ISO and OSI model

CST 05202: BASICS OF DATA COMMUNICATION NETWORKS

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Protocols and Standards

Standards Organizations for data communication industry

- International Organization for Standardization (ISO)
- International Telecommunication Union - Telecommunication Standards (ITU-T)
- American National Standards Institute (ANSI)
- Institute of Electrical and Electronics Engineers (IEEE)
- Electronic Industries Association (EIA)

ISO Standard

Established in 1947, the International Standards Organization (ISO) is a multinational body dedicated to worldwide agreement on international standards.

- An ISO is the Open Systems Interconnection (OSI) model; is the standard that covers all aspects of network communications from ISO. It was first introduced in the late 1970s.

Introduction to OSI 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 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 consists of seven layers, and it divides the whole task into seven smaller and manageable tasks.
- Each layer is assigned a particular task.
- Each layer is self-contained, so that task assigned to each layer can be performed independently.

Computer Network model

The OSI model use Layered Architecture:

- The main aim of the layered architecture is to divide the design into small pieces.
- Each lower layer adds its services to the higher layer to provide a full set of services to manage communications and run the applications.
- It provides modularity and clear interfaces, i.e., provides interaction between subsystems.
- It ensures the independence between layers by providing the services from lower to higher layer without defining how the services are implemented. Therefore, any modification in a layer will not affect the other layers.
- The number of layers, functions, contents of each layer will vary from network to network. However, the purpose of each layer is to provide the service from lower to a higher layer and hiding the details from the layers of how the services are implemented.

Computer Network model

Layered Architecture:

The basic elements of layered architecture are services, protocols, and interfaces.

- **Service:** It is a set of actions that a layer provides to the higher layer.
- **Protocol:** It defines a set of rules that a layer uses to exchange the information with peer entity. These rules mainly concern about both the contents and order of the messages used.
- **Interface:** It is a way through which the message is transferred from one layer to another layer.

In a layer n architecture, layer n on one machine will have a communication with the layer n on another machine and the rules used in a conversation are known as a layer-n protocol.

