is a process of compressing the data, i.e., it reduces the number of bits to be transmitted. Data compression is very important in multimedia such as text, audio, video.

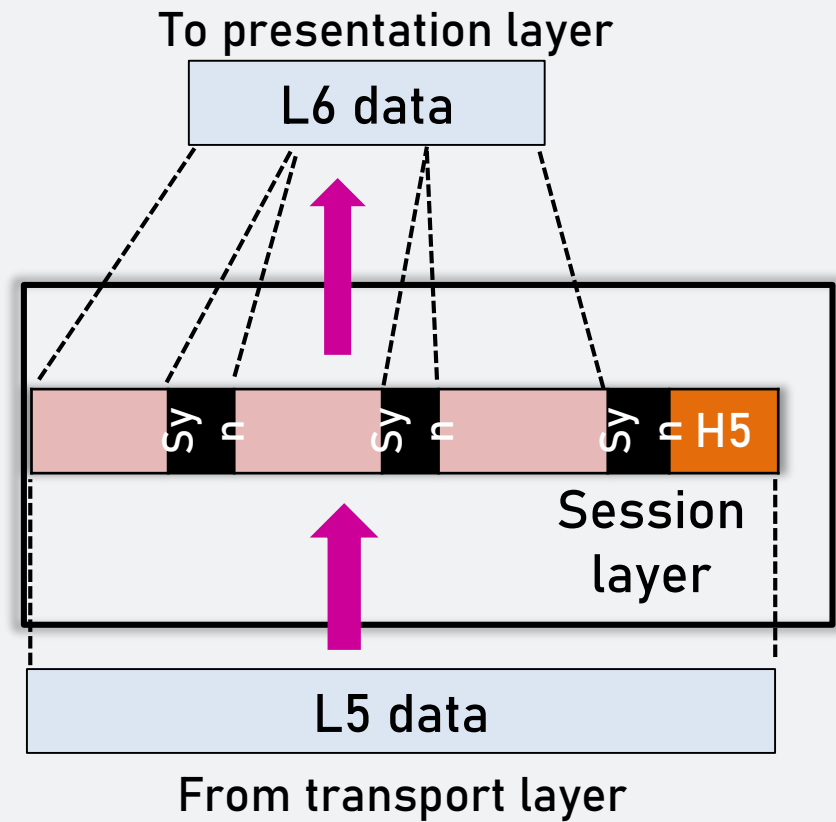
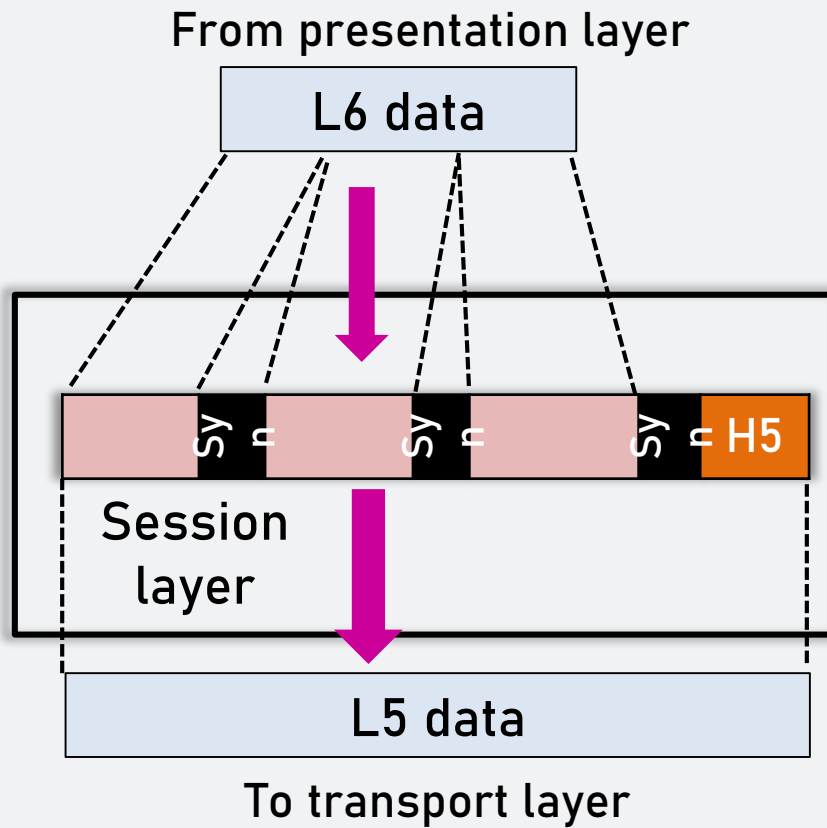
# Functions of the OSI Layers

- **Session Layer:** This layer maintains sessions between remote hosts. For example, once user/password authentication is done, the remote host maintains this session for a while and does not ask for authentication again in that time span.

# Session Layer

- It is a layer 5 in the OSI model.
- The Session layer is used to establish, maintain and synchronizes the interaction between communicating devices.

# Session Layer



# Functions of Session Layer

**Dialog control:** Session layer acts as a dialog controller that creates a dialog between two processes or we can say that it allows the communication between two processes which can be either half-duplex or full-duplex.

# Functions of Session layer

**Synchronization:** Session layer adds some checkpoints when transmitting the data in a sequence. If some error occurs in the middle of the transmission of data, then the transmission will take place again from the checkpoint. This process is known as Synchronization and recovery.



# Functions of the OSI Layers

**Transport Layer:** This layer is responsible for process-to-process delivery between hosts.

# Transport Layer

- The Transport layer is a Layer 4 ensures that messages are transmitted in the order in which they are sent and there is no duplication of data.
- The main responsibility of the transport layer is to transfer the data completely.

# Transport Layer

- It receives the data from the upper layer and converts them into smaller units known as segments.
- This layer can be termed as a process-to-process layer as it provides a point-to-point connection between source and destination to deliver the data reliably.

# Transport Layer

From session layer

L5 data

Transport  
layer



L4 data  
L4 data  
L4 data

To network layer

To session layer

L5 data

Transport  
layer



L4 data  
L4 data  
L4 data

From network  
layer

# The Two Protocols Used in Transport Layer

- Transmission Control Protocol
- User Datagram Protocol

# Transmission Control Protocol

- It is a standard protocol that allows the systems to communicate over the internet.
- It establishes and maintains a connection between hosts.
- When data is sent over the TCP connection, then the TCP protocol divides the data into smaller units known as segments. Each segment travels over the internet using multiple routes, and they arrive in different orders at the destination. The transmission control protocol reorders the packets in the correct order at the receiving end.

# User Datagram Protocol

- User Datagram Protocol is a transport layer protocol.
- It is an unreliable transport protocol as in this case receiver does not send any acknowledgment when the packet is received, the sender does not wait for any acknowledgment. Therefore, this makes a protocol unreliable.

# Functions of Transport Layer

**Service-point addressing:** Computers run several programs simultaneously due to this reason, the transmission of data from source to the destination not only from one computer to another computer but also from one process to another process. The transport layer adds the header that contains the address known as a service-point address or port address. The responsibility of the network layer is to transmit the data from one computer to another computer and the responsibility of the transport layer is to transmit the message to the correct process.



# Functions of Transport Layer

**Segmentation and reassembly:** When the transport layer receives the message from the upper layer, it divides the message into multiple segments, and each segment is assigned with a sequence number that uniquely identifies each segment. When the message has arrived at the destination, then the transport layer reassembles the message based on their sequence numbers.

