Chapter 2

Network Models

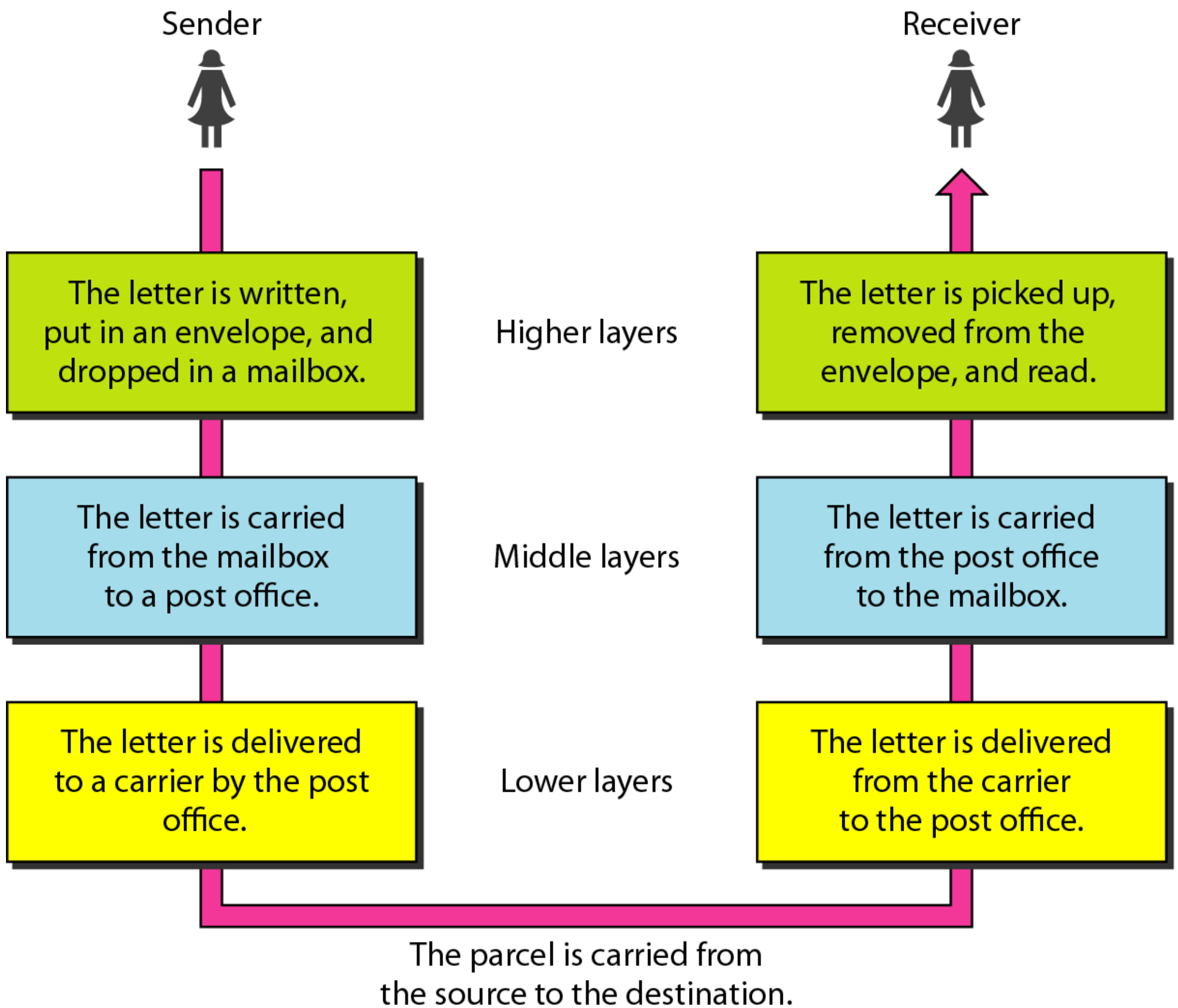
2-1 LAYERED TASKS

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

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.

Topics discussed in this section:

Layered Architecture
Peer-to-Peer Processes
Encapsulation

Note

ISO is the organization.
OSI is the model.

