Computer Networks(CS30006)
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Network Stack

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Network

❑ Network, in computer science, a group of computers and associated devices that are connected by communications facilities.

❑ Network is an inter connected collection of autonomous computers.

❑ When two or more computers are joined together so that they are capable of exchanging information, they form a network.

Need for Networking:

❑ **Resource sharing** - Through a network, data, software and hardware resources can be shared irrespective of the physical location of the resources and the user.

❑ **Reliability** – A file can have its copies on two or more computers of the network.

❑ **Reduced Cost** – Sharing resources reduces the cost.

❑ **Fast Communication** – Information can be exchanged at a very fast speed.

Internet

❑ Internet is worldwide network of computer networks.

❑ **How does it work?**

  ➢ Most computers are not connected directly to the internet.

  ➢ They are connected to smaller networks.

  ➢ Which are connected through gateways to the internet backbone.

Network Model:

❑ A method of describing and analyzing data communication networks by breaking the entire set of communication process into a number of layers.
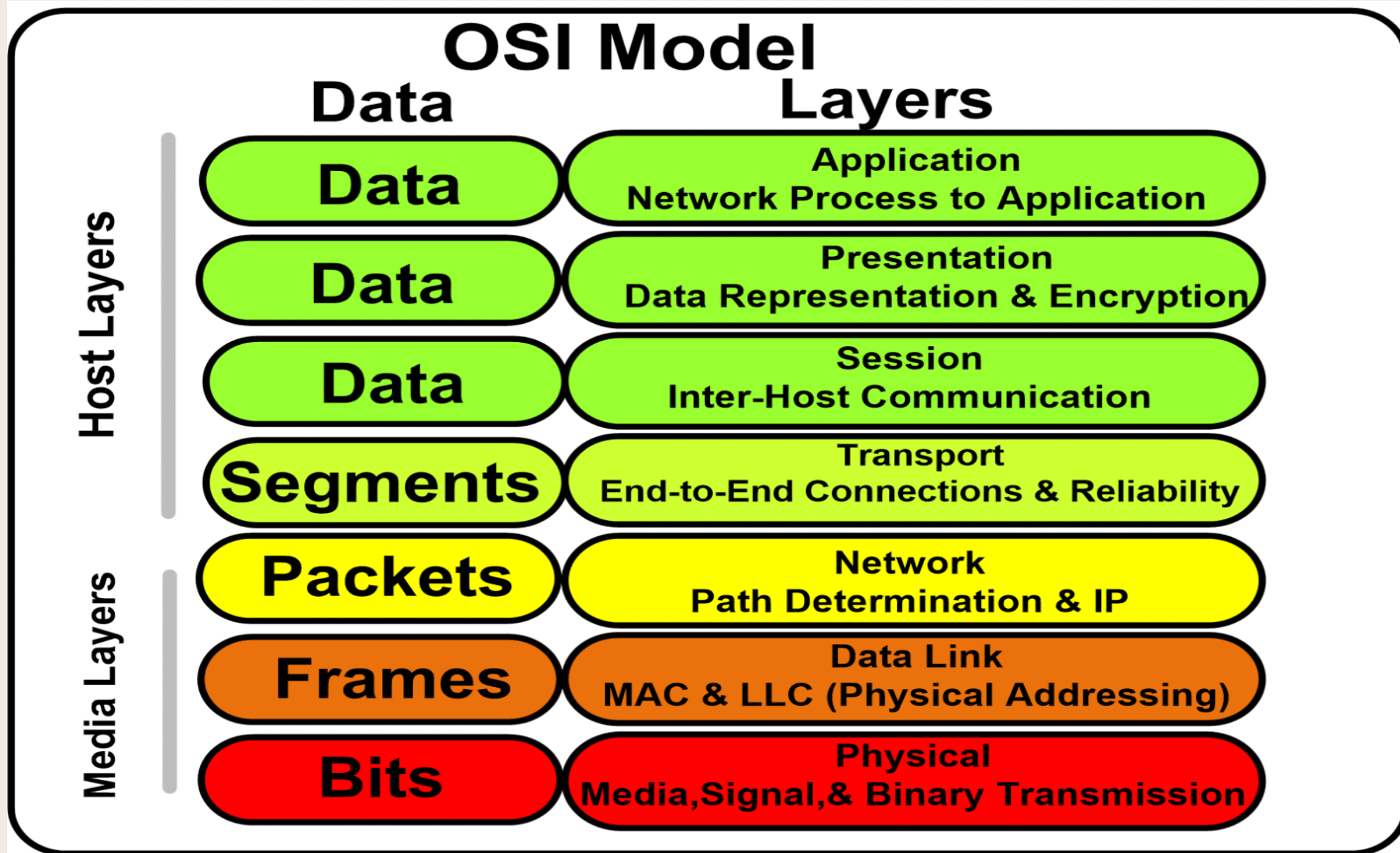
❑ Each layer has a specific function.

Cont…

❑ International standard organization (ISO) established a committee in 1977 to develop an architecture for systems communication.

❑ Open System Interconnection (OSI) reference model is the result of this effort.

❑ This model allows any two different systems to communicate regardless of their underlying architecture.

Cont...

❑The OSI model describes how data flows from one computer, through a network to another computer.

❑The OSI model is not a protocol; it is a model for understanding and designing a network architecture that is flexible and robust.