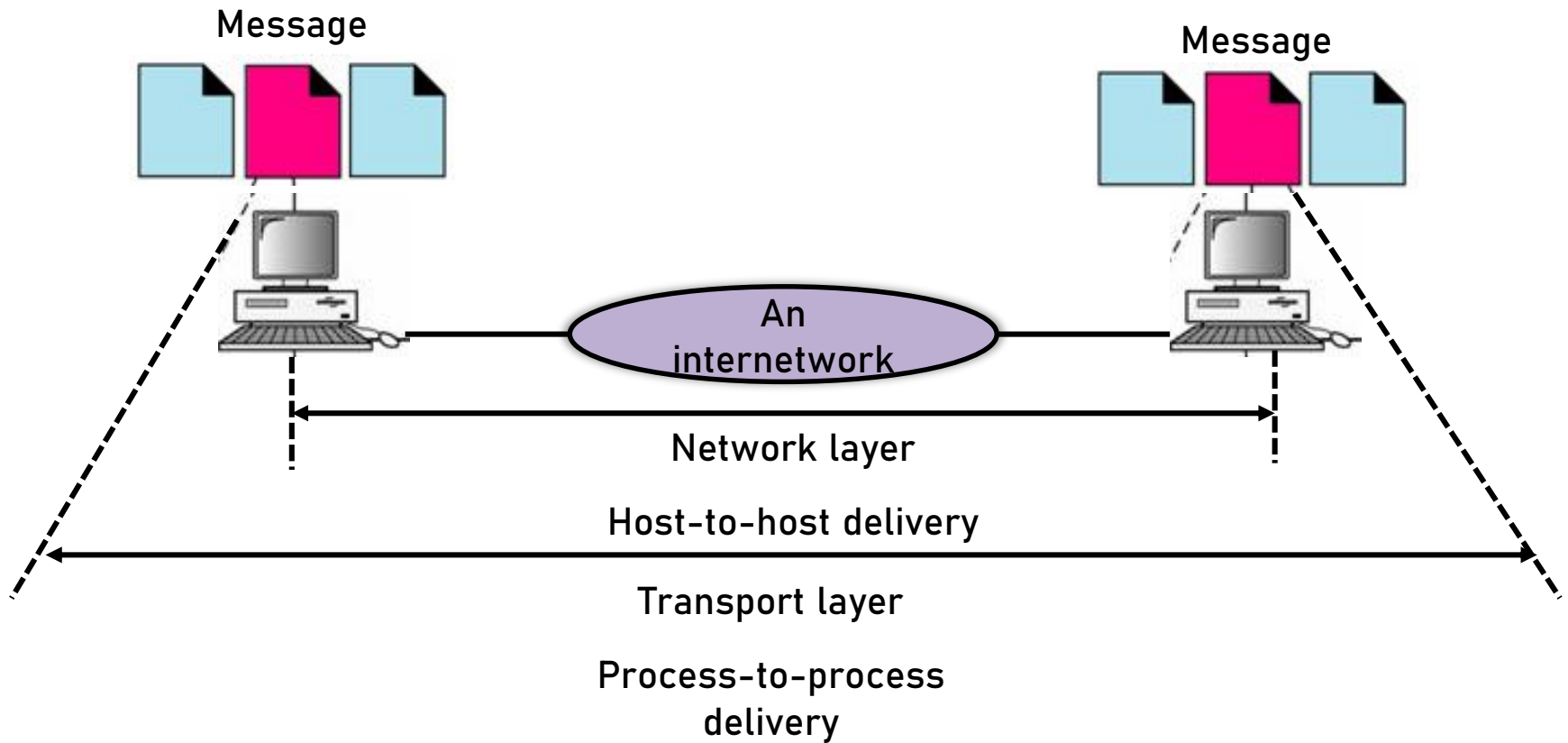
# Functions of Transport Layer

**Connection control:** Transport layer provides two services Connection-oriented service and connectionless service. A connectionless service treats each segment as an individual packet, and they all travel in different routes to reach the destination. A connection-oriented service makes a connection with the transport layer at the destination machine before delivering the packets. In connection-oriented service, all the packets travel in the single route.

# Functions of Transport Layer

- **Flow control:** The transport layer also responsible for flow control but it is performed end-to-end rather than across a single link.
- **Error control:** The transport layer is also responsible for Error control. Error control is performed end-to-end rather than across the single link. The sender transport layer ensures that message reach at the destination without any error.

# Functions of Transport Layer



# Functions of the OSI Layers

**Network Layer:** This layer is responsible for address assignment and uniquely addressing hosts in a network.

# Network Layer

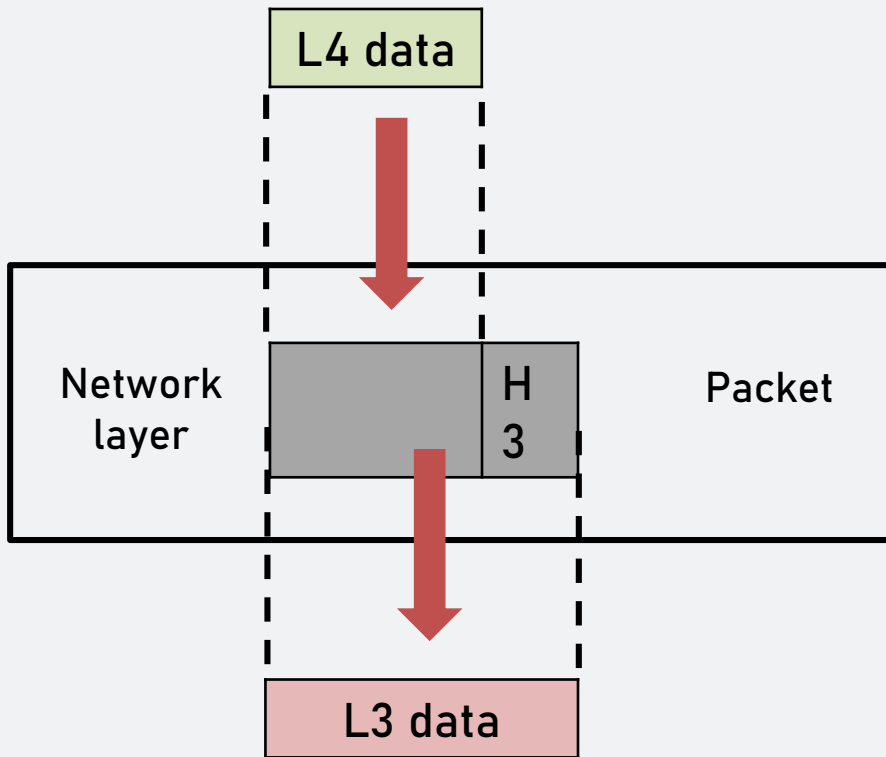
- It is a layer 3 that manages device addressing, tracks the location of devices on the network.
- It determines the best path to move data from source to the destination based on the network conditions, the priority of service, and other factors.
- The Data link layer is responsible for routing and forwarding the packets.

# Network Layer

- Routers are the layer 3 devices, they are specified in this layer and used to provide the routing services within an internetwork.
- The protocols used to route the network traffic are known as Network layer protocols. Examples of protocols are IP and Ipv6.

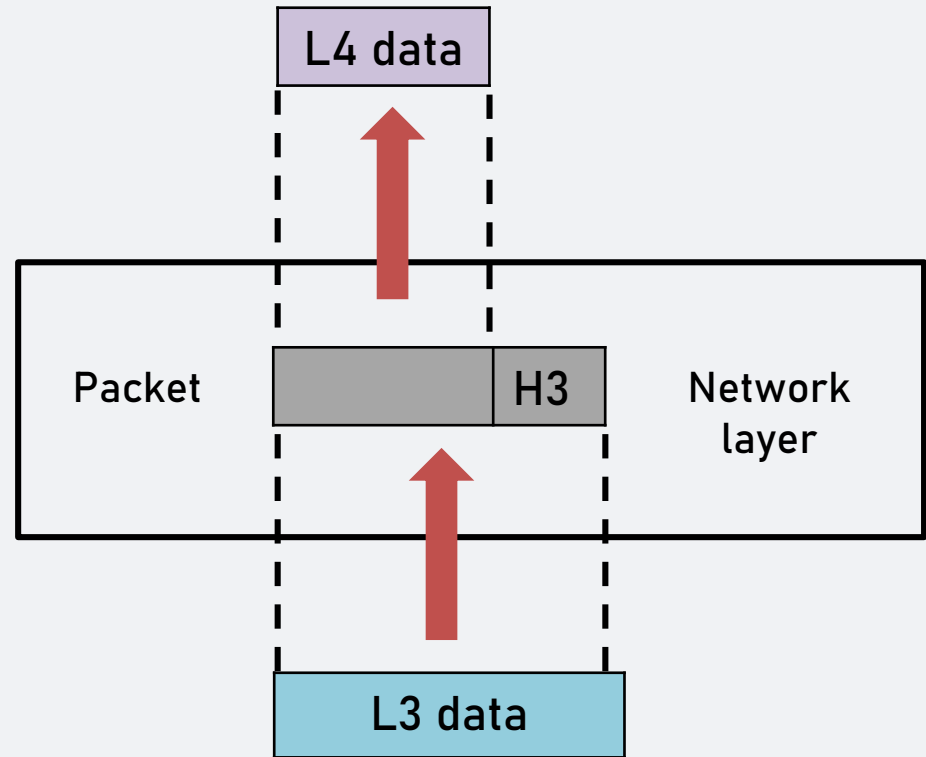
# Network Layer

From transport layer



To data link layer

To transport layer



From data link layer



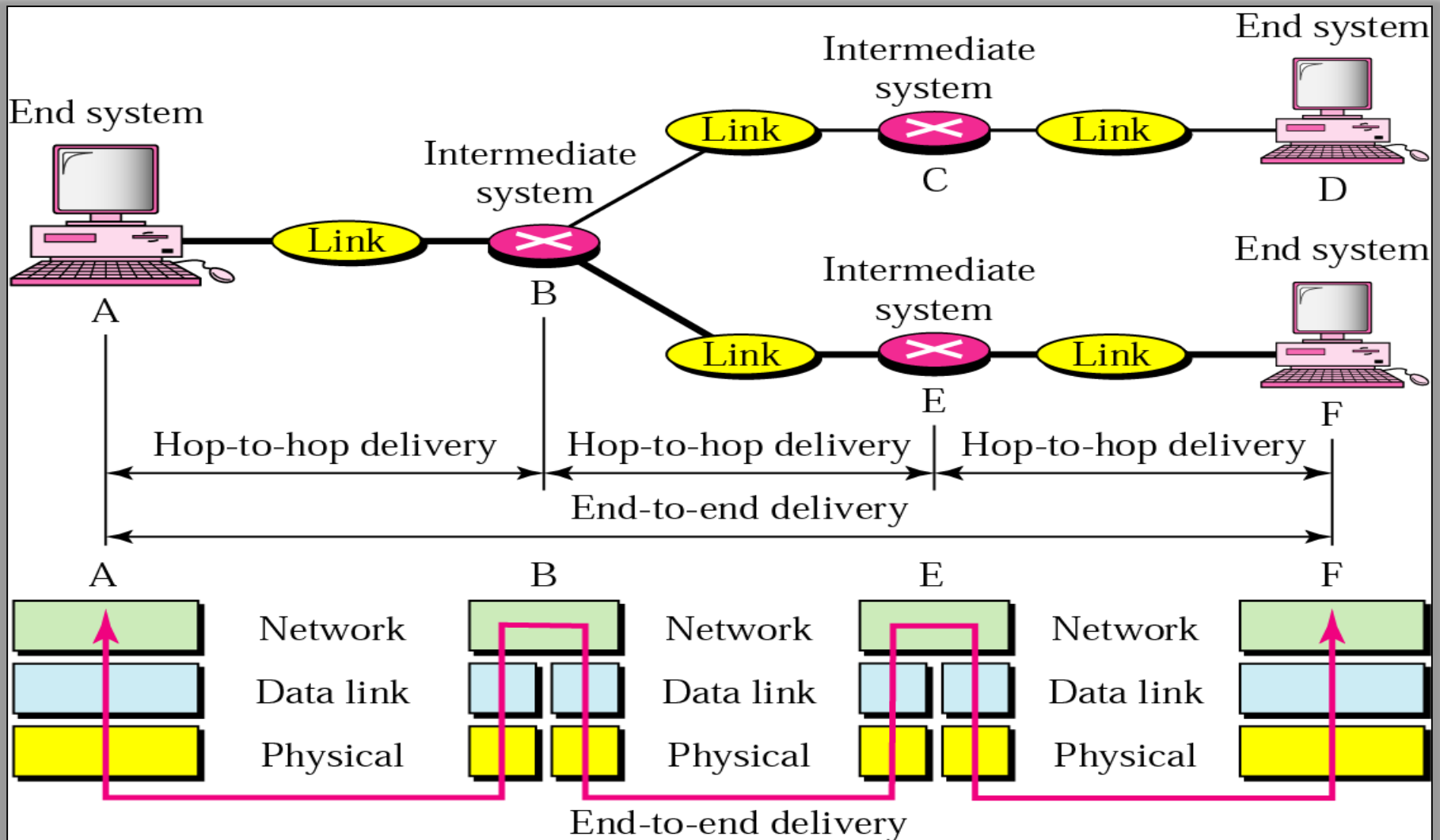
# Functions of Network Layer

- **Internetworking:** An internetworking is the main responsibility of the network layer. It provides a logical connection between different devices.
- **Addressing:** A Network layer adds the source and destination address to the header of the frame. Addressing is used to identify the device on the internet.

