Lec2: CCNA

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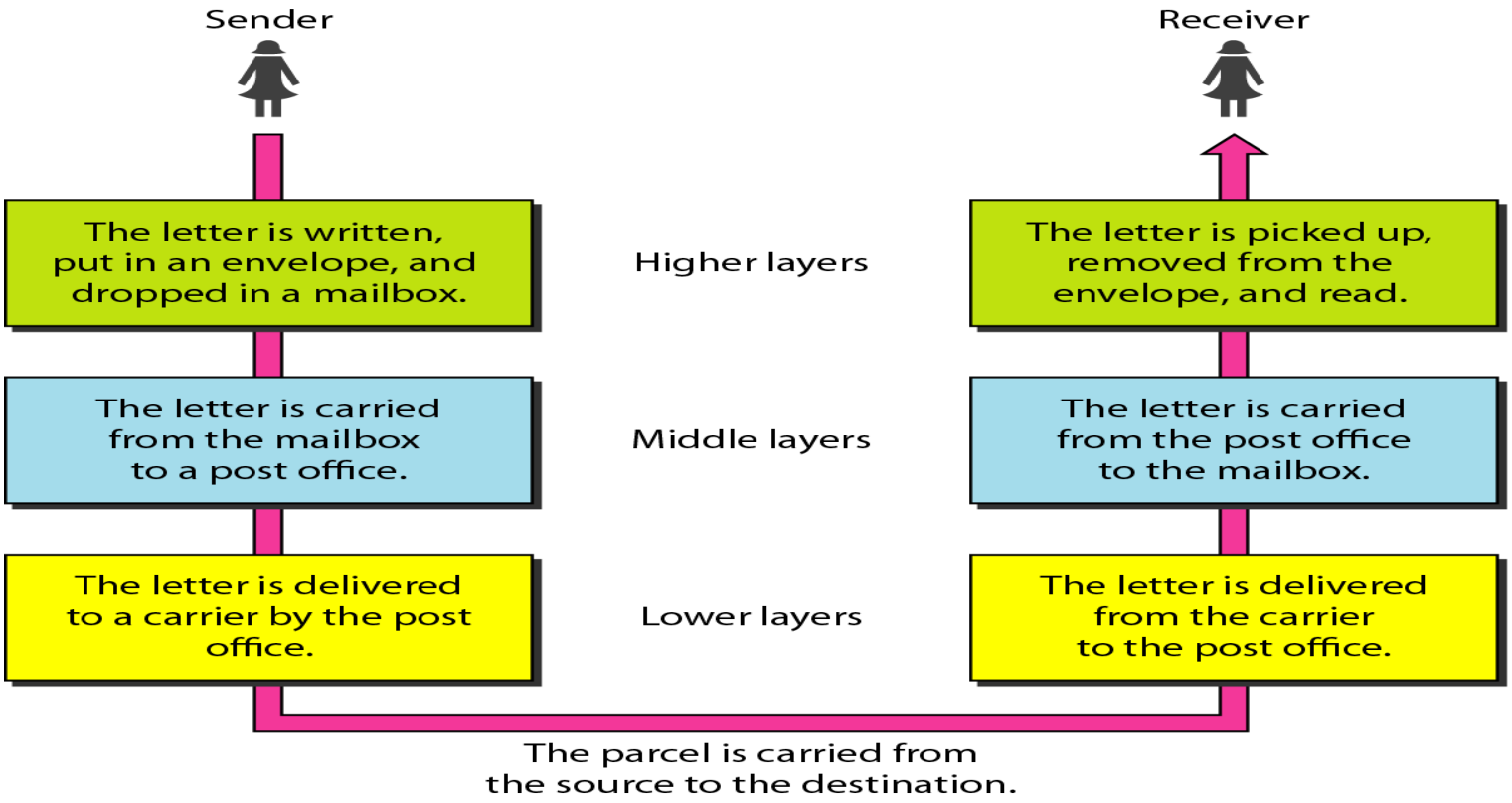
Layered Tasks

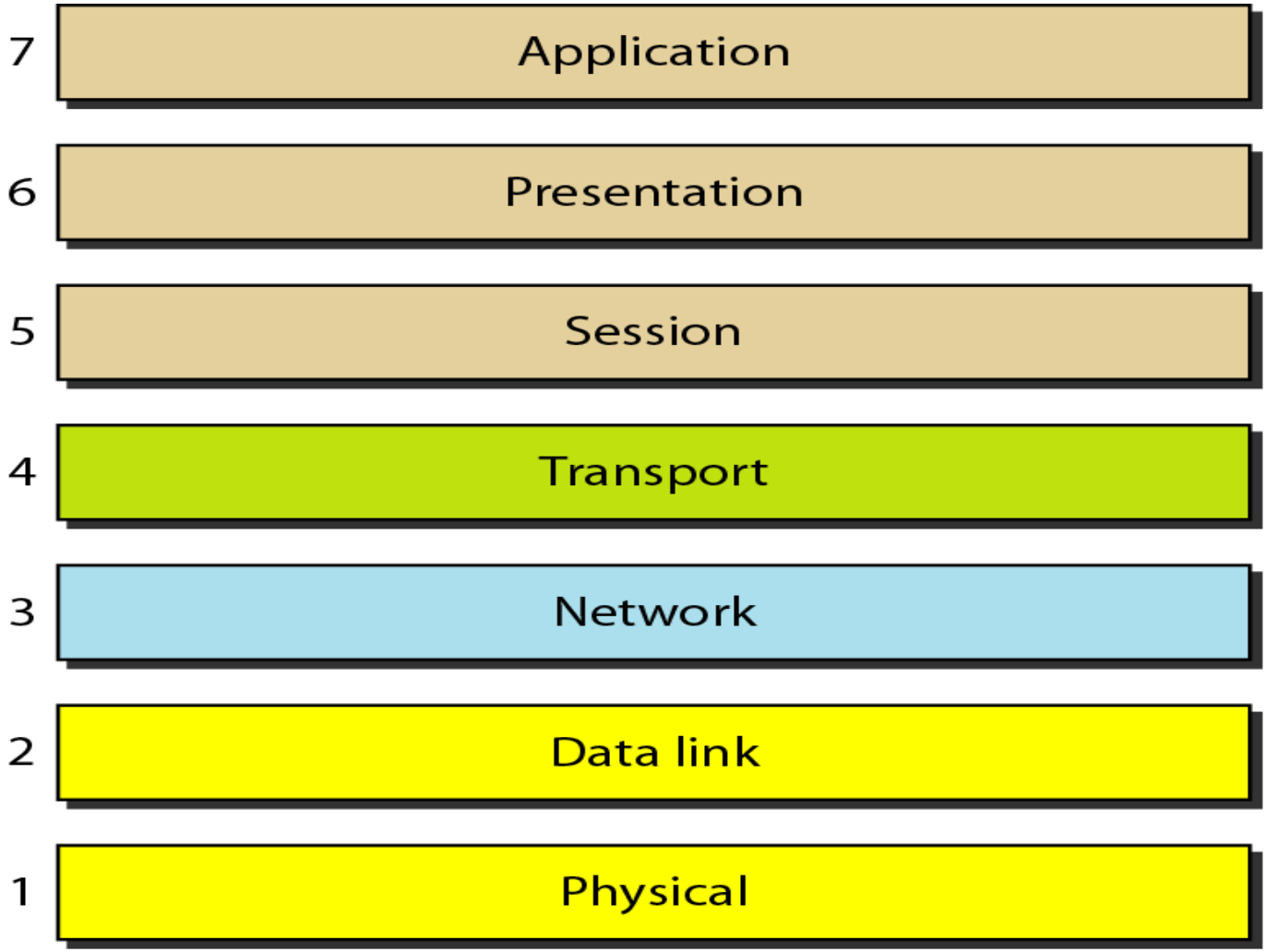
As an example, let us consider two friends who communicate through postal mail. The process of sending a letter to a friend would be complex if there were no services available from the post office.



