# Chapter 2 Network Models

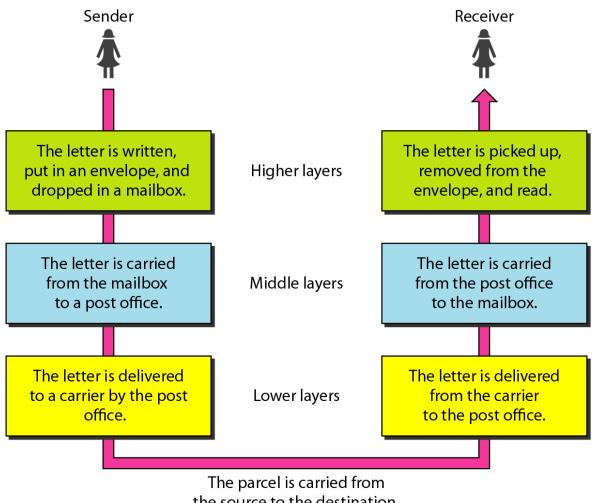
### 2-1 LAYERED TASKS

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



the source to the destination.

### 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.

ISO is the organization and OSI is the model.

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

Layered Architecture
Peer-to-Peer Processes
Encapsulation

### Figure 2.2 Seven layers of the OSI model

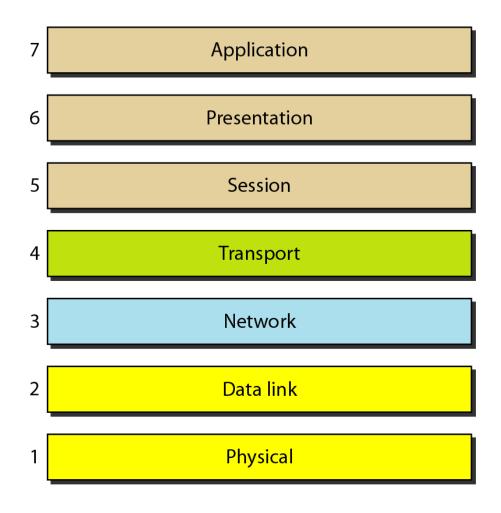
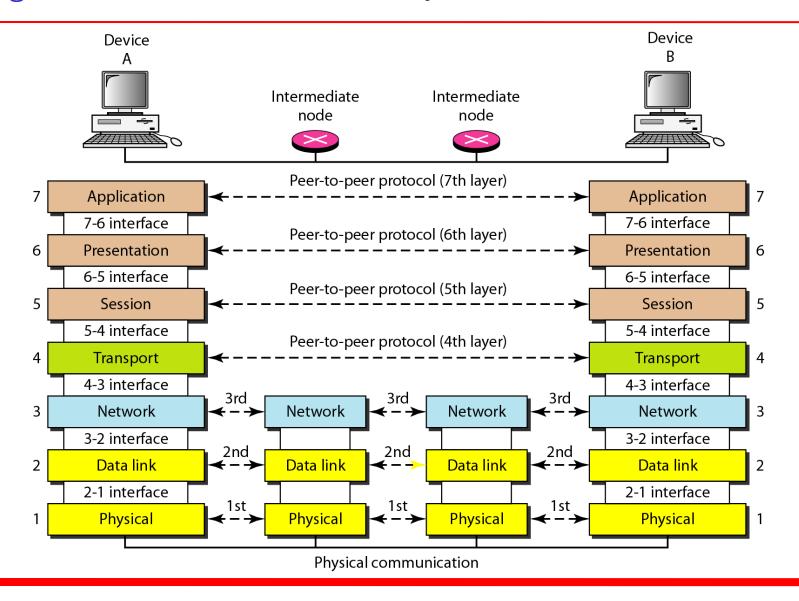
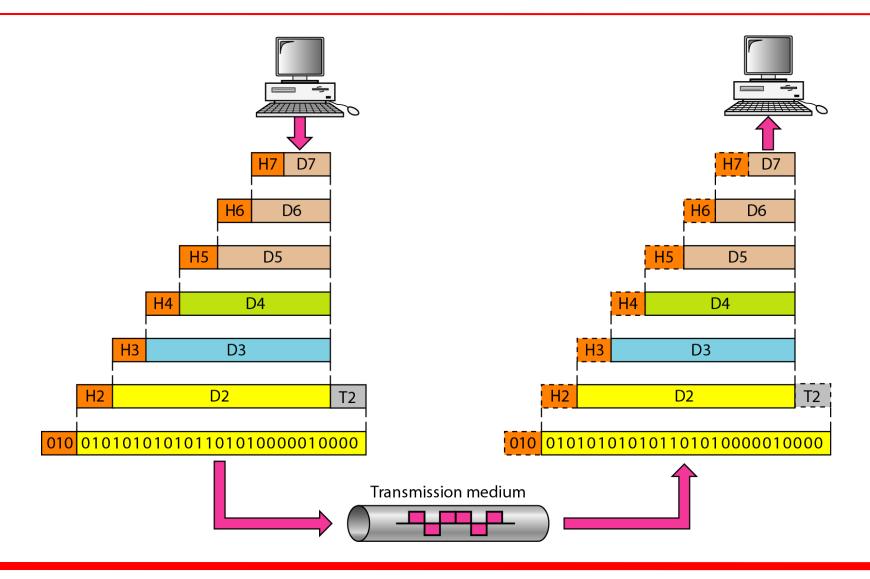