Layered Architecture

Layers

Layer 7. Application

Layer 6. Presentation

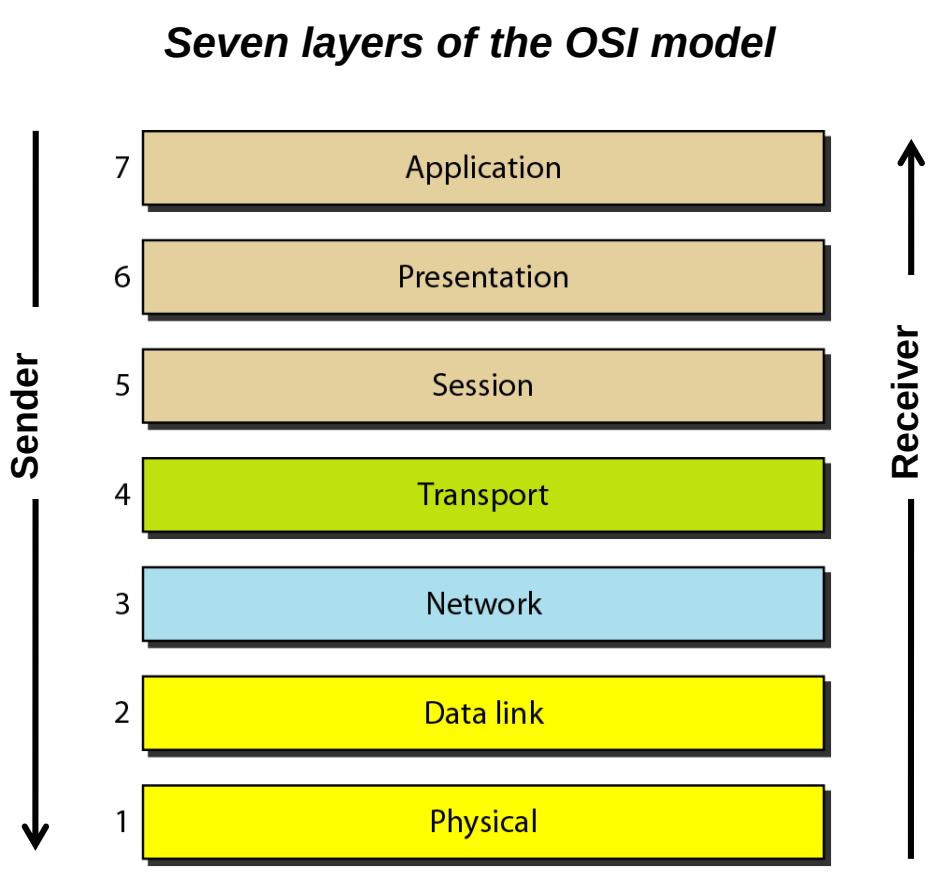
Layer 5. Session

Layer 4. Transport

Layer 3. Network

Layer 2. Data Link

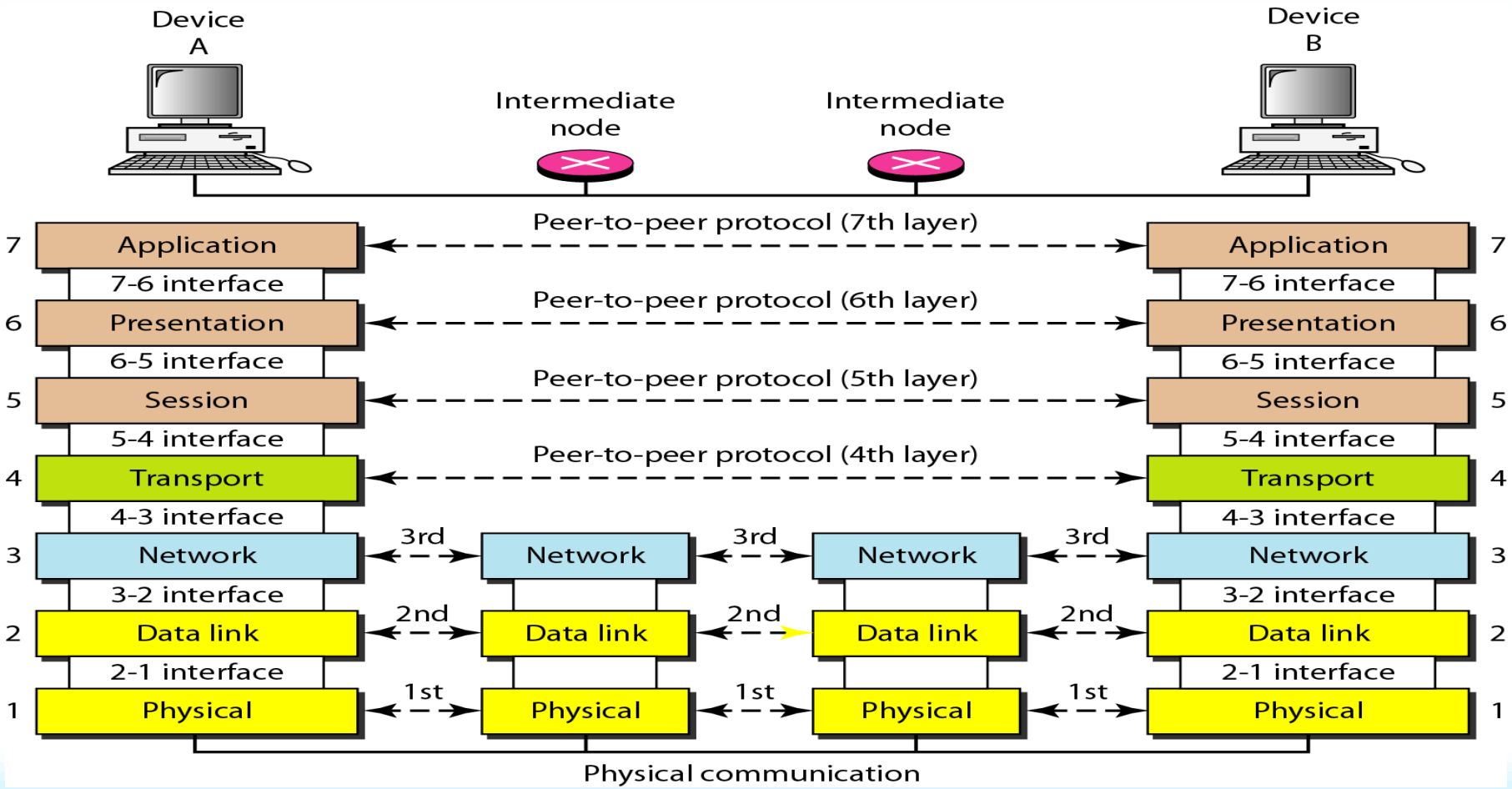
Layer 1. Physical



Peer-To-Peer Process

- Communication must move downward through the layers on the sending device, over the communication channel, and upward to the receiving device
- Each layer in the sending device adds its own information to the message it receives from the layer just above it and passes the whole package to the layer just below it
- At the receiving device, the message is unwrapped layer by layer, with each process receiving and removing the data meant for it.
- The passing of the data and network information down through the layers of the sending device and backup through the layers of the receiving device is made possible by interface between each pair of adjacent layers
  - Interface defines what information and services a layer must provide for the layer above it.

The interaction between layers in the OSI model



1. 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:

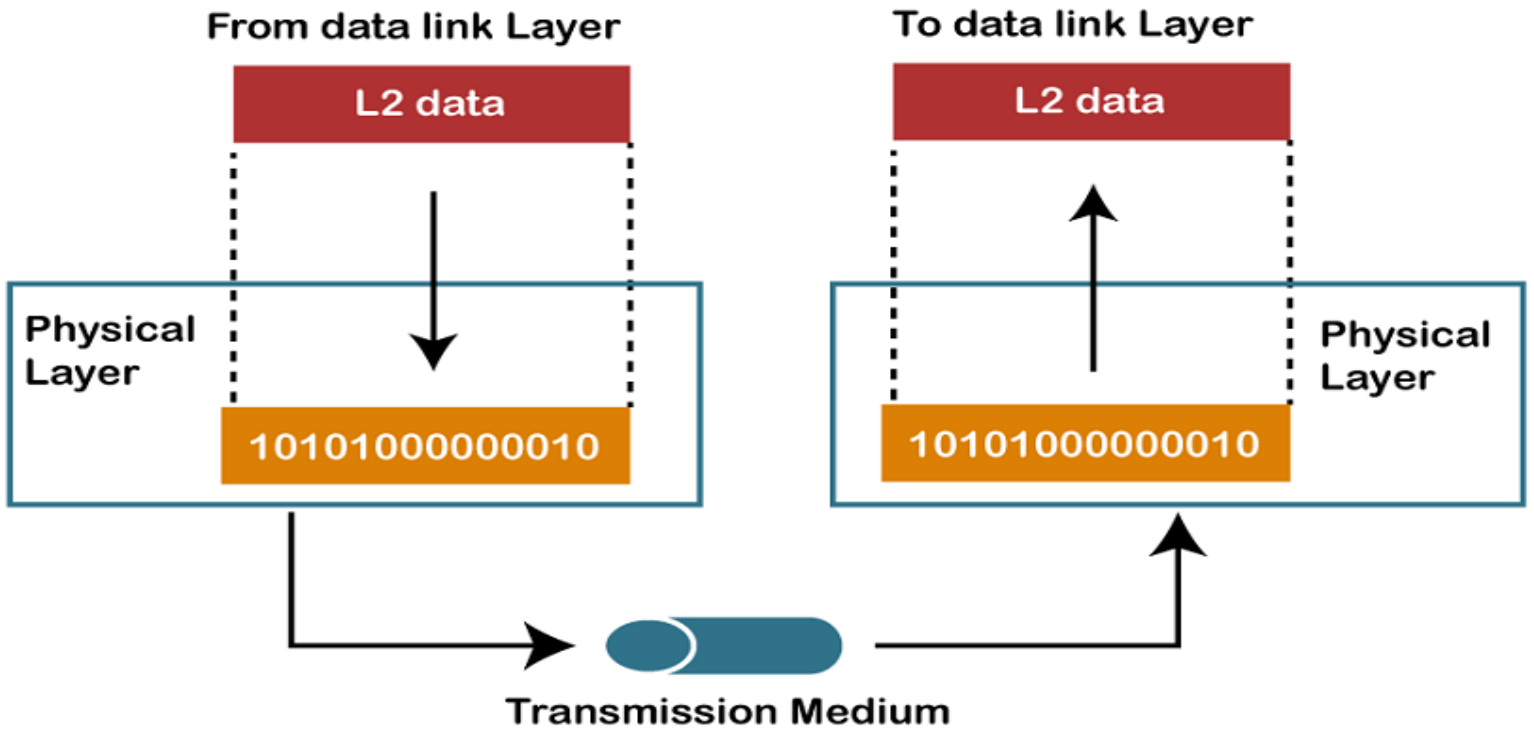
Line Configuration: It defines the way how two or more devices can be connected physically.