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.

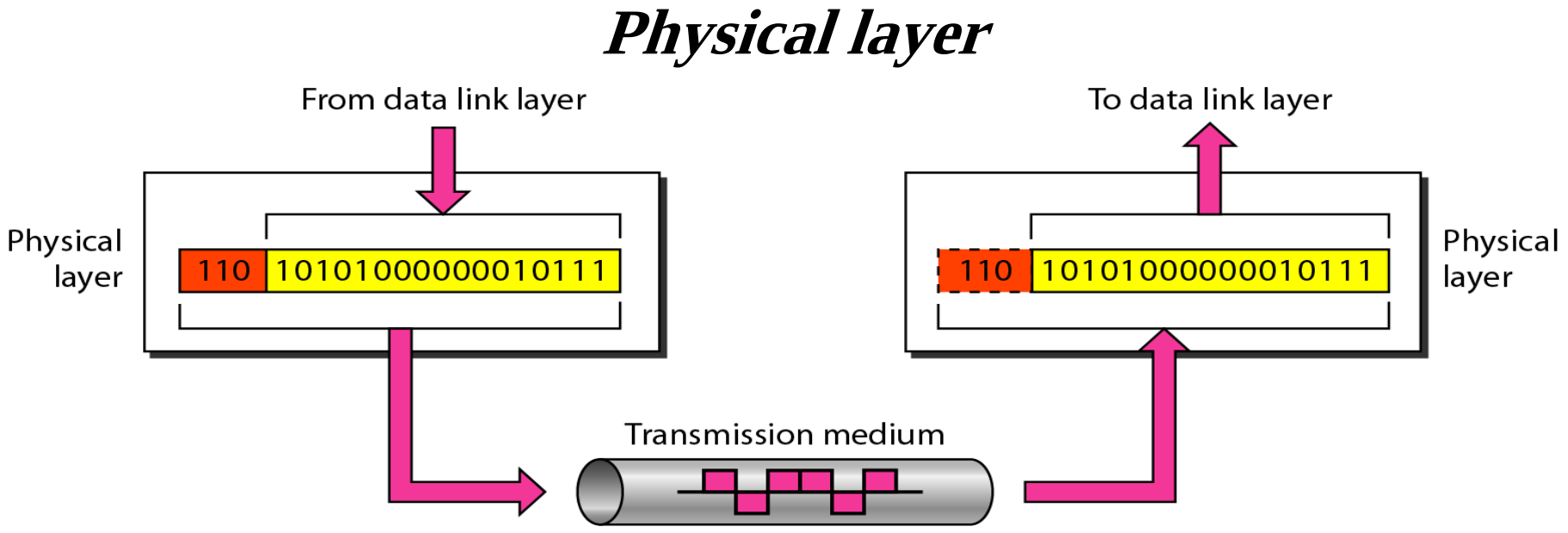
Seven layers of the OSI model



Note

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

Data



Characteristics of Copper Cabling

Copper cabling is the most common type of cabling used in networks today. It is inexpensive, easy to install, and has low resistance to electrical current flow.

Limitations:

- Attenuation – the longer the electrical signals have to travel, the weaker they get.
- The electrical signal is susceptible to interference from two sources, which can distort and corrupt the data signals (Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI) and Crosstalk).

Mitigation: تخفيف

- Strict adherence to cable length limits will mitigate attenuation.
- Some kinds of copper cable mitigate EMI and RFI by using metallic shielding and grounding.
- Some kinds of copper cable mitigate crosstalk by twisting opposing circuit pair wires together.

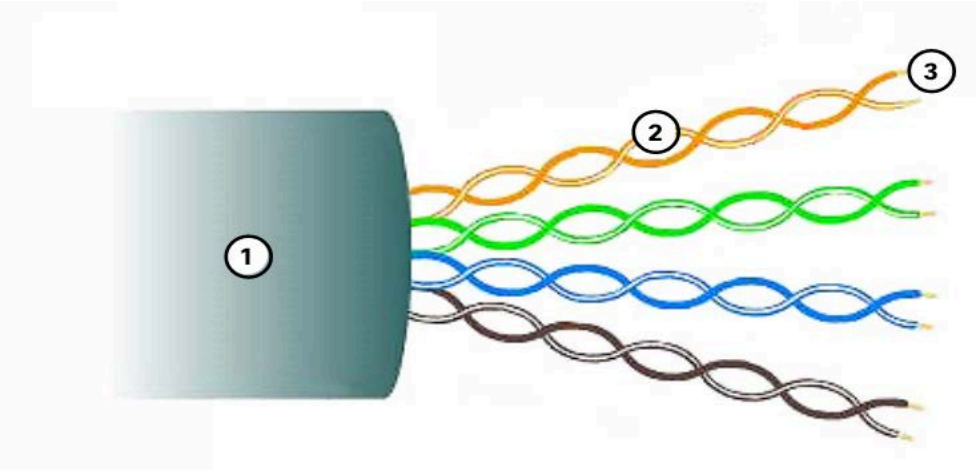
Types of Copper Cabling

Unshielded Twisted-Pair (UTP) Cable

Shielded Twisted-Pair (STP) Cable

Coaxial Cable

Unshielded Twisted Pair (UTP)

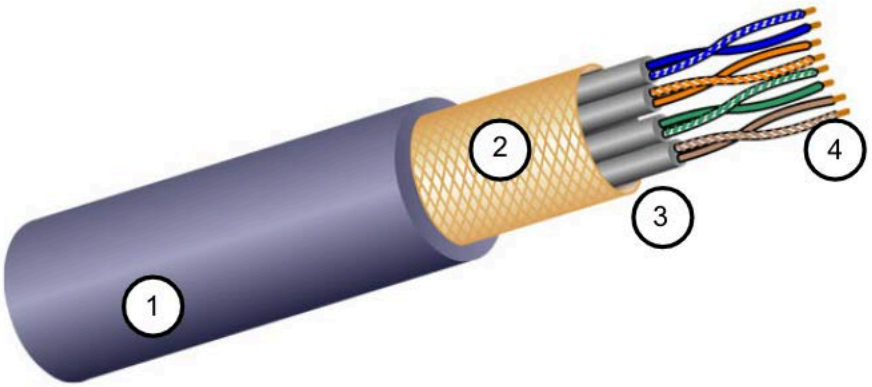


- UTP is the most common networking media.
- Terminated with RJ-45 connectors
- Interconnects hosts with intermediary network devices.

Key Characteristics of UTP

1. The outer jacket protects the copper wires from physical damage.
2. Twisted pairs protect the signal from interference.
3. Color-coded plastic insulation electrically isolates the wires from each other and identifies each pair.

Shielded Twisted Pair (STP)



- Better noise protection than UTP
- More expensive than UTP
- Harder to install than UTP
- Terminated with RJ-45 connectors
- Interconnects hosts with intermediary network devices

Key Characteristics of STP

1. The outer jacket protects the copper wires from physical damage
2. Braided or foil shield provides EMI/RFI protection
3. Foil shield for each pair of wires provides EMI/RFI protection
4. Color-coded plastic insulation electrically isolates the wires from each other and identifies each pair