# Functions of Network Layer

- **Routing:** Routing is the major component of the network layer, and it determines the best optimal path out of the multiple paths from source to the destination.
- **Packetizing:** A Network Layer receives the segments from the upper layer and converts them into packets. This process is known as Packetizing. It is achieved by internet protocol (IP).

# Functions of Network Layer



# Functions of the OSI Layers

**Data Link Layer:** This layer is responsible for reading and writing data from and onto the line. Link errors are detected at this layer.

# Data-Link Layer

- This layer is responsible for the error-free transfer of data frames.
- It defines the format of the data on the network.
- It provides a reliable and efficient communication between two or more devices.
- It is mainly responsible for the unique identification of each device that resides on a local network.

# Data-Link Layer

It contains two sub-layers:

1. Logical Link Control Layer
2. Media Access Control Layer

# Logical Link Control Layer

- It is responsible for transferring the packets to the Network layer of the receiver that is receiving.
- It identifies the address of the network layer protocol from the header.
- It also provides flow control.

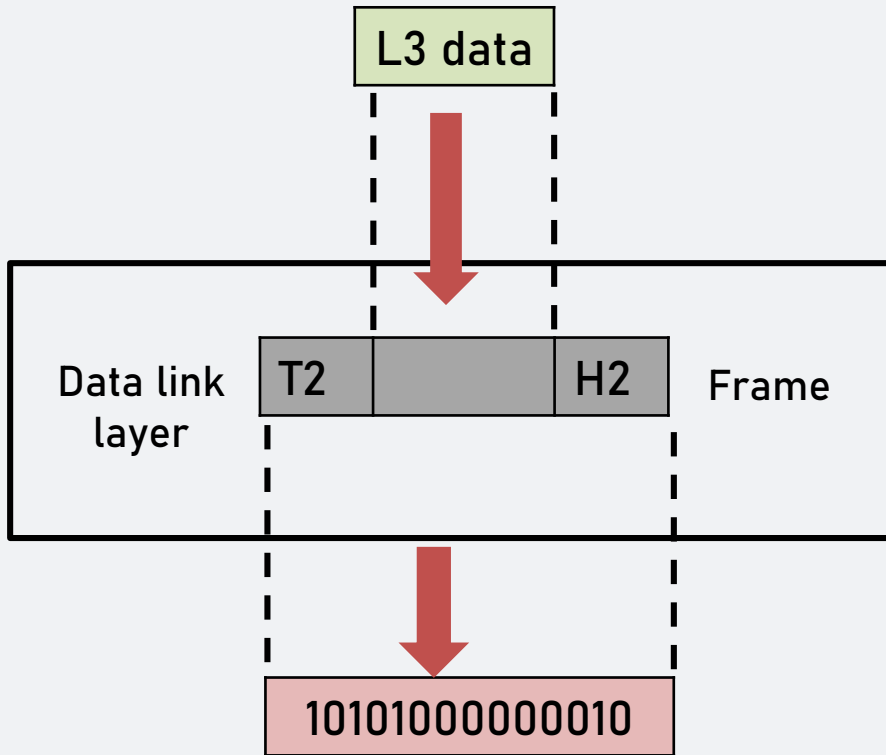
# Media Access Control Layer

- A Media access control layer is a link between the Logical Link Control layer and the network's physical layer.
- It is used for transferring the packets over the network.



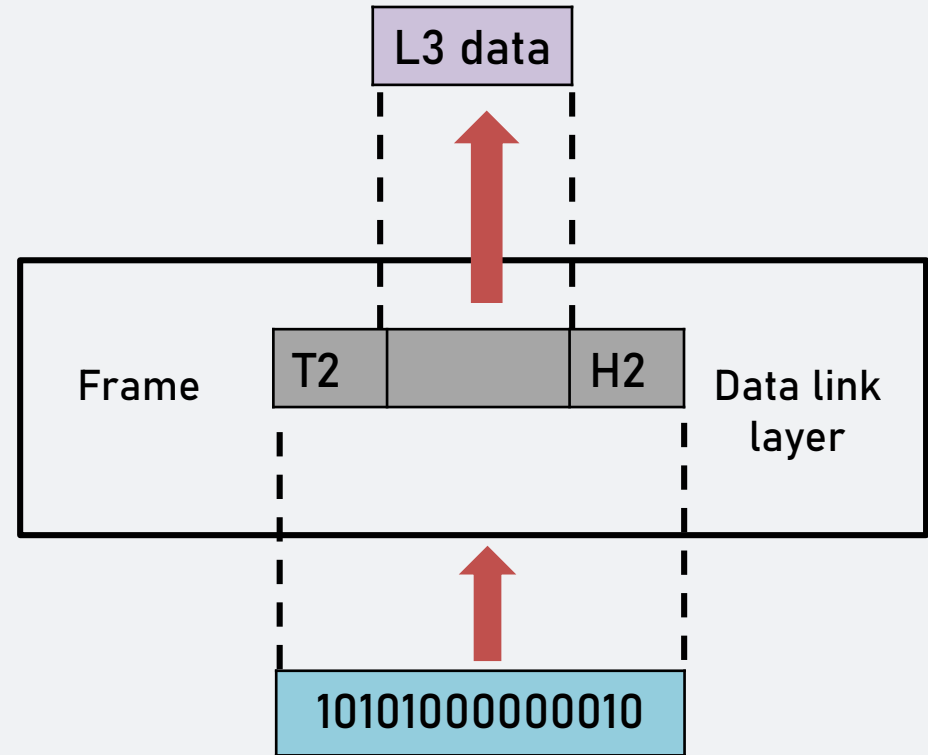
# Data-Link Layer

From Network layer



To physical layer

To Network layer



From physical layer

# Functions of the Data-link layer

**Framing:** The data link layer translates the physical's raw bit stream into packets known as Frames. The Data link layer adds the header and trailer to the frame. The header which is added to the frame contains the hardware destination and source address.

# Functions of the Data-link layer

**Physical Addressing:** The Data link layer adds a header to the frame that contains a destination address. The frame is transmitted to the destination address mentioned in the header.

# Functions of the Data-link layer

**Flow Control:** Flow control is the main functionality of the Data-link layer. It is the technique through which the constant data rate is maintained on both the sides so that no data get corrupted. It ensures that the transmitting station such as a server with higher processing speed does not exceed the receiving station, with lower processing speed.