Figure 2.2 *Seven layers of the OSI model*

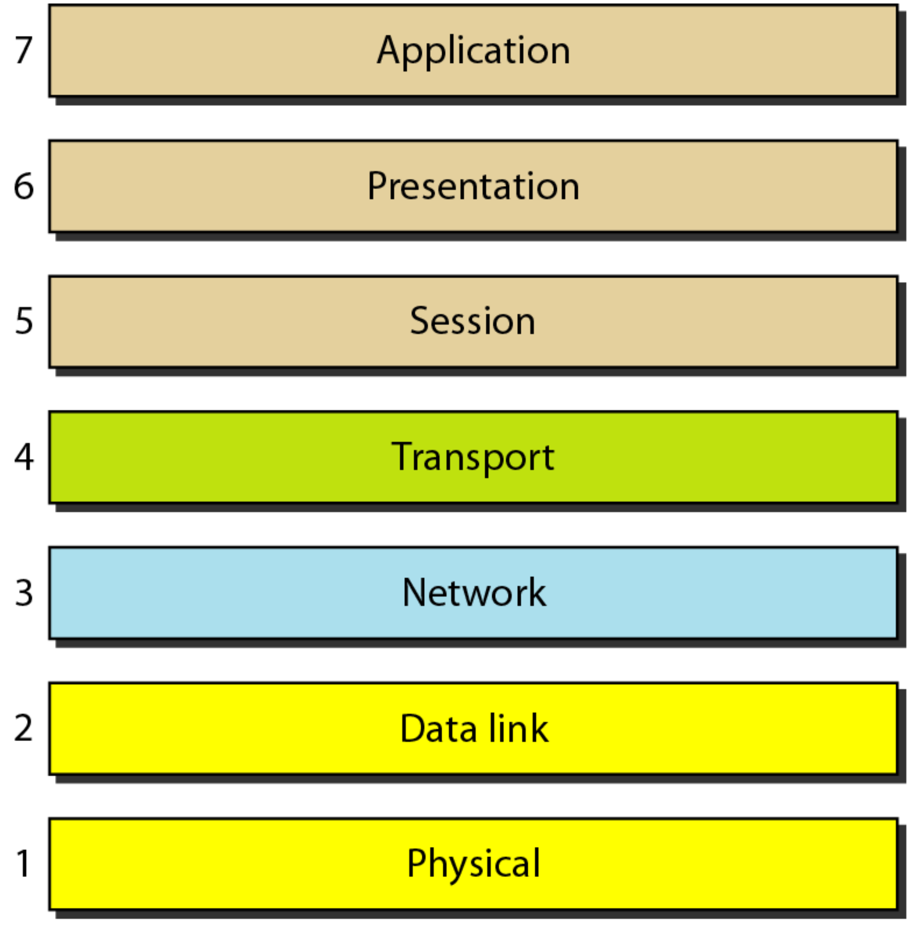


Figure 2.3 *The interaction between layers in the OSI model*

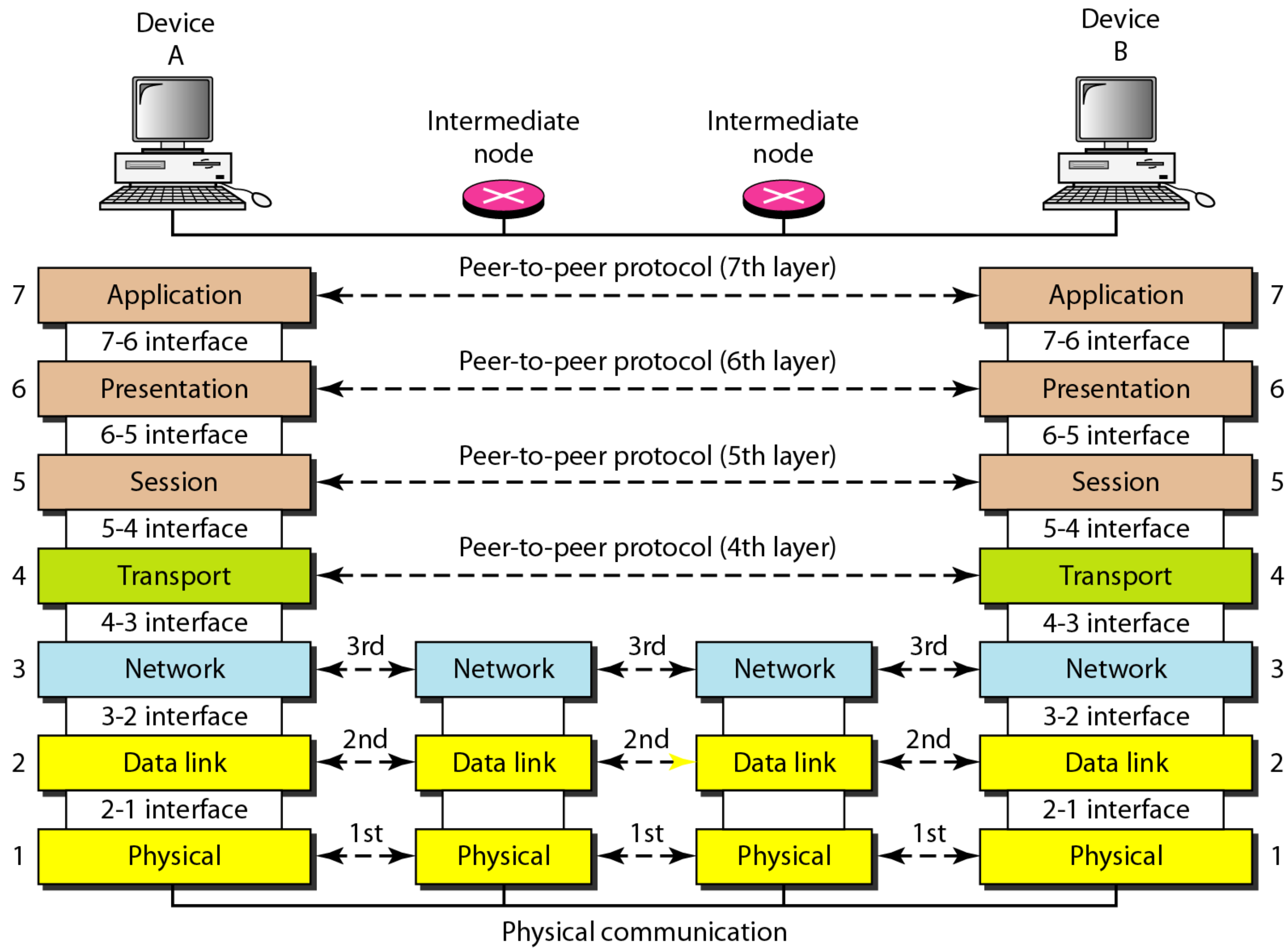
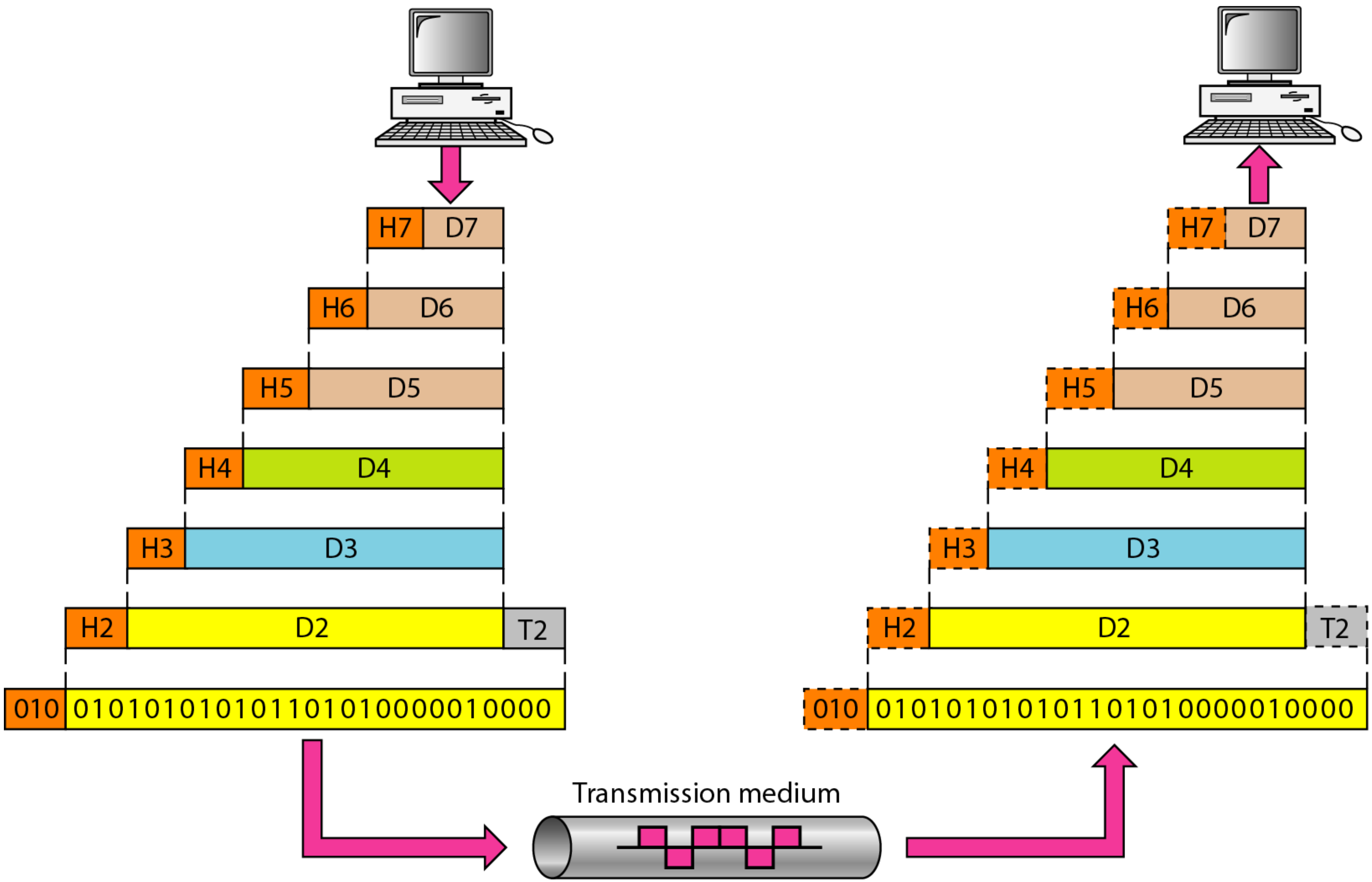


