
# Network Models

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# NETWORK MODELS

- Network- combination of hardware and software that sends data from one location to another
  - Hardware- physical equipment that carries signal
  - Software- consists instruction sets that make network services possible

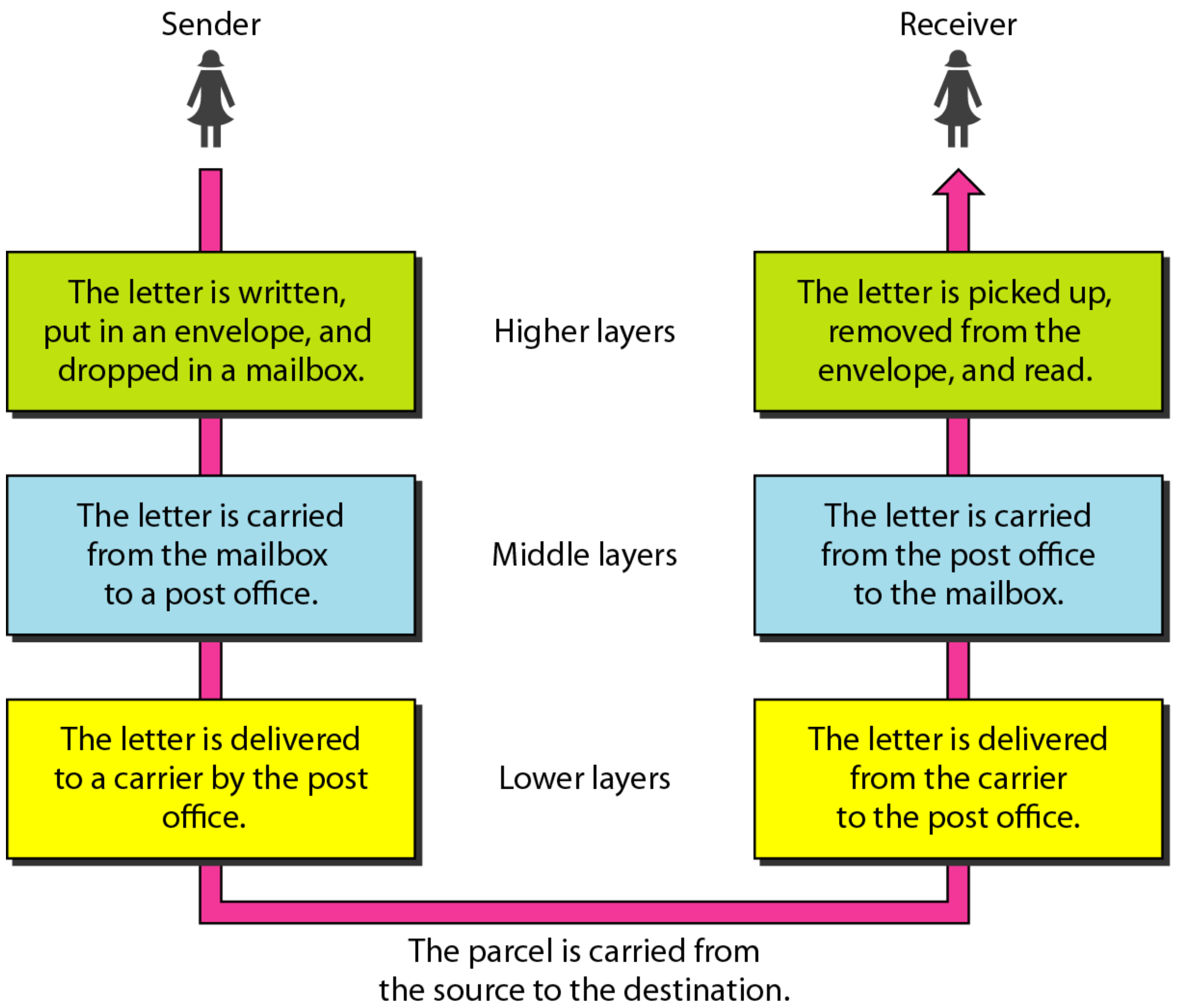
# 2-1 LAYERED TASKS

***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.***

***Topics discussed in this section:***

**Sender, Receiver, and Carrier**
**Hierarchy**

## Figure 2.1 Tasks involved in sending a letter



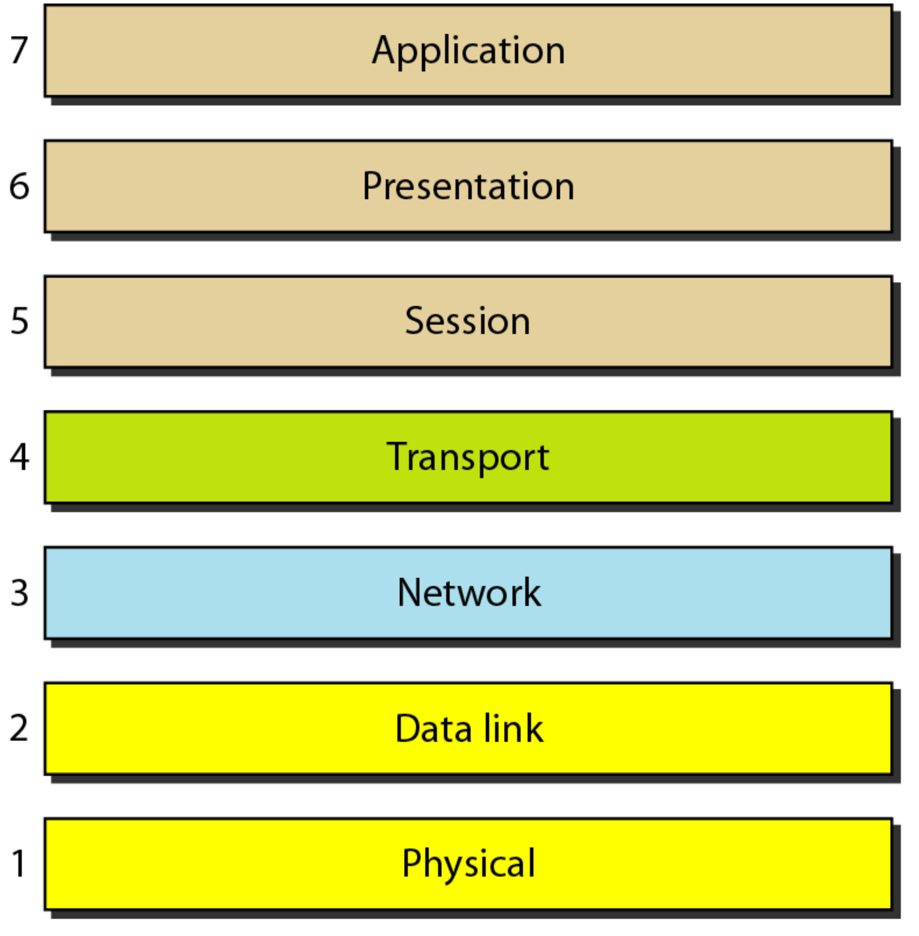
# 2-2 THE OSI MODEL

- ISO standard that covers all aspects of network communications is the Open Systems Interconnection (OSI) model; introduced in the late 1970s
  - To Facilitate communication between different systems without requiring changes to the underlying hardware and software
- Layered framework for the design of network systems that allows communication between all types of computer systems
- Composed of 7 separate but related layers (ordered)