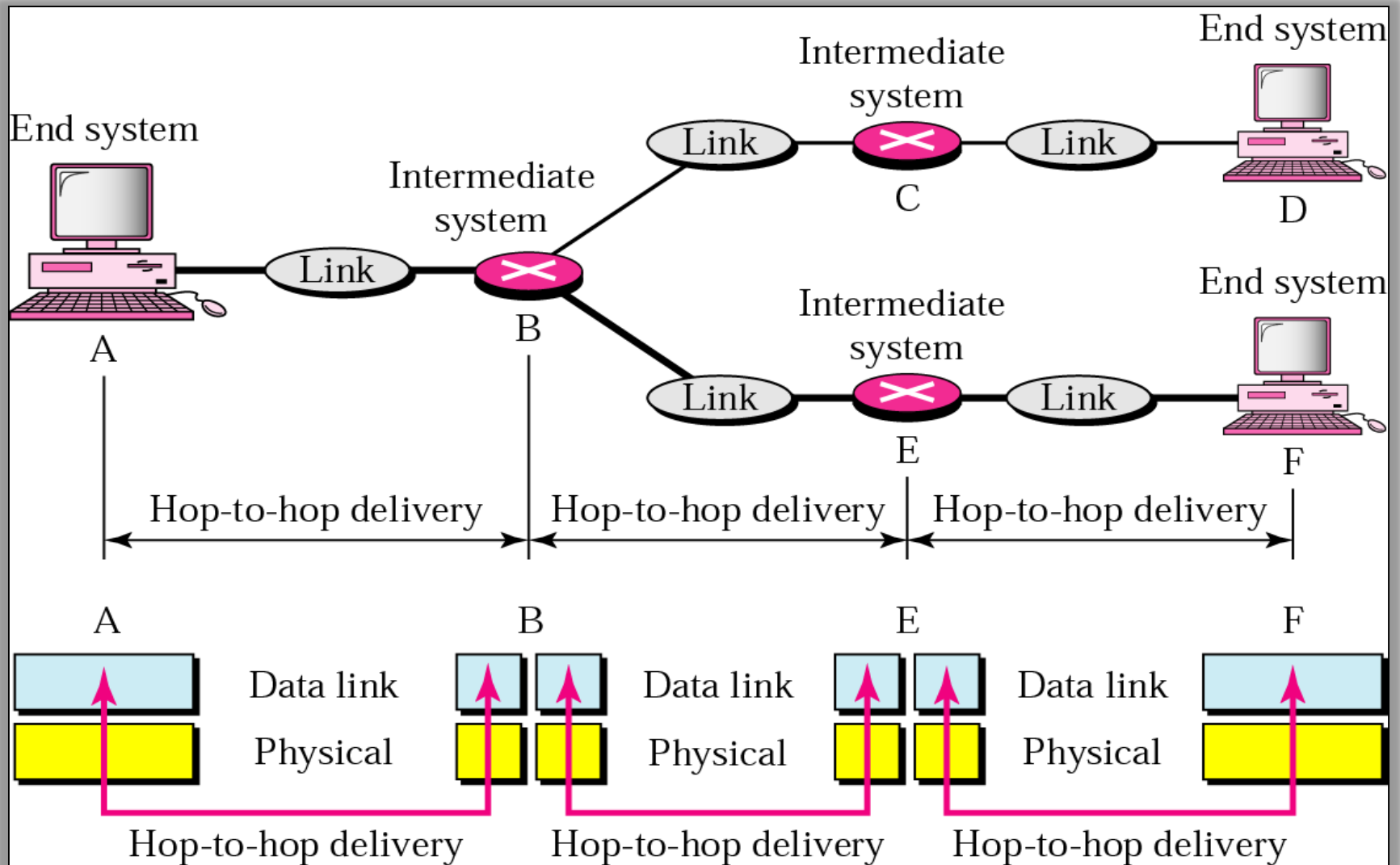
# Functions of the Data-link layer

**Error Control:** Error control is achieved by adding a calculated value CRC (Cyclic Redundancy Check) that is placed to the Data link layer's trailer which is added to the message frame before it is sent to the physical layer. If any error seems to occur, then the receiver sends the acknowledgment for the retransmission of the corrupted frames.

# Functions of the Data-link layer

**Access Control:** When two or more devices are connected to the same communication channel, then the data link layer protocols are used to determine which device has control over the link at a given time.

# Functions of the Data-link layer

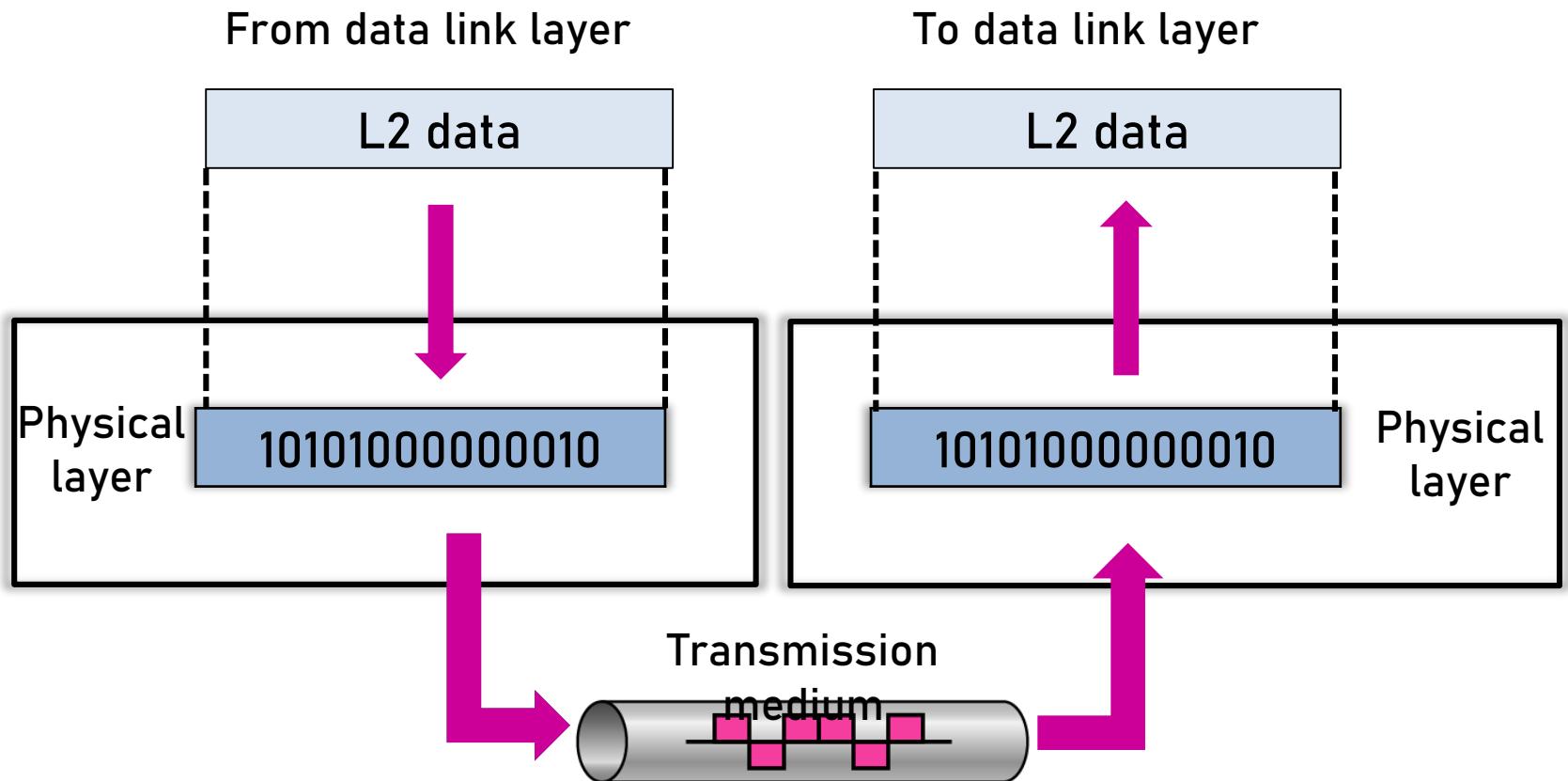


# Functions of the OSI Layers

**Physical Layer:** This layer defines the hardware, cabling wiring, power output, pulse rate etc.



# Physical Layer



# Physical Layer

- The main functionality of the physical layer is to transmit the individual bits from one node to another node.
- It is the lowest layer of the OSI model.
- It establishes, maintains and deactivates the physical connection.
- It specifies the mechanical, electrical and procedural network interface specifications.

# Functions of a Physical layer

- **Line Configuration:** It defines the way how two or more devices can be connected physically.
- **Data Transmission:** It defines the transmission mode whether it is simplex, half-duplex or full-duplex mode between the two devices on the network.

# Functions of a Physical layer

- **Topology:** It defines the way how network devices are arranged.
- **Signals:** It determines the type of the signal used for transmitting the information.

# Advantages Of OSI Model

The OSI Model being one of the most widely used computer network models does possess some major advantages which makes it so popular.

- Each layer has its definite structure and functionality which makes OSI model simple and easy to use.

# Advantages Of OSI Model

- It is a general purpose reference model that can be used for data communication.
- Connection oriented and connection-less services are supported.
- Connection between any type of devices or host or hardware or software is possible.

# Disadvantages Of OSI Model

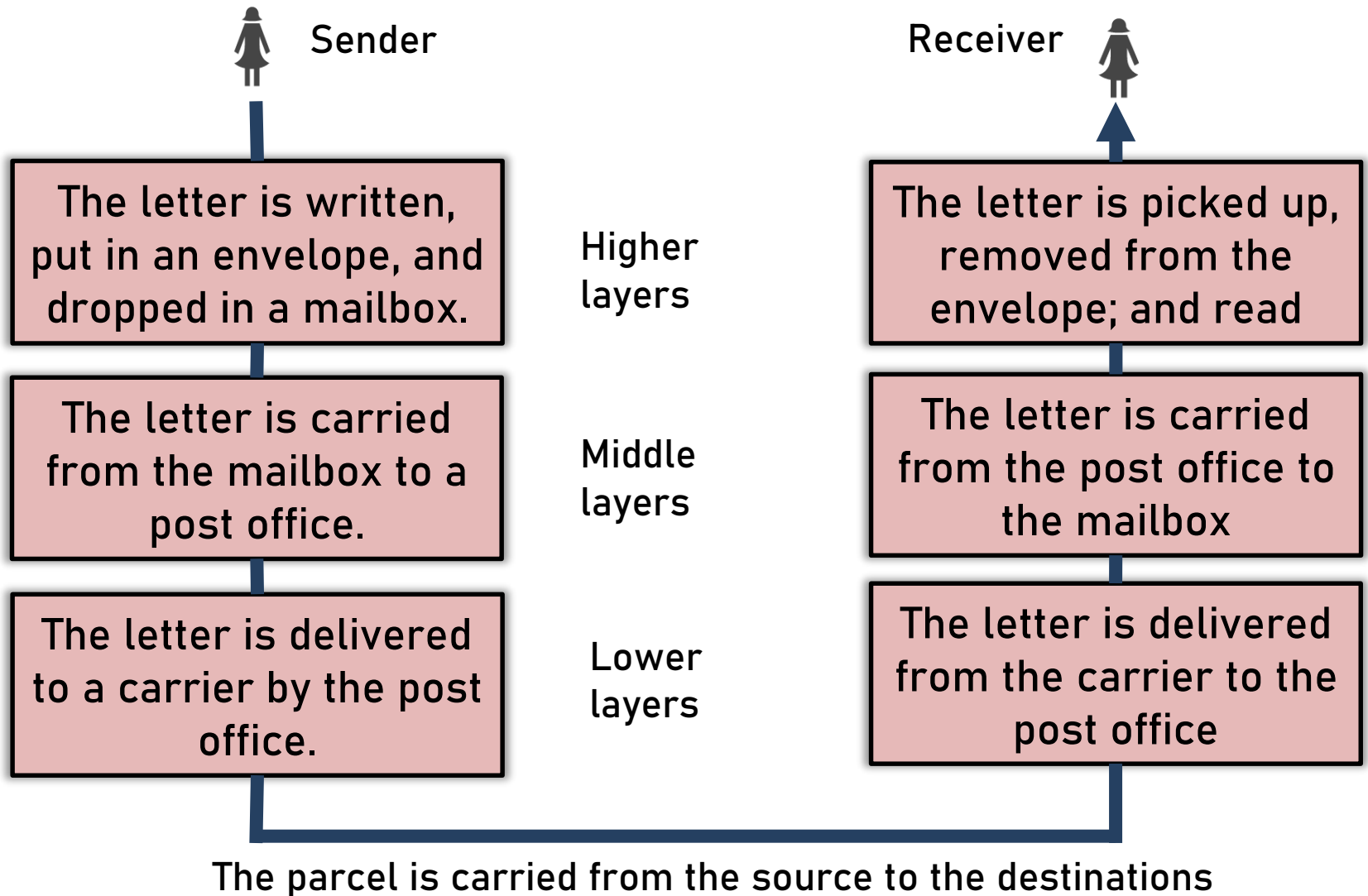
- Because of its inability to fit protocols, this model was replaced by TCP/IP Internet Model.
- Session and Presentation layers does not provide high end functionalities and are not of much use as compared to other layers.
- Connection oriented and connection-less services are supported.
- Connection between any type of devices or host or hardware or software is possible.