Figure 2.4 *An exchange using the OSI model*



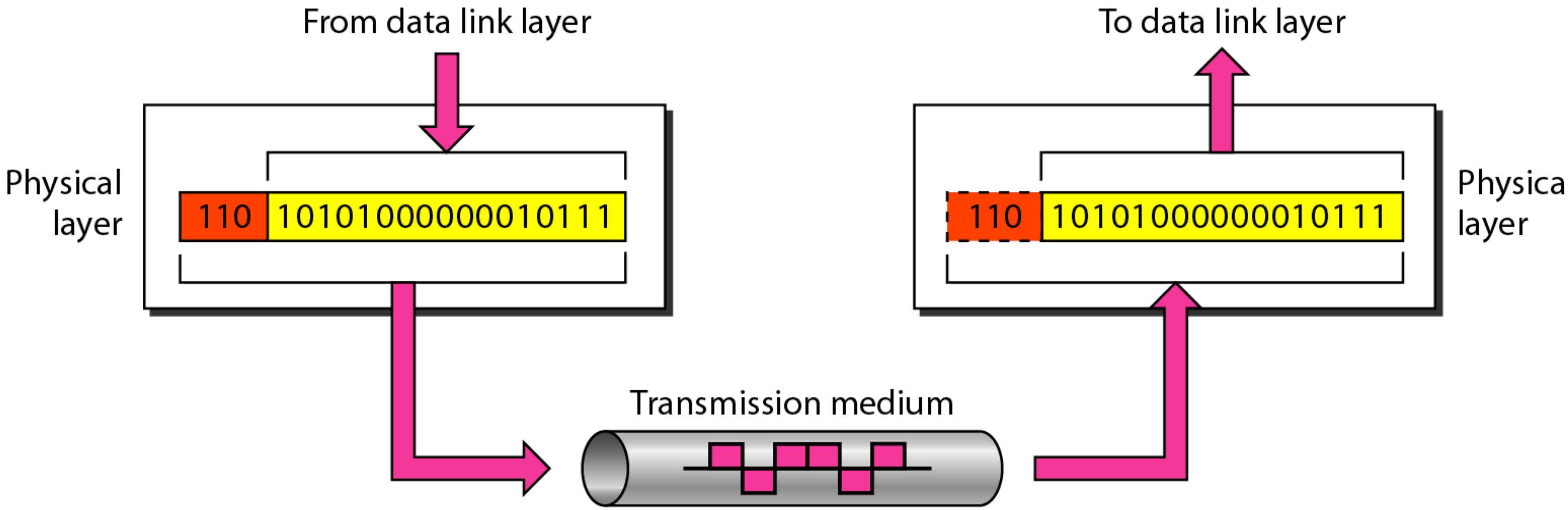
2-3 LAYERS IN THE OSI MODEL

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

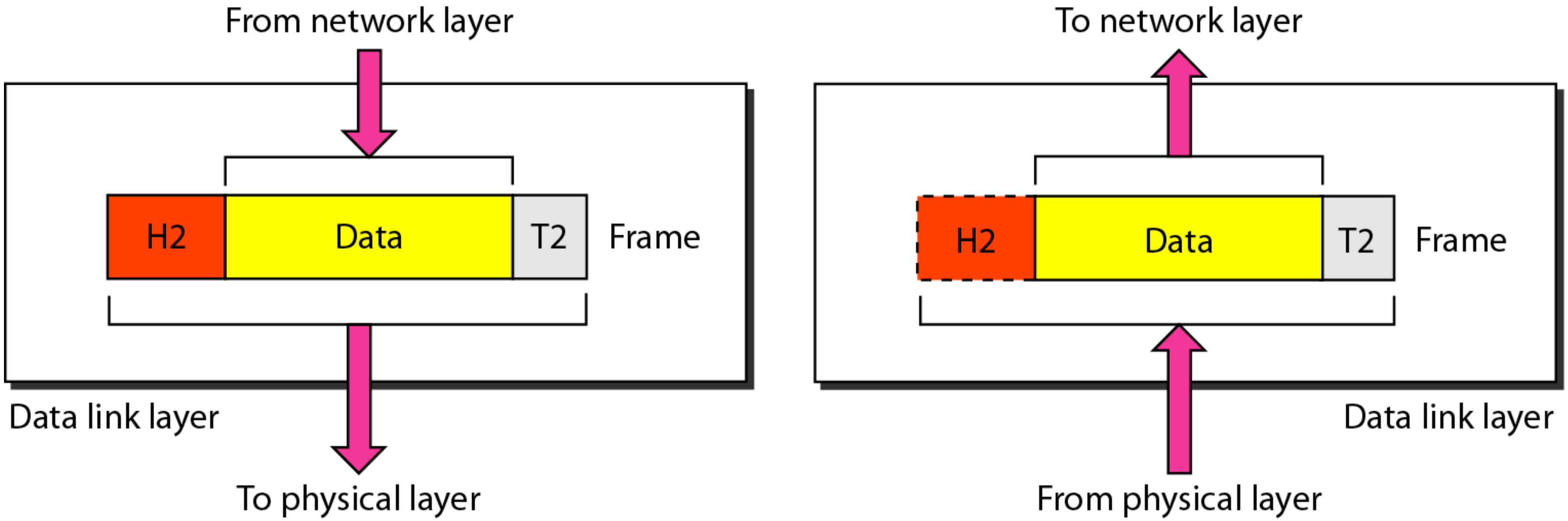
Figure 2.5 *Physical layer*



Note

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

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*

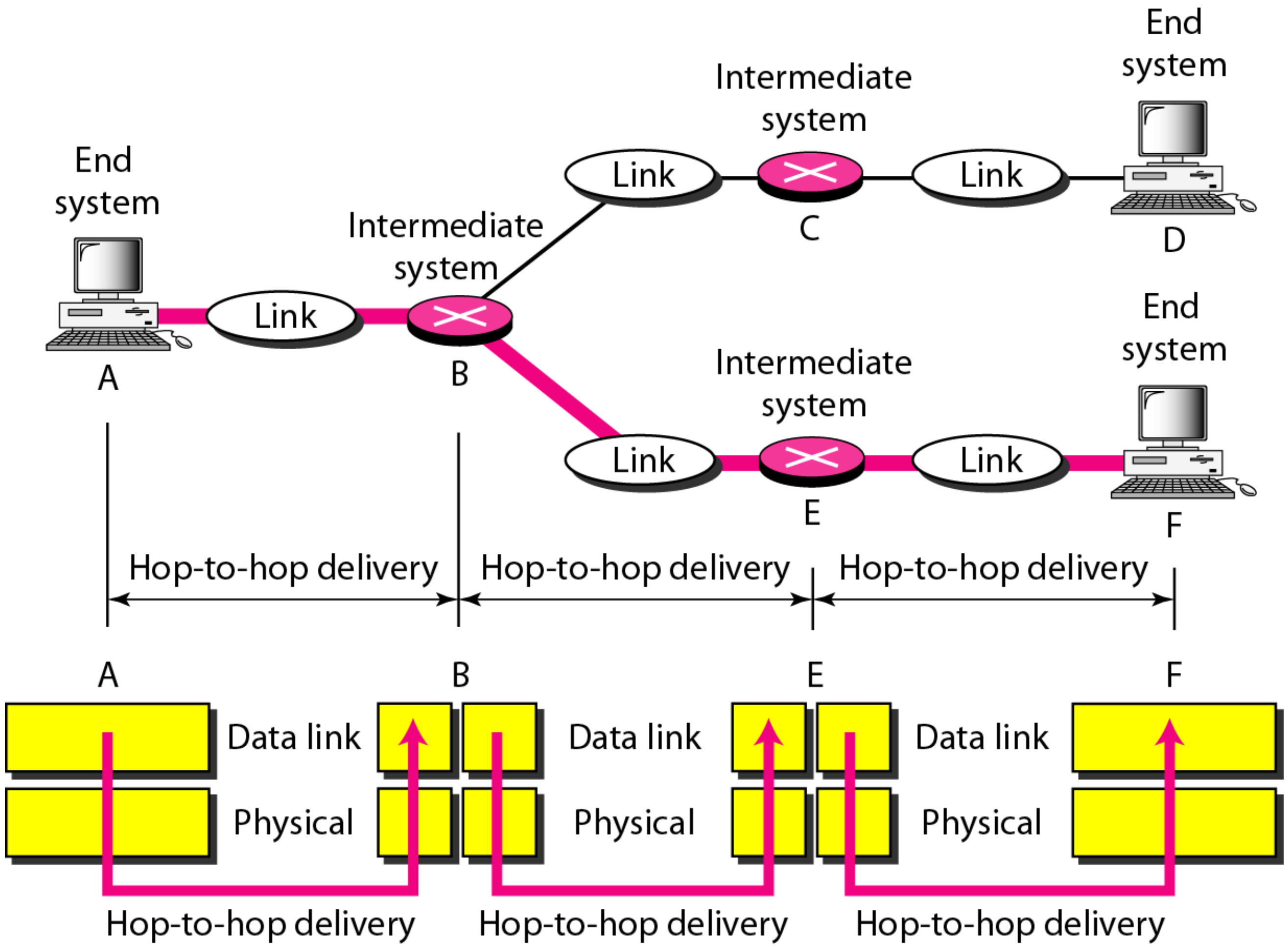
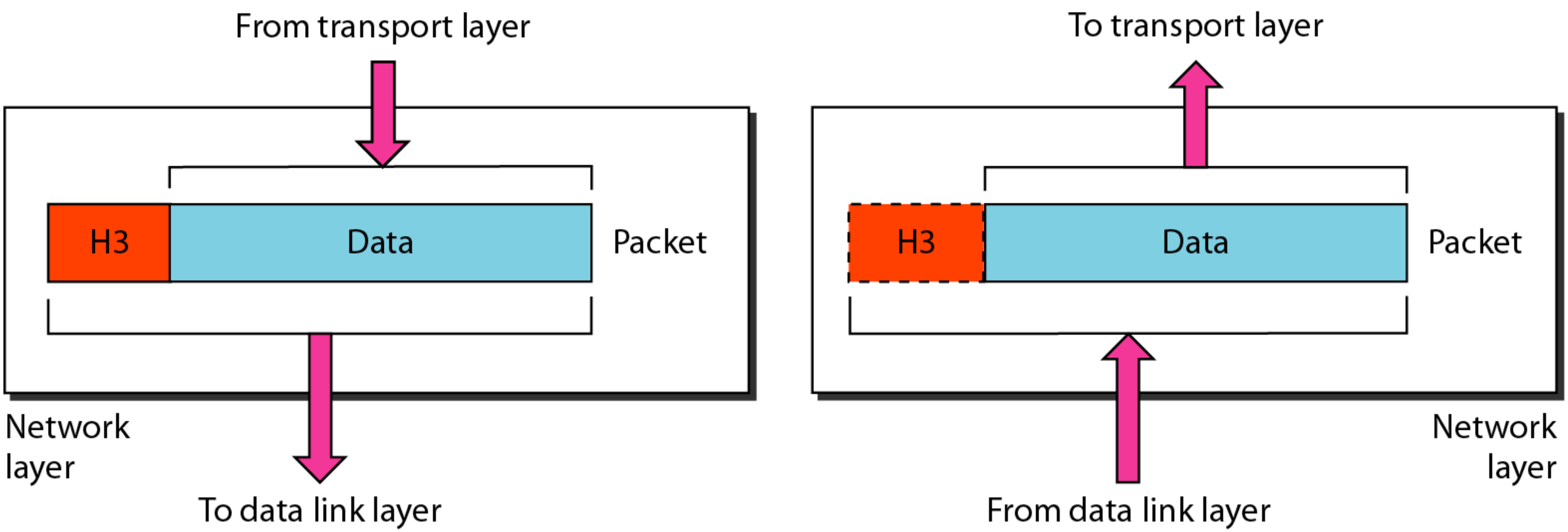