Data Transmission: It defines the transmission mode whether it is simplex, half-duplex or full-duplex mode between the two devices on the network.

Topology: It defines the way how network devices are arranged.

Signals: It determines the type of the signal used for transmitting the information.

1. Physical layer cont…



***Examples of hardware in the physical layer are network adapters, ethernet, repeaters, networking hubs, etc.

2. Data link layer

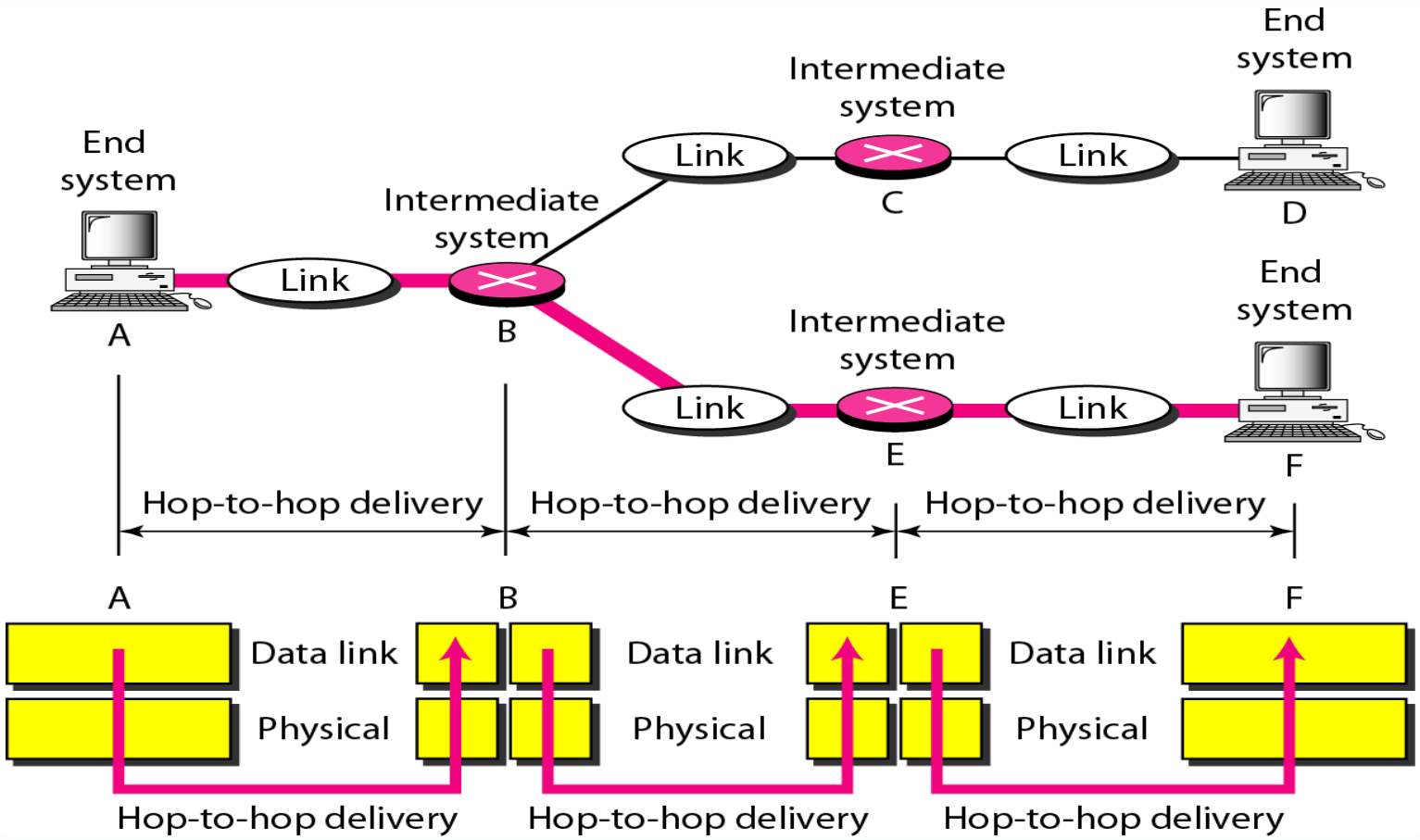
The data link layer is responsible for moving **data frames** from one hop (node) to the next.

- 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.