Figure 2.3 The interaction between layers in the OSI model



**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** 

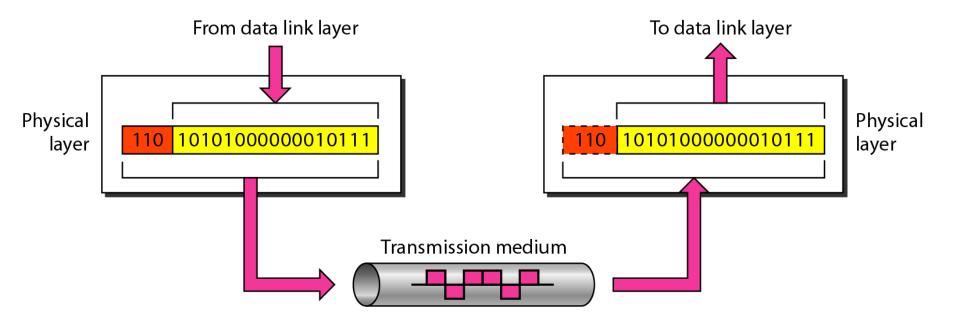
**Transport Layer** 

**Session Layer** 

**Presentation Layer** 

**Application Layer** 

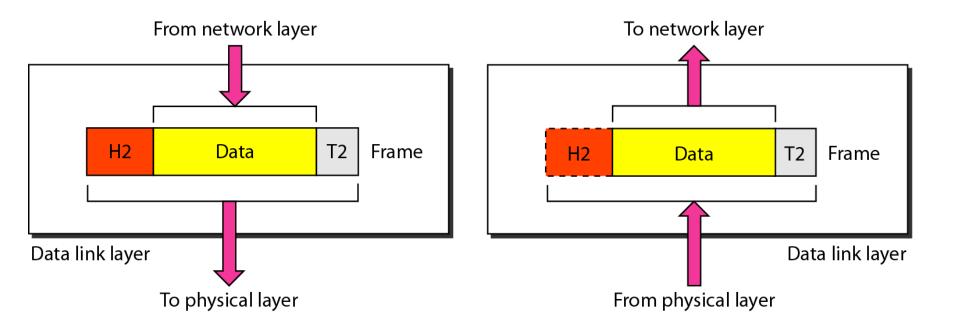
### Figure 2.5 Physical layer



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

- Physical characteristics of interface and medium
- Representation of bits how 0s/1s are changed to signals (electrical or optical)
- Data rate number of bits sent each second
- Synchronization bits (clock synchronization)
- Physical Topology star, bus, mesh
- Transmission media simplex, half duplex, full duplex