CHOOSING THE RIGHT NETWORK CABLE

Cat5

100 MHz
100 Mbps

IP Camera

Cat5e

100 MHz
1 Gbps up
to 100 m

Router

Cat6

250 MHz
1 Gbps up
to 100 m

Switch

Cat6a

500 MHz
10 Gbps
up to 100 m

Server

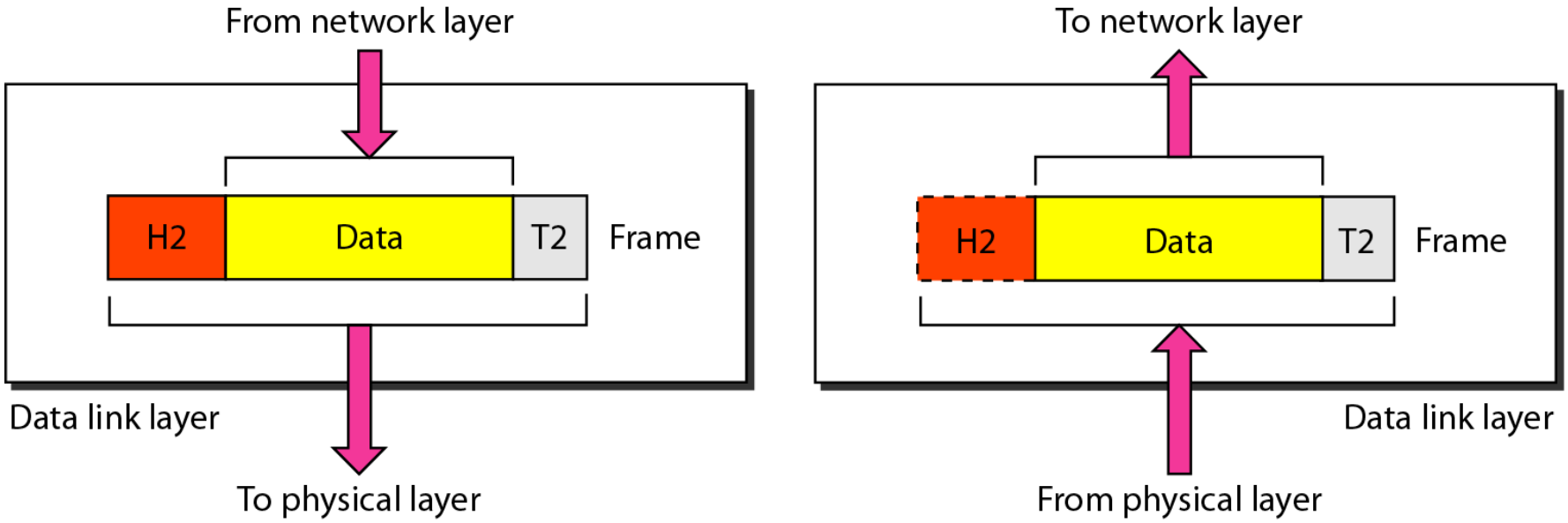
Cat7

600–1000 MHz
10 Gbps
up to 100 m

High Speed

Note

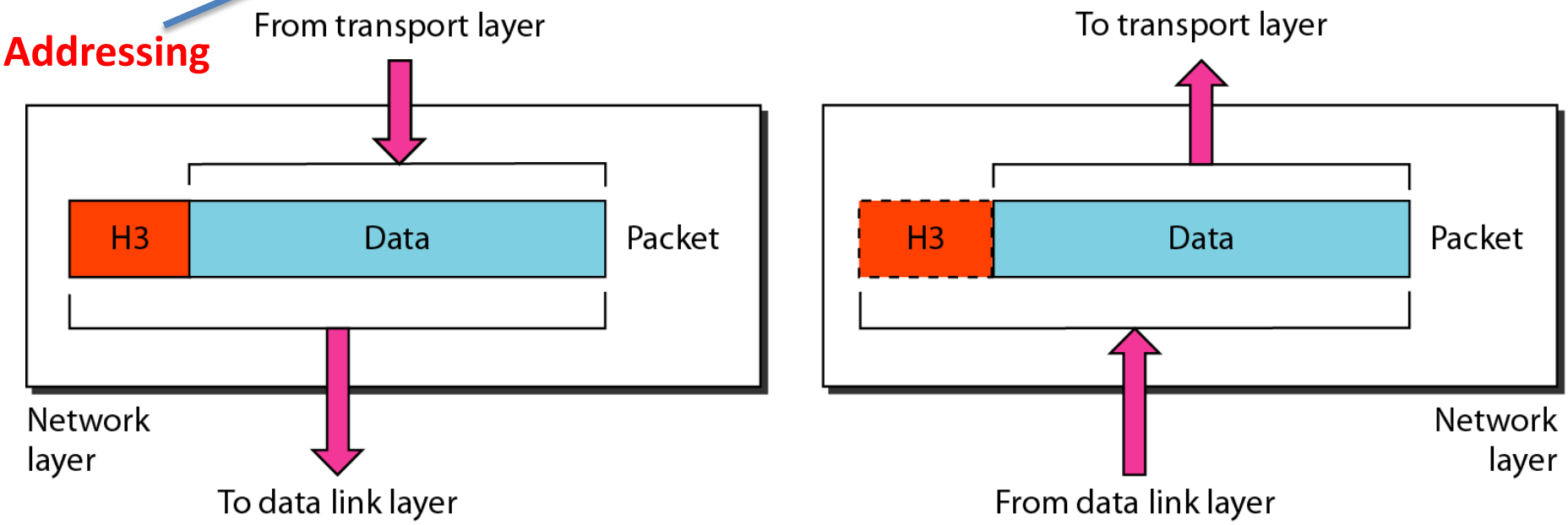
The data link layer is responsible for moving **frames** from one hop (node) to the next.



Network layer

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

Addressing



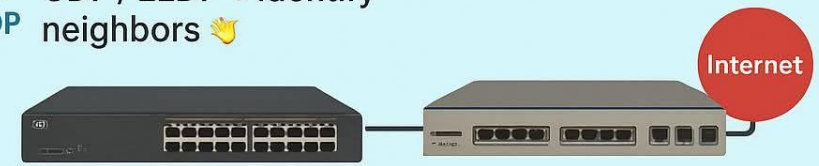
Layer 2 vs Layer 3 made easy😎

Layer 2 – Switching

- STP / RSTP / MSTP → prevent loops
- VTP → distributes VLAN info 🦷
- LACP → bundles cables together ⚡
- CDP / LLDP → identify neighbors 👋

Layer 3 – Routing

- RIP → simple, for small networks 🐢
- OSPF → fast, finds shortest path
- EIGRP → Cisco, hybrid & quick ⚙️



Cisco Catalyst 2960 | Juniper MX480

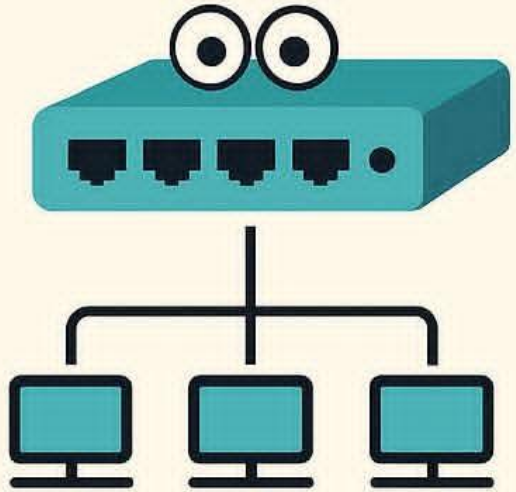
Layer 2 = within a network 🌍 MAC
Layer 3 = between networks 🌎 IP