Figure 2.8 *Network layer*



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*

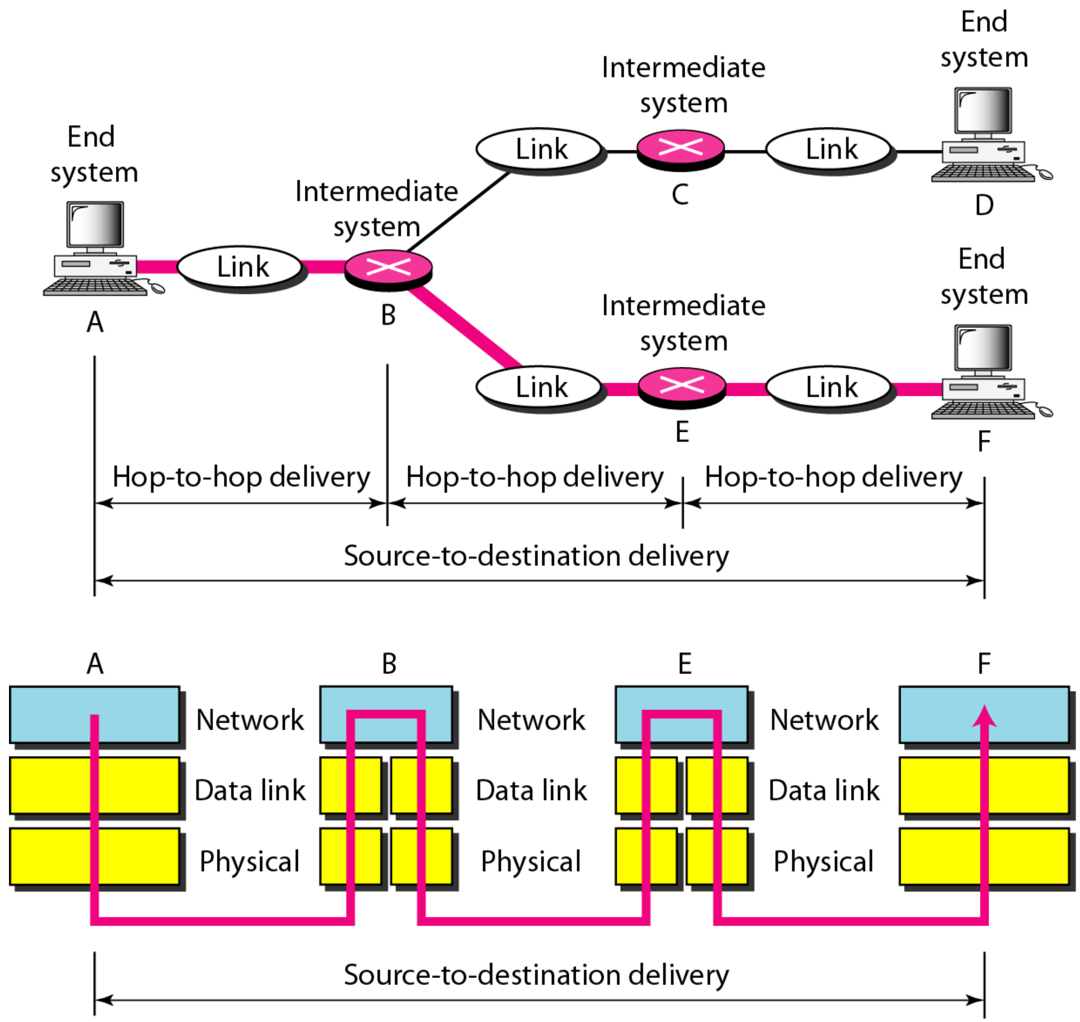
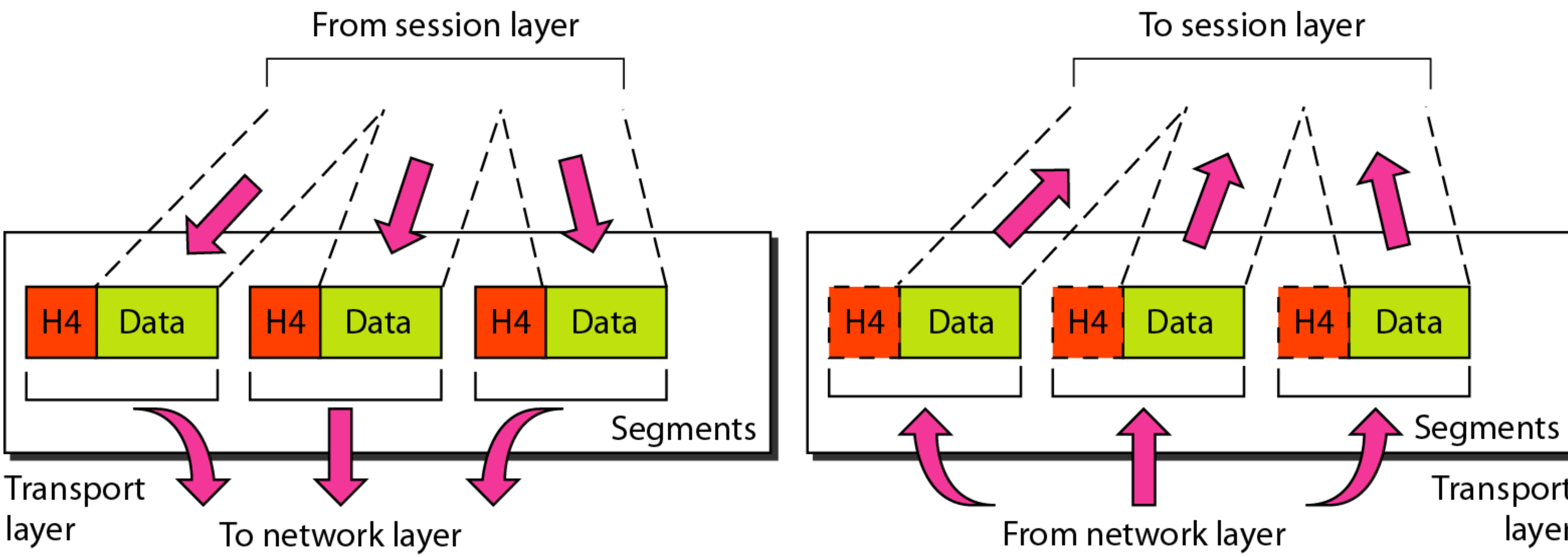


Figure 2.10 *Transport layer*



Note

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

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

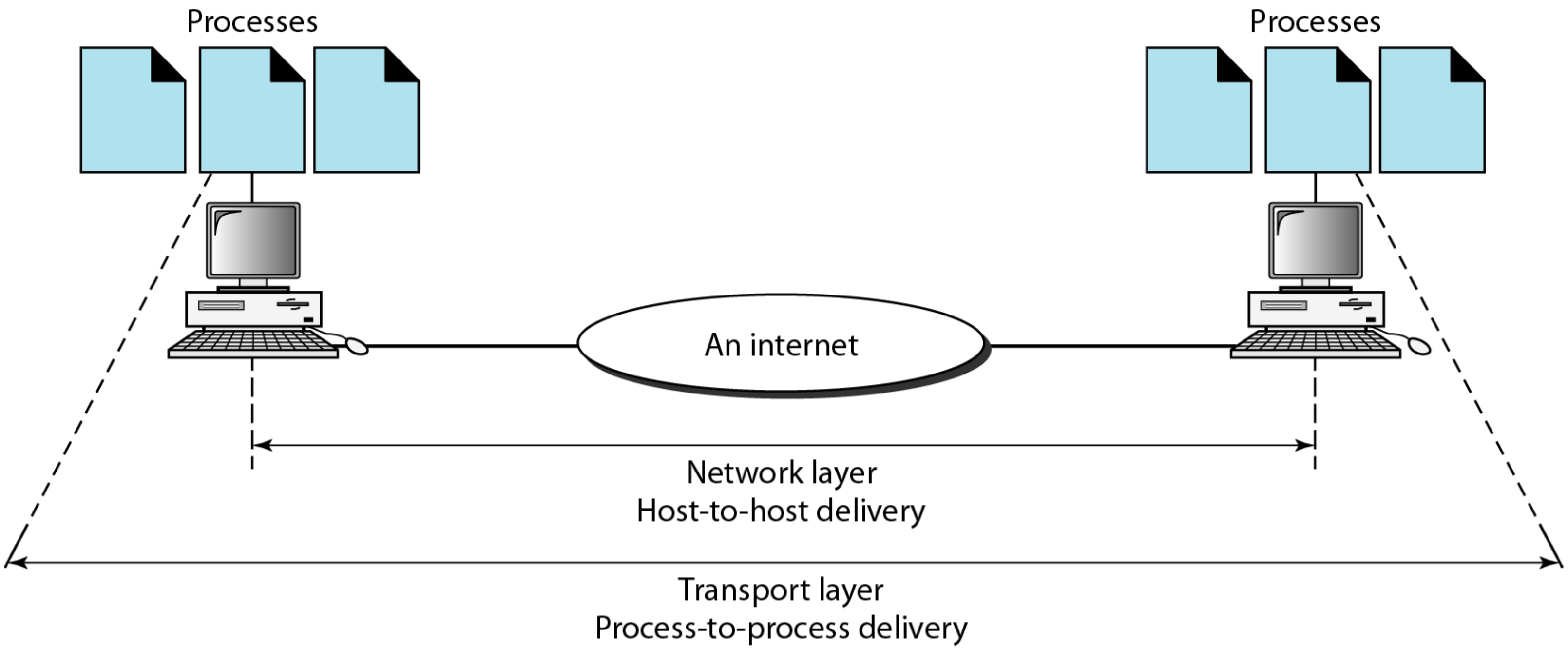
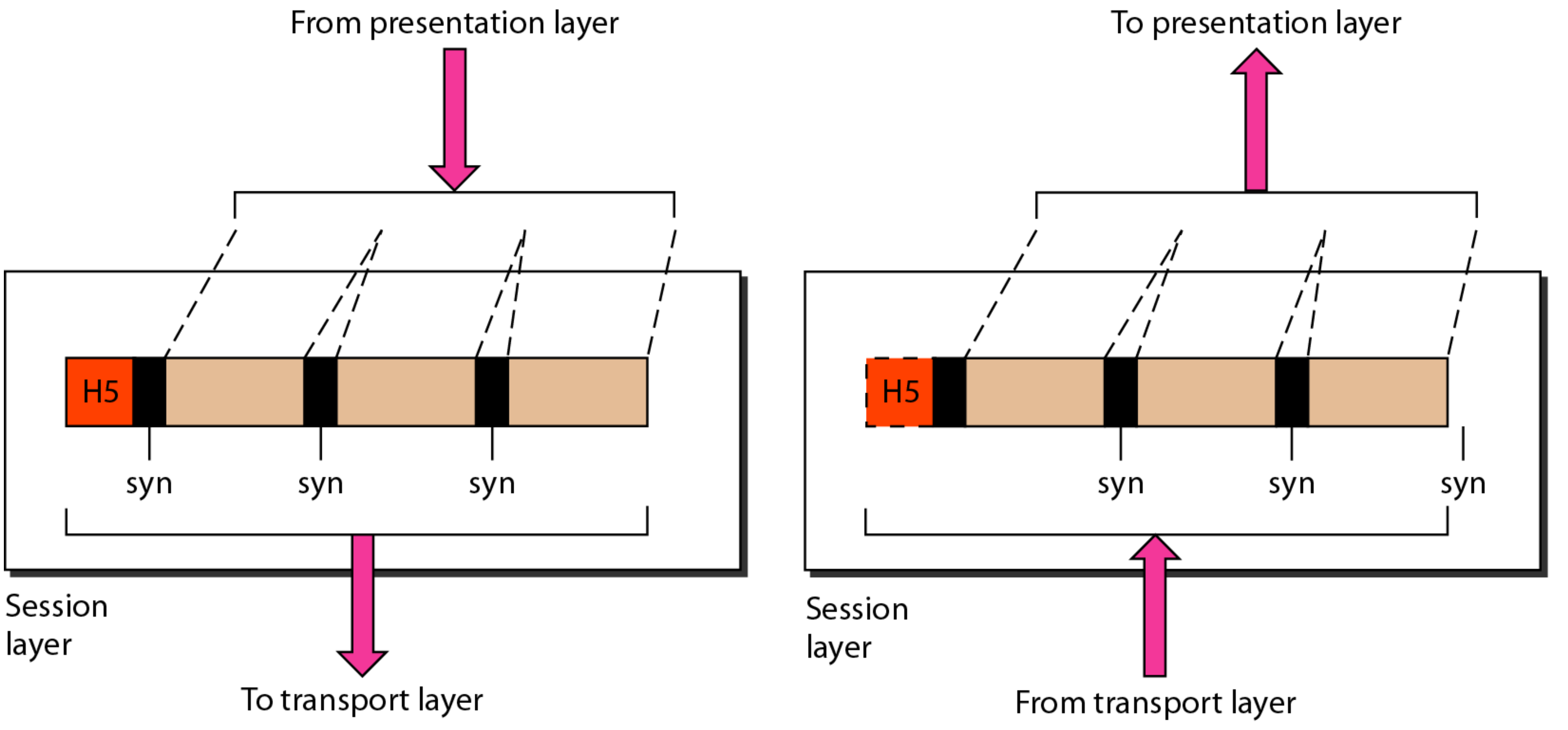