❑The OSI model consists of seven separate but related layers, each of which defines a part of the process of moving information across a network.
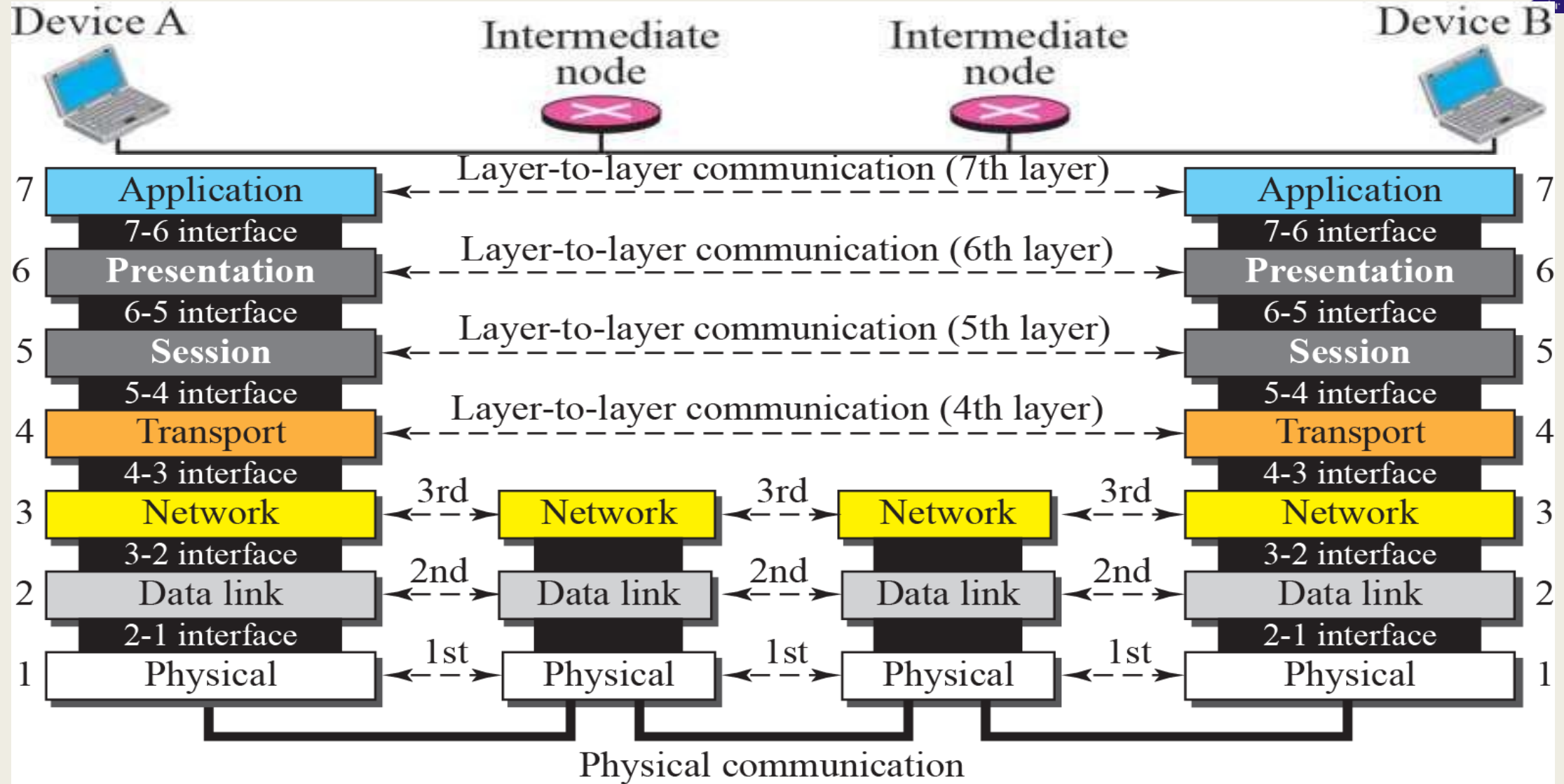
Cont…

OSI Model

Data	Layers
Data	**Application** — Network Process to Application
Data	**Presentation** — Data Representation & Encryption
Data	**Session** — Inter-Host Communication
Segments	**Transport** — End-to-End Connections & Reliability
Packets	**Network** — Path Determination & IP
Frames	**Data Link** — MAC & LLC (Physical Addressing)
Bits	**Physical** — Media, Signal, & Binary Transmission

Host Layers: Application, Presentation, Session
Media Layers: Network, Data Link, Physical

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Why so many layers?

❑ To reduce the complexity, networks are organized as a stack of layers, one below the other.

❑ Each layer performs a specific task. It provides services to an adjacent layer.

Cont…

Source: Studyregular,"OSI Models", [Online], Available:
https://studyregular.blogspot.com/2016/10/computer-networks-topic-osi-model.html[10]

Cont...

❑ Layers 1, 2, 3- physical, data link and   network are network support layers.

❑ Layer 4, the transport layer, links the two subgroups.

❑ Layers 5, 6, 7- session, presentation, and application are user support layers.

An exchange using the OSI model:

Source: Datacommandnet,"OSI Models", [Online], Available:
https://datacommandnet.blogspot.com/p/the-osi-model.html
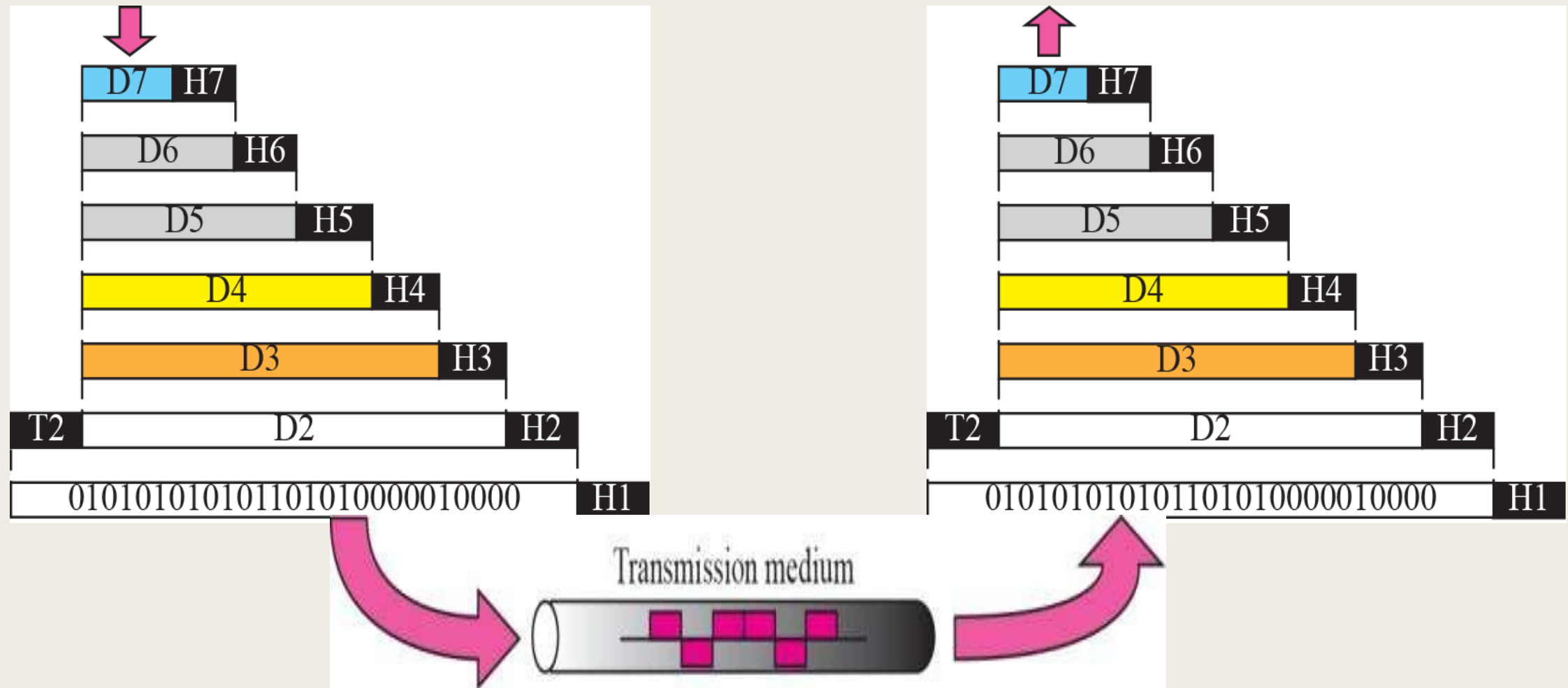
Physical Layer:

❑ Physical layer is the bottom(layer 1) of OSI model.