Layer 2 = parking attendant

Layer 3 = road maps 🗺️

ROUTER VS SWITCH VS HUB

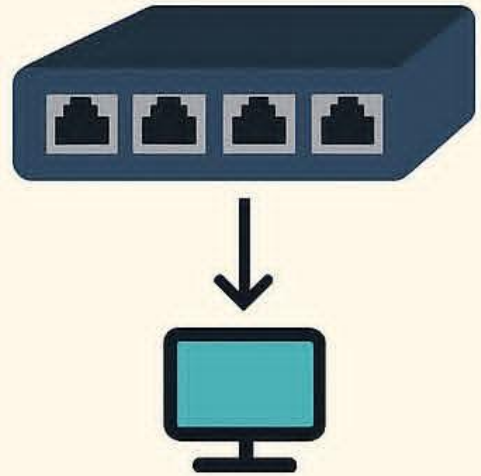
HUB



broadcastts data to all devices

- **Function:** distributes data
- **Intelligence:** dumb
- **Speed:** slow

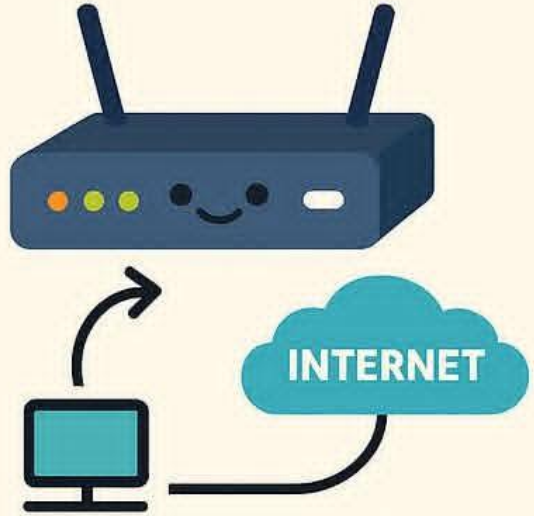
SWITCH



Sends data to specific device

- **Function:** forwards data
- **Intelligence:** smart
- Speed: fast

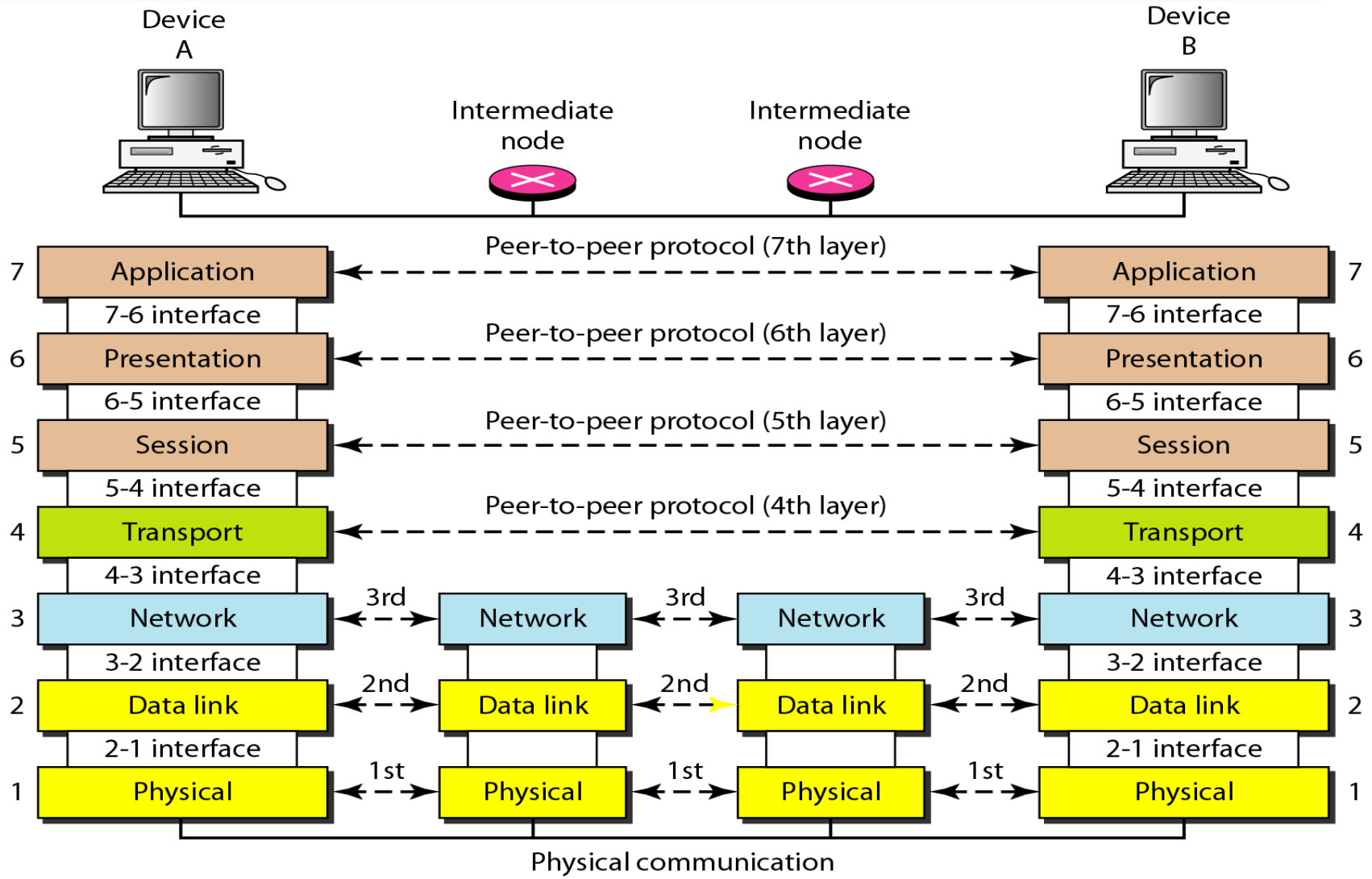
ROUTER



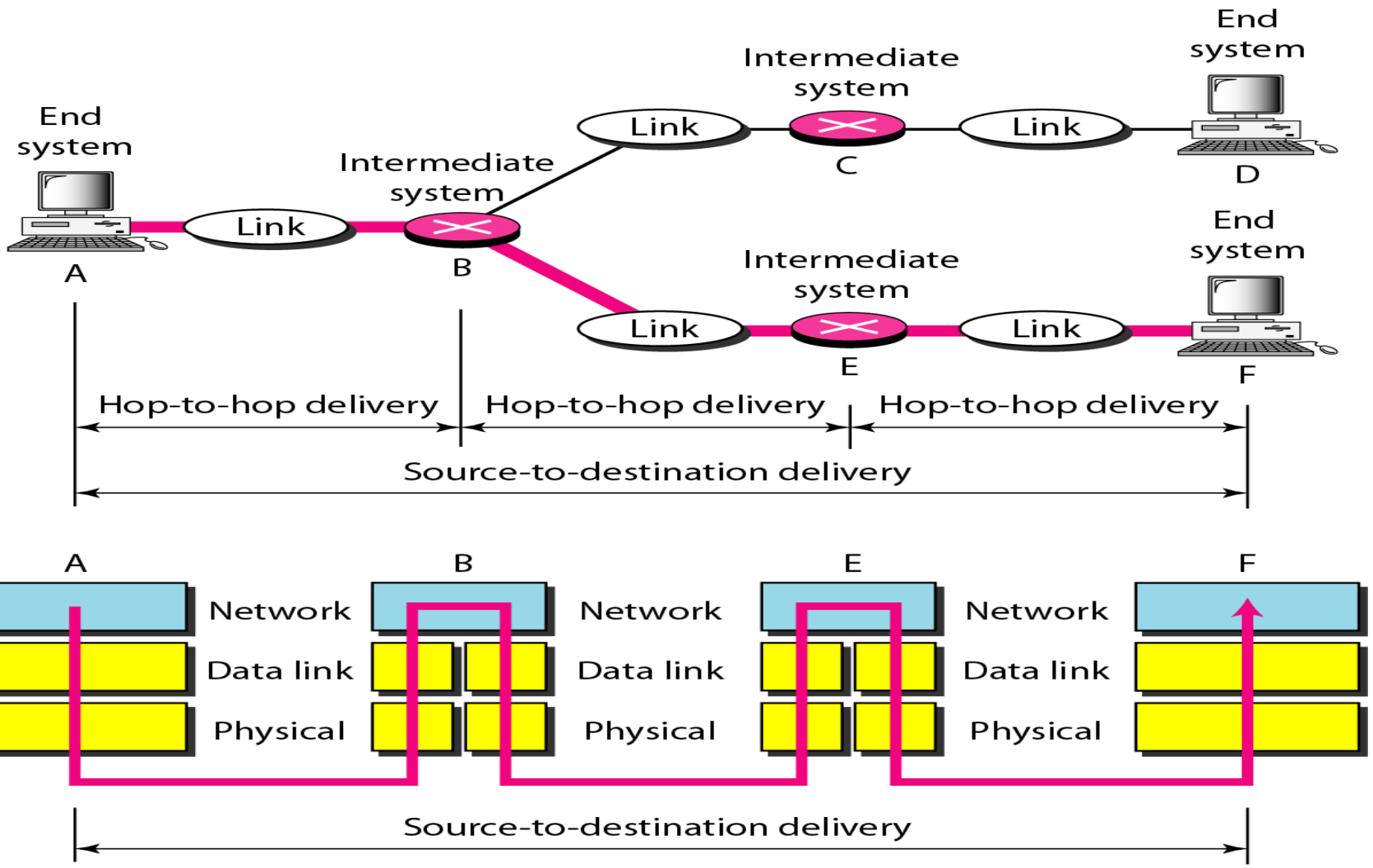
routes data between networks

- **Function:** directs traffic
- **Intelligence:** very smart
- **Speed:** moderate