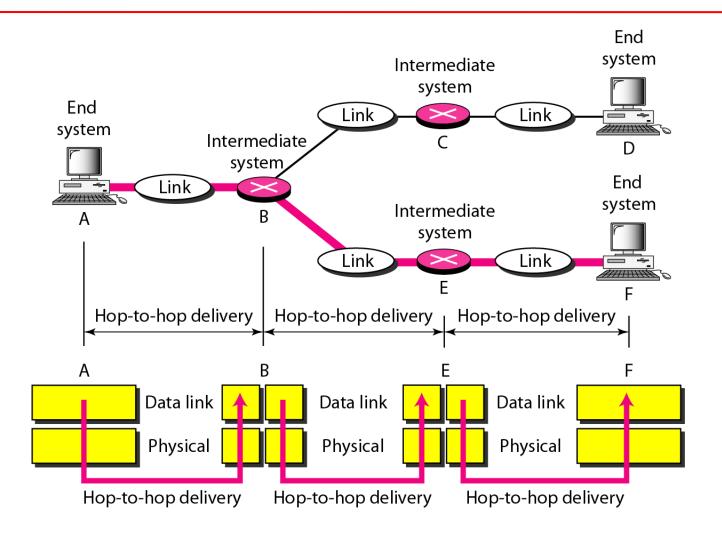
### Figure 2.6 Data link layer



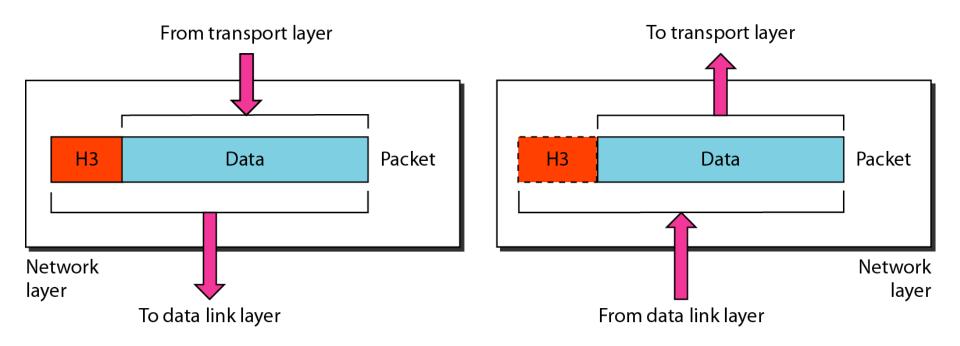
### The data link layer is responsible for moving frames from one hop (node) to the next.

- Framing
- Physical addressing
- Flow control to avoid overwhelming
- Error control to provide reliability
- Access control determine which device has control over the link

### Figure 2.7 Hop-to-hop delivery (Data Link Layer)



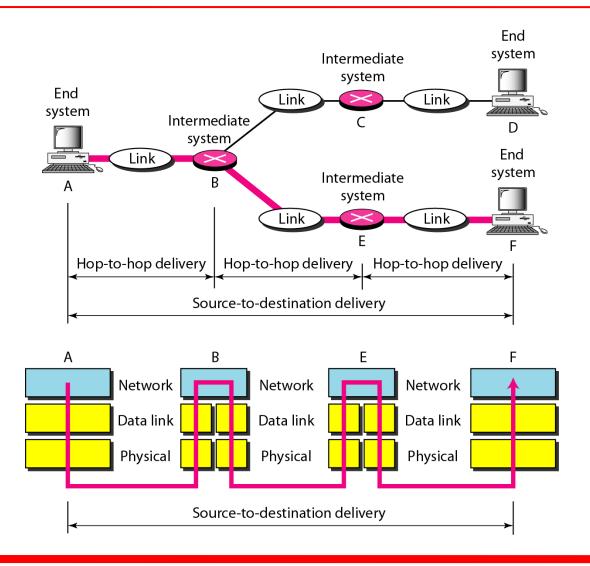
### Figure 2.8 Network layer



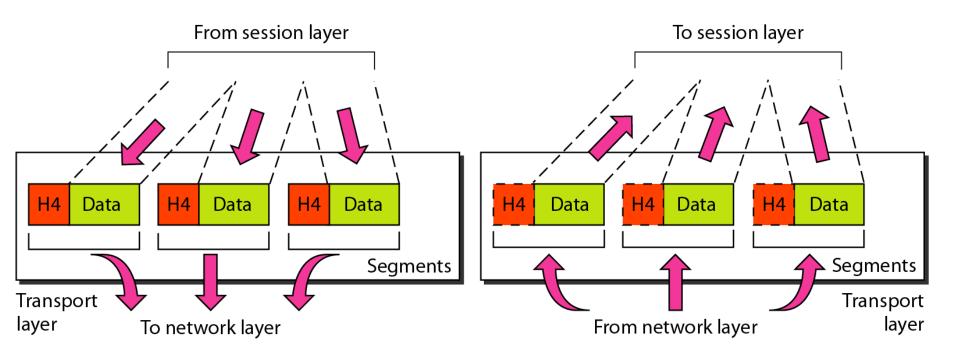
## The network layer is responsible for the delivery of individual packets from the source host to the destination host.