❑ It is responsible for the actual physical connection between the devices.

❑ The physical layer is responsible for movements of individual bits from one node to next.
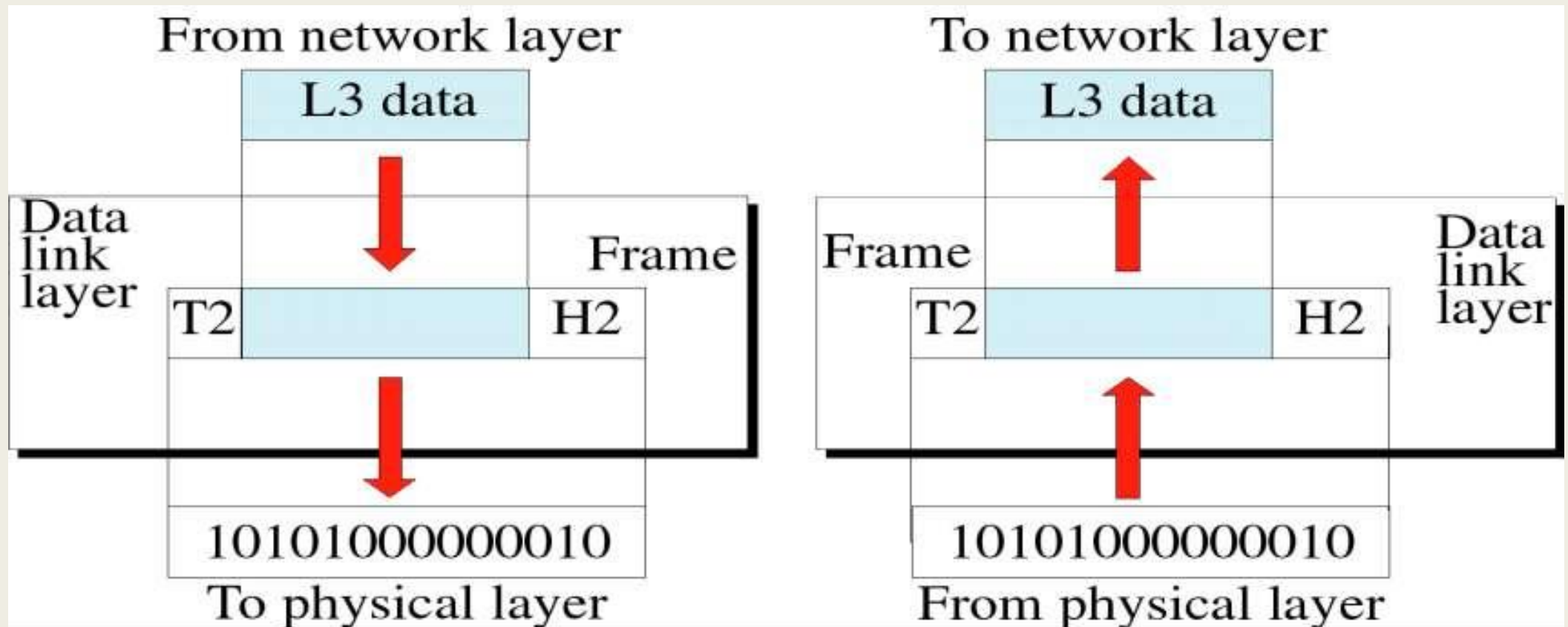
Physical Layer:

Source: Kataria,"OSI Models", [Online], Available:
https://codes.pratikkataria.com/osi-models-explaination/
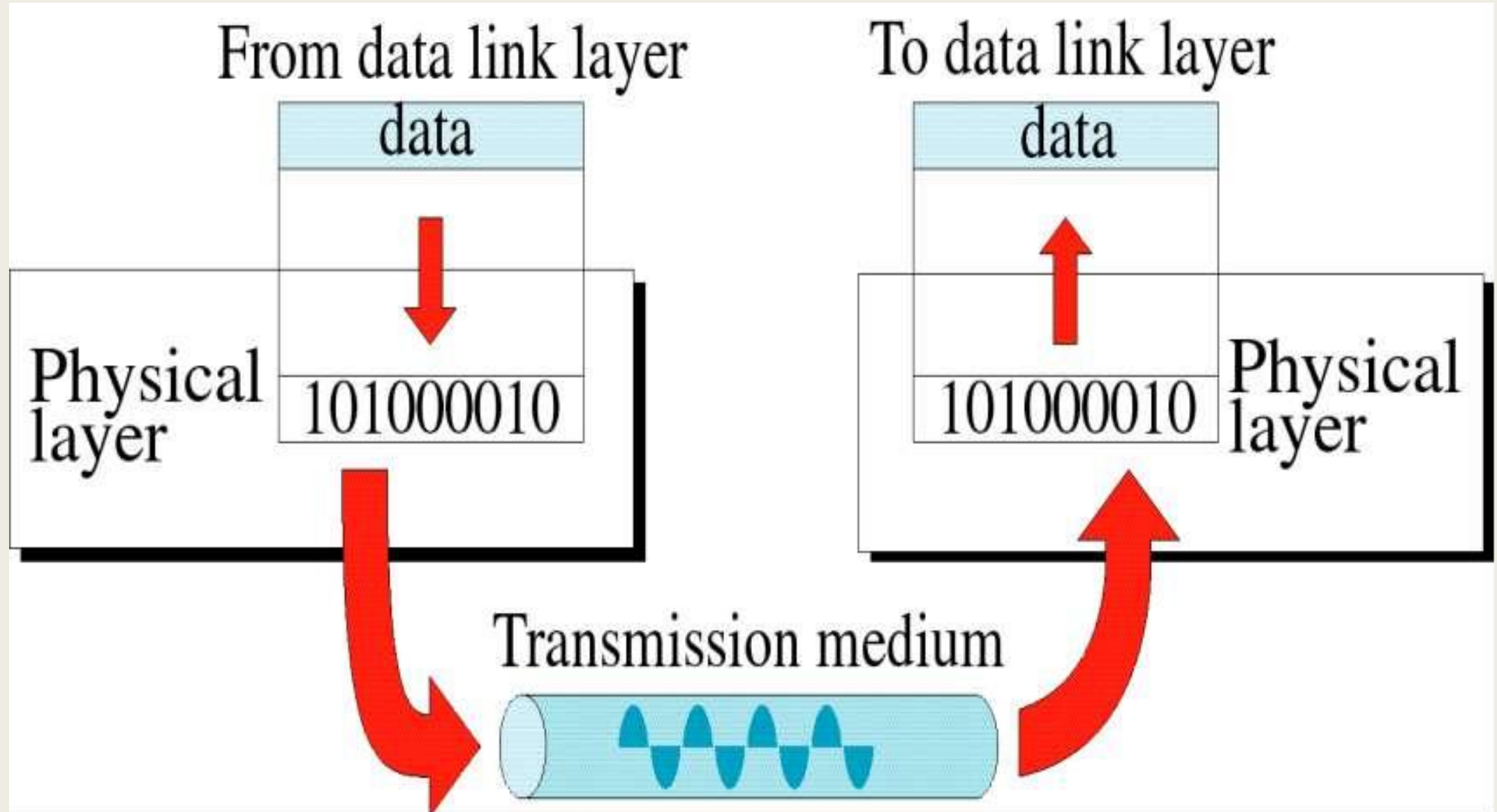
Functions of Physical Layer:

❑ Convert bits to signals

❑ Bit synchronization

❑ Manage physical connection

❑ Bit rate control

❑ Line configuration

❑ Physical topology

❑ Transmission mode

❑ Multiplexing

❑ Switching

Data Link Layer:

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

Source: Kataria,"OSI Models", [Online], Available:
https://codes.pratikkataria.com/osi-models-explaination/

Functions of Data Link Layer:

❑ Framing:- divides the data from N/W layer into frames.

❑ Physical Addressing:- Add a header to the frame to define the physical address of the source and the destination machines.

❑ Flow Control:- It is the traffic regulatory mechanism implemented by Data Link layer that prevents the fast sender from drowning the slow receiver.

❑ Error Control:- It provides the mechanism of error control in which it detects and retransmits damaged or lost frames.

❑ Feedback:- after transmitting the frames, the system waits for the feedback.

# Network Layer:

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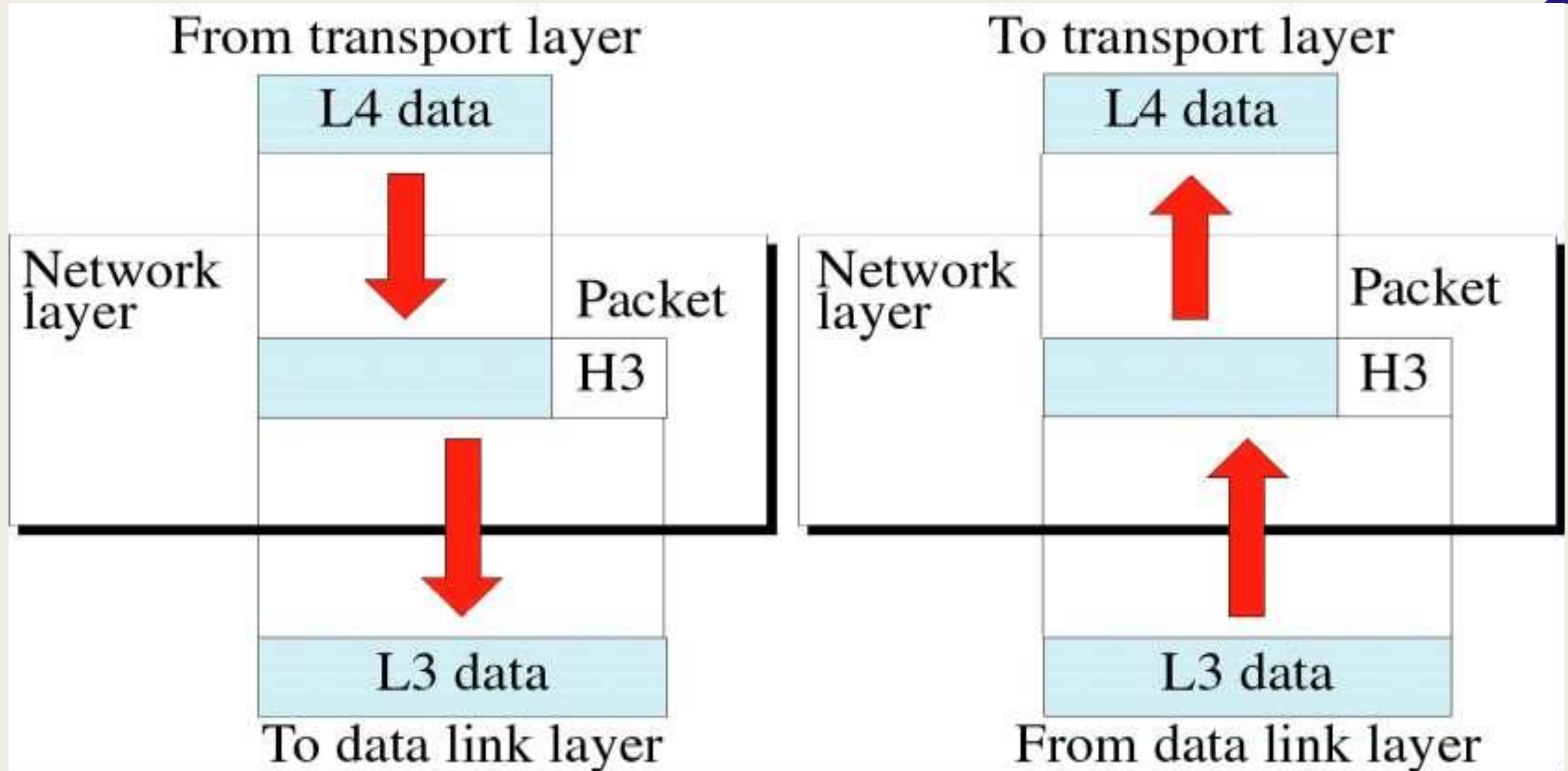
Functions of Network layer:

❑ It is responsible for the source to destination delivery of a packets across multiple networks.

❑ Routing:- Provide mechanism to transmit data over independent networks that are linked together.

❑ Logical addressing:- Adds Logical addresses of sender and Receiver.

Transport Layer:

It is responsible for source process to destination process delivery of entire message.