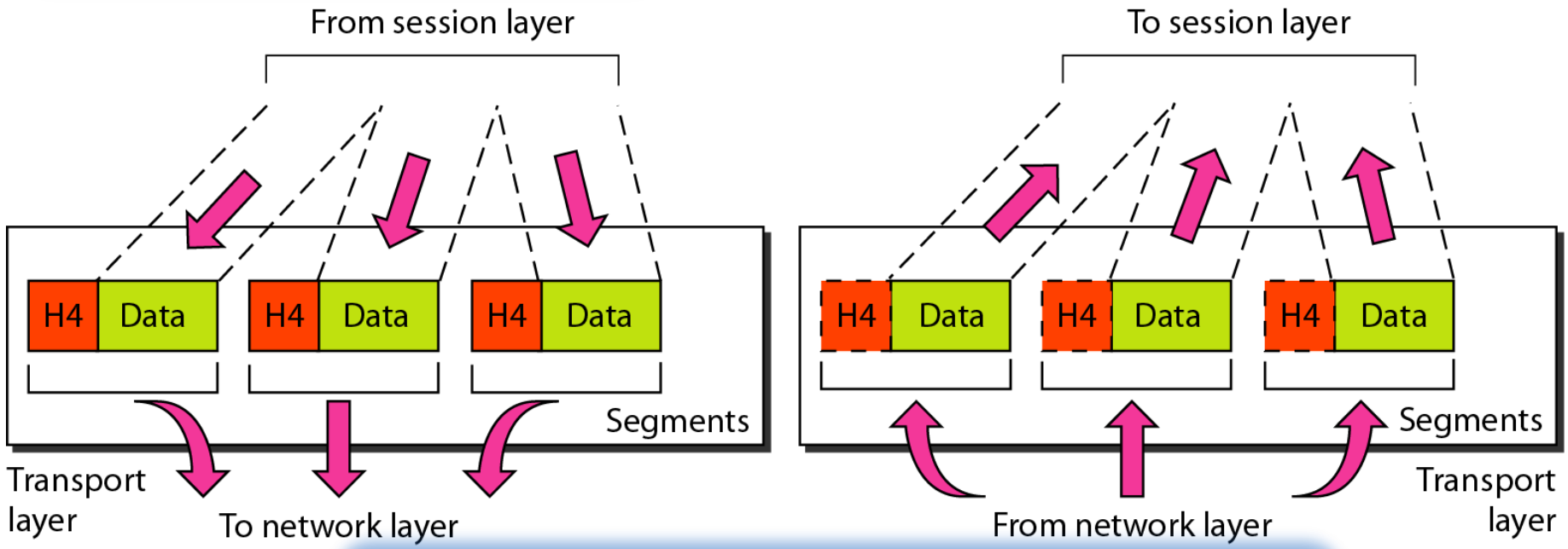
The interaction between layers in the OSI model



Source-to-destination delivery



Transport layer



Process to process delivery

Note

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

Transport Layer Protocol Comparison (TCP vs UDP)

TCP(Transmission Control Protocol): Reliable Connection

TCP provides a reliable connection, guaranteeing data delivery, ensuring order, and handling errors.

Ensures data integrity and delivery order. Requires a connection setup and provides error checking, making it suitable for applications like email and file transfers.

UDP (User Datagram Protocol): Fast and Efficient

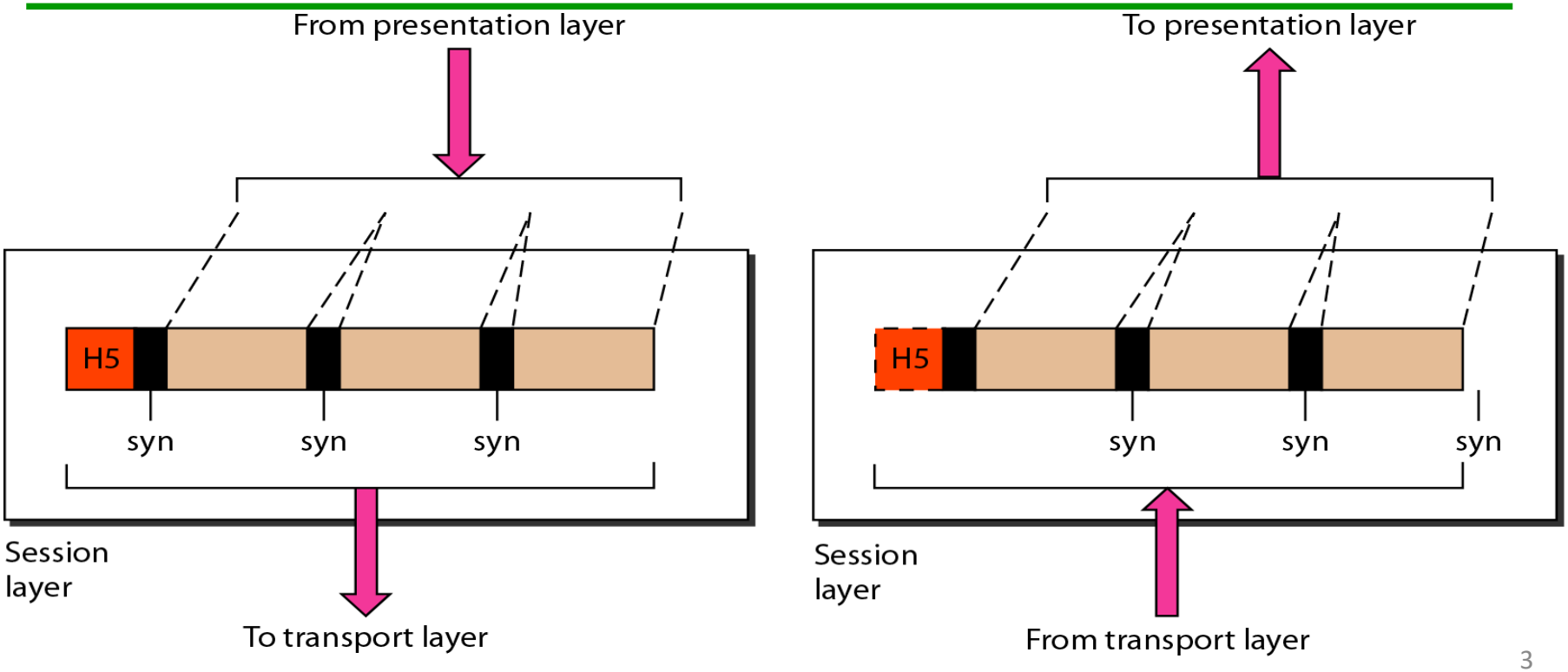
UDP is a connectionless protocol that prioritizes speed and efficiency, offering minimal error checking or order guarantees.

Focuses on speed and efficiency over guaranteed delivery. No connection setup or error checking, suitable for streaming media, gaming, and applications where speed is crucial.