***Note***

**ISO is the organization.**
**OSI is the model.**

## **Figure 2.2** *Seven layers of the OSI model*

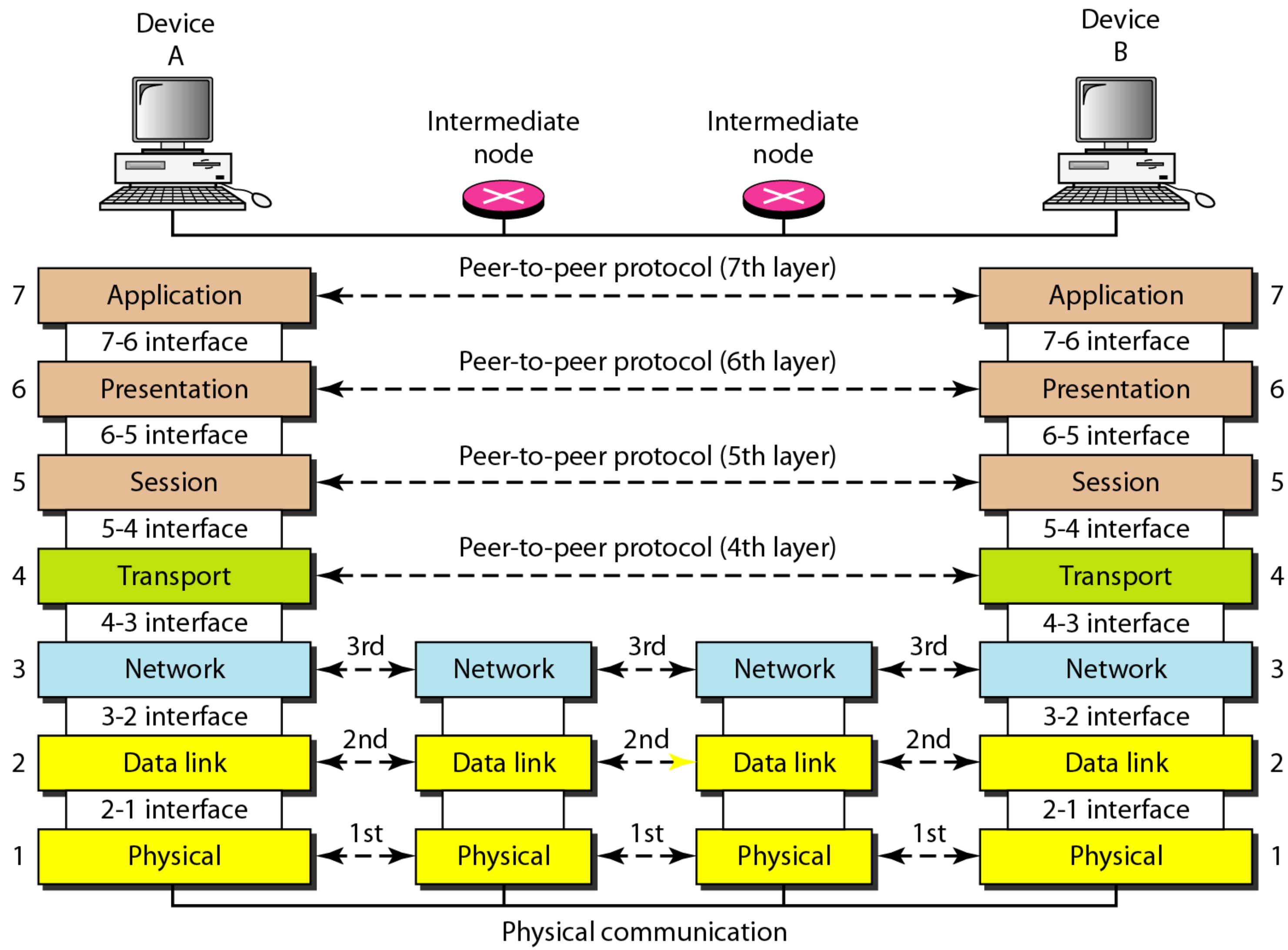


# OSI MODEL …

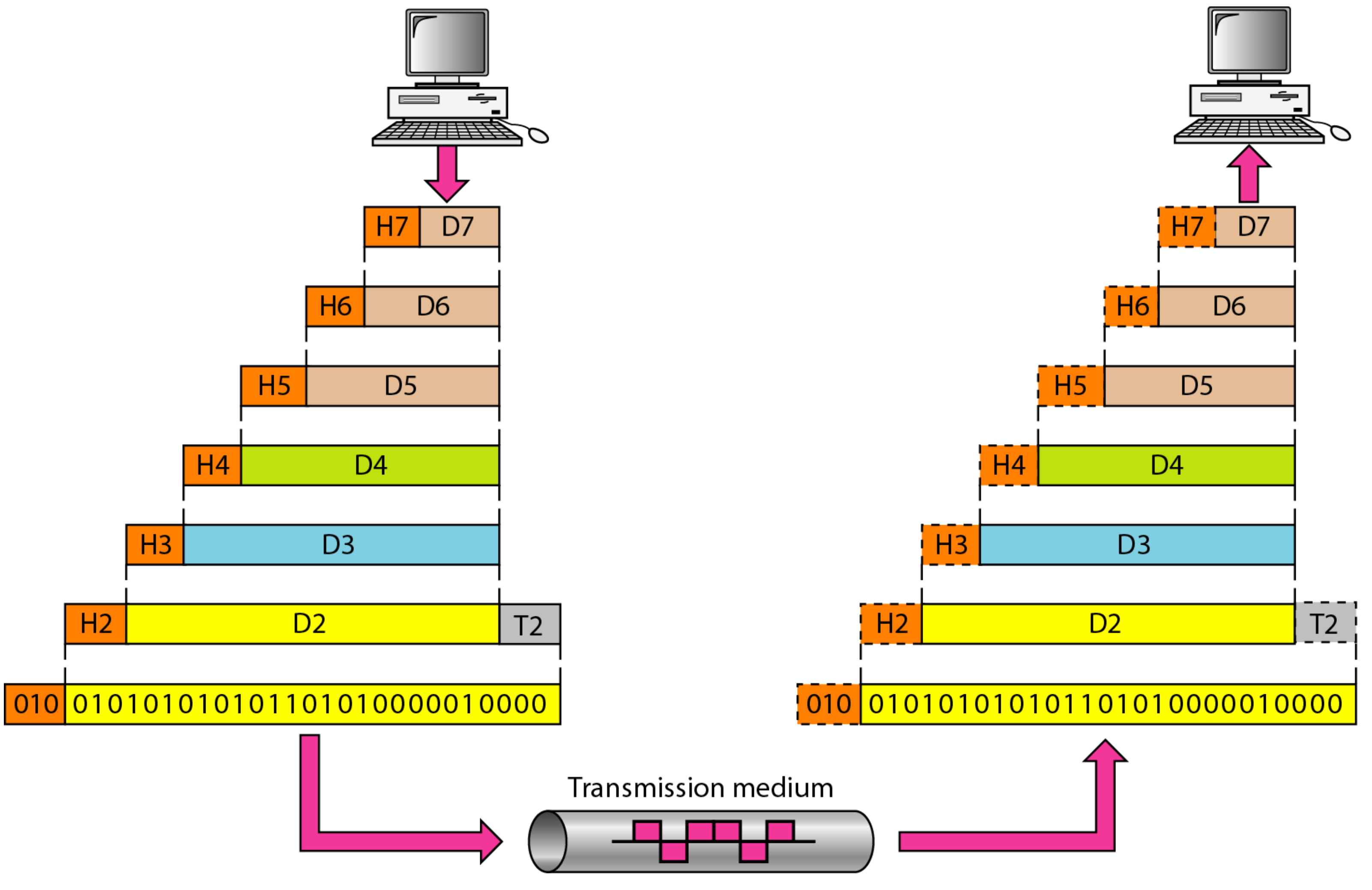
- Each layer defines part of the process of moving information across a network
- Networking functions with related uses are collected into discrete groups→ layers
- Allows complete interoperability between incompatible systems
- Subgroups: Network support layers (Physical, Data link and Network layer), User support layers (Application, Presentation and Session); Transport layer -interface between the two
- Within a single machine, each layer calls upon the services of a layer just below it

- Peer Processes: processes on each machine that communicate at a given layer

## Figure 2.3 *The interaction between layers in the OSI model*



## Figure 2.4 *An exchange using the OSI model*



# 2-3 LAYERS IN THE OSI MODEL

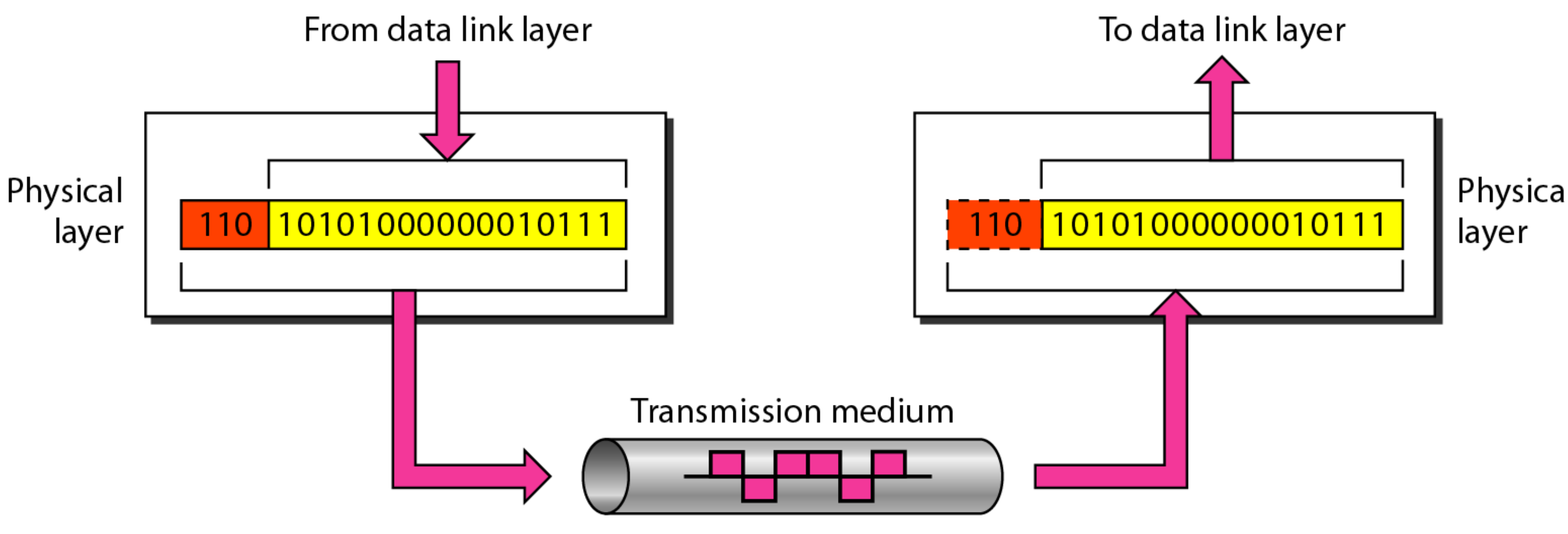
***In this section we briefly describe the functions of each layer in the OSI model.***