# 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.

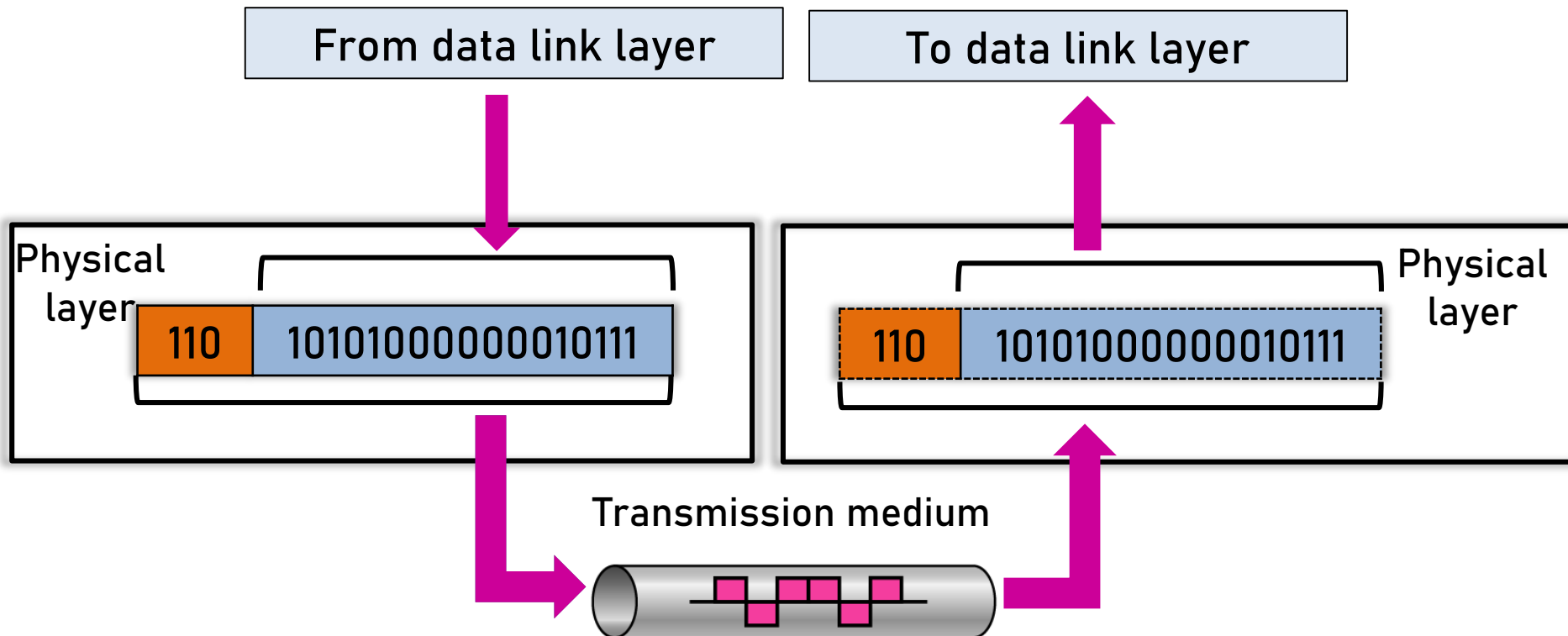


# Tasks involved in sending a letter



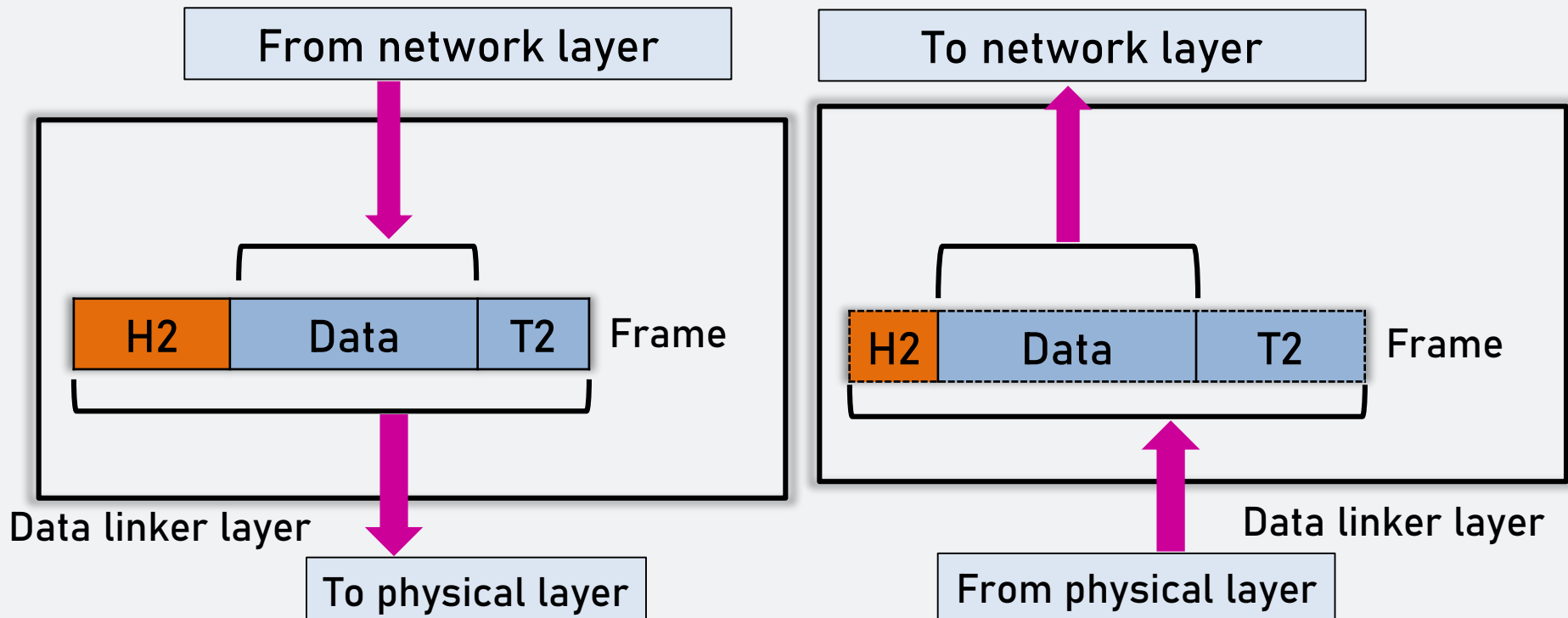
# Physical Layer

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

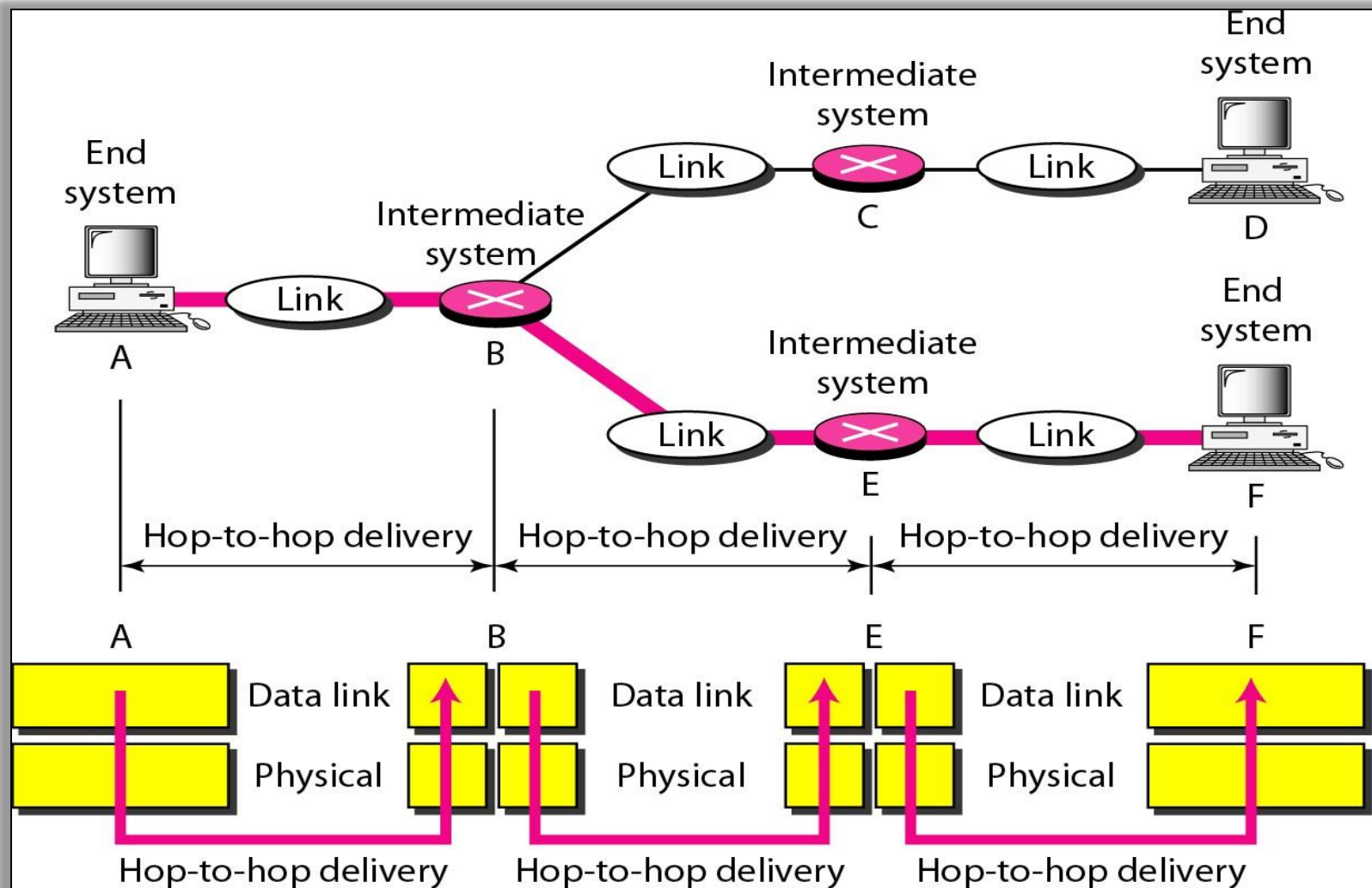


# Data Link Layer

The data link layer is responsible for moving frames from one hop (node) to the next.