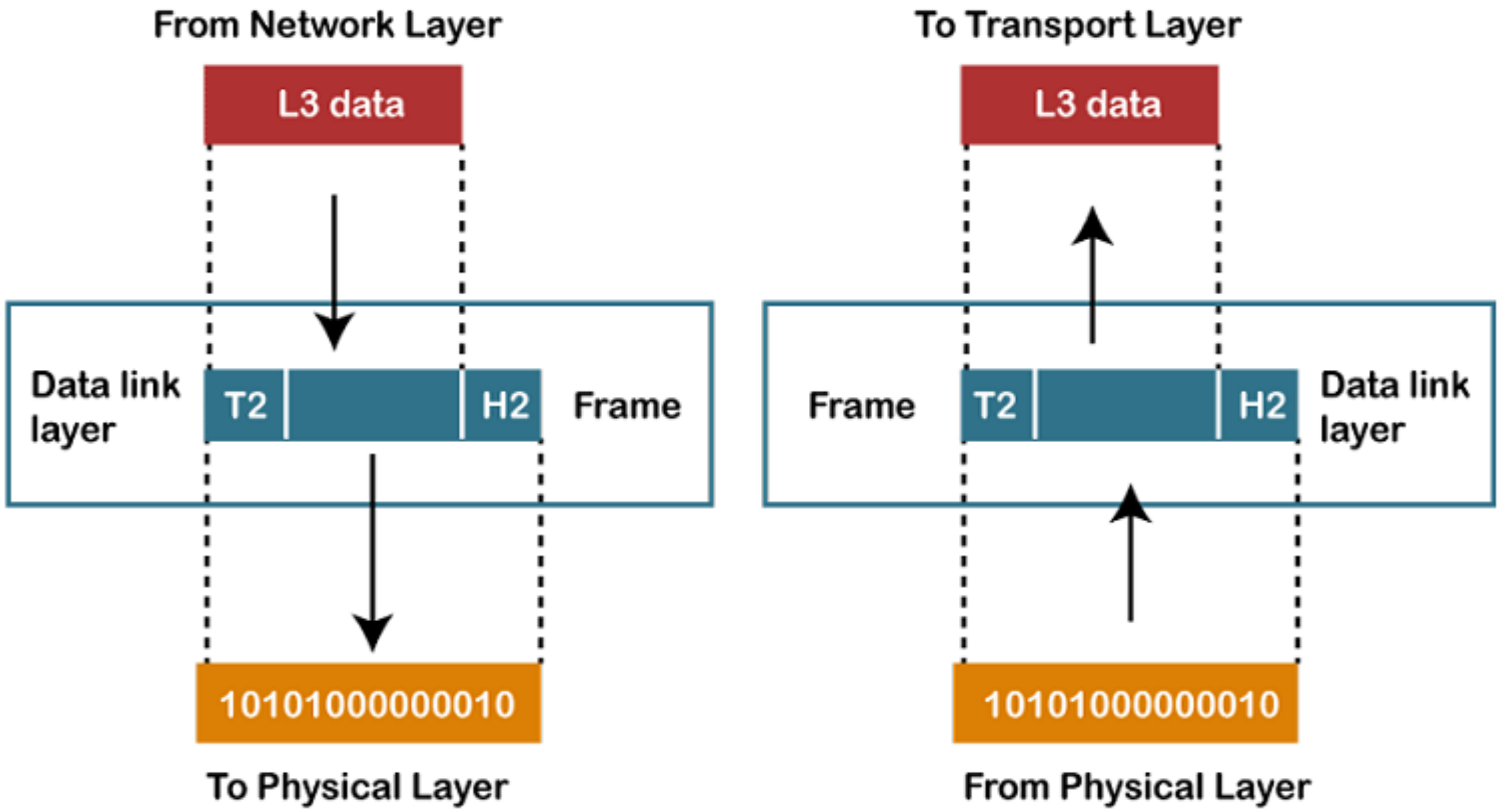
It contains two sub-layers:

- **Logical Link Control (LLC) 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 (MAC) 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 frame over the network.

2. Data link layer Hop to hop delivery



2. Data link layer cont…



2. Data link layer functions

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.

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

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.

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.

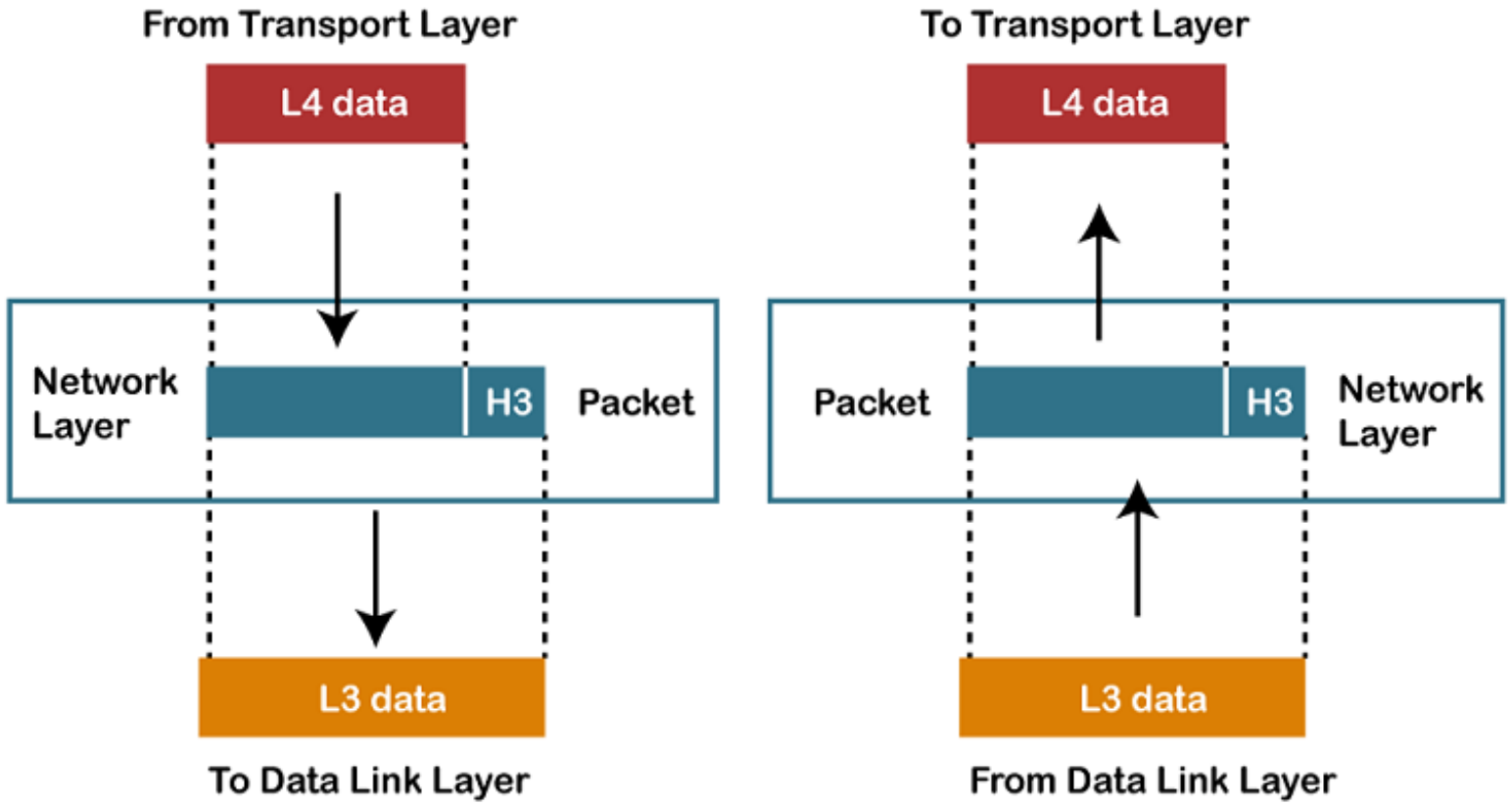
Access Control: When two or more devices are connected to the same communication channel, then the data link layer protocols are used to determine which device has control over the link at a given time.