Session layer

Note

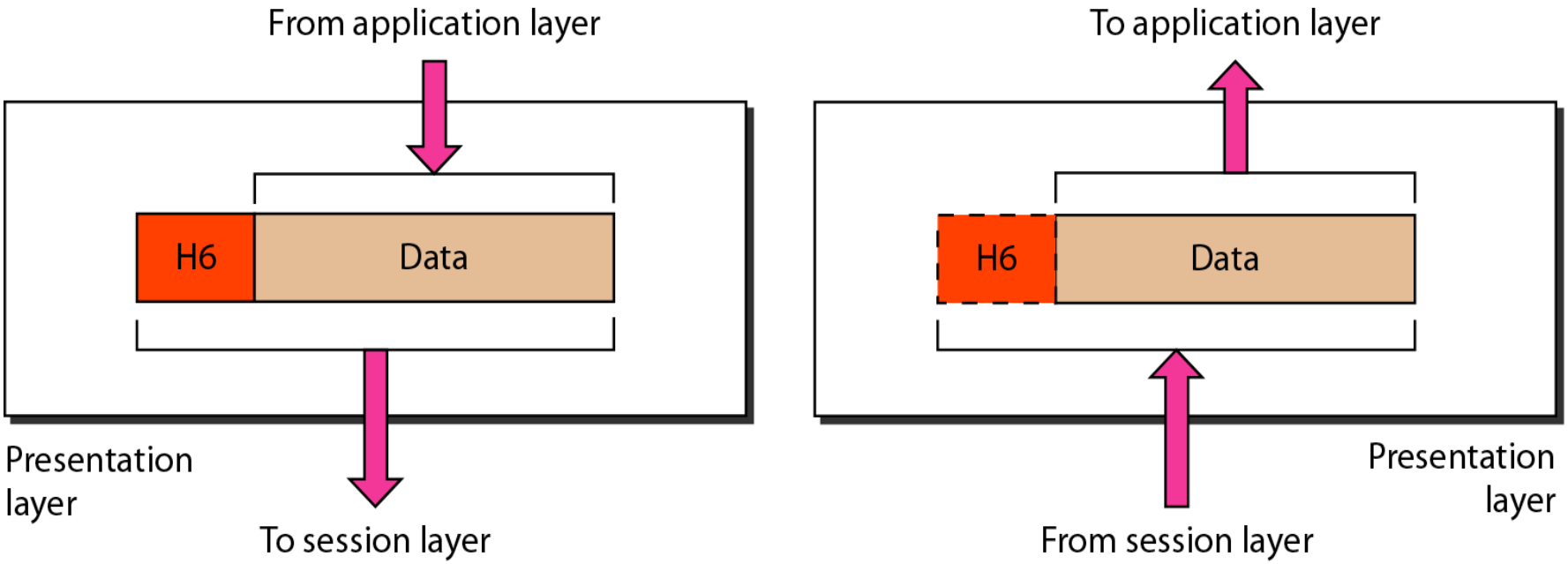
The session layer is responsible for **dialog control and synchronization**.



Presentation layer

Note

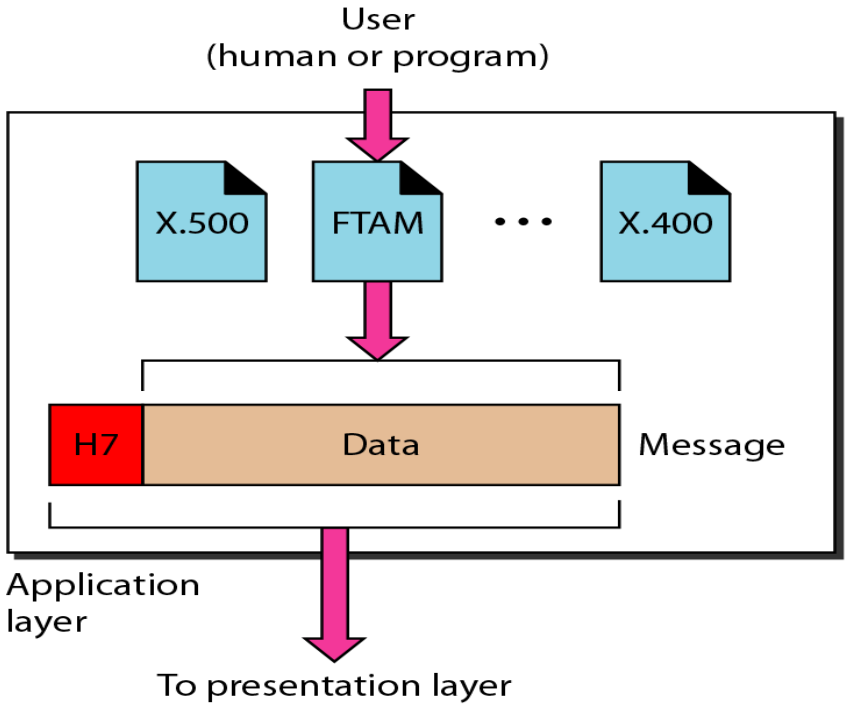
The presentation layer is responsible for translation, compression, and encryption.