***Topics discussed in this section:***

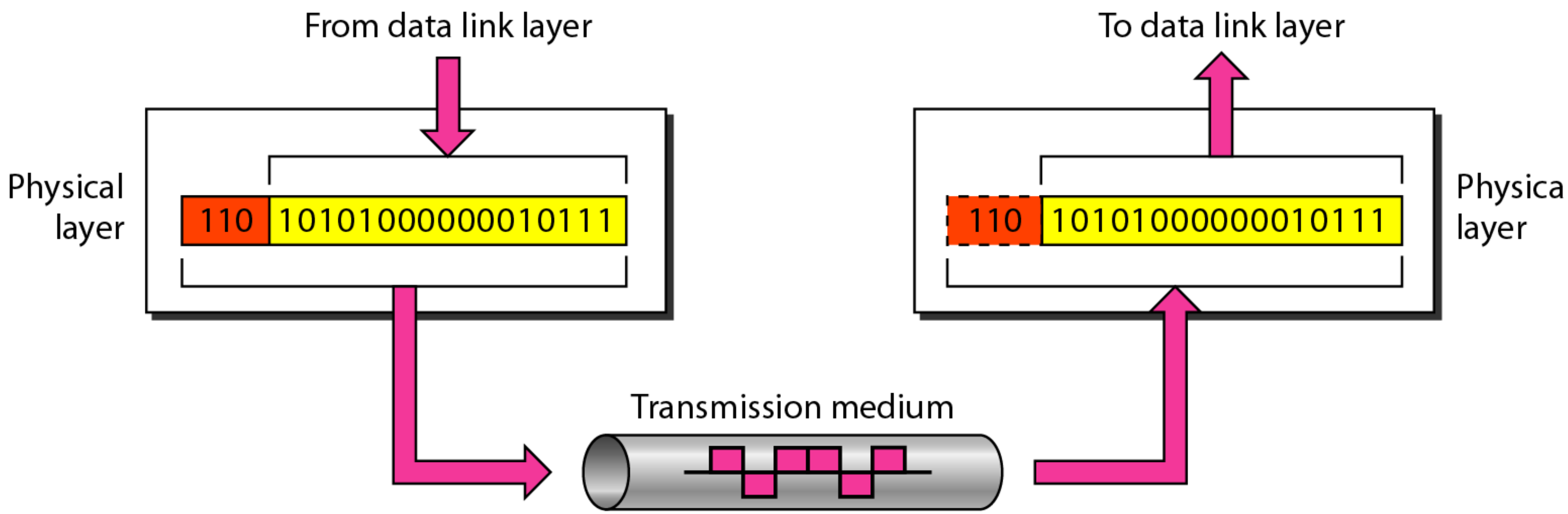
**Physical Layer**
**Data Link Layer**
**Network Layer**
**Transport Layer**
**Session Layer**
**Presentation Layer**
**Application Layer**

# Physical layer

- Coordinates functions required to carry a bit stream over physical medium
  - Electrical specifications of the interface and transmission medium
  - Defines procedures and functions to be performed by physical devices and interfaces



# Figure 2.5 *Physical layer*



# Physical layer

- Physical layer is also concerned with following:
  - Physical characteristics of interfaces and medium
  - Representation of bits (encoding; 0s and 1s changed to signals)
  - Data rate (bit duration)
  - Synchronization of bits (clock synchronization)
  - Line configuration (point-to-point/ multipoint)
  - Physical topology
  - Transmission mode (simplex/duplex)

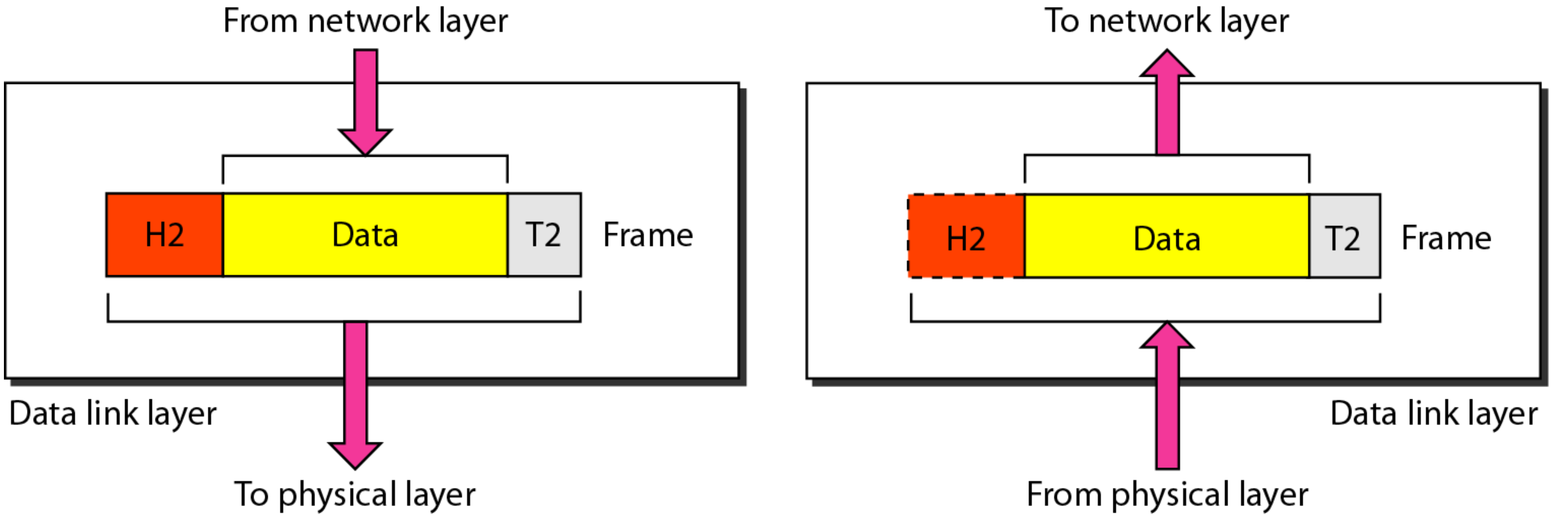
***Note***

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

# Data Link layer

- Data link layer transforms the physical layer from raw transmission facility to a reliable link
  - responsible for moving frames from one hop (node) to the next
- Responsibilities
  - Framing: divides the stream of bits received into manageable data units called Frames
  - Physical Addressing: Address of sender and receiver of frame
  - Error control: adds reliability to the physical layer; detect and retransmit damaged or lost frame
  - Flow control: avoid overwhelming the receiver
  - Access control: defines which device has right to use the shared link/channel