3. 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.
- **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**.
- **IP** protocol in the network layer delivers a datagram from a source host to the destination host.

3. Network layer cont…



Network layer functions

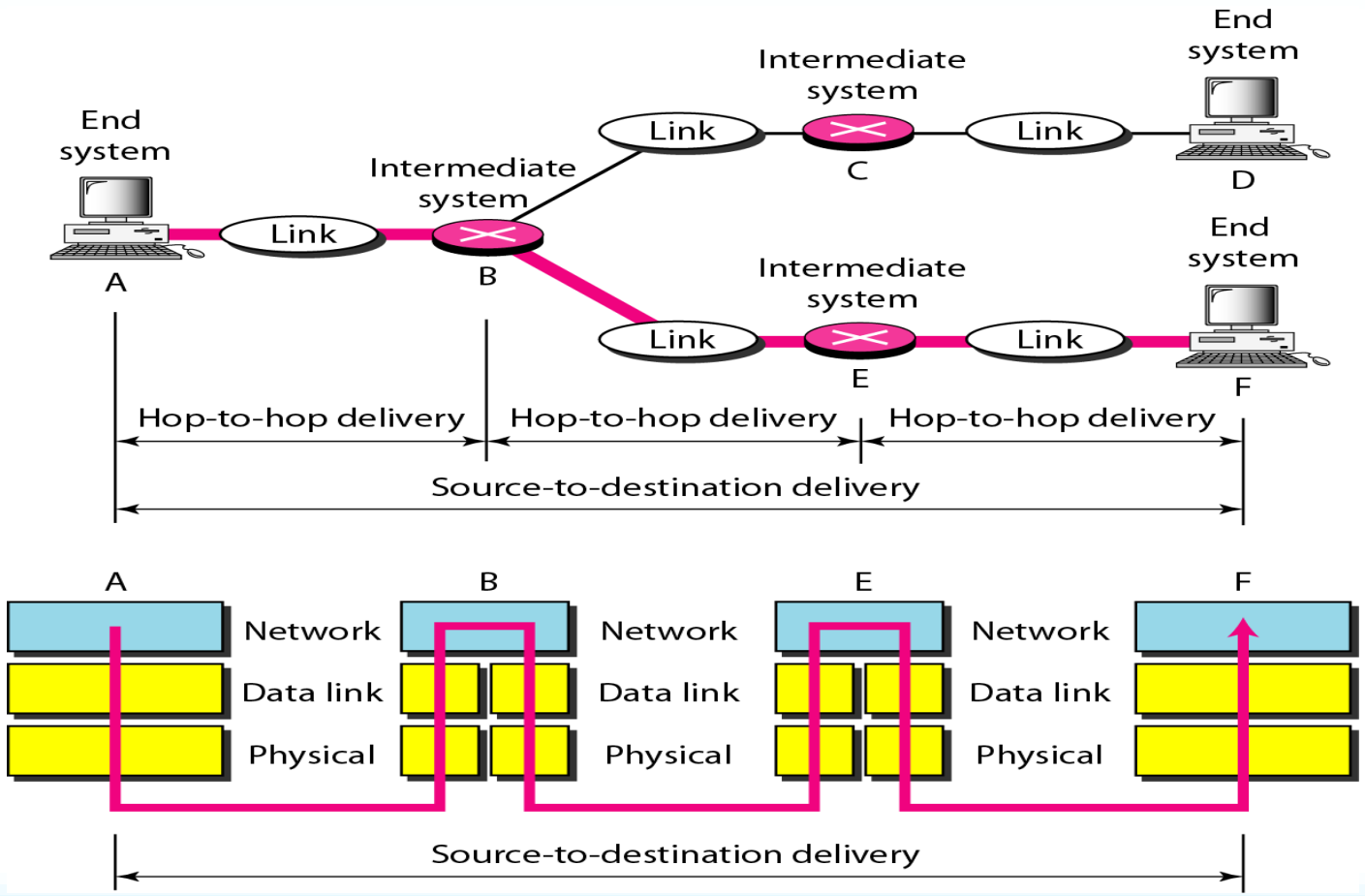
Internetworking: An internetworking is the main responsibility of the network layer. It provides a logical connection between different devices.

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.

Routing: Router 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).

Network layer Source-to-destination delivery



4. 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.

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

4. Transport layer Protocol

The two protocols used in this layer are:

I. **Transmission Control Protocol**

- It is a standard protocol that allows the systems to communicate over the internet.
- It is a connection-oriented protocol means the connection established between both the ends of the transmission.
- For creating the connection, TCP generates a virtual circuit between sender and receiver for the duration of a transmission.
- 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.