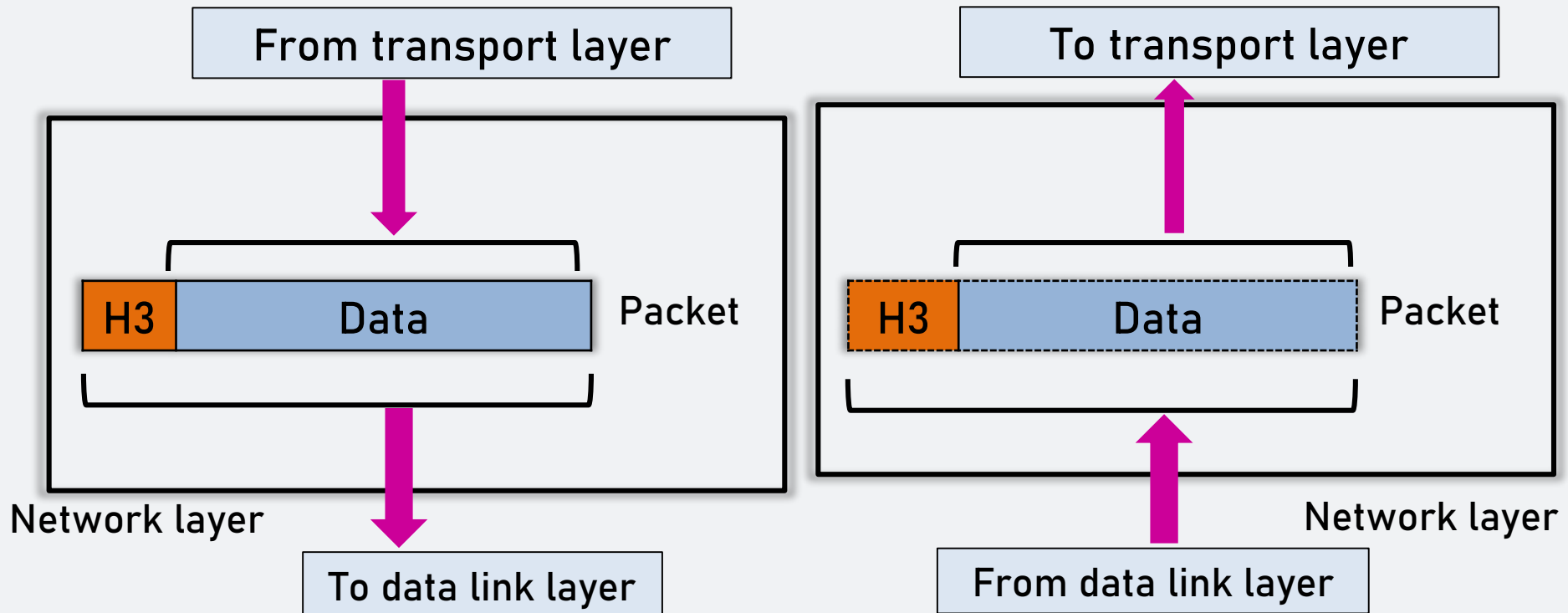


# Hop-to-Hop Delivery

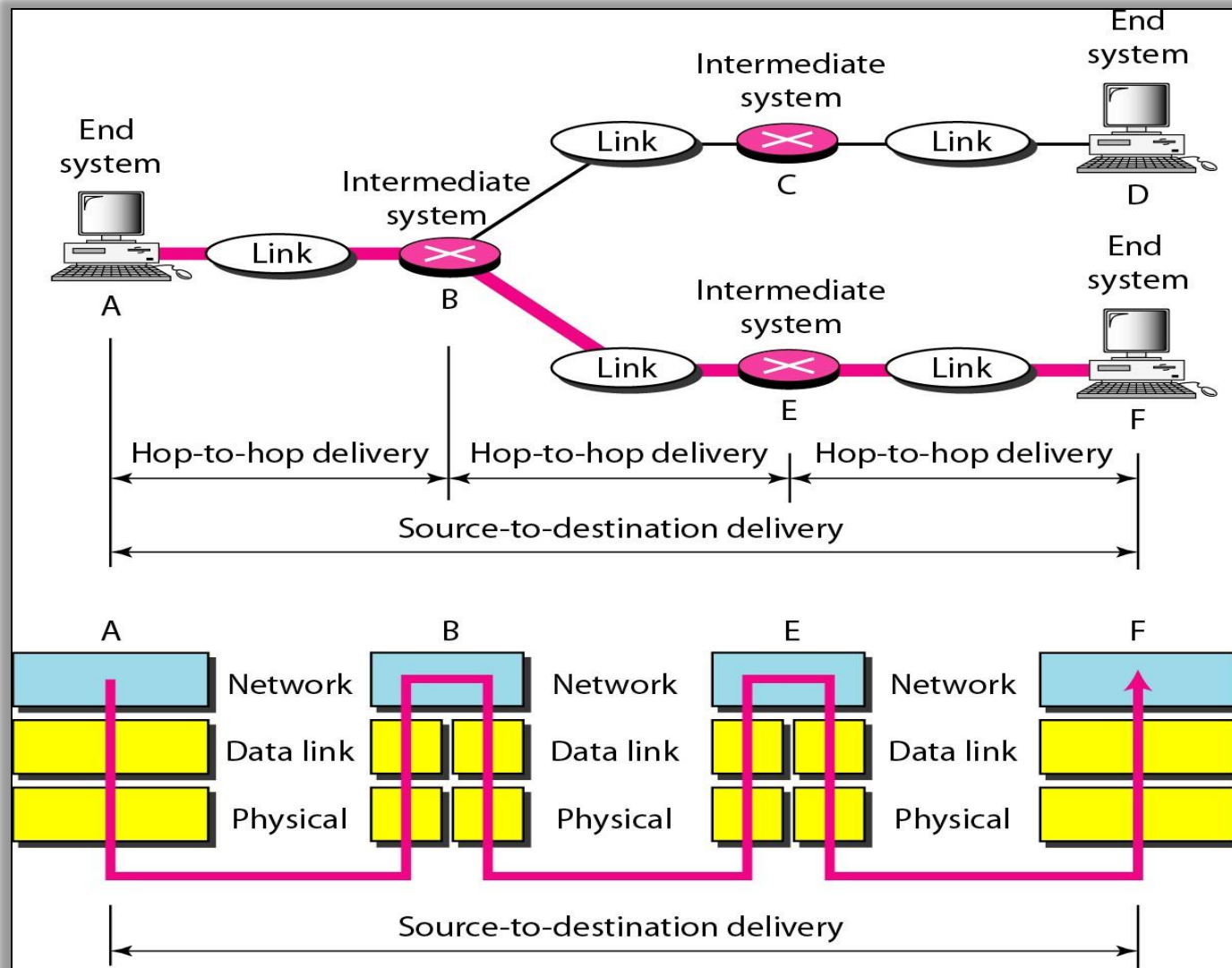


# Network Layer

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

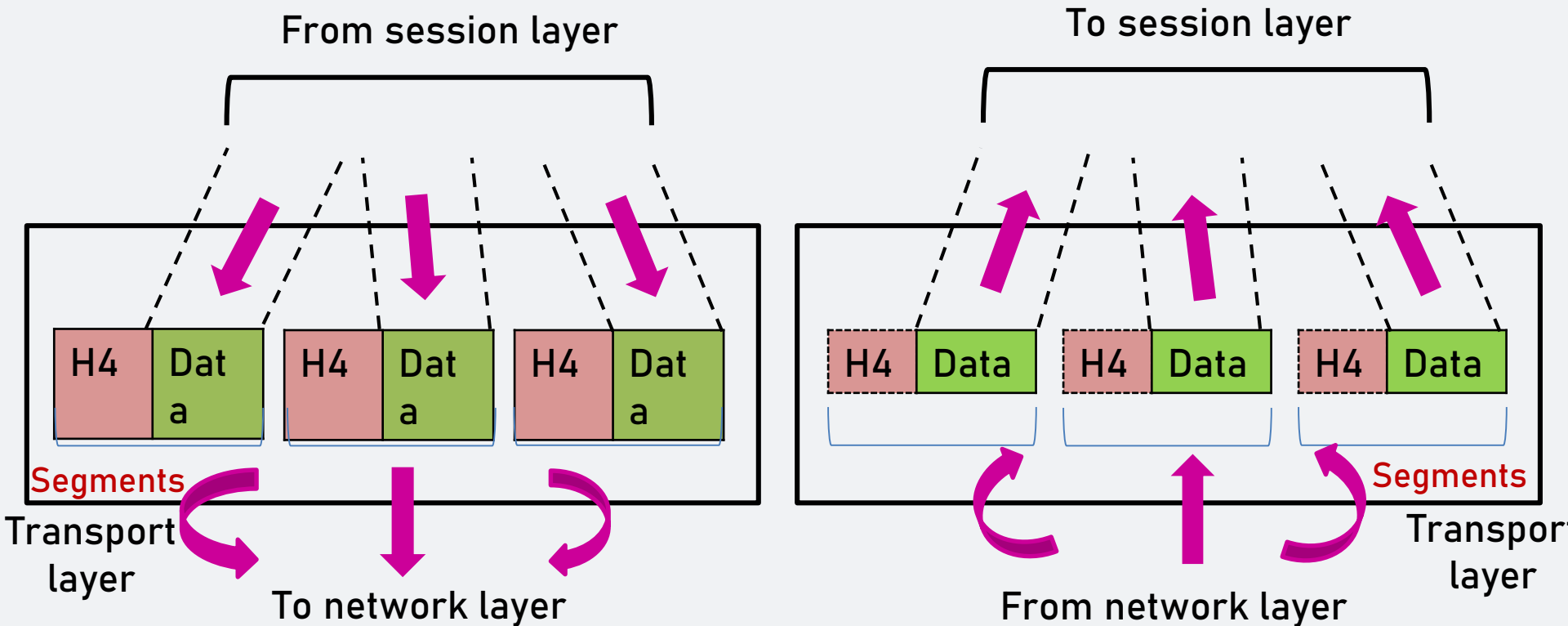