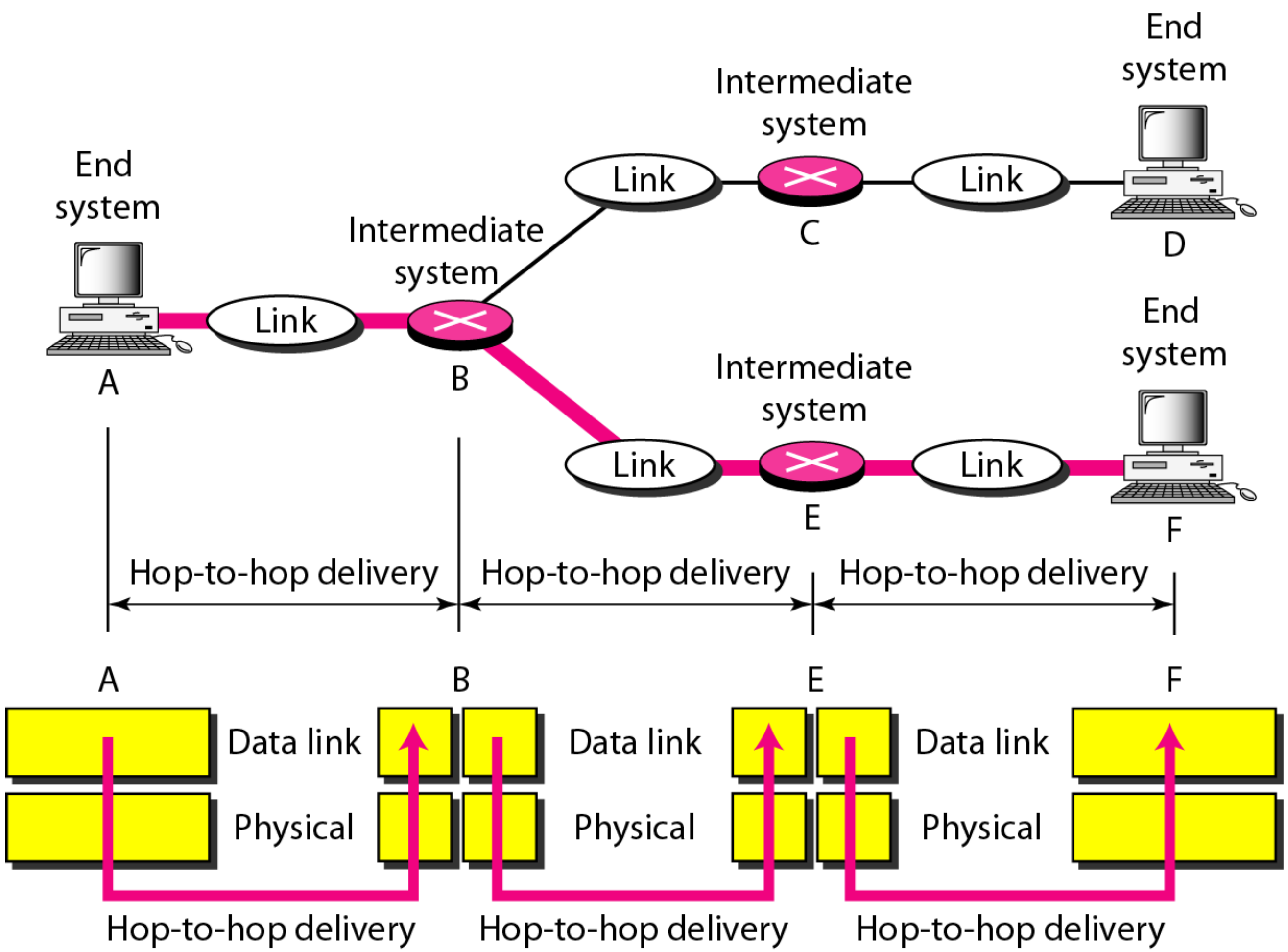
# **Figure 2.6** *Data link layer*



***Note***

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

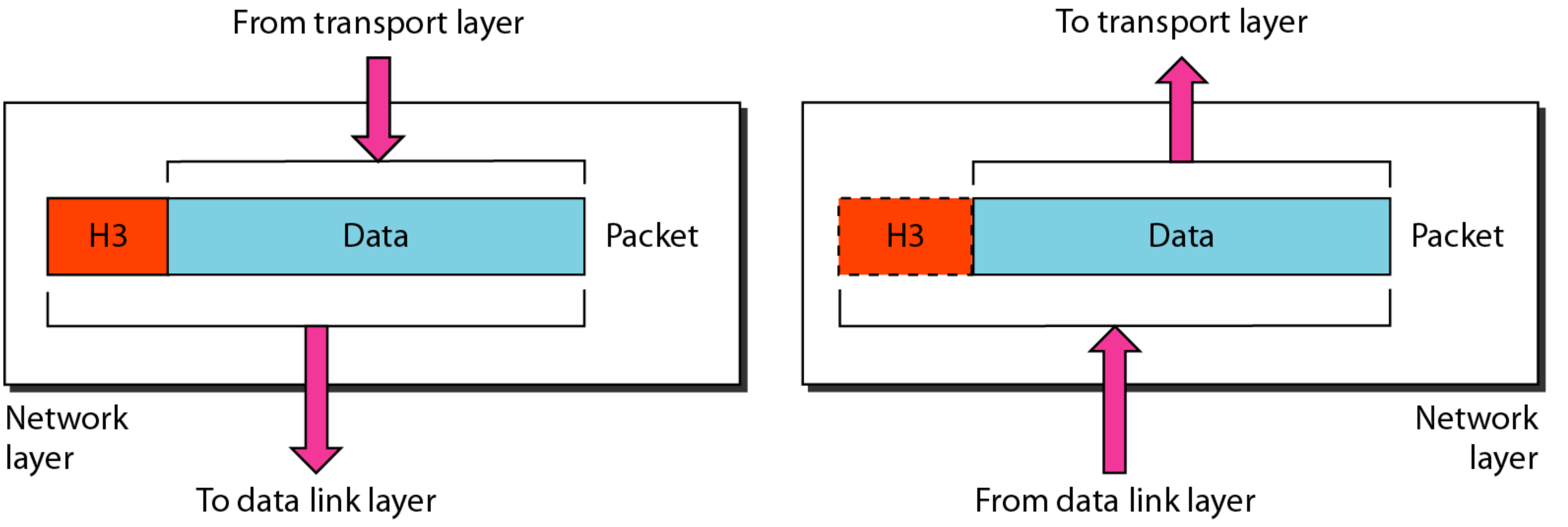
## Figure 2.7 *Hop-to-hop delivery*



# Network layer

- Responsible for source-to-destination delivery of packets across multiple networks
  - Needed when two systems are connected to different networks, with connecting devices between the networks
- Responsibilities
  - Logical Addressing: physical address cannot be used when packet passes the network boundary
  - Logical addressing used to distinguish source and destination system
  - Routing: Route packets to final destination over a large network or an internetwork of independent networks

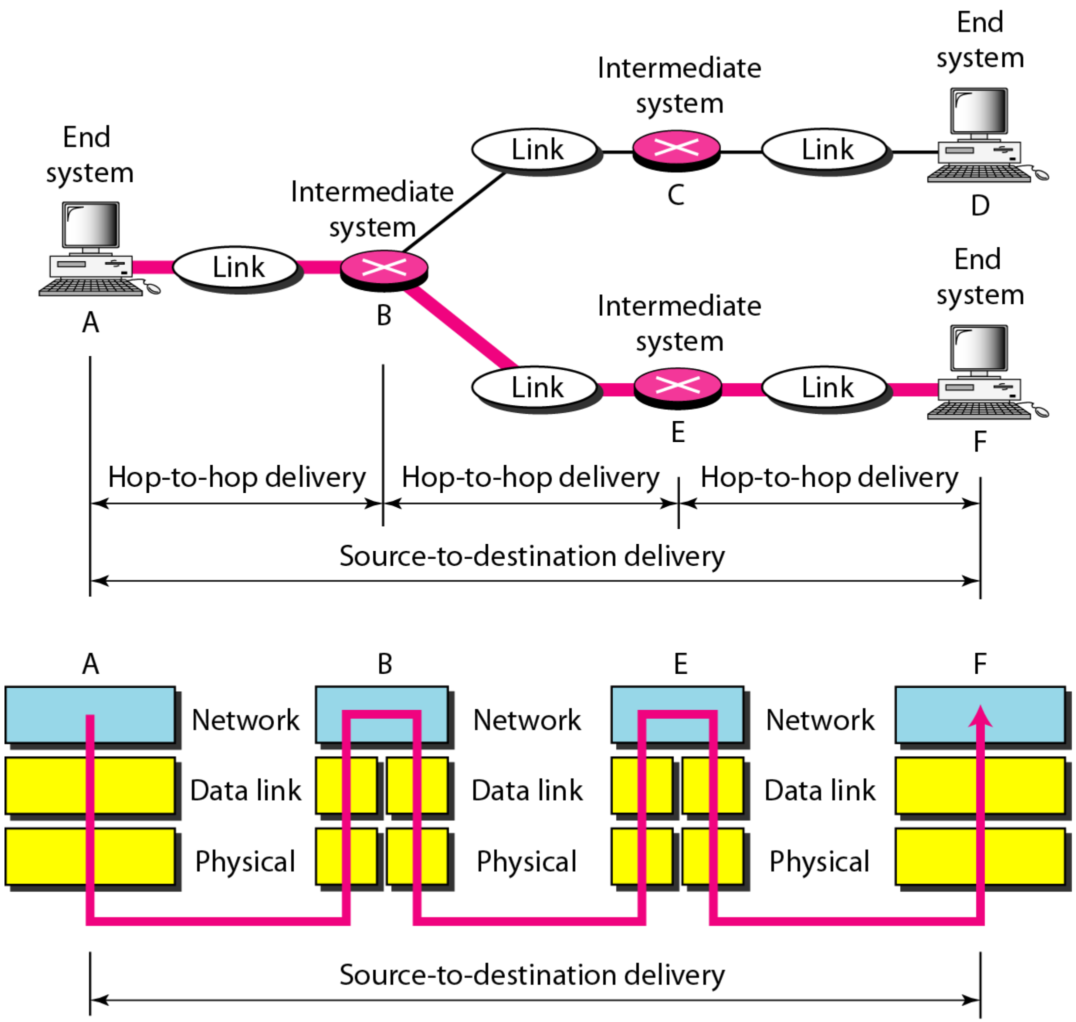
## Figure 2.8 *Network layer*



***Note***

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

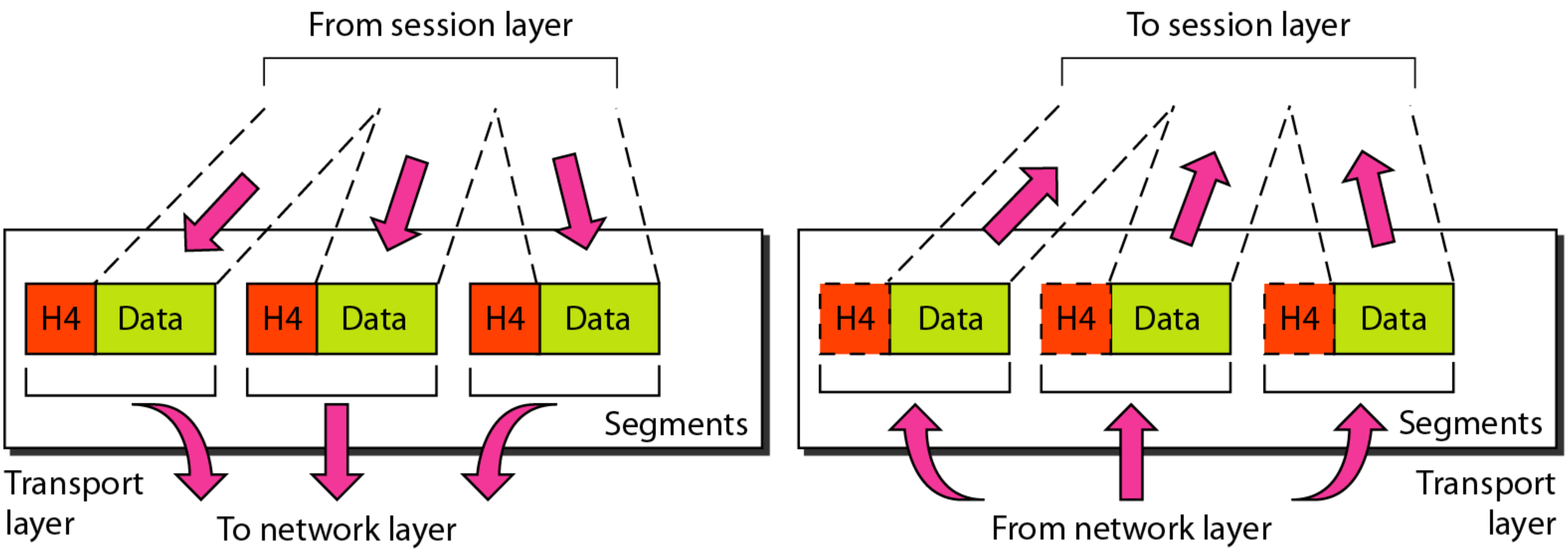
## Figure 2.9 *Source-to-destination delivery*



# Transport layer

- Responsible for process-to-process delivery of packets
  - Process- an application program running on host
  - Transport layer ensures that whole message arrives intact and in order
- Responsibilities
  - Service-point Addressing: Port addressing
    - *Network layer gets each packet to correct computer, Transport layer gets the entire message to correct process*
  - Segmentation and Reassembly: message divided into transmittable segments; sequence number
  - Connection control
  - Flow control and Error control