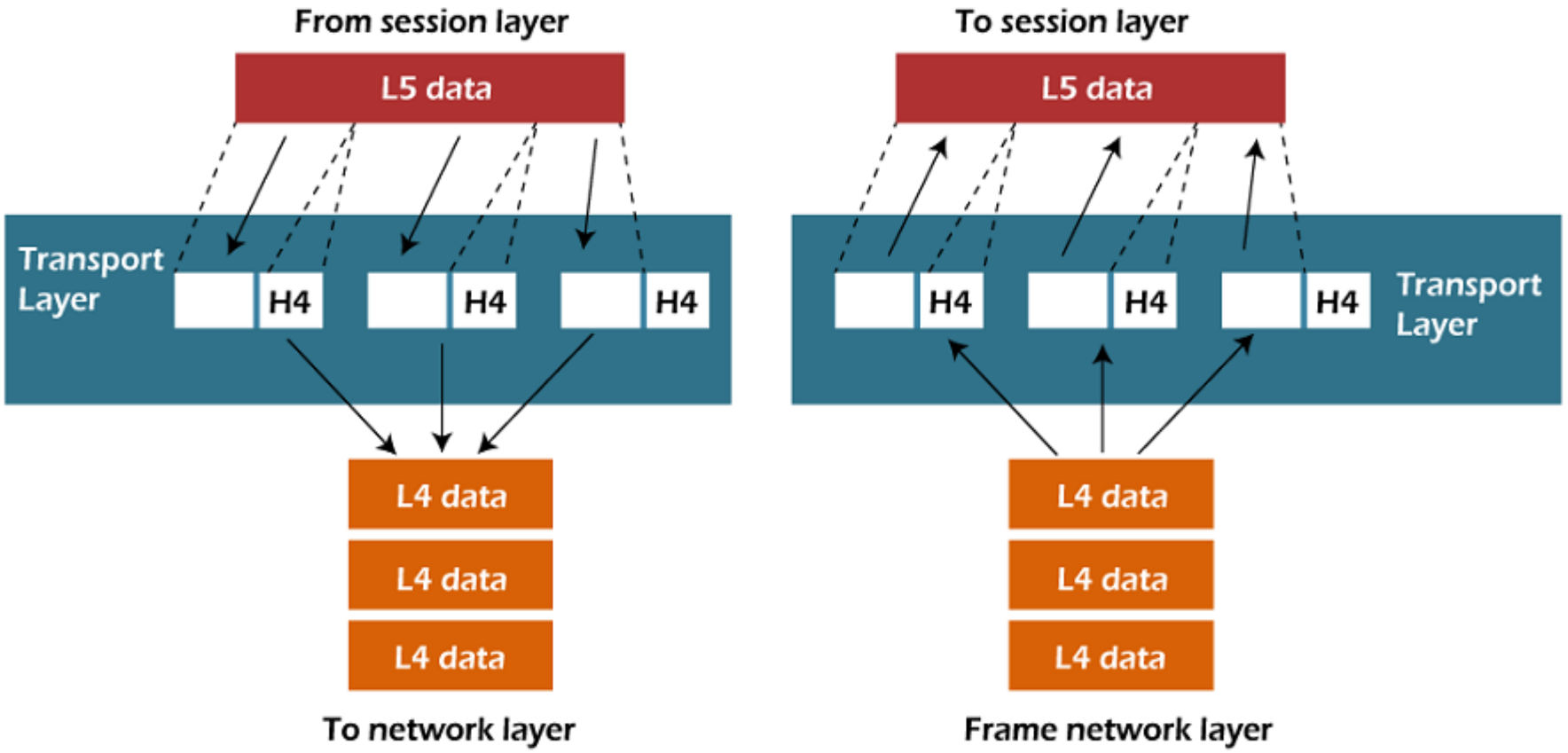
4. Transport layer Protocol

The two protocols used in this layer are:

II. **User Datagram Protocol**

- UDP is a simple protocol and it provides non-sequenced transport functionality.
- UDP is a connectionless protocol.
- This type of protocol is used when reliability and security are less important than speed and size.
- UDP is an end-to-end transport level protocol that adds transport-level addresses, checksum error control, and length information to the data from the upper layer.
- The packet produced by the UDP protocol is known as a user datagram.

4. Transport layer cont…



4. Transport layer Functions

Service-point addressing: The responsibility of the network layer is to transmit the data from one computer to another computer while the responsibility of the transport layer is to transmit the message to the correct process.

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.

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.

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 sender transport layer ensures that message reach at the destination without any error.

5. Session layer

The Session layer is used to establish, maintain and synchronizes the interaction between communicating devices.

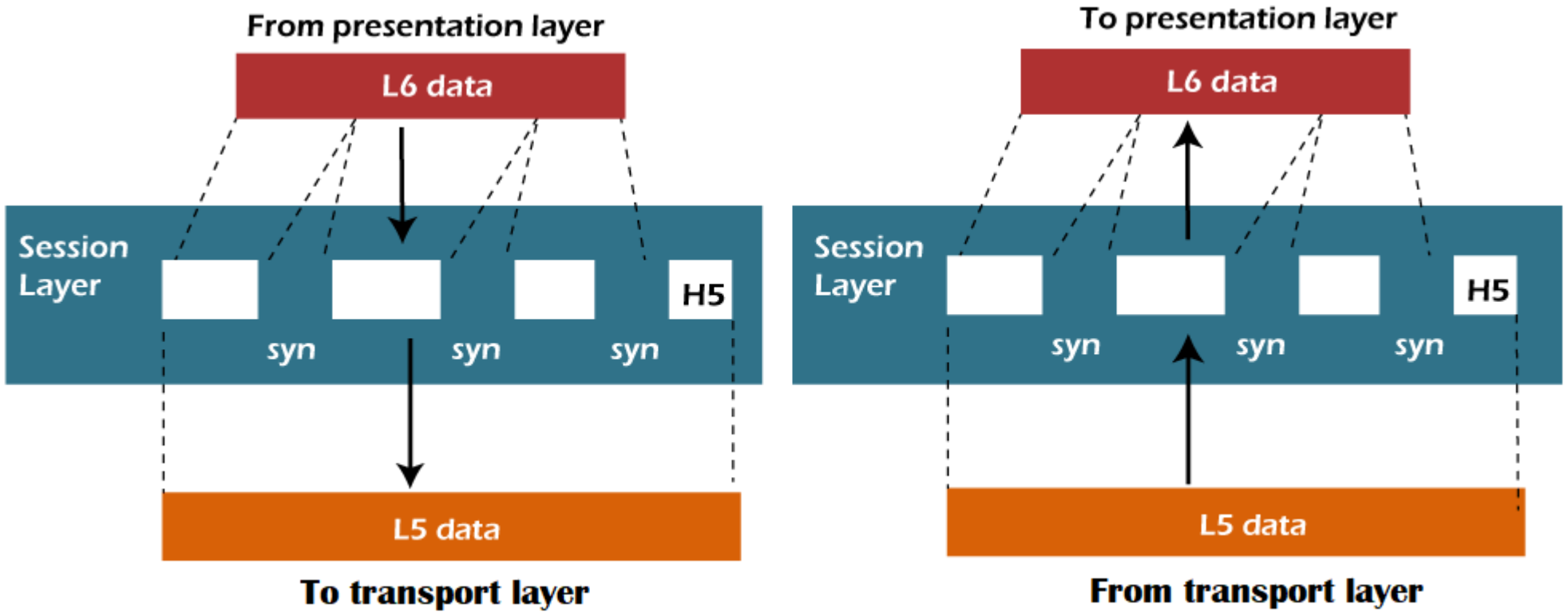
Functions of Session layer:

Dialog control: Session layer acts as a dialog controller that creates a dialog between two processes.