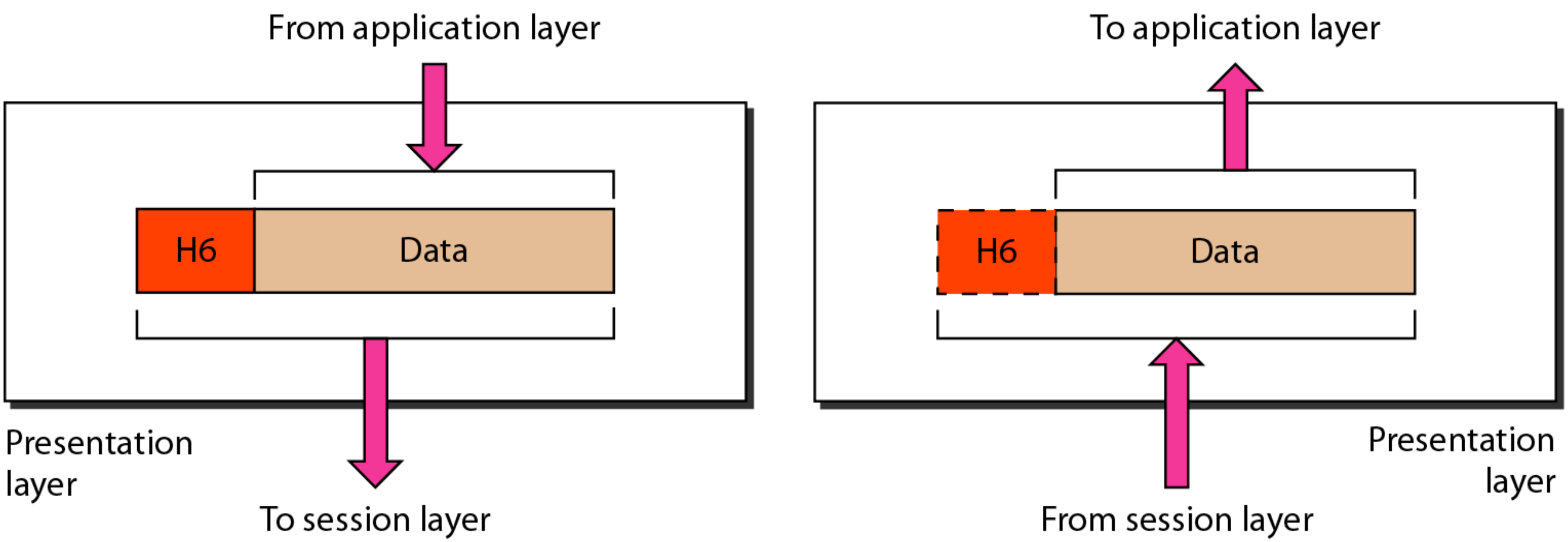
Figure 2.12 *Session layer*



Note

The session layer is responsible for dialog control and synchronization.