Source: Kataria,"OSI Models", [Online], Available: https://codes.pratikkataria.com/osi-models-explaination/
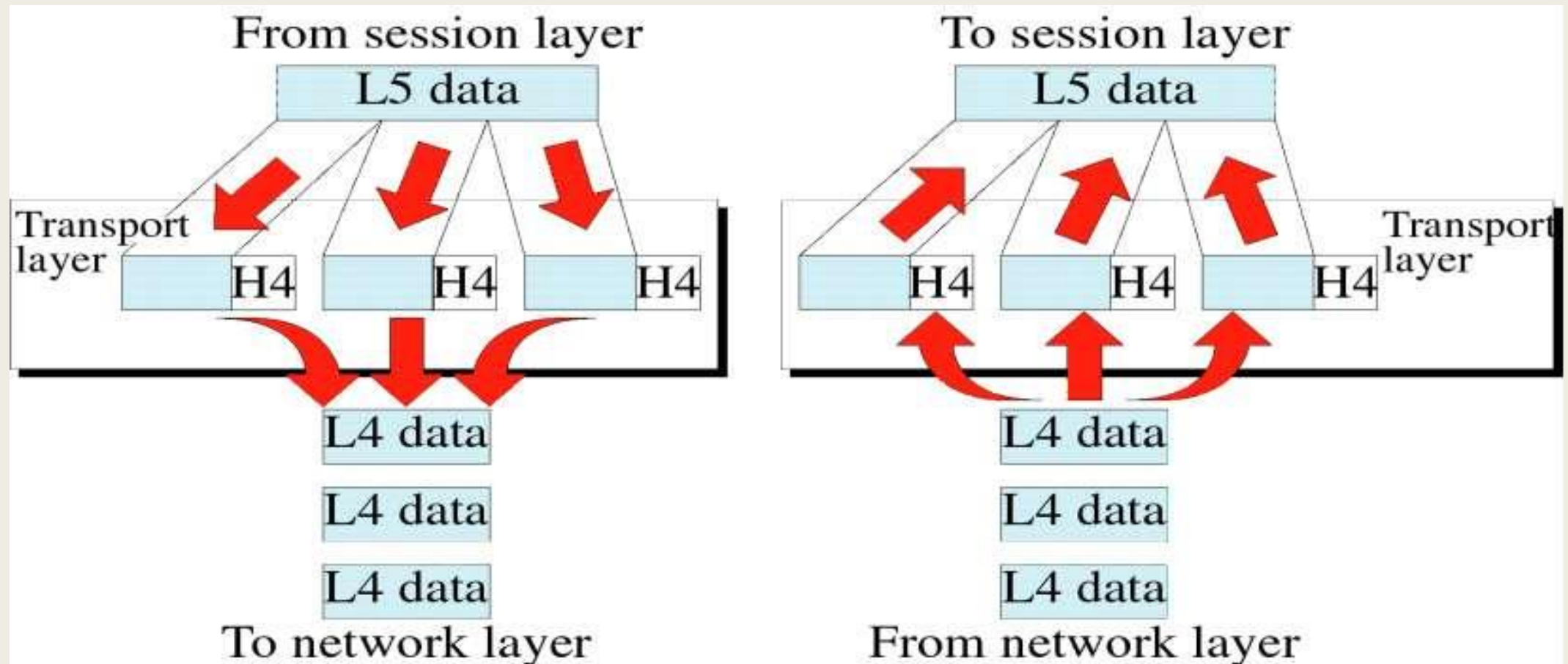
Transport Layer:

Transport layer provides two types of services:

1) **Connection Oriented Transmission:** In this type of transmission the receiving device sends an acknowledgment back to the source after a packet or group of packet is received.

2) **Connectionless Transmission:** In this type of transmission the receiver does not acknowledge receipt of a packet.

Functions of Transport Layer:

❑ Segmentation and Reassembly: Divide the message received from Session layer into Segments and number them to make a sequence for reassembly at the receiving side.

❑ Service point addressing: Transport layer makes sure that the message is delivered to the correct process on destination machine.

❑ Error Control: Make sure that the entire message arrives without errors else retransmit.

❑ Flow Control: Transport layer makes sure that the sender and the receiver communicate at a rate they both can handle.

Session Layer:

❑ It is responsible for beginning, maintaining & ending the communication between two devices, which is called session.
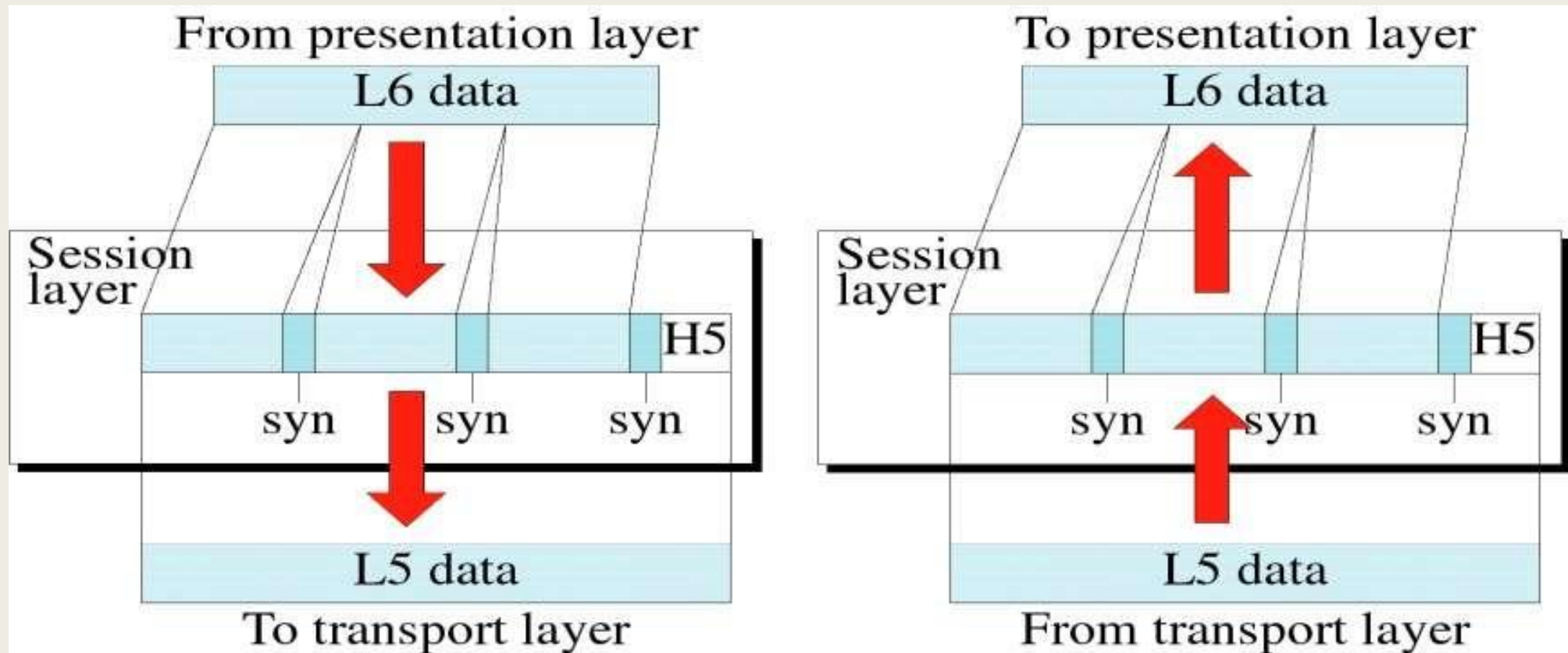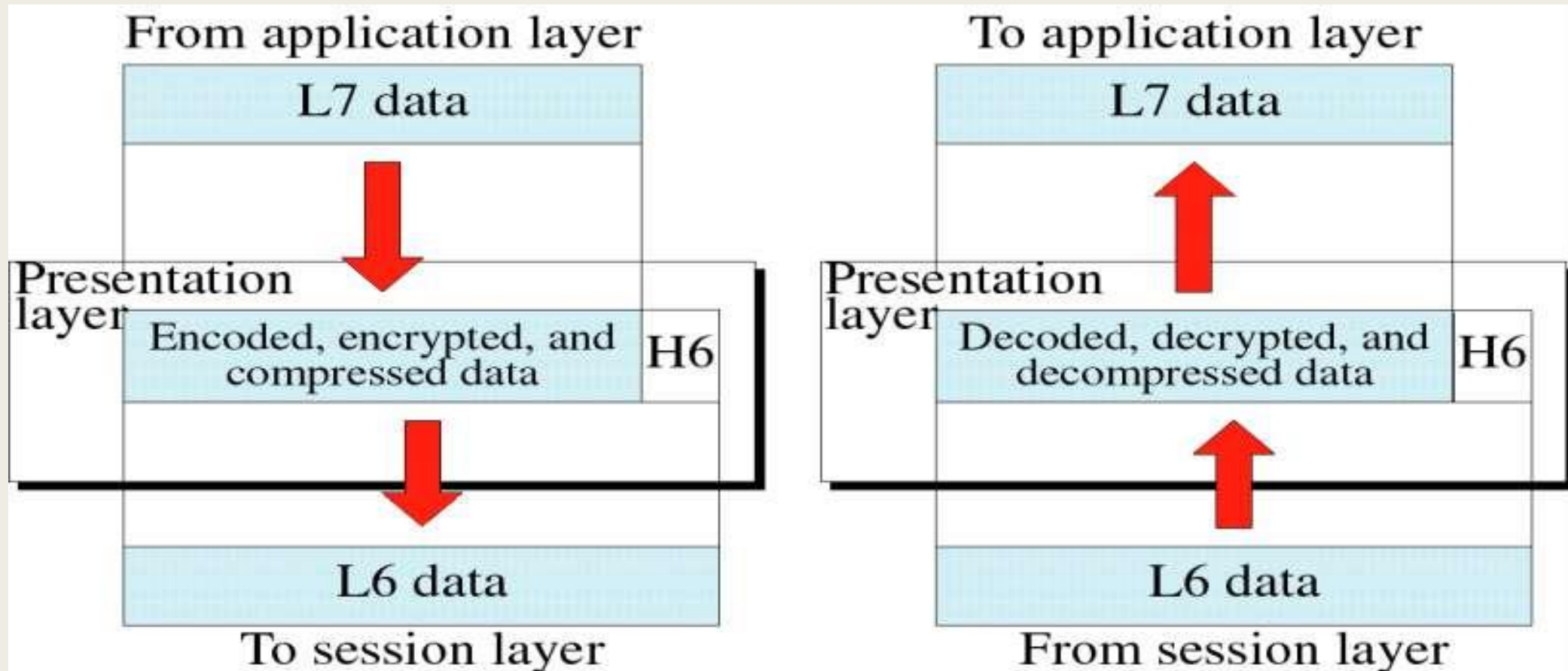
Functions of Session Layer:

❑ Establishment, maintaining and ending a session:

  ❑ Sends SYN packet – establish request

  ❑ Receives ACK & SYN- established

  ❑ To end – Sender sends ACK

❑ Dialog Control: The session layer allows two systems to enter into a dialog.

❑ Synchronization: Allows a process to add checkpoints to a stream of data.

Presentation Layer:

❑ This layer is concerned with the syntax and semantics of the information exchanged between two systems.
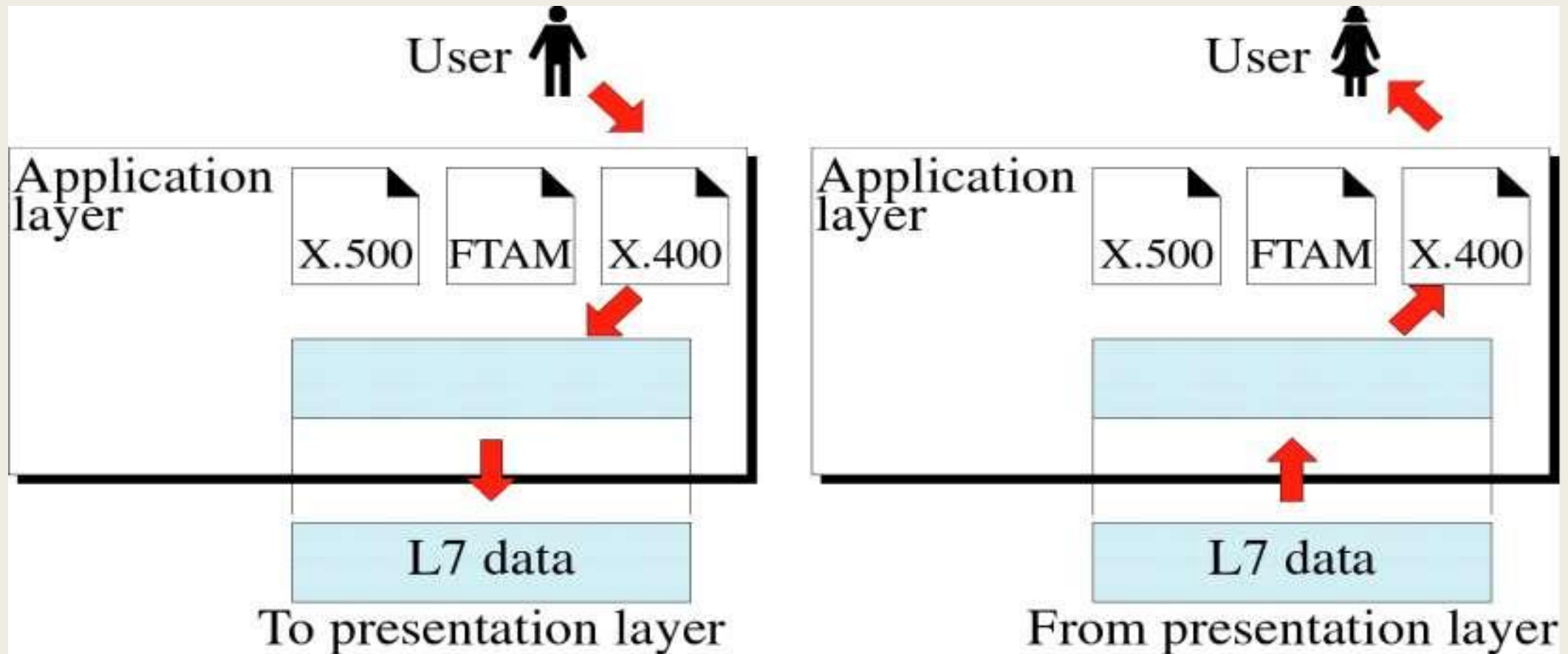

Source: Kataria,"OSI Models", [Online], Available:
https://codes.pratikkataria.com/osi-models-explaination/

Functions of Presentation Layer:

❑ Data Translation: Encoding and Decoding Sender to Common format on Sending side Common to Receiving format on Receiver side

❑ Data Encryption: For security and privacy purpose.