- we can say that it allows the communication between two processes which can be either half-duplex or full-duplex.

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.

5. Session layer cont…



6. 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.

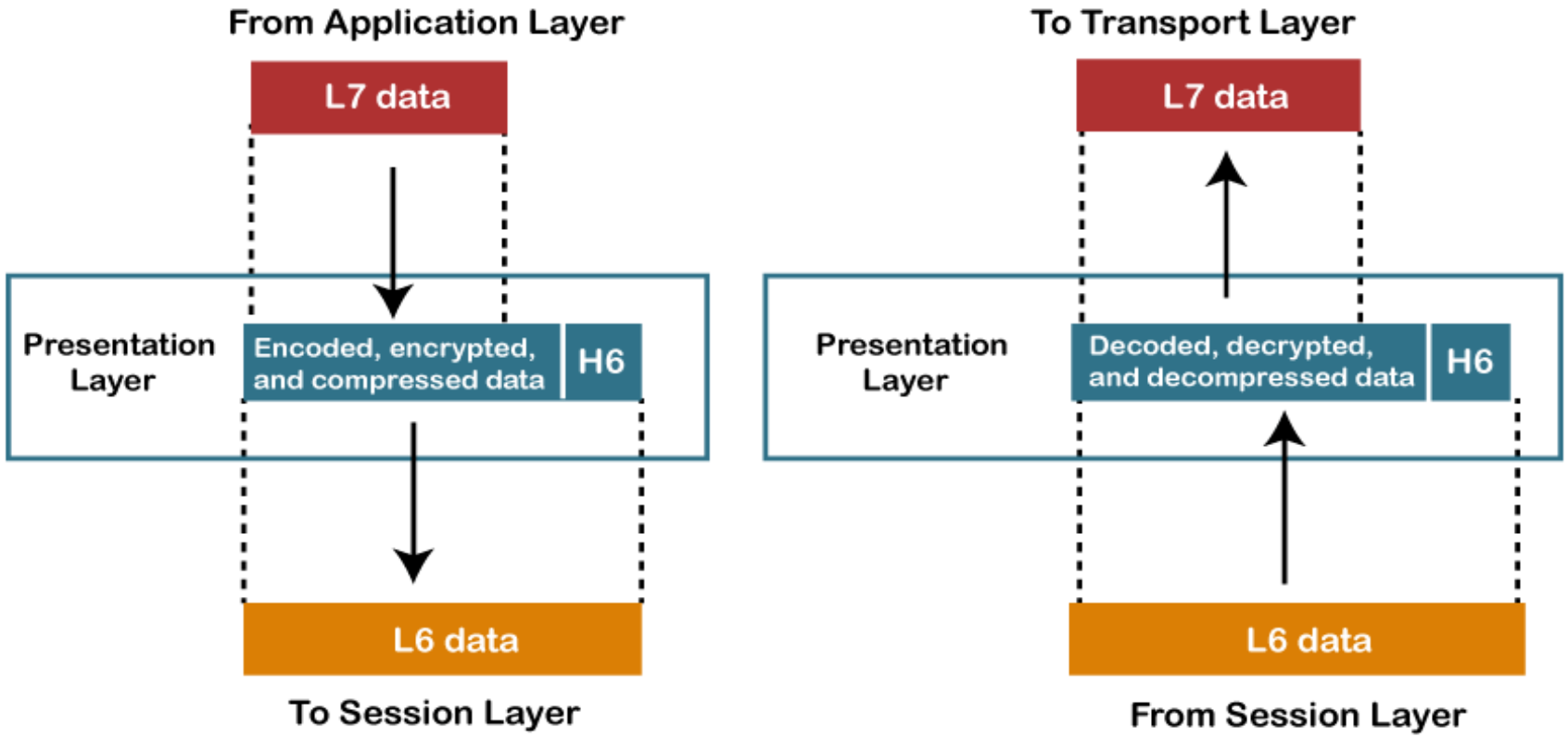
Functions of Presentation layer:

Translation: 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.

Encryption and decryption: 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.

6. Presentation layer cont…



7. Application layer cont...

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.