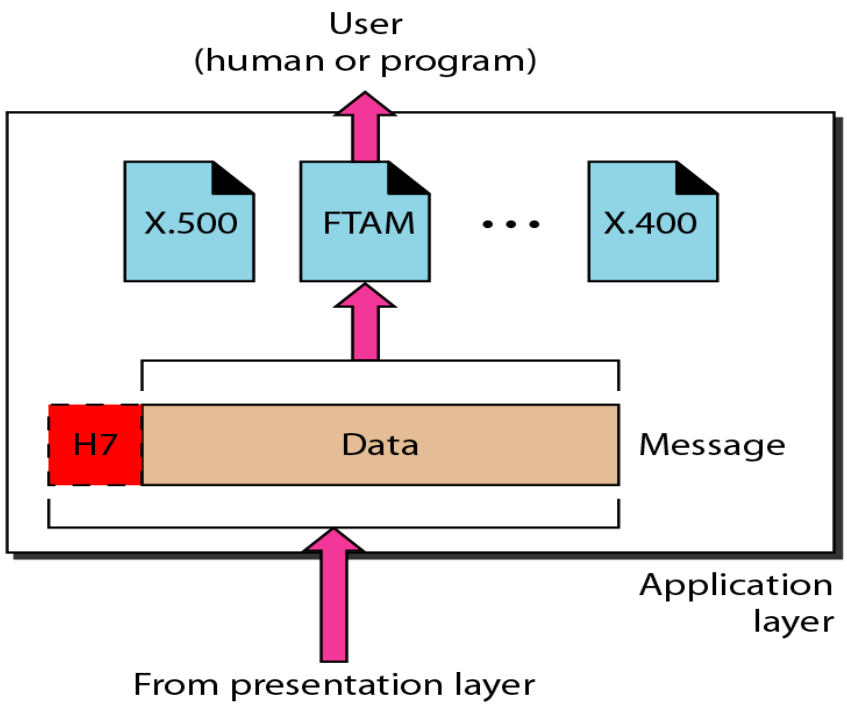


Application layer

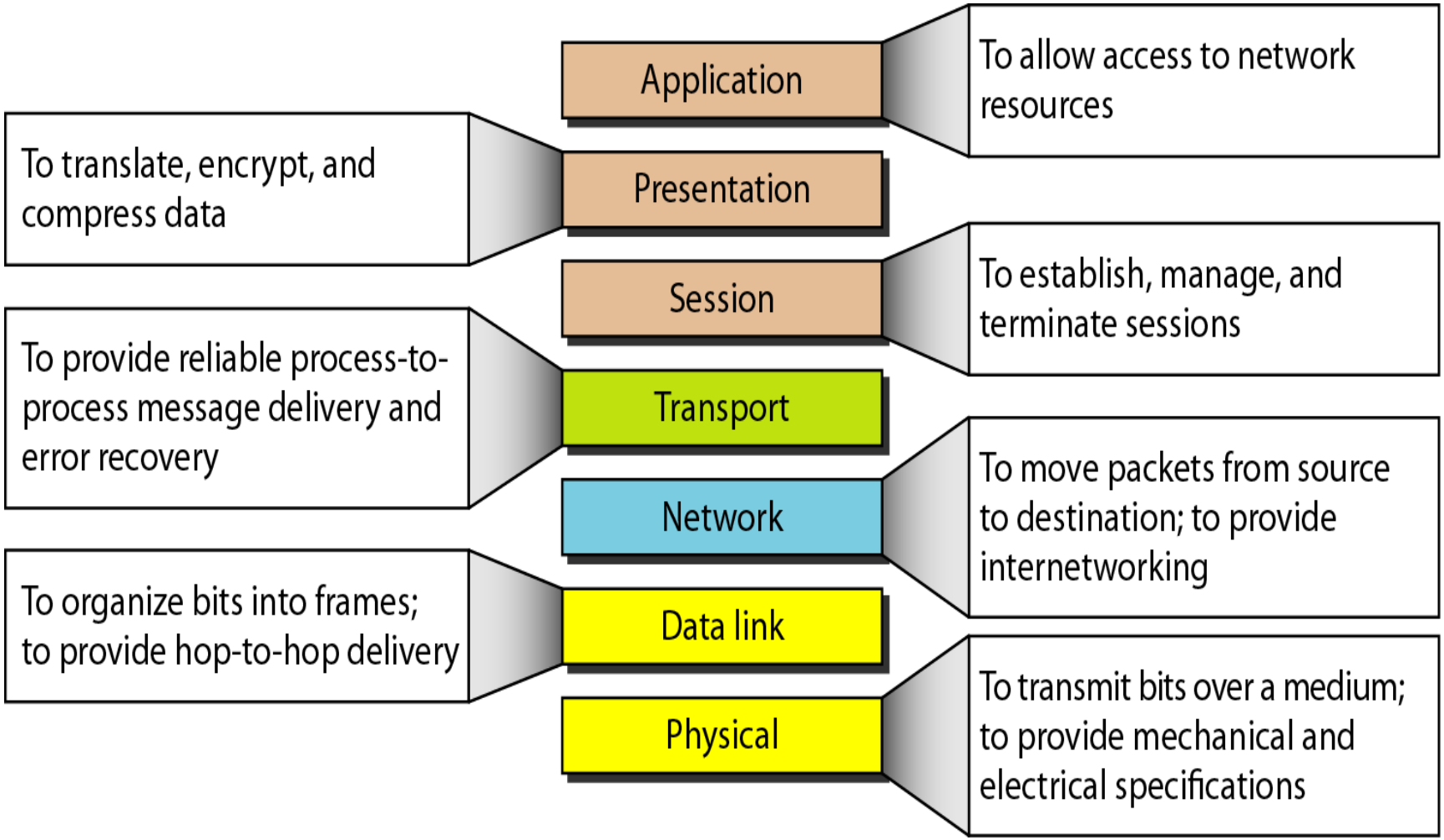
Note

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





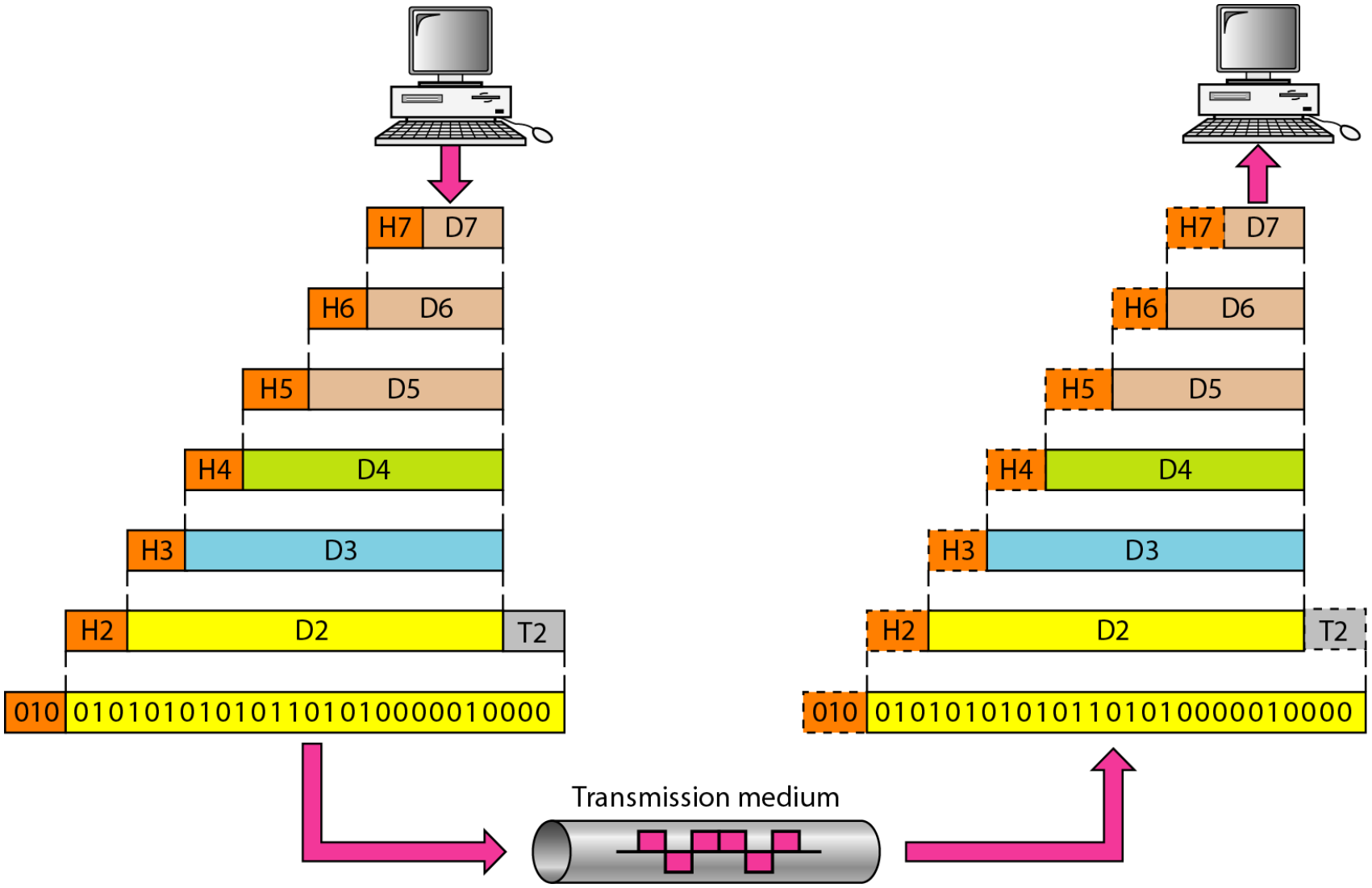
Summary of layers



Encapsulation

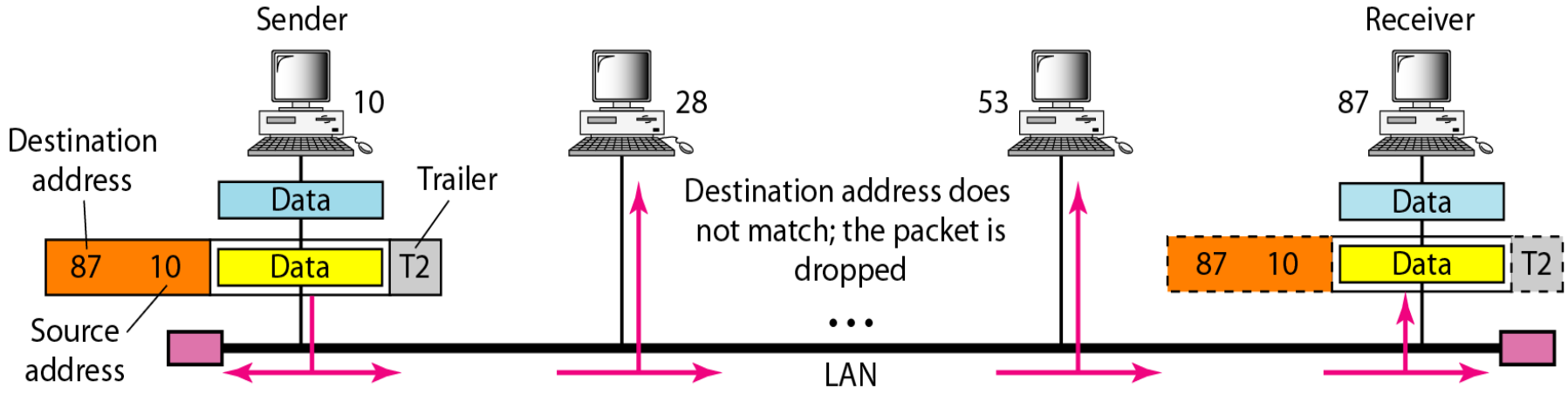
- Each layer on the sending system adds information to the data it receives from the layer above, this process called encapsulate.
- The purpose of encapsulate process is that the peer layer on the receiving system need this information.
- This added information is called “Protocol Data Unit – PDU”
- Each layer on the receiving system unwraps the received message and remove the PDU related to this layer, inspect it to make decision based on it, then pass the remainder to the upper layer.

An exchange using the OSI model



Example

A node with physical address 10 sends a frame to a node with physical address 87. The two nodes are connected by a link (bus topology LAN). As the figure shows, the computer with physical address 10 is the sender, and the computer with physical address 87 is the receiver.



Layers & Network Protocols

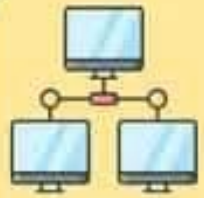
www.thenetworkdna.com

Layer 1 Protocols

- 10BASE-T
- 100BASE-TX
- 1000BASE-T
- DSL Lines
- ISDN, USB
- RS-232
- EIA-422
- EIA-423
- SONET/SDH
- DWDM
- T1/E1
- Hubs
- Repeaters

Layer 2 Protocols

- CDP
- Ethernet
- Frame-Relay
- CHAP