❑ Data Compression: Data compression reduces the number of bits contained in the information.

Application Layer:

❑ Provides User interfaces and support for Services, like e-mail, file transfer.
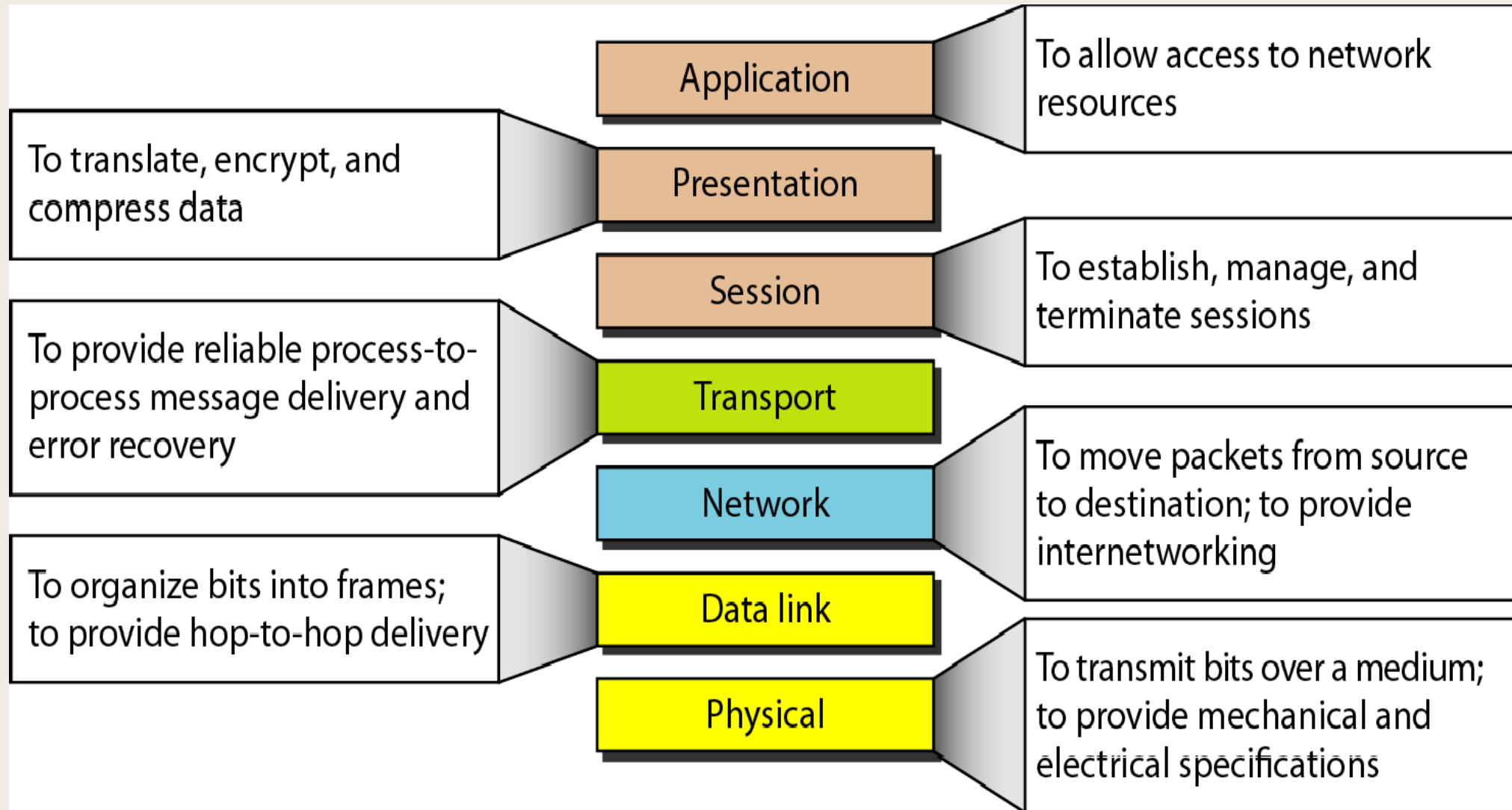
Functions of Application Layer:

❑ Network Virtual terminal: It allows a user to log on to a remote host.

❑ File Transfer Access, and Management: This application allows a user to access files in a remote host.

❑ Mail Services: This application provides various e-mail services.