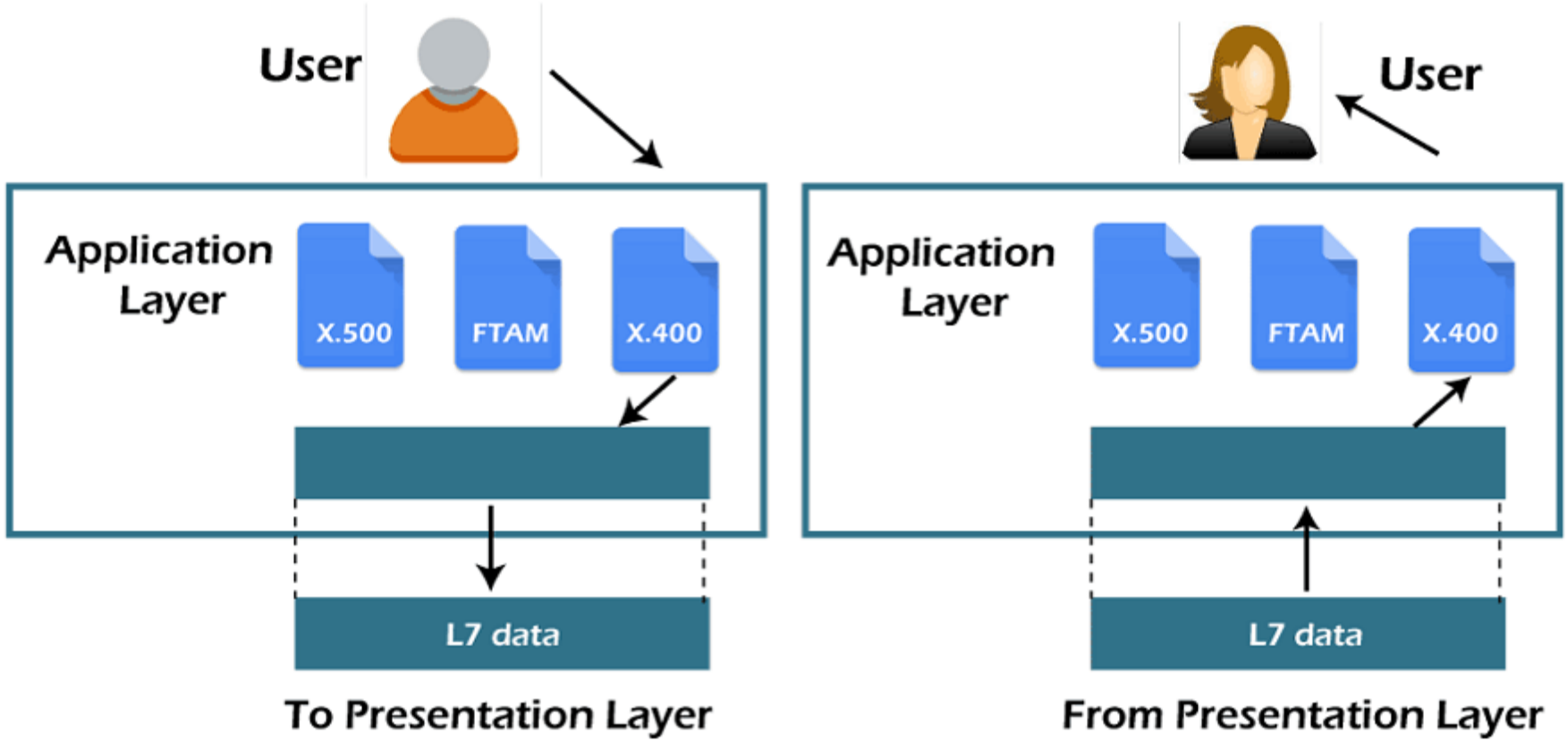
Functions of Application layer:

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.

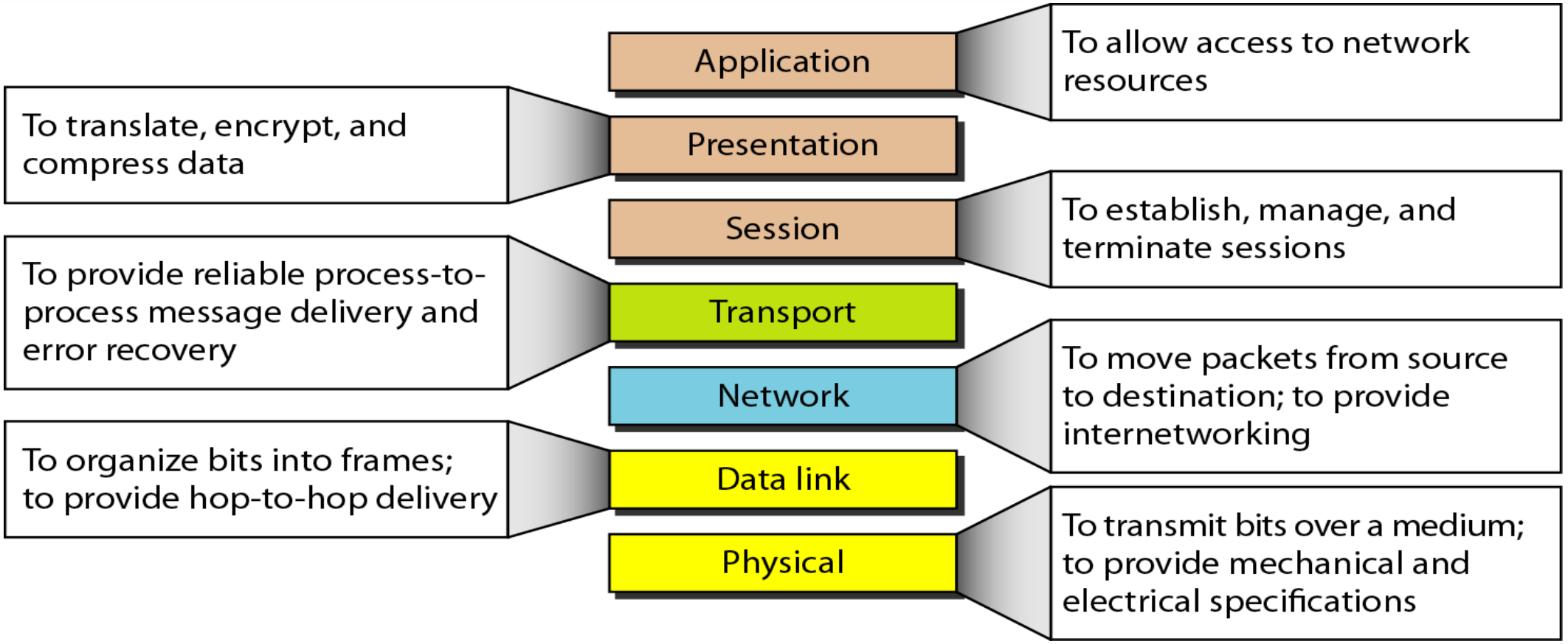
7. Application layer cont...



Protocols supported at various levels

Layer	Name	Protocols
Layer 7	Application	SMTP, HTTP, FTP, POP3, SNMP
Layer 6	Presentation	MPEG, ASCH, SSL, TLS
Layer 5	Session	NetBIOS, SAP
Layer 4	Transport	TCP, UDP
Layer 3	Network	IPV5, IPV6, ICMP, IPSEC, ARP, MPLS.
Layer 2	Data Link	RAPA, PPP, Frame Relay, ATM, Fiber Cable, etc.
Layer 1	Physical	RS232, 100BaseTX, ISDN, 11.

Summary of layers



Summary of layers

OSI Model			
	Data unit	**Layer**	**Function**
User support layers	Data	7. Application	Network process to application
		6. Presentation	Data representation and encryption
		5. Session	Inter-host communication
User⇔ Network	Segment	4. Transport	End-to-end connections and reliability
Network support layers	Packet	3. Network	Path determination and logical addressing
	Frame	2. Data Link	Physical addressing
	Bit	1. Physical	Media, signal and binary transmission

Sender ↓

↑ Receiver

Thank you!

For listen