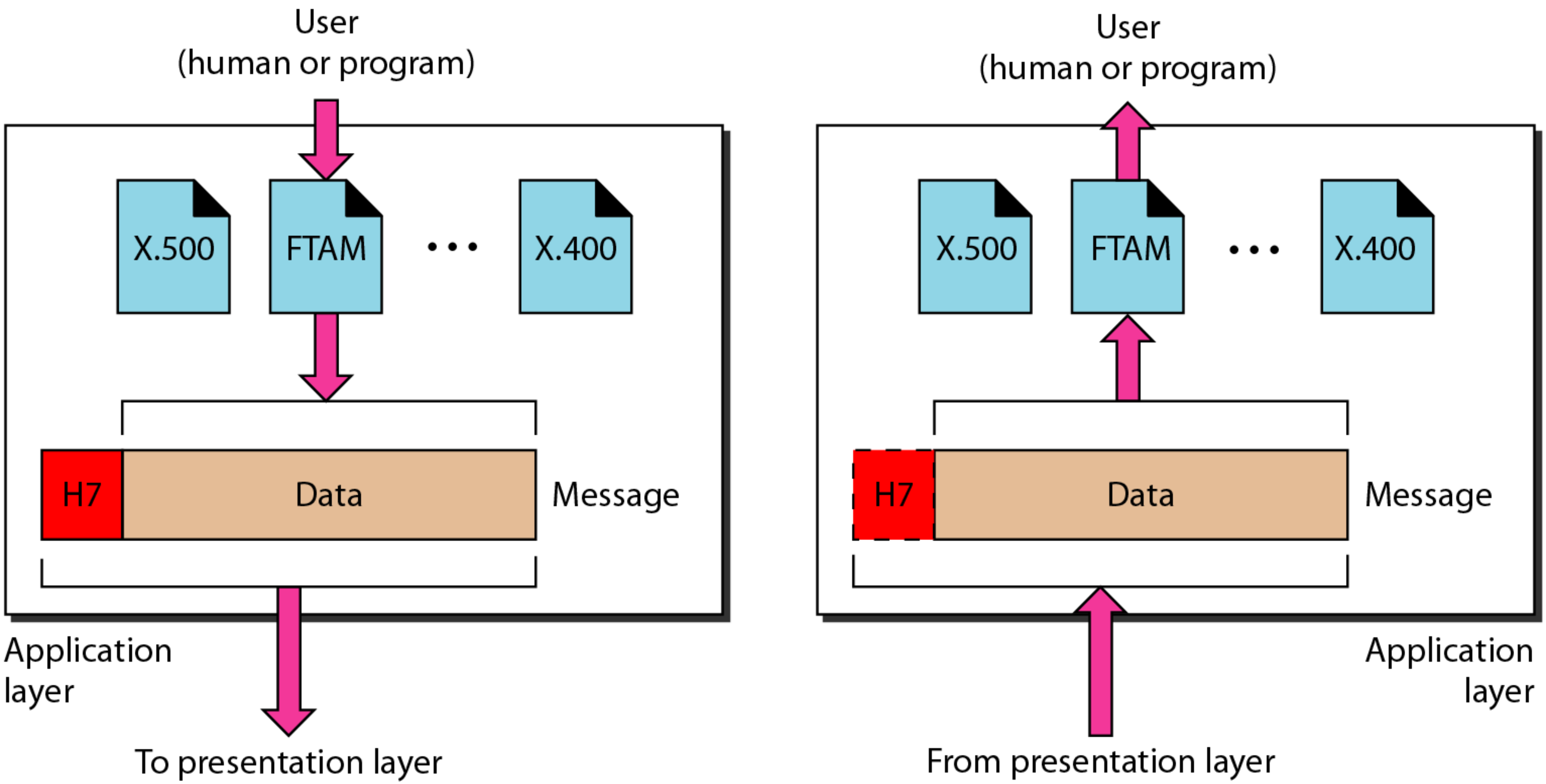
Figure 2.13 ***Presentation layer***



Note

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

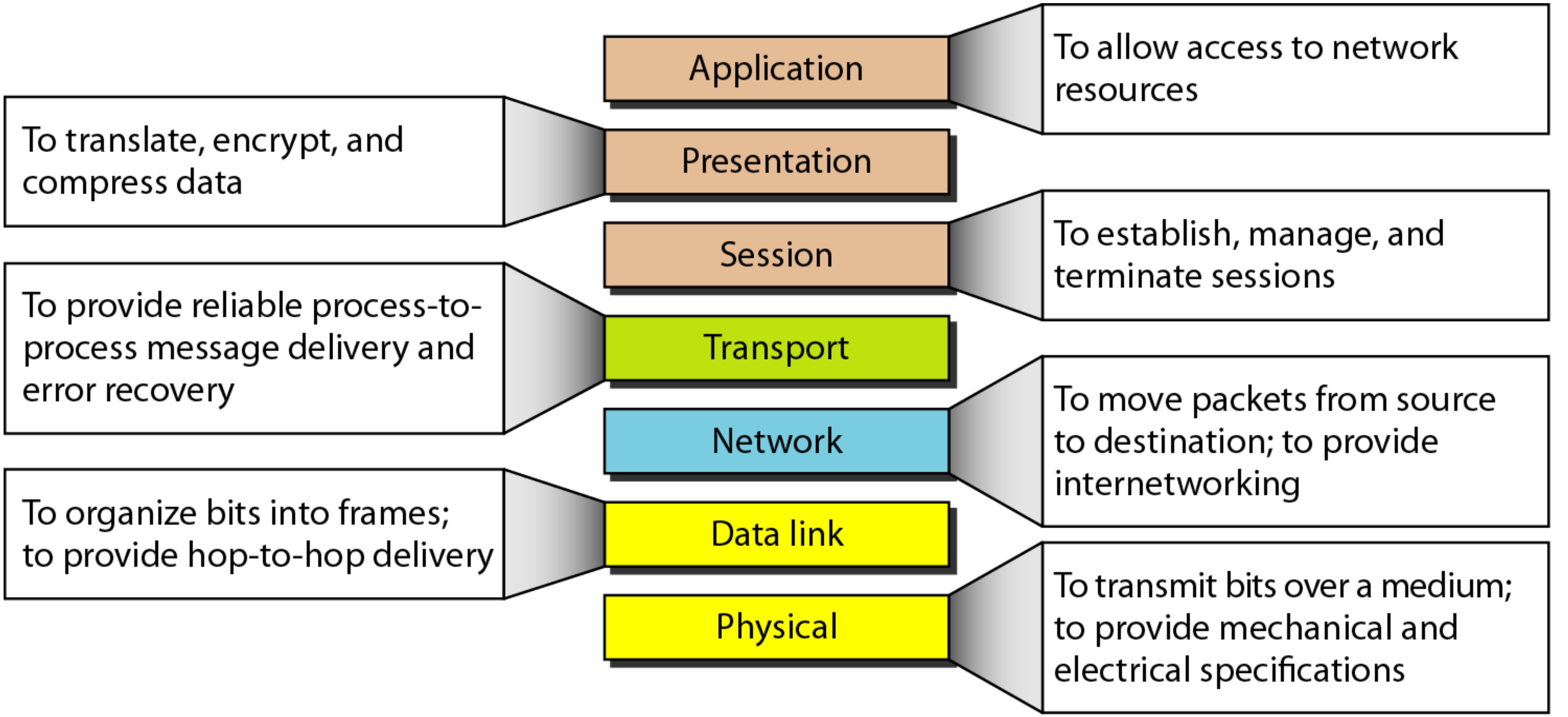
Figure 2.14 *Application layer*



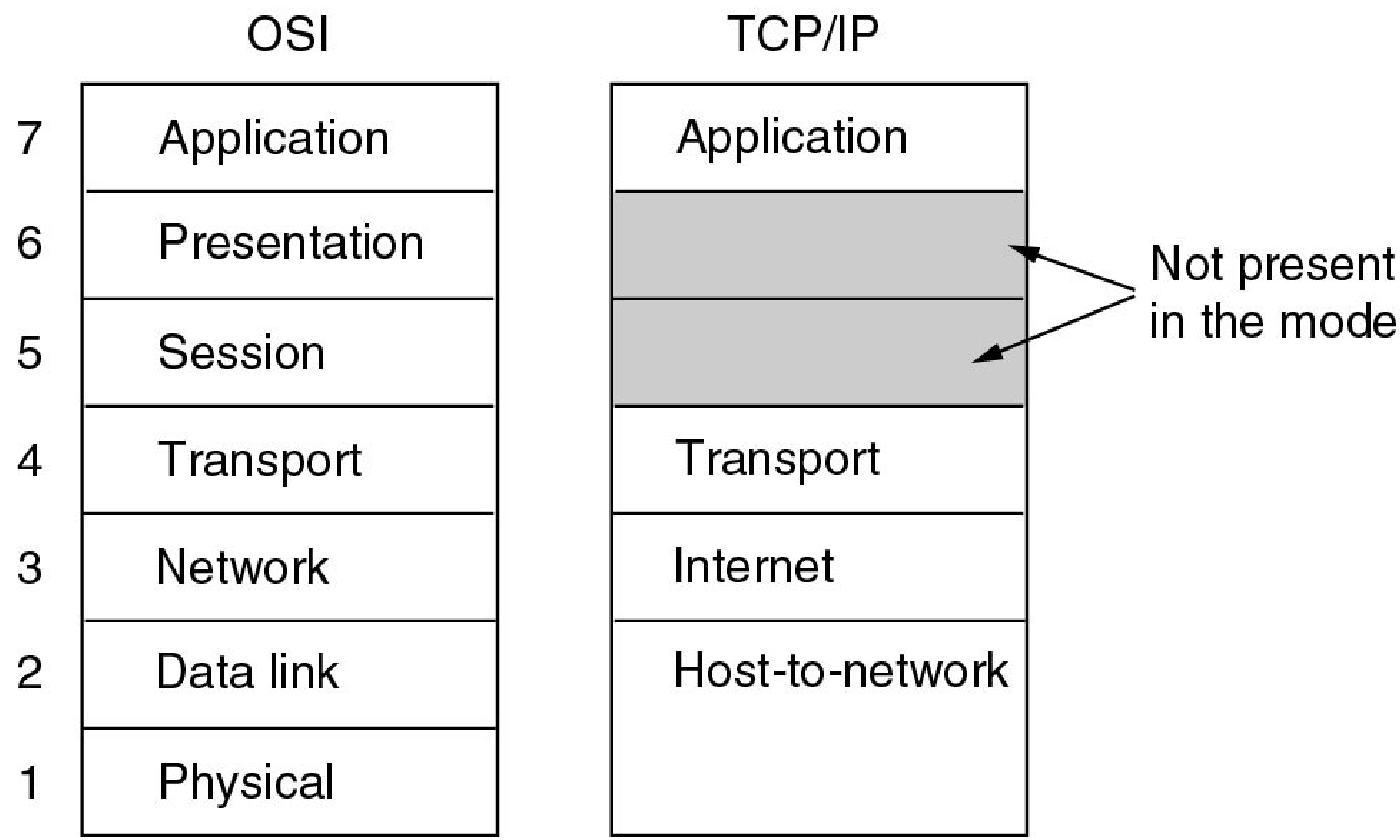
Note

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

Figure 2.15 *Summary of layers*



The TCP/IP Reference Model



- The TCP/IP reference model.

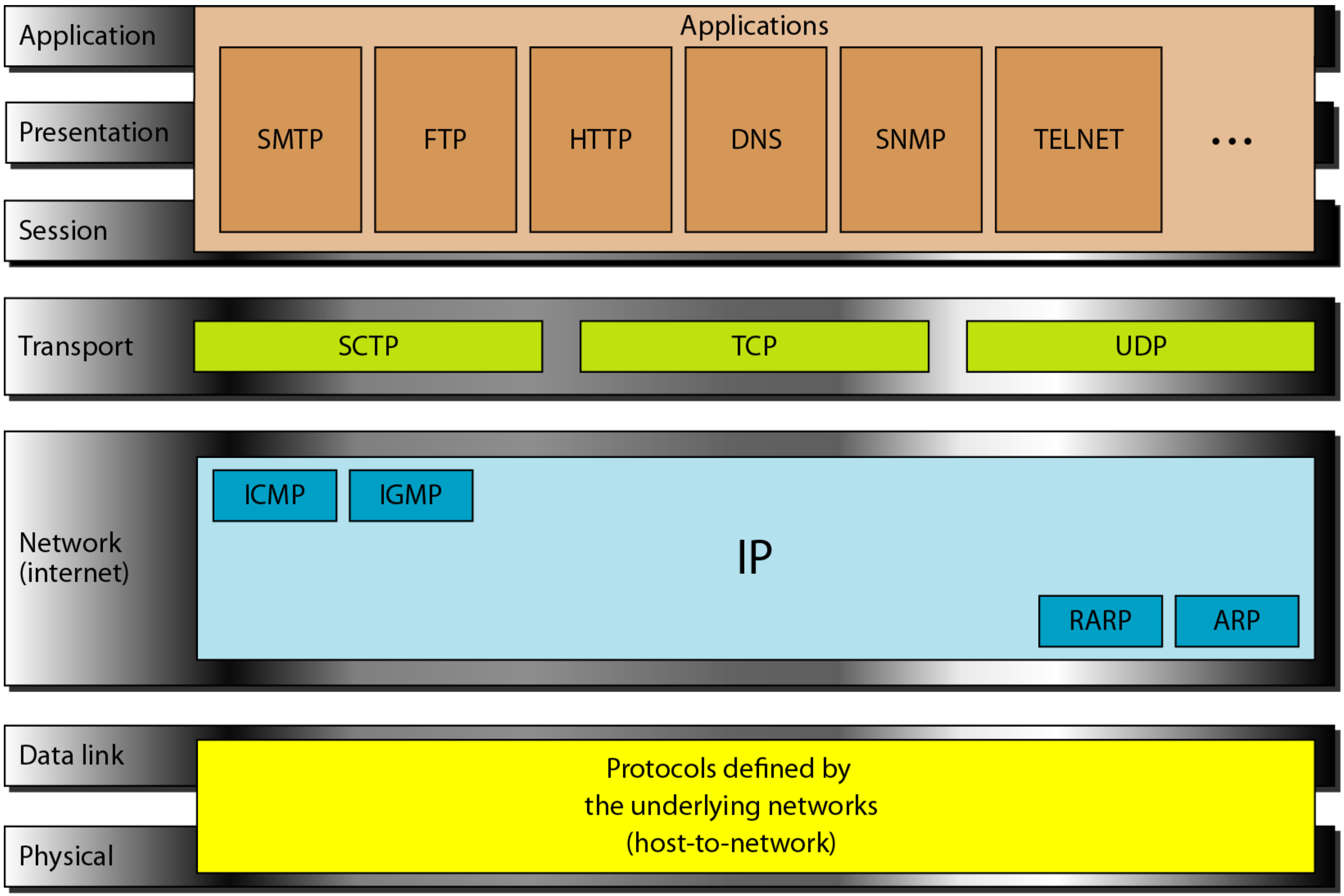
2-4 TCP/IP PROTOCOL SUITE

The layers in the TCP/IP protocol suite do not exactly match those in the OSI model. The original TCP/IP protocol suite was defined as having four layers: host-to-network, internet, transport, and application. However, 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*