❑ Directory Services: This application provides the distributed database sources and access for global information about various objects and services.
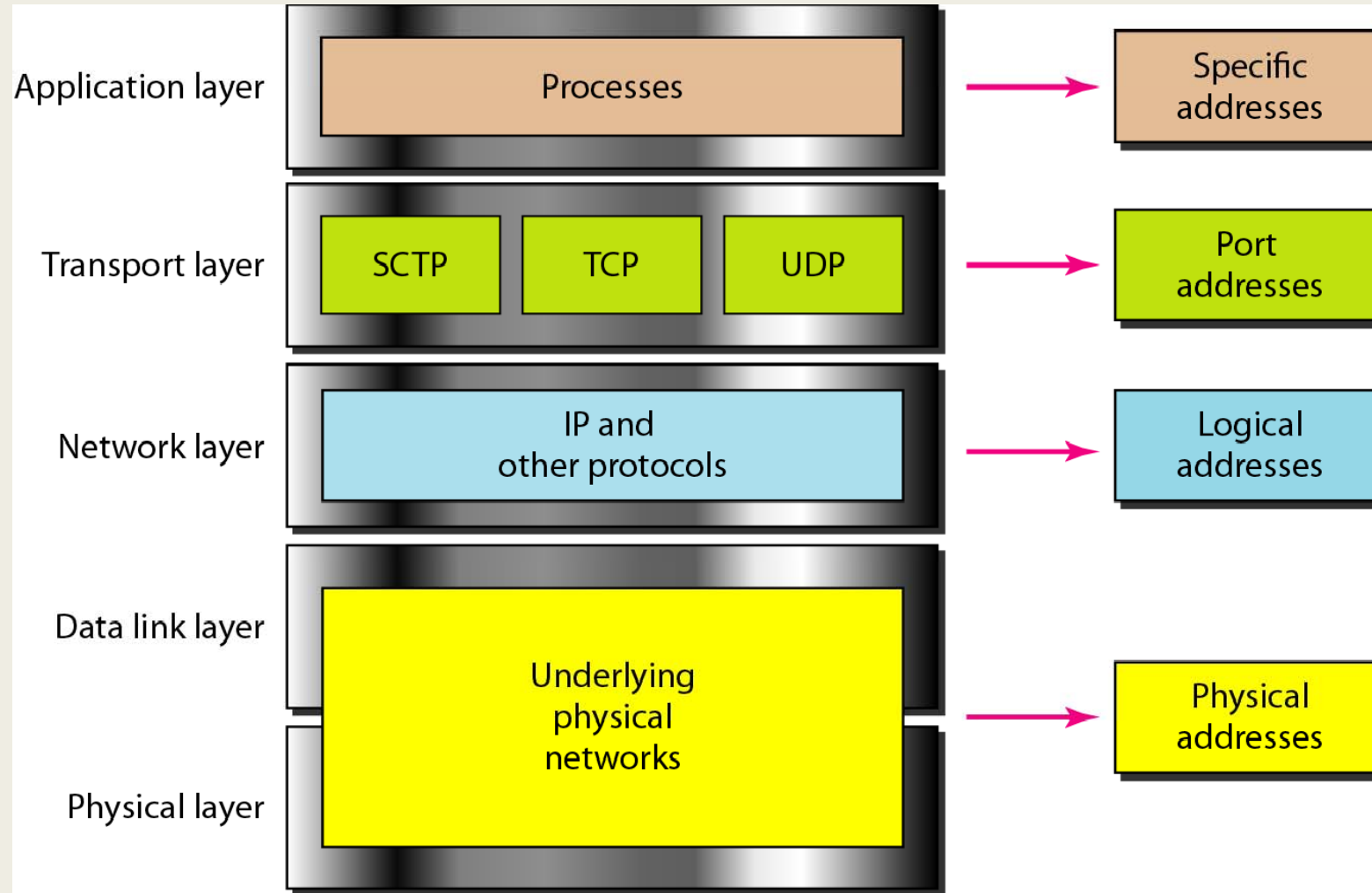
Summary

To translate, encrypt, and compress data

Application — To allow access to network resources

Presentation

Session — To establish, manage, and terminate sessions

To provide reliable process-to-process message delivery and error recovery

Transport

Network — To move packets from source to destination; to provide internetworking

To organize bits into frames; to provide hop-to-hop delivery

Data link

Physical — To transmit bits over a medium; to provide mechanical and electrical specifications

TCP/IP Model:

❑ TCP/IP forms the base of present day internet.

❑ TCP and IP are two protocols of this model.

❑ This model was initially used by ARPANET.

❑ The TCP/IP protocol suite was defined as having four layers:
   ❑ Host-to-network
   ❑ Internet
   ❑ Transport
   ❑ Application

TCP/IP Model:

https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvb
WFpbnxlZWJhaHJpYTV8Z3g6MjE2MzY2MjcxMGU3MmQ4Nw

Addressing

Four levels of addresses are used in an internet employing the *TCP/IP* protocols:
physical (link) addresses, logical (IP) addresses, port addresses, and specific addresses.

https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvb
WFpbnxlZWJhaHJpYTV8Z3g6MjE2MzY2MjcxMGU3MmQ4Nw
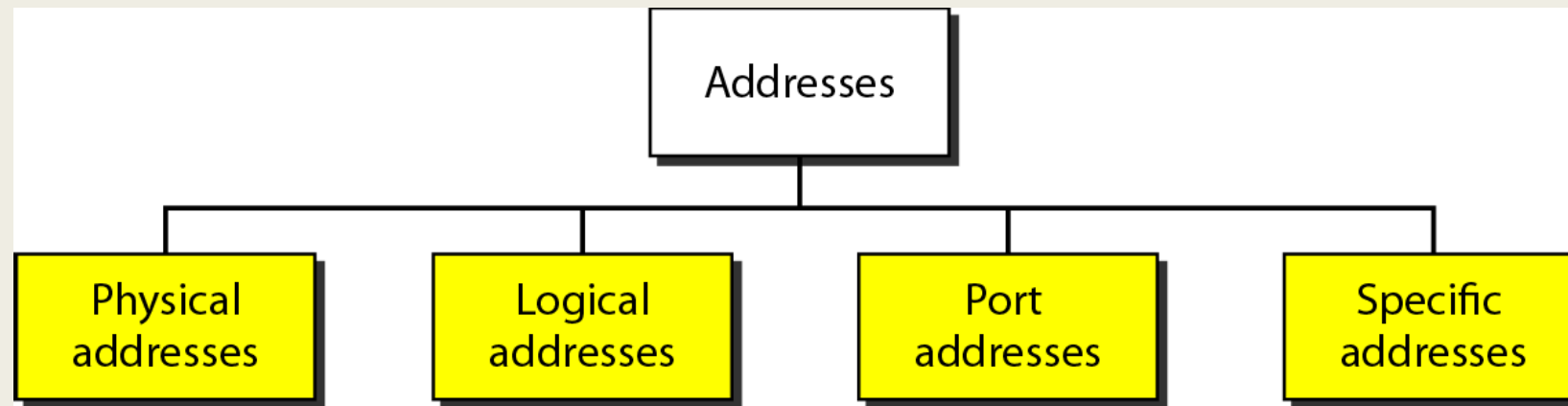
Physical Addresses

- The physical address, also known as the link address, is the address of a node as defined by its LAN or WAN.

- It is included in the frame used by the data link layer.

- It is the lowest-level address.

- The physical addresses have authority over the network (LAN or WAN).

- The size and format of these addresses vary depending on the network.

- For example, Ethernet uses a 6-byte (48-bit) physical address that is imprinted on the network interface card (NIC).

Logical Addresses

- Logical addresses are necessary for universal communications that are independent of underlying physical networks.

- A logical address in the Internet is currently a 32-bit address.

- Uniquely define a host connected to the Internet.

- No two publicly addressed and visible hosts on the Internet can have the same IP address.

Port Addresses

- A port number is the logical address of each application or process that uses a network or the Internet to communicate.

- A port number uniquely identifies a network-based application on a computer.

- Each application/program is allocated a 16-bit integer port number.

- This number is assigned automatically by the OS, manually by the user or is set as a default for some popular applications.

Specific Addresses

- Some applications have user-friendly addresses that are designed for that specific application.

- Examples include the e-mail address (for example, forouzan@fhda.edu) and the Universal Resource Locator (URL) (for example, www.mhhe.com).

- The first defines the recipient of an e-mail; the second is used to find a document on the World Wide Web.

Thank You!!!