- Logical addressing
- Routing

### Figure 2.9 Source-to-destination delivery (Network Layer)



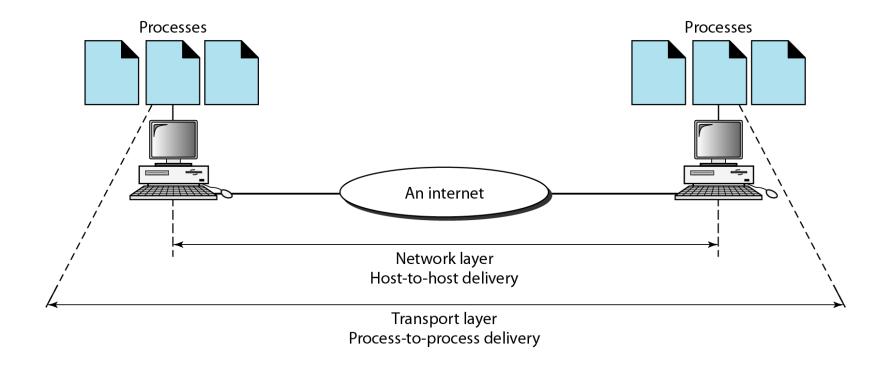
### Figure 2.10 Transport layer



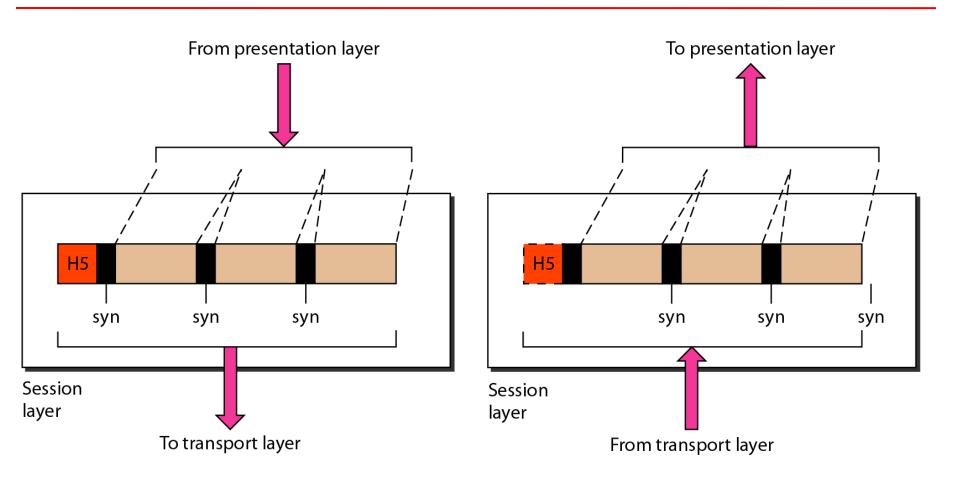
### The transport layer is responsible for the delivery of a message from one process to another.

- Port addressing
- Segmentation and reassembly
- Connection control connectionless or connection oriented
- Flow control
- Error control

### Figure 2.11 Reliable process-to-process delivery of a message (Transport Layer)



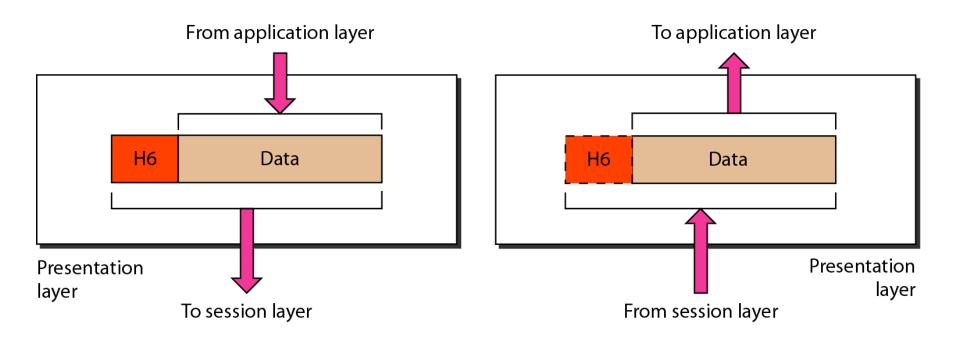
### Figure 2.12 Session layer



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

- Dialog control two processes enter into dialog via half duplex or full duplex
- Synchronization check points