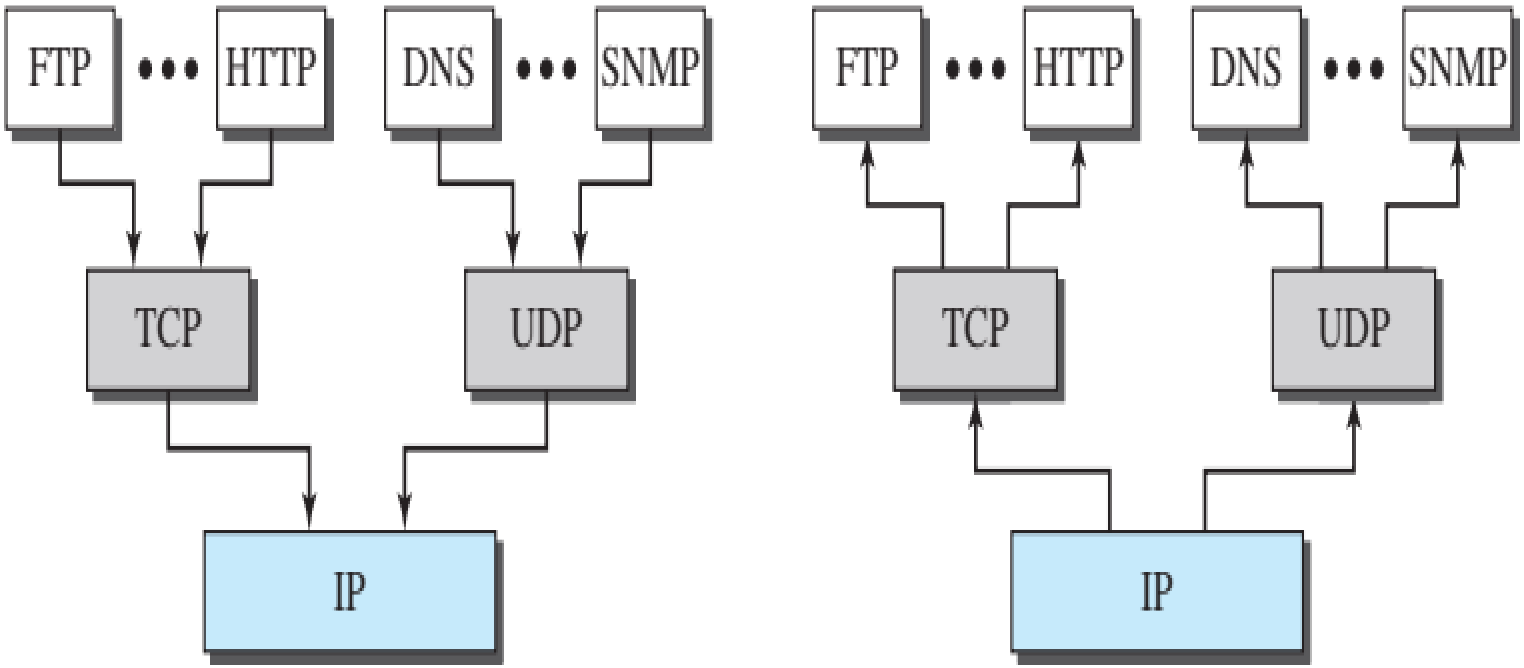


Full Forms: ***TCP/IP and OSI model***

- SMTP – Simple Mail Transfer Protocol
- FTP – File Transfer Protocol
- HTTP – Hyper Text Transfer Protocol
- DNS – Domain Name Server
- SNMP – Simple Network Management Protocol
- SCTP - Stream Control Transmission Protocol
- TCP – Transmission Control Protocol
- UDP – User Datagram Protocol
- ARP - Address Resolution Protocol
- RARP - Reverse Address Resolution Protocol
- ICMP - Internet Control Message Protocol
- IGMP - Internet Group Management Protocol
- IP – Internet Protocol

Multiplexing and Demultiplexing

Figure 2.10 *Multiplexing and demultiplexing*



a. Multiplexing at source

b. Demultiplexing at destination

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*

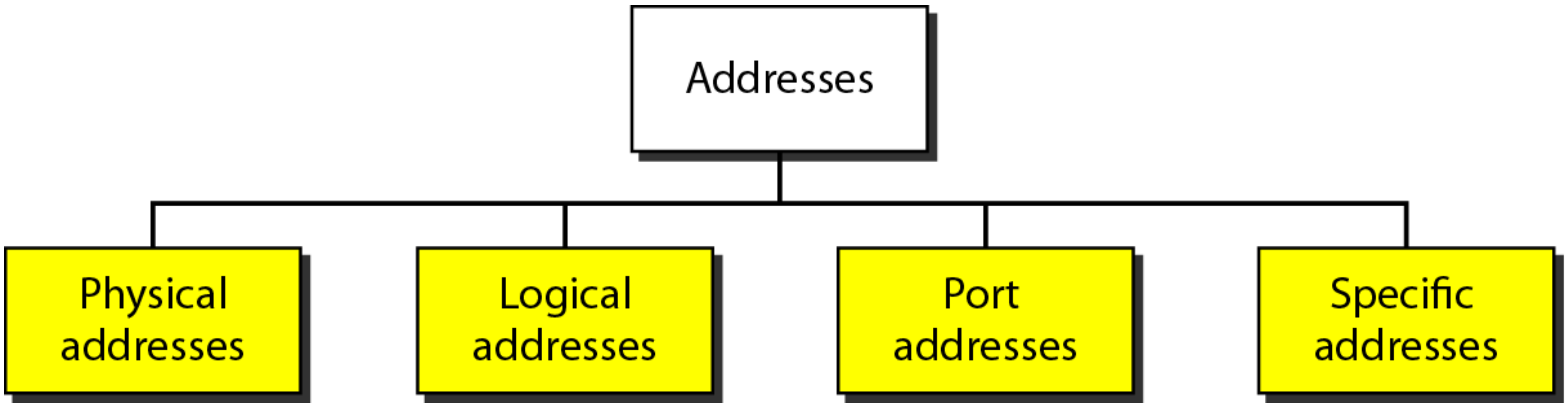
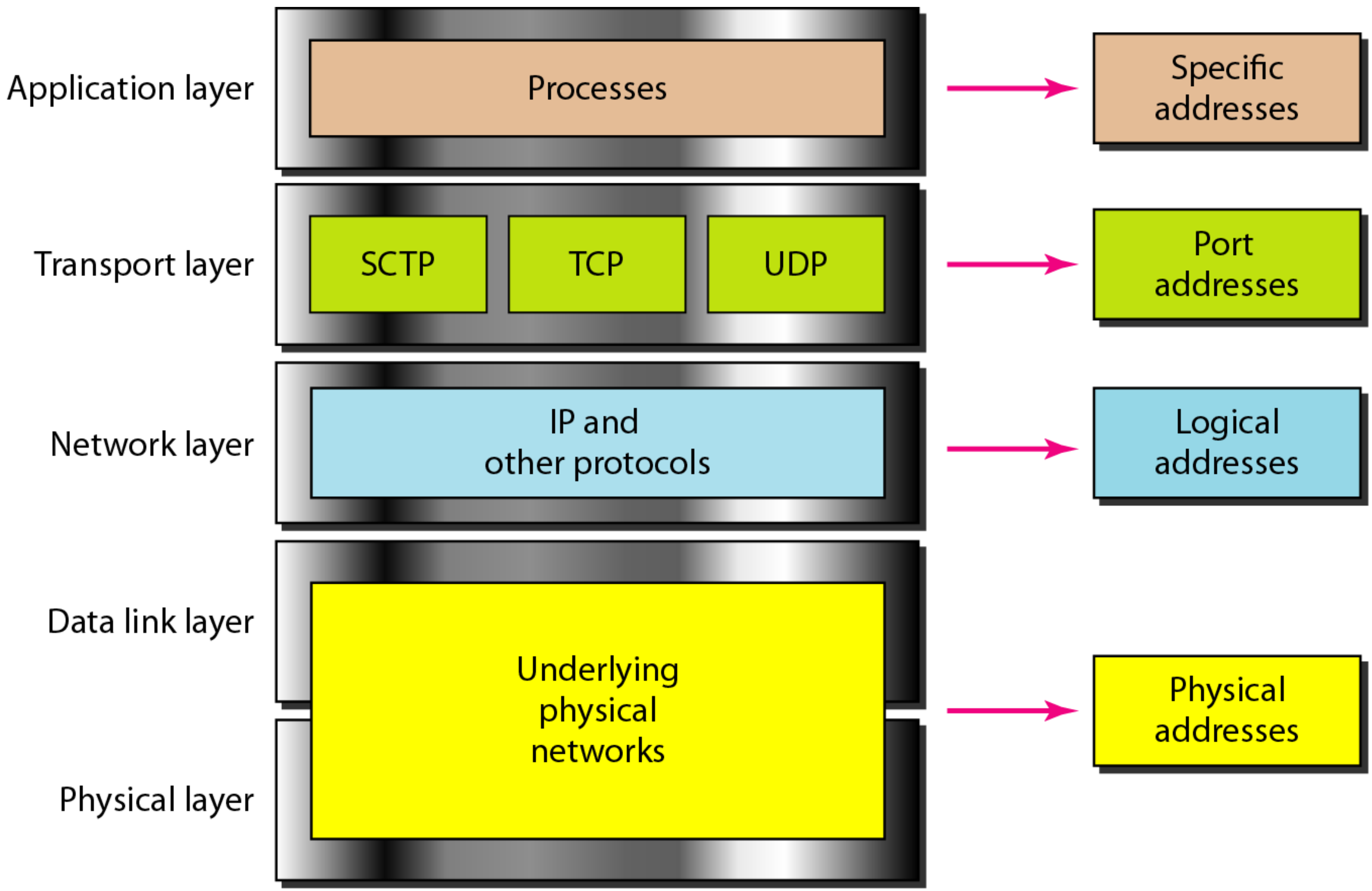


Figure 2.18 *Relationship of layers and addresses in TCP/IP*



TCP/IP v/s OSI

- 4 Layers
- Did not clearly distinguish between service, interface and protocol.
- Protocols in TCP/IP model are not hidden and tough to replace if technology changes.

- 7 Layers
- Distinction between these three concepts are explicit.
- Protocols in the OSI model are better hidden than in the TCP/IP model and can be replaced relatively easily as the technology changes.