# Source-to-Destination Delivery

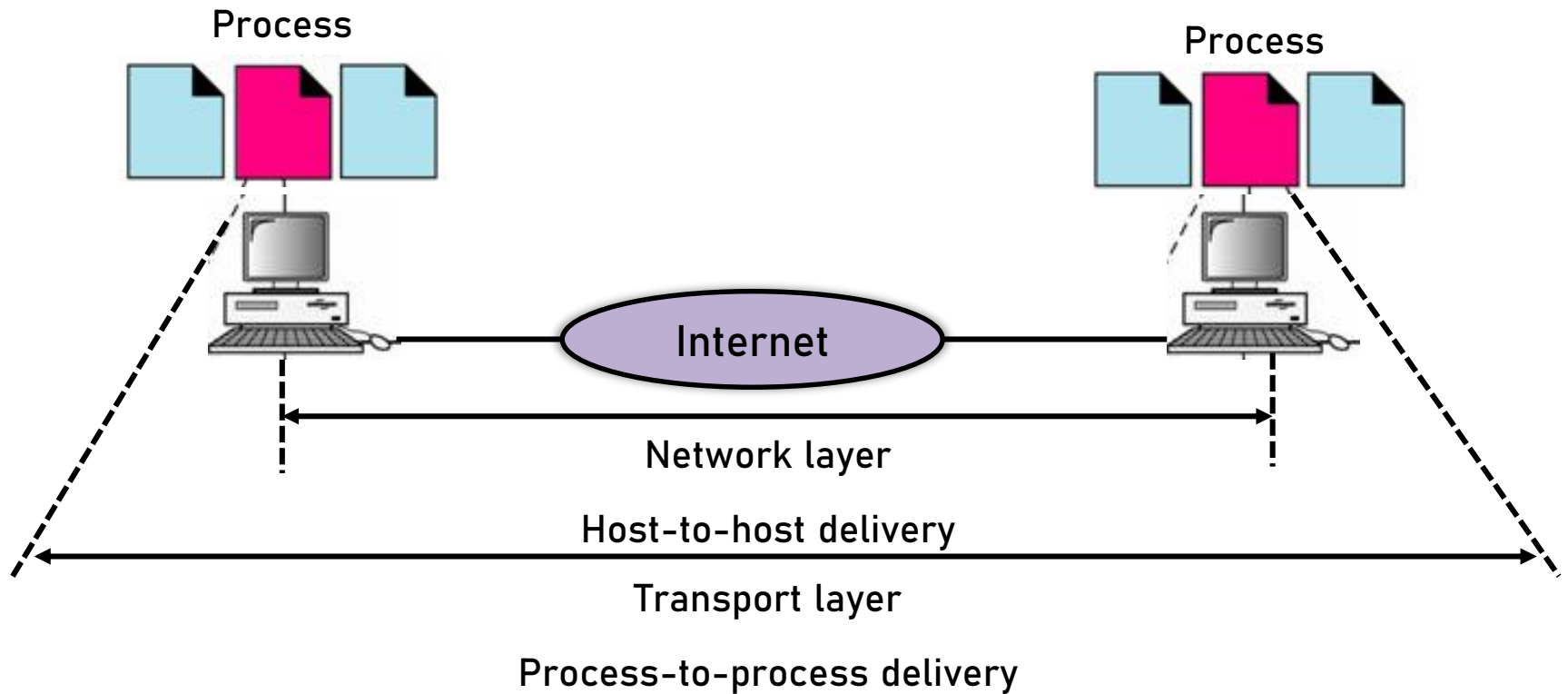


# Transport layer

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



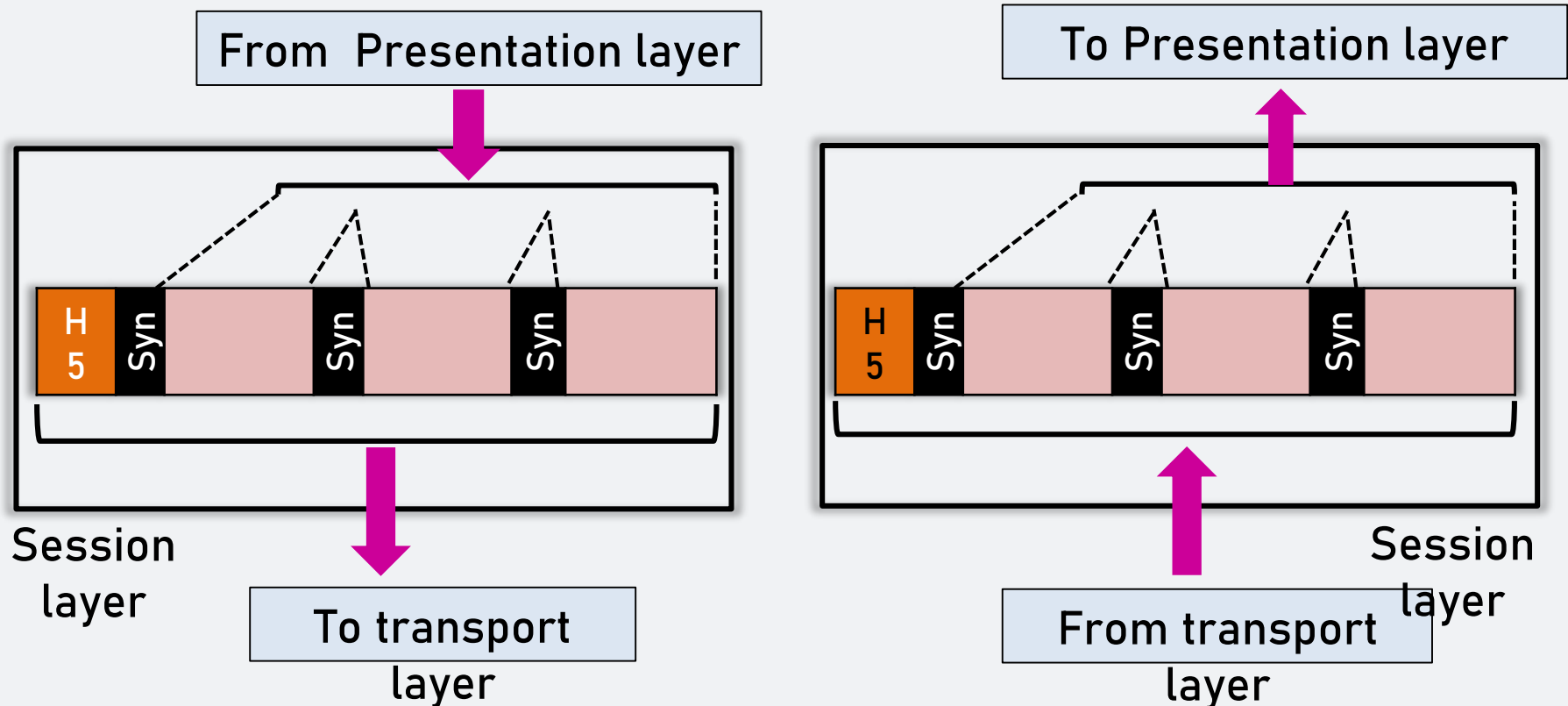
# Reliable Process-to-Process Delivery of a Message