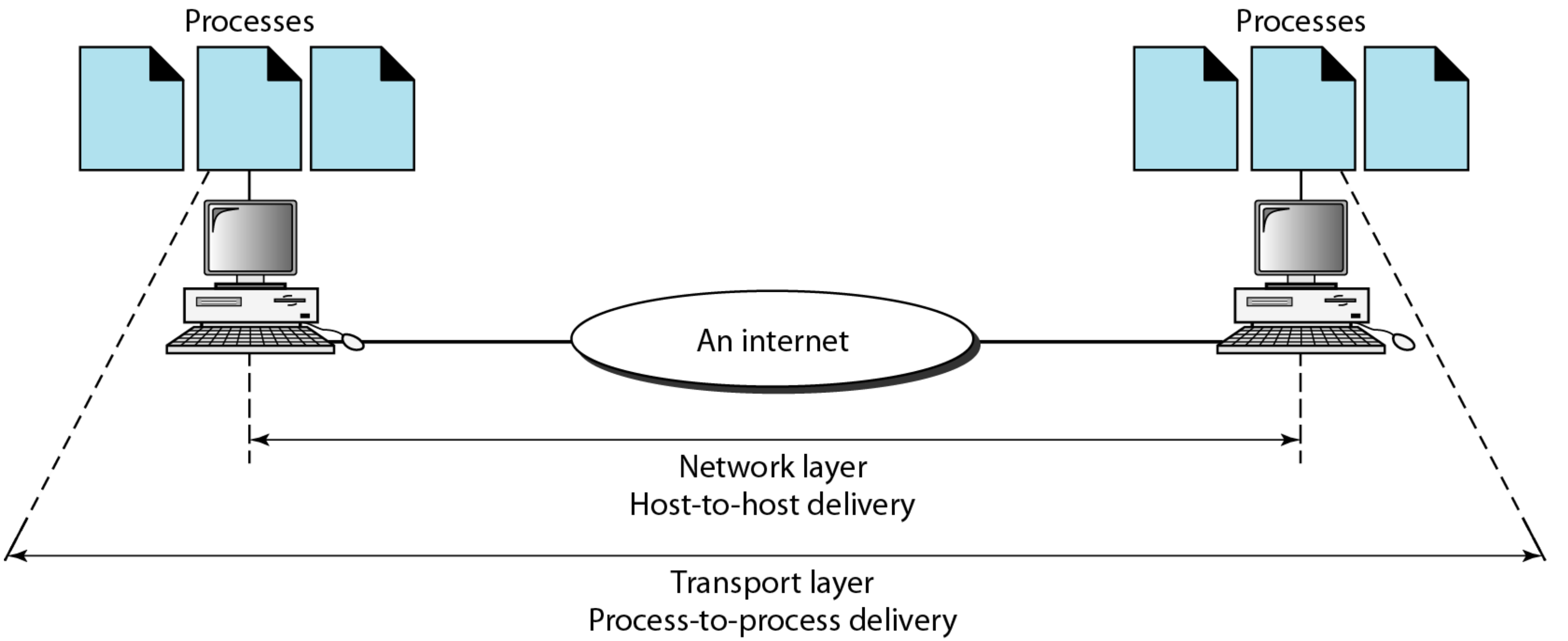
## Figure 2.10 *Transport layer*



***Note***

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

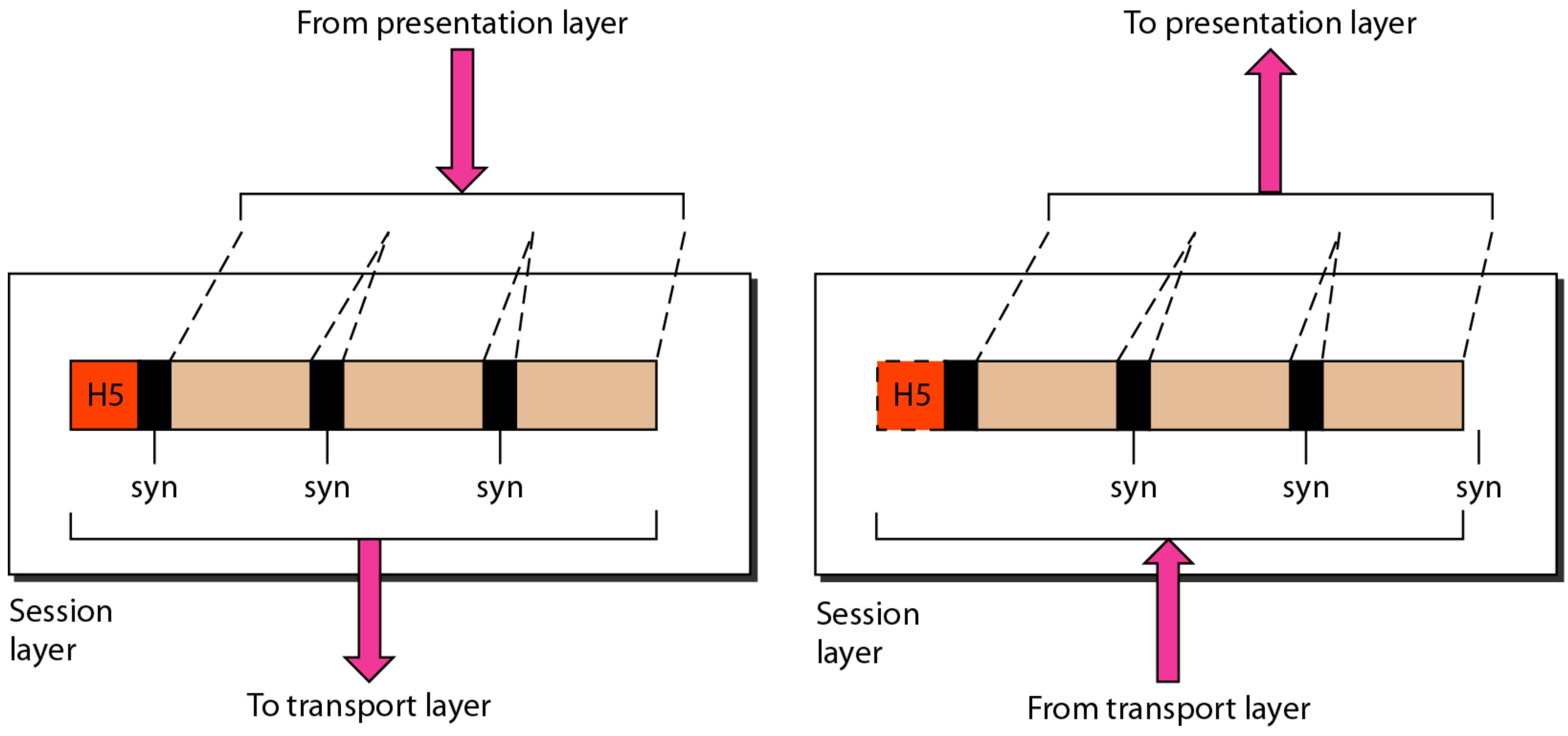
## Figure 2.11 *Reliable process-to-process delivery of a message*



# Session Layer

- Is the network *dialog controller; session manager*
  - Establishes, maintains and synchronizes the interaction among communicating systems
- Responsibilities
  - Dialog control: allows dialog between two systems; communication can take place in half-duplex or full-duplex
  - Synchronization: Check points/synchronization points added to stream of data
  - e.g large file of 1000 pages; checkpoint every 100 page

# Figure 2.12 *Session layer*



***Note***

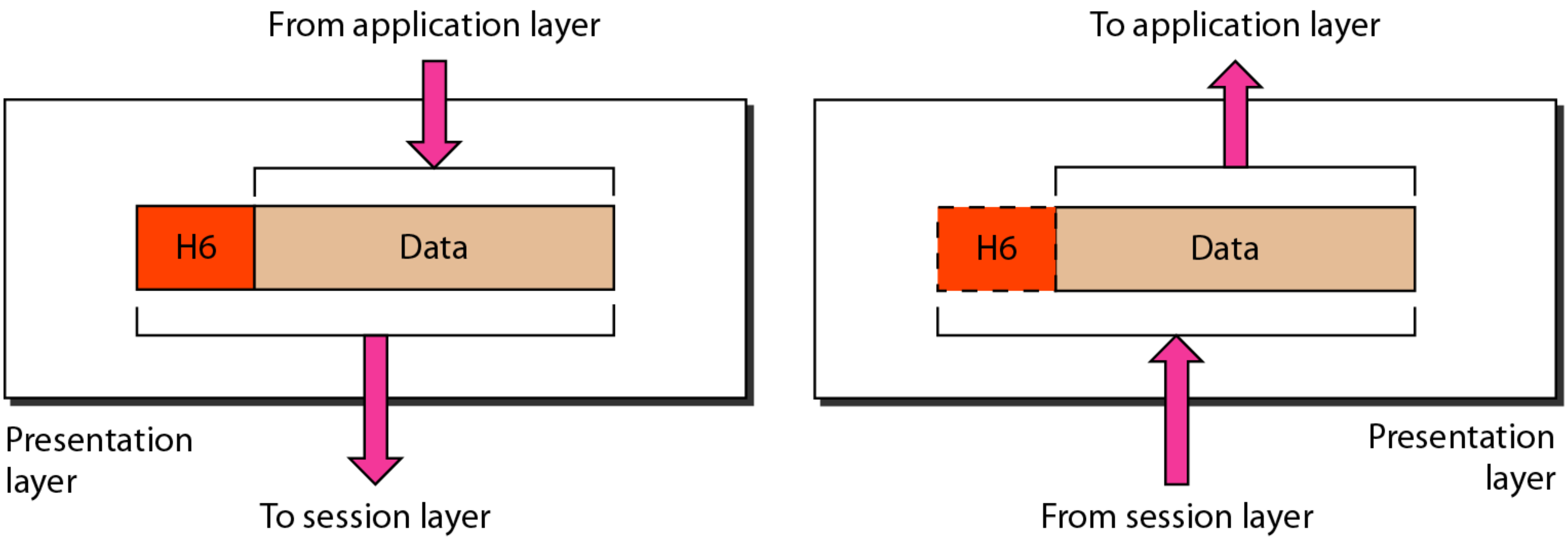
**The session layer is responsible for dialog control and synchronization.**

# Presentation Layer

- Concerned with syntax and semantics of the information exchanged

- Responsibilities
  - Translation: changes the information from machine dependent format to machine independent format
  - Compression: reduce the amount of bits/data in the information
  - Encryption: ensure privacy