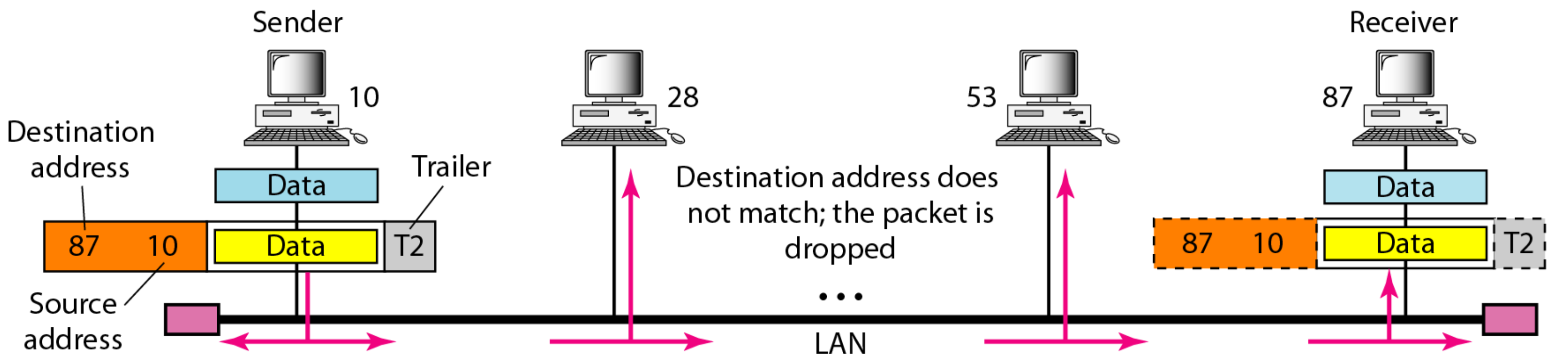
- The <u>protocols came first</u>, and the model was really just a description of the existing protocols.
- <u>Designers</u> have much experience with the subject and have <u>clear idea of which functionality to put in which layer.</u>

- The model was <u>not biased toward one particular set of protocols</u>, a fact that made it quite general.
- Designers did not have much experience with the subject and did <u>not have a good idea of which functionality to put in which layer.</u>

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:

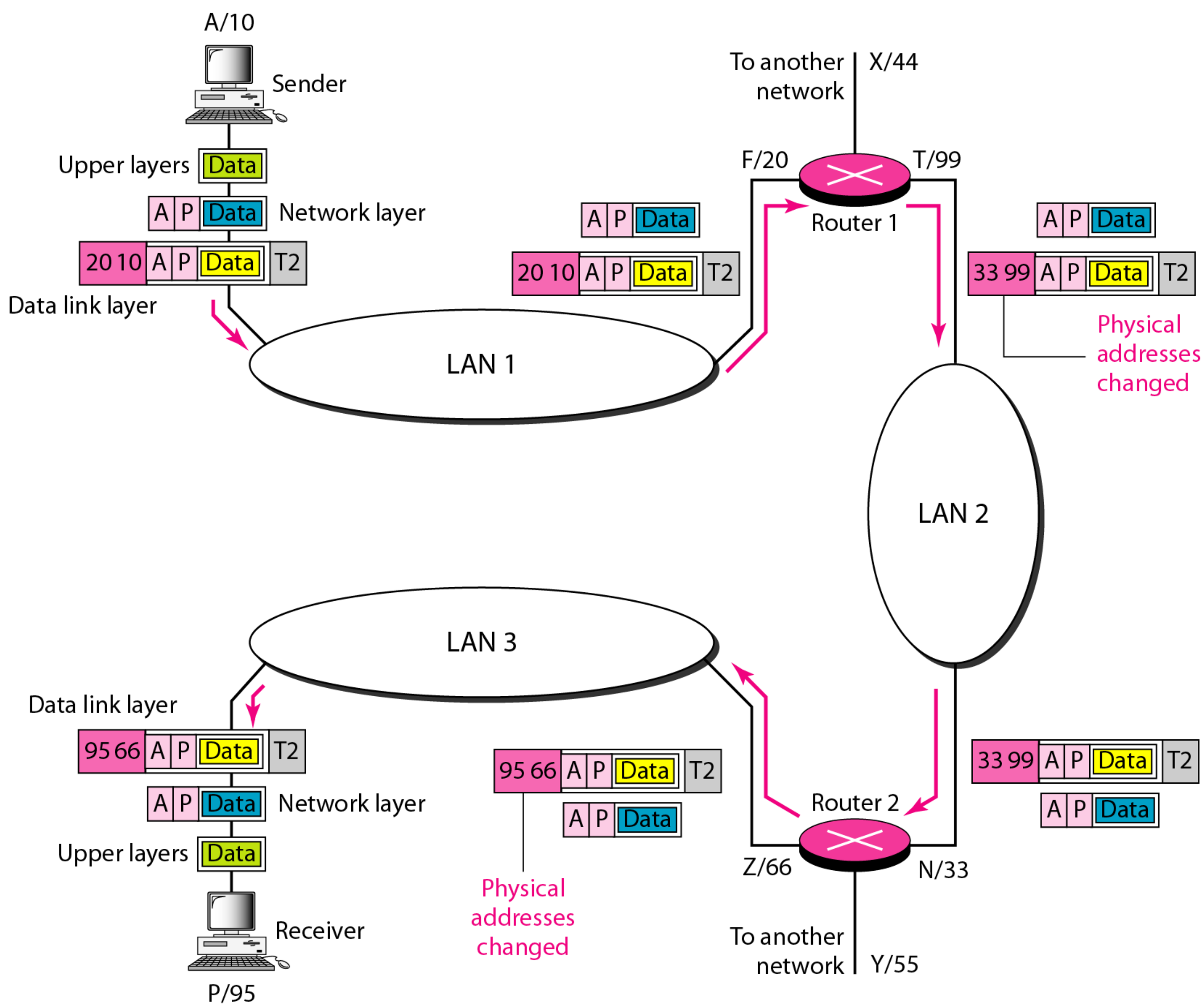
07:01:02:01:2C:4B

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.

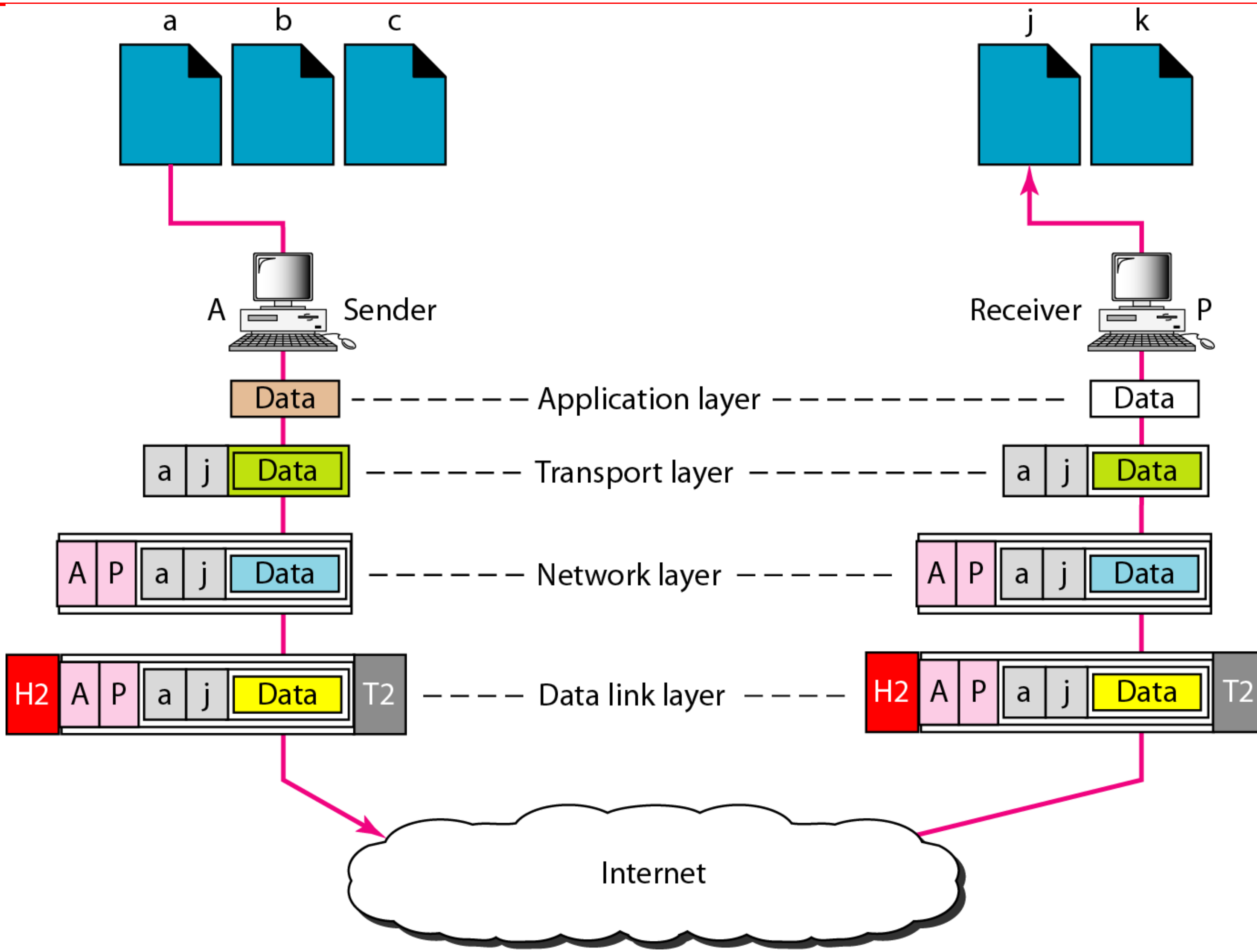
Figure 2.20 *IP addresses*



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. <u>Note that although physical addresses change from hop to hop, logical and port addresses remain the same from the source to destination.</u>

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.