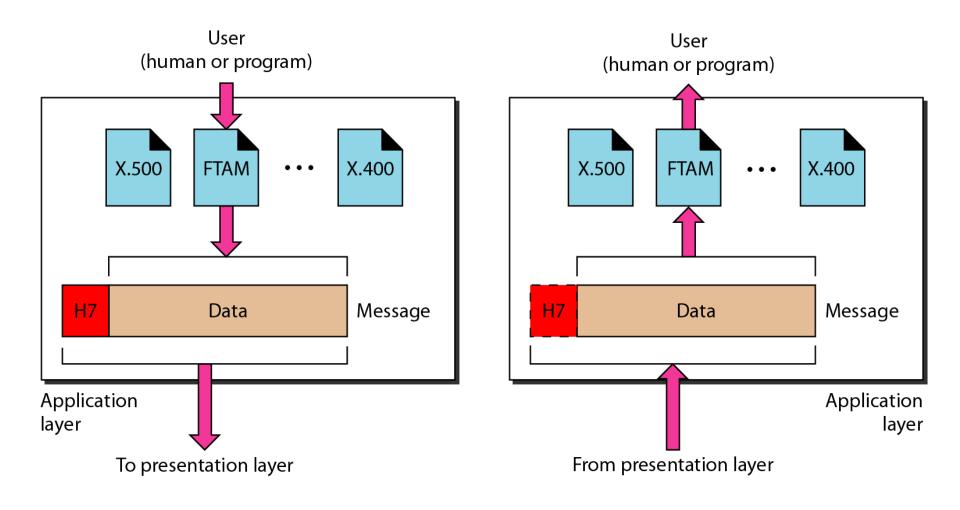
### Figure 2.13 Presentation layer



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

- Translation Bit stream to character strings, vice-versa
- Encryption
- Compression reduces the number of bits

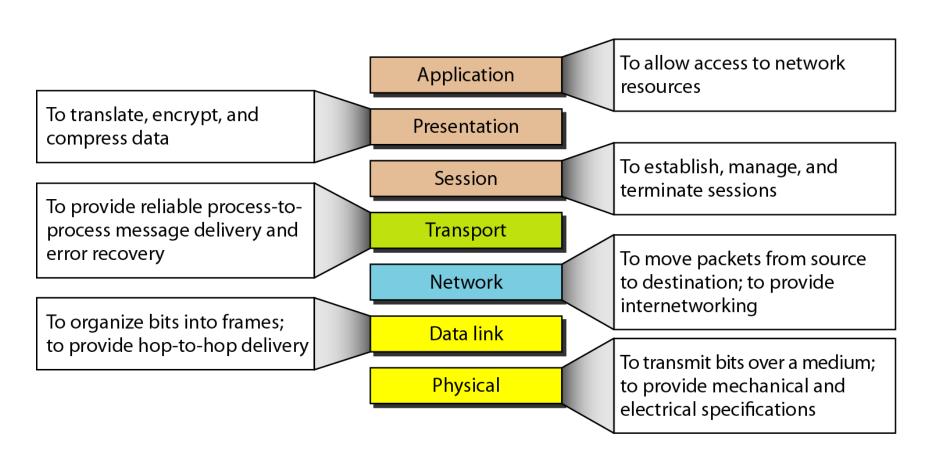
### Figure 2.14 Application layer



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

- Network virtual terminal software to login into a remote host
- File transfer, access, management
- Mail services
- Directory services