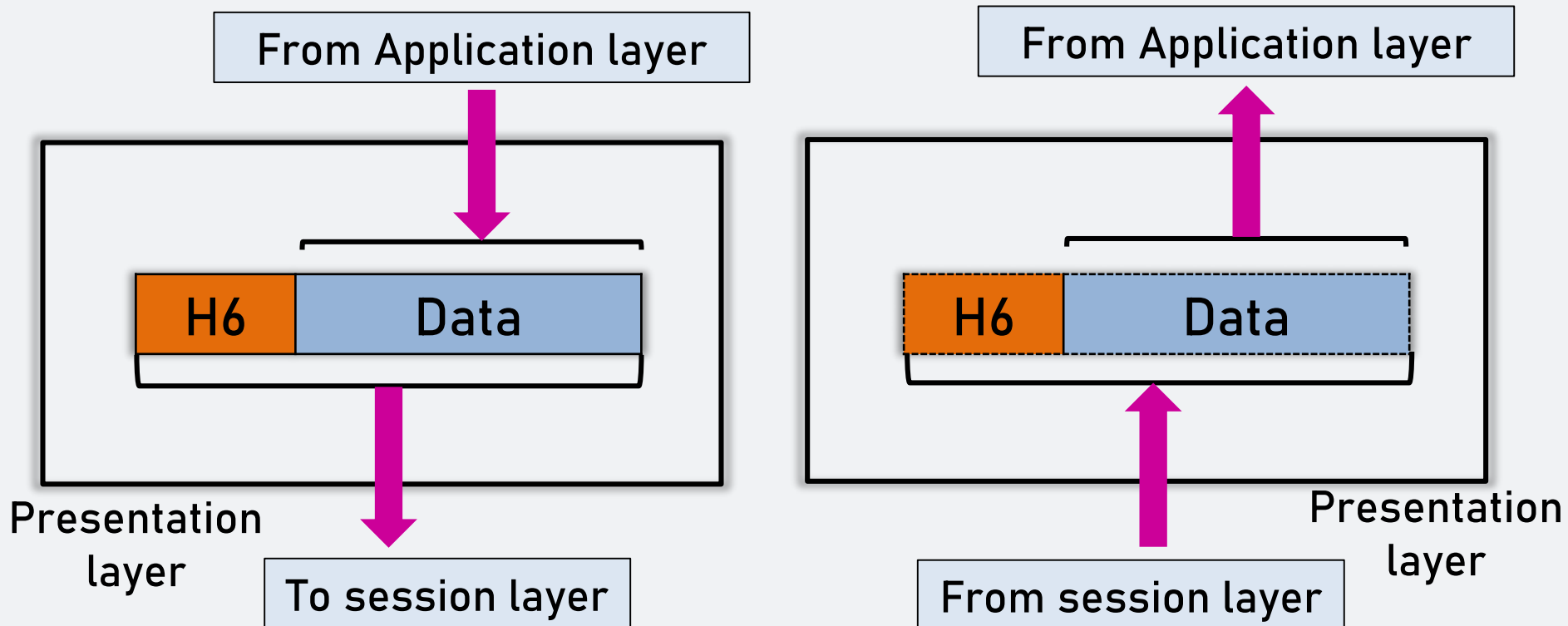
# Session layer

The session layer is responsible for dialog control and synchronization.



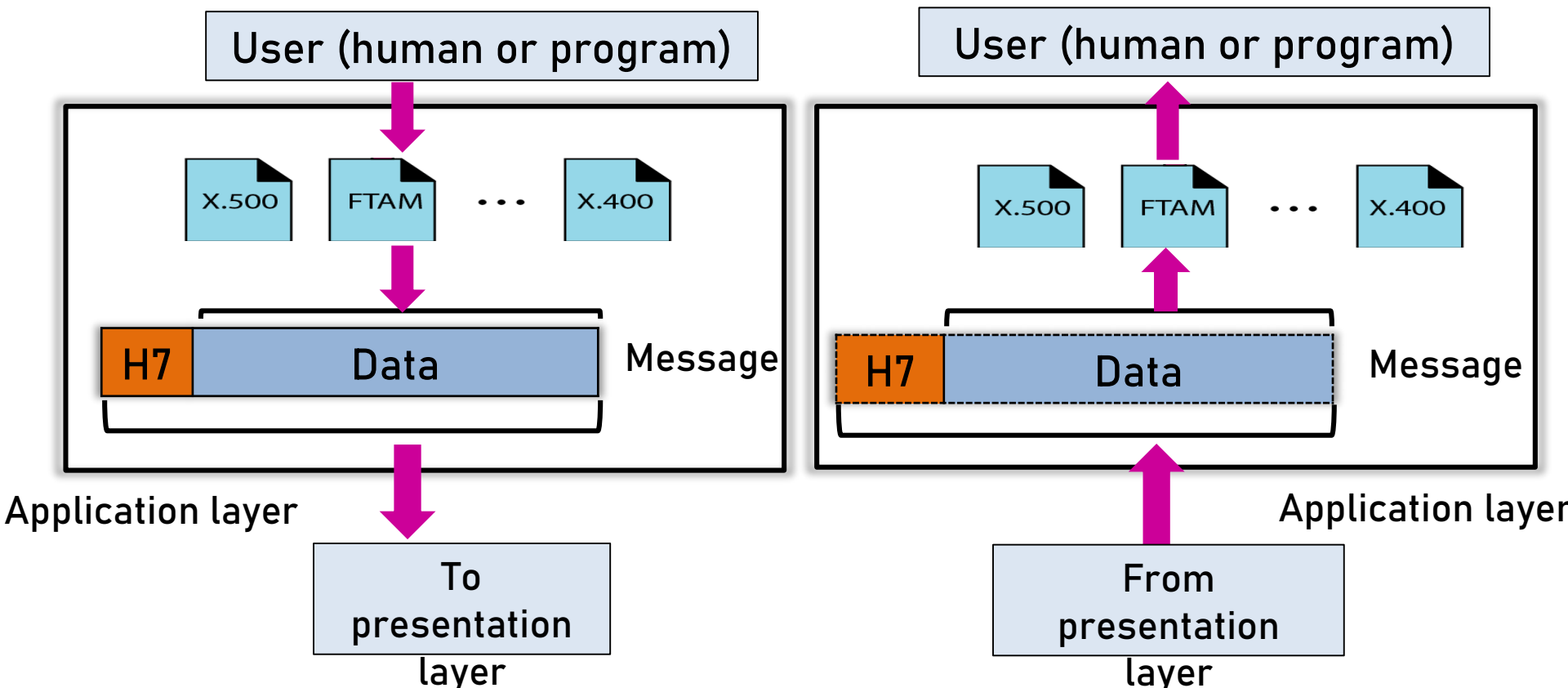
# Presentation layer

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

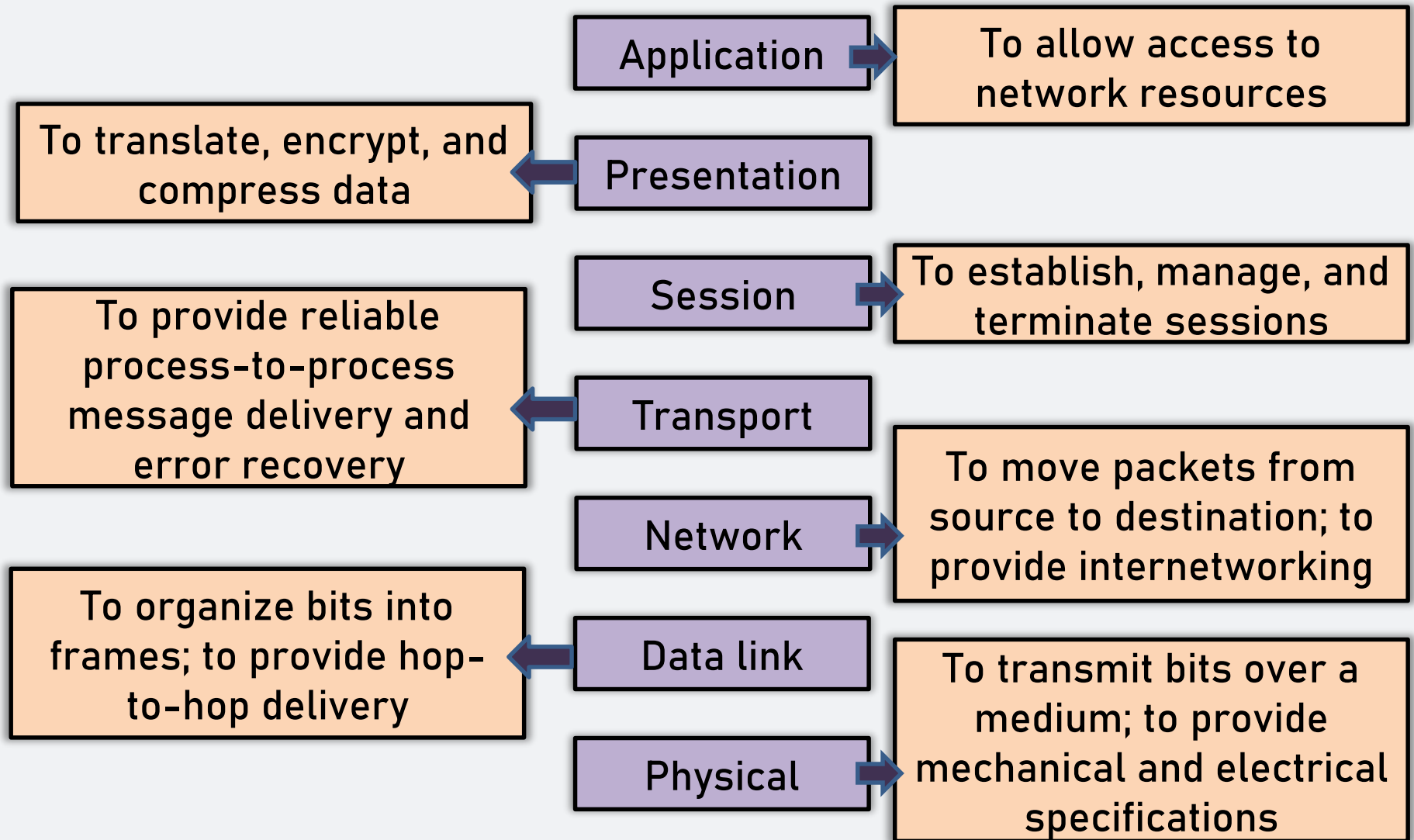


# Application Layer

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



# Summary of Layers



**That's all for now...**