- HDLC
- LLC
- LACP
- LLDP
- LCP
- MAC
- PPP
- STP
- VTP
- VLAN



Layer 3 Protocols

- IPv4
- IPv6
- ATM
- EIGRP
- GRE
- GLBP
- HSRP
- RIP
- RIPv2
- IGRP
- ICMP
- IGMP
- IPSEC
- IS-IS
- MPLS
- NAT
- OSPF
- VRRP

Layer 4 Protocols

- AH
- TCP
- UDP
- DCCP
- ESP
- FCP
- SCTP

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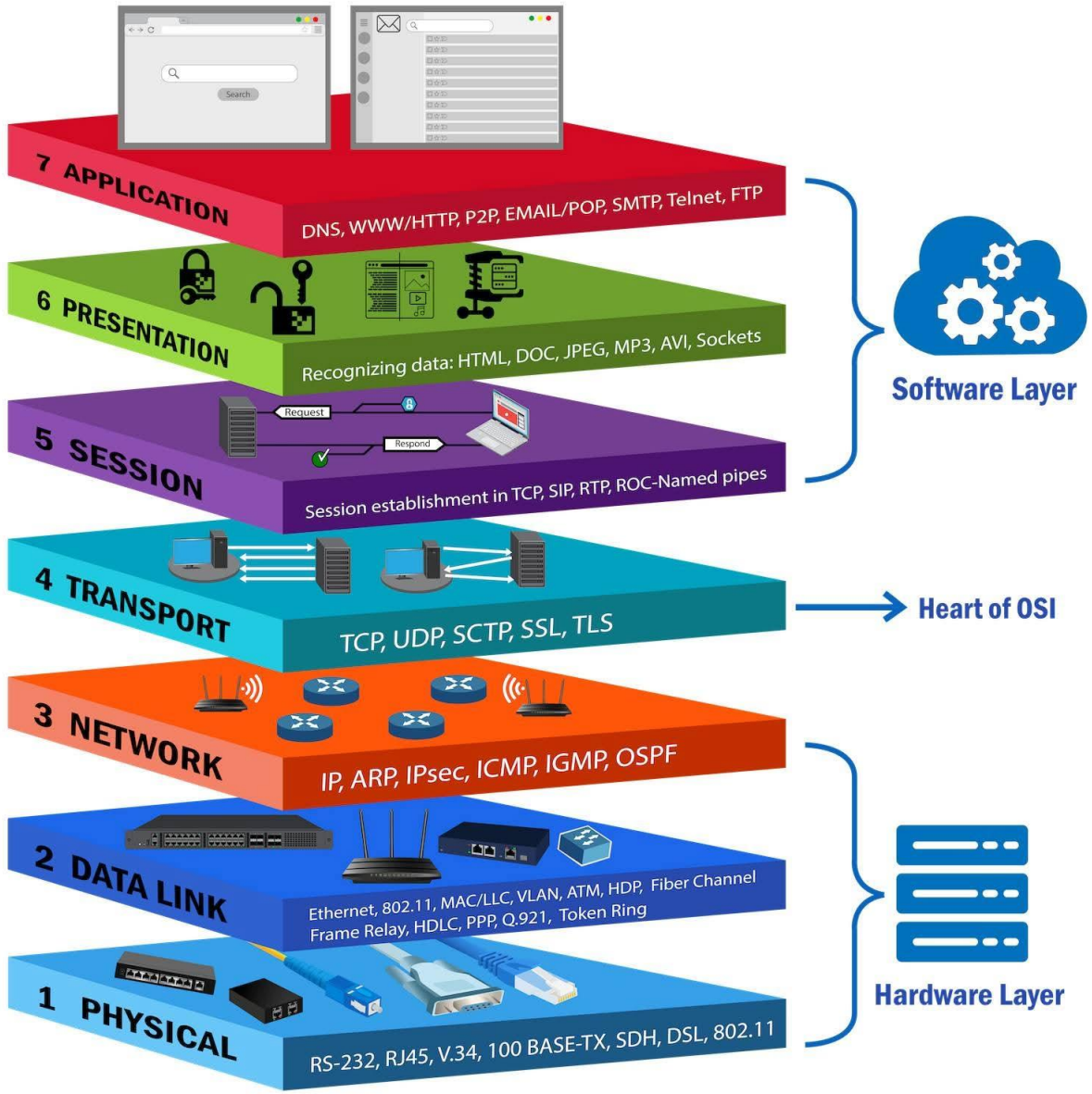
Layer 5 Protocols

- SIP
- PPTP
- SMB
- NFS
- PAP
- RPC
- SMPP
- TLS
- SSL
- AFP

Layer 7 Protocols

- BitTorrent
- BGP
- DNS
- DHCP
- FTP
- HTTP
- HTTPS
- IRC
- NTP
- POP3
- RTP
- SSH
- SMTP
- SNMP
- Telnet
- TFTP
- URL

The Open Systems Interconnection (OSI) model



The TCP/IP Model

-The TCP/IP model is fundamental for internet communication, enabling secure and reliable data transfer. Understanding its layers and protocols is crucial for effective network design and troubleshooting. Network design should prioritize security, performance, and scalability to support diverse applications and users.

- **The layers in the TCP/IP protocol suite (Transmission Control Protocol/ Internet Protocol) do not exactly match those in the OSI model.** It consists of four layers:

1-Physical and Data Link Layers

2-Network Layer

3-Transport Layer

4-Application Layer

- Application Layer has three combined layers which are:

Session Layer ,Presentation Layer, Application Layer

TCP/IP(Transmission Control Protocol) and OSI model