## Figure 2.13 *Presentation layer*



***Note***

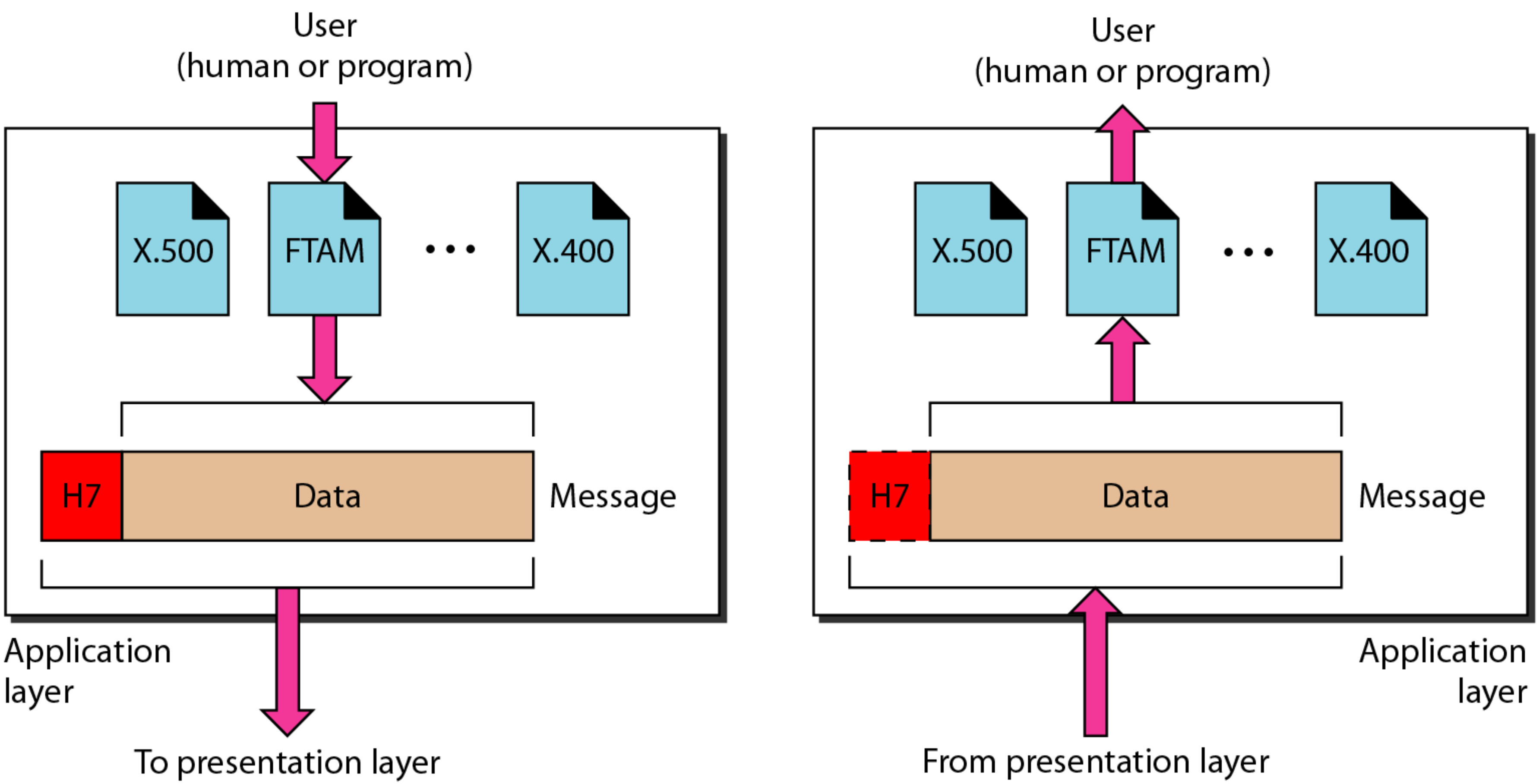
**The presentation layer is responsible for translation, compression, and encryption.**

# Application Layer

- Enables users to access the network; provides user interfaces and support for services
  - Responsible for providing services to the user

- Services provided-
  - Network virtual terminal: allows user to log on to remote host
  - File transfer, access and management: allows user to access files on remote host
  - Mail services: e-mail forwarding and storage
  - Directory services: provides database sources and access for global information about various objects and services

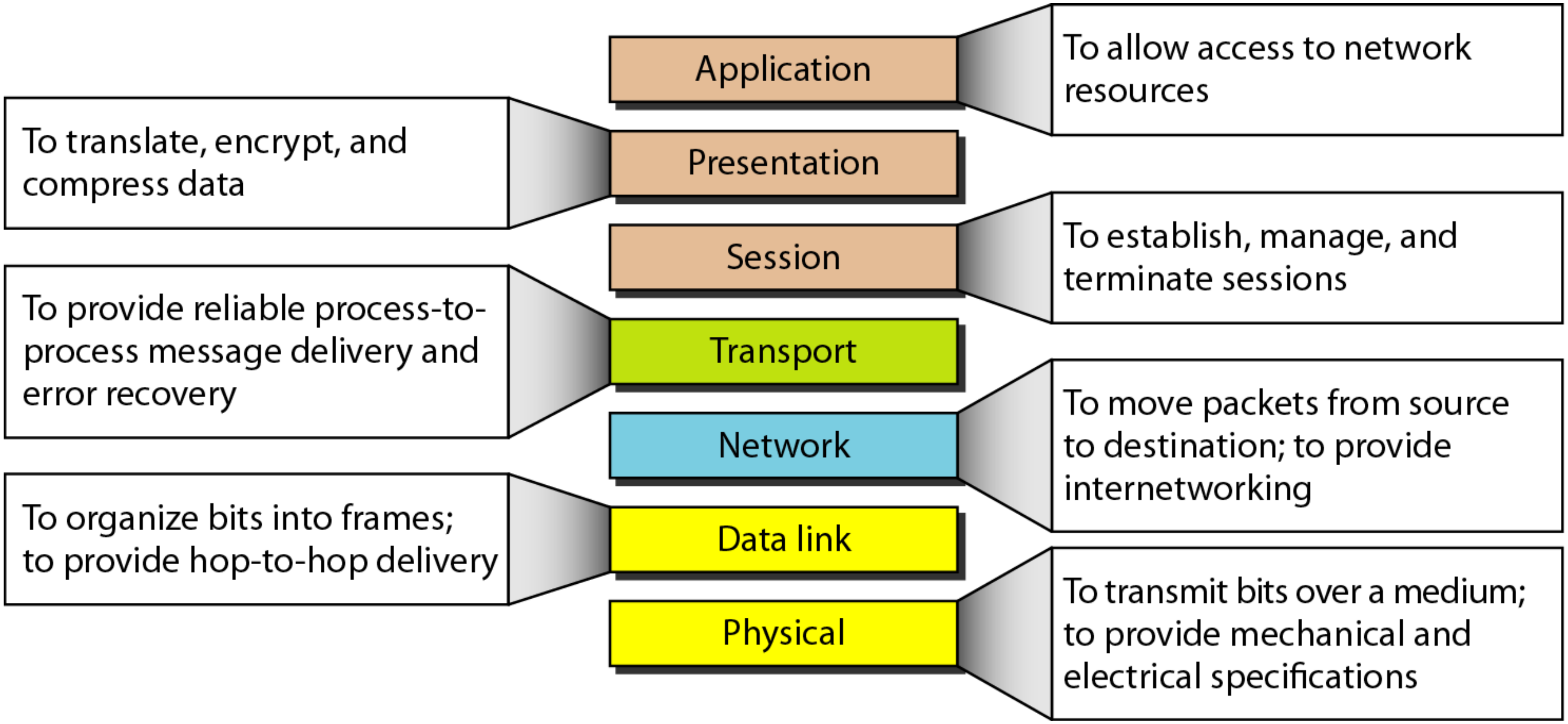
## Figure 2.14 *Application layer*



***Note***

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

## Figure 2.15 *Summary of layers*



# 2-4 TCP/IP PROTOCOL SUITE

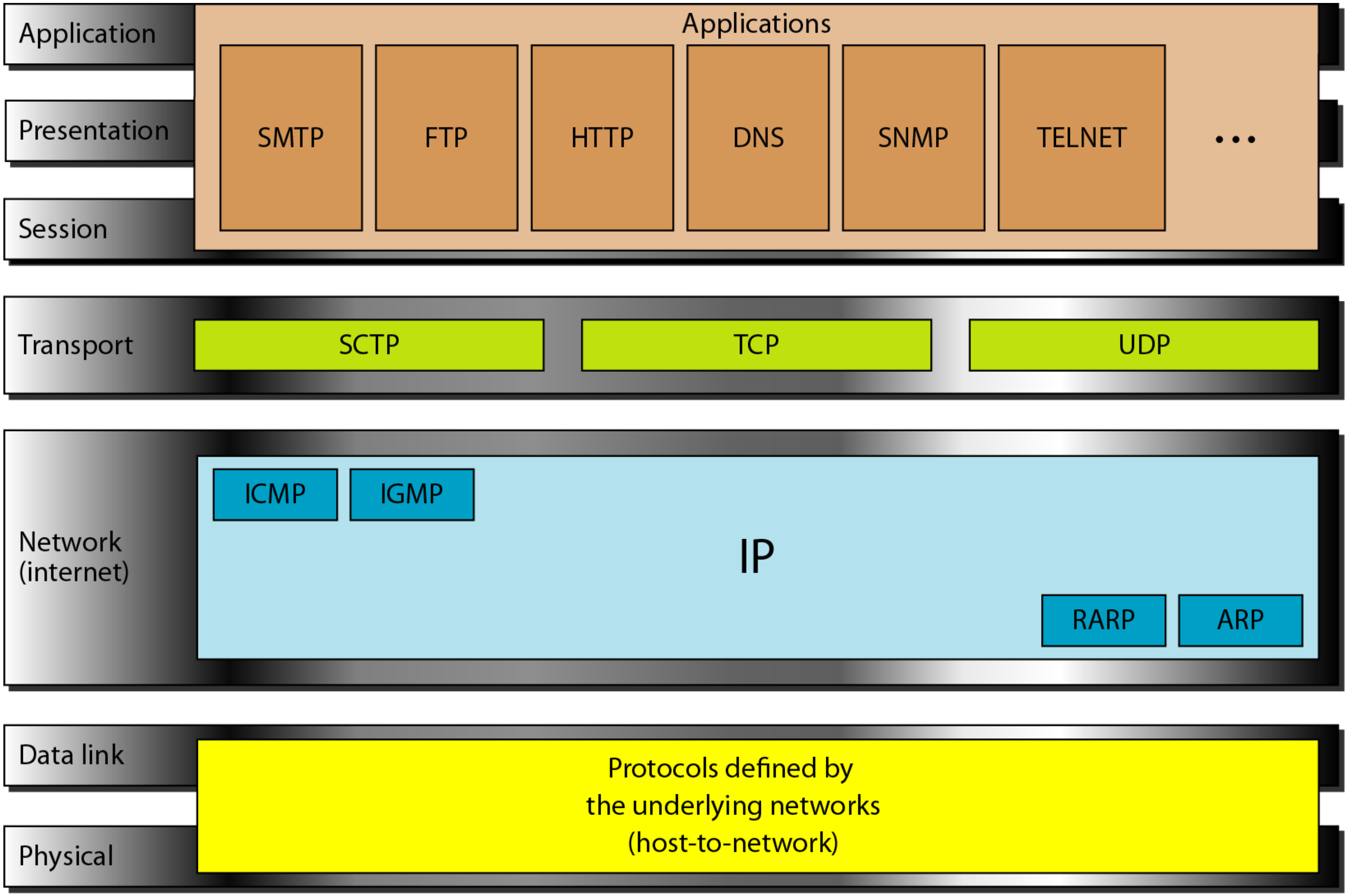
***The layers in the TCP/IP protocol suite do not exactly match those in the OSI model.***

***The original TCP/IP protocol suite had four layers: host-to-network, internet, transport, and application. When TCP/IP is compared to OSI, we can say that the TCP/IP protocol suite is made of five layers: physical, data link, network, transport, and application.***

***Topics discussed in this section:***

**Physical and Data Link Layers**
**Network Layer**
**Transport Layer**
**Application Layer**

## Figure 2.16 *TCP/IP and OSI model*



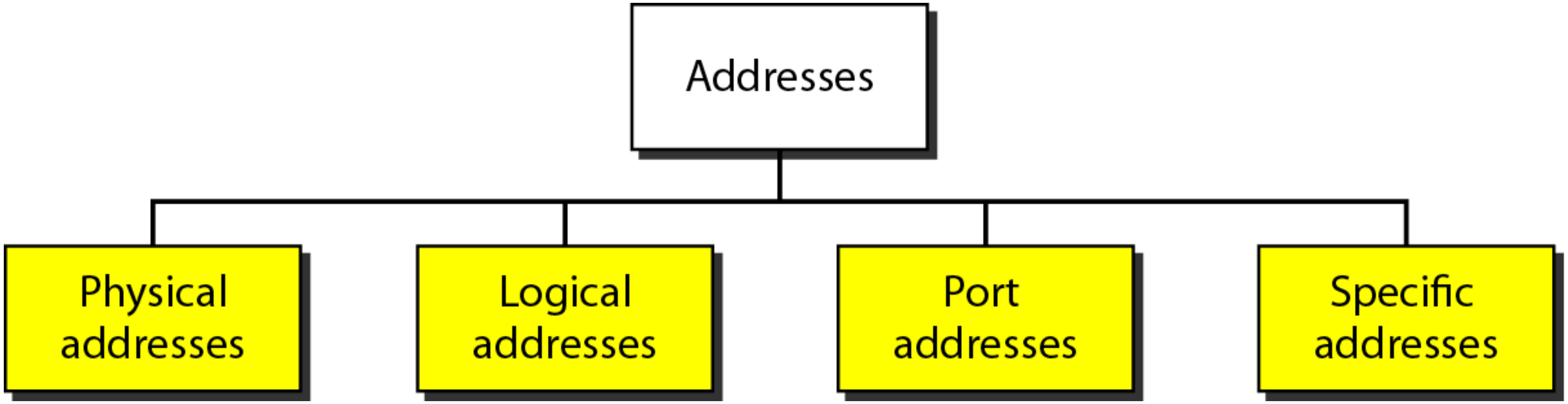
# 2-5 ADDRESSING

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

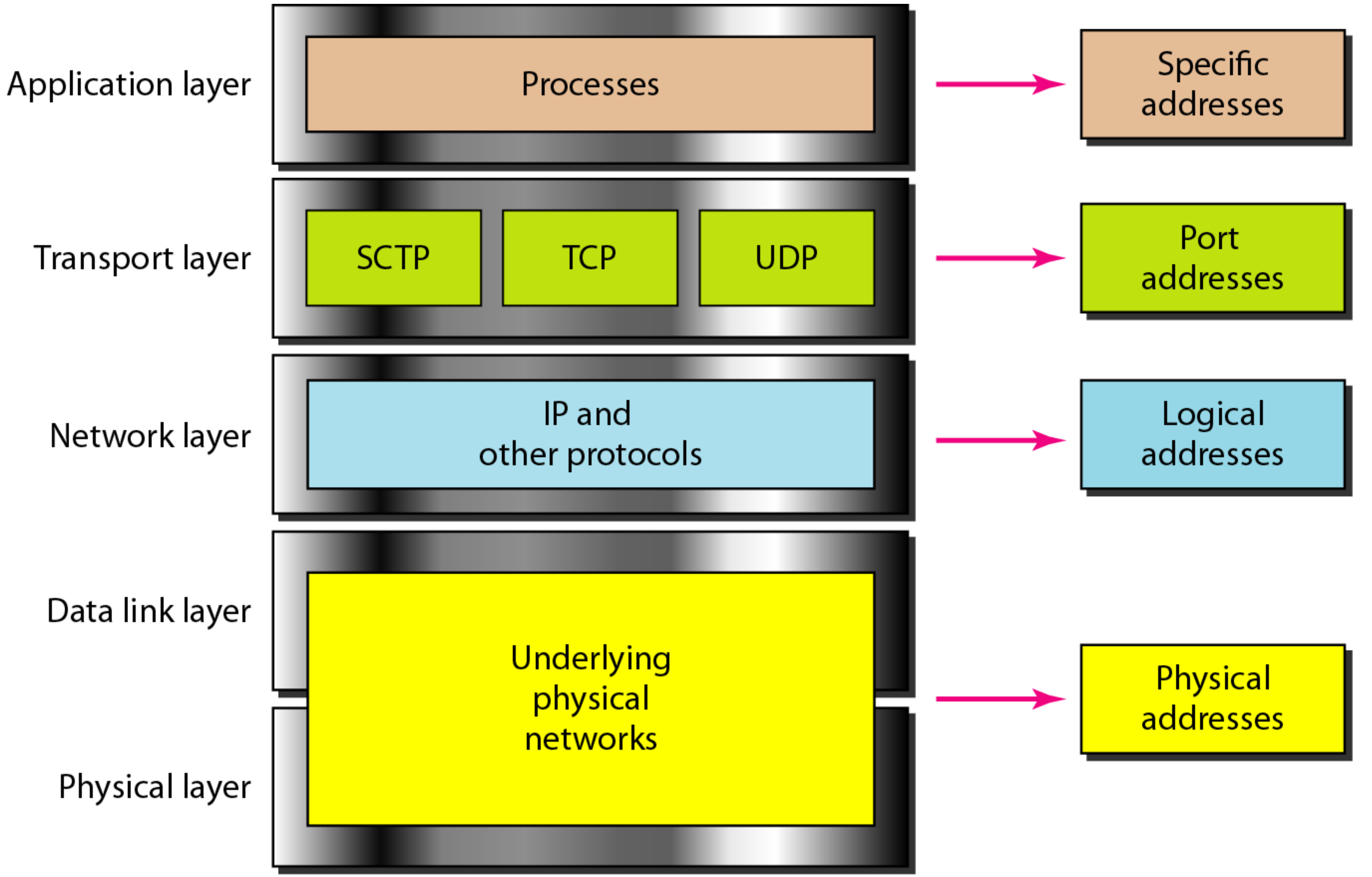
***Topics discussed in this section:***

**Physical Addresses**
**Logical Addresses**
**Port Addresses**
**Specific Addresses**

## Figure 2.17 *Addresses in TCP/IP*



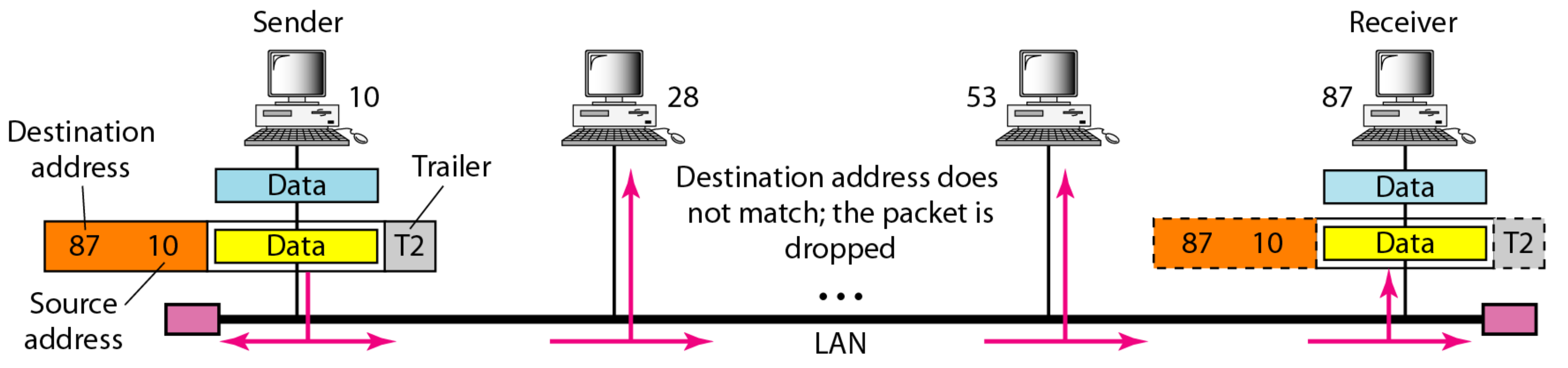
## Figure 2.18 *Relationship of layers and addresses in TCP/IP*



# *Example 2.1*

***In Figure 2.19 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.***

# Figure 2.19 *Physical addresses*



# *Example 2.2*

***As we will see in Chapter 13, most local-area networks use a 48-bit (6-byte) physical address written as 12 hexadecimal digits; every byte (2 hexadecimal digits) is separated by a colon, as shown below:***

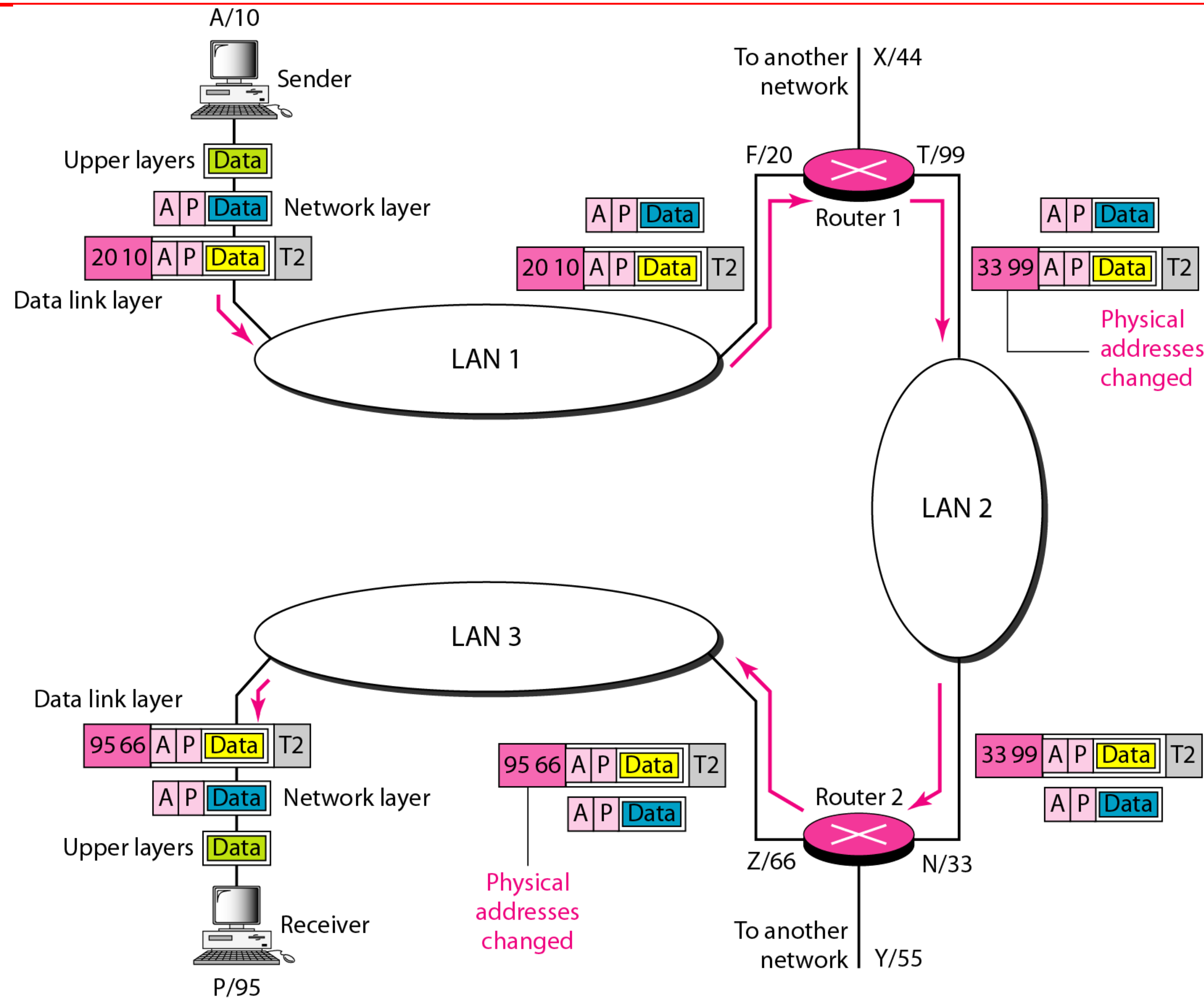
**07:01:02:01:2C:4B**

**A 6-byte (12 hexadecimal digits) physical address.**

# *Example 2.3*

***Figure 2.20 shows a part of an internet with two routers connecting three LANs. Each device (computer or router) has a pair of addresses (logical and physical) for each connection. In this case, each computer is connected to only one link and therefore has only one pair of addresses. Each router, however, is connected to three networks (only two are shown in the figure). So each router has three pairs of addresses, one for each connection.***

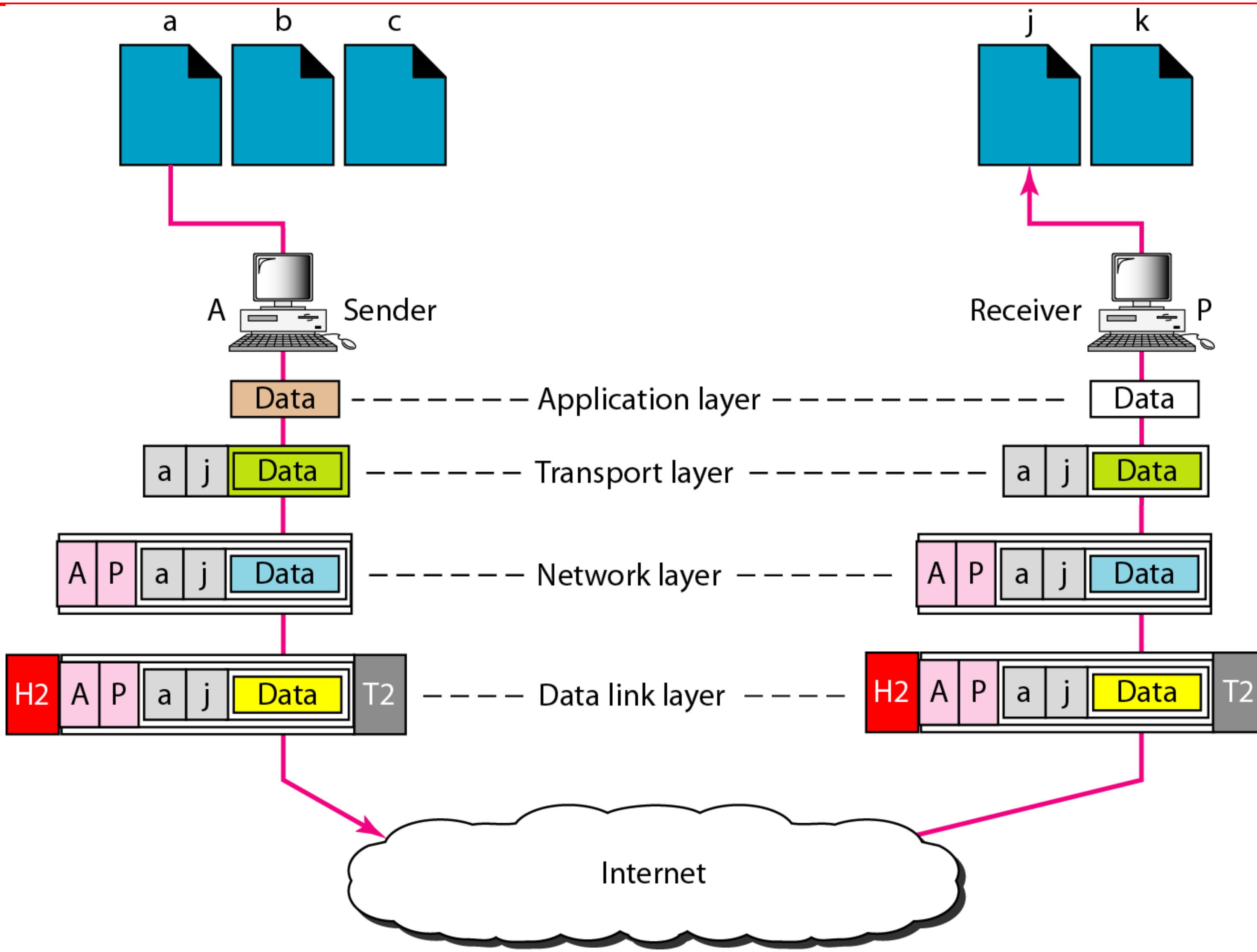
# Figure 2.20 *IP addresses*



# *Example 2.4*

***Figure 2.21 shows two computers communicating via the Internet. The sending computer is running three processes at this time with port addresses a, b, and c. The receiving computer is running two processes at this time with port addresses j and k. Process a in the sending computer needs to communicate with process j in the receiving computer. Note that although physical addresses change from hop to hop, logical and port addresses remain the same from the source to destination.***

# Figure 2.21 *Port addresses*



***Note***

**The physical addresses will change from hop to hop, but the logical addresses usually remain the same.**

# *Example 2.5*

***As we will see in Chapter 23, a port address is a 16-bit address represented by one decimal number as shown.***

| |
|---|
| **753** |
| **A 16-bit port address represented as one single number.** |

***Note***

**The physical addresses change from hop to hop,
but the logical and port addresses usually remain the same.**