### Figure 2.15 Summary of layers



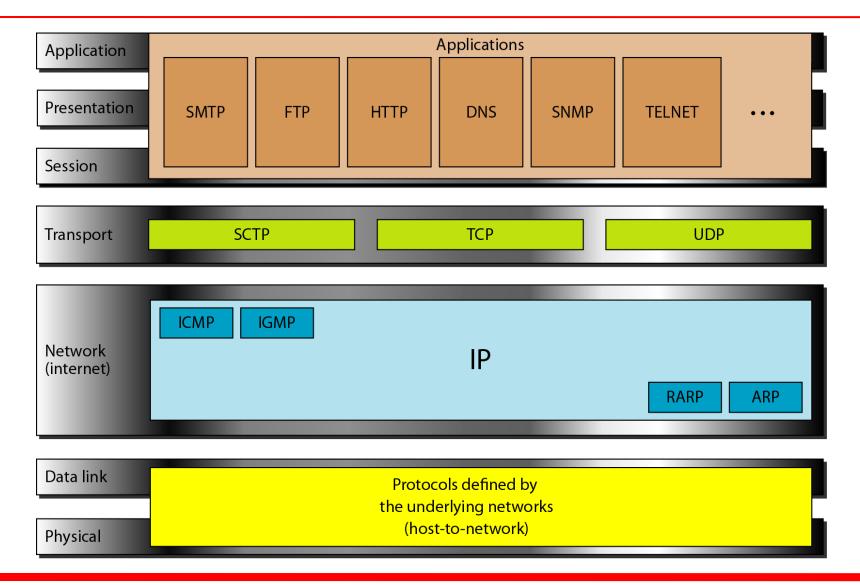
### 2-4 TCP/IP PROTOCOL SUITE

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



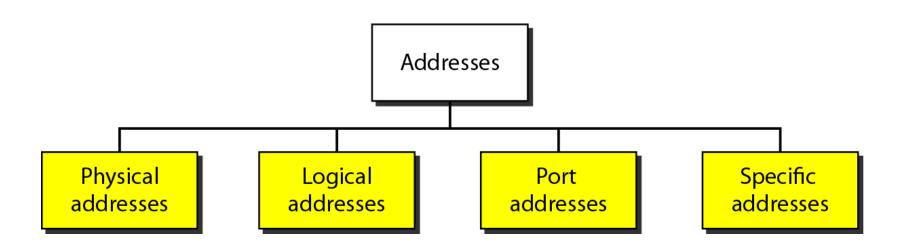
### 2-5 ADDRESSING

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

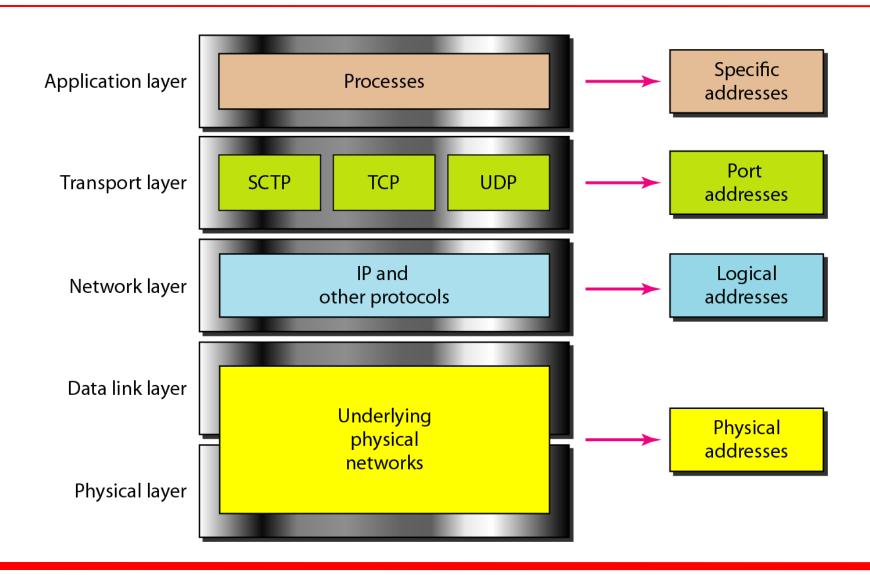
### **Topics discussed in this section:**

Physical Addresses
Logical Addresses
Port Addresses
Specific Addresses

### Figure 2.17 Addresses in TCP/IP



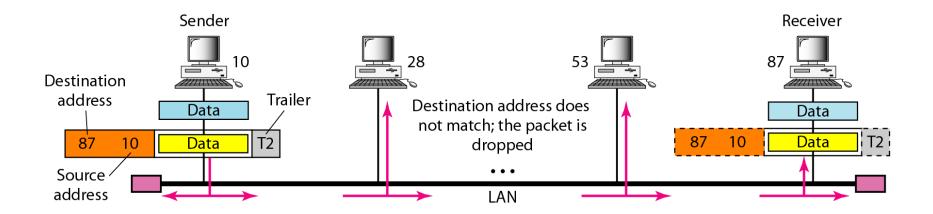
### Figure 2.18 Relationship of layers and addresses in TCP/IP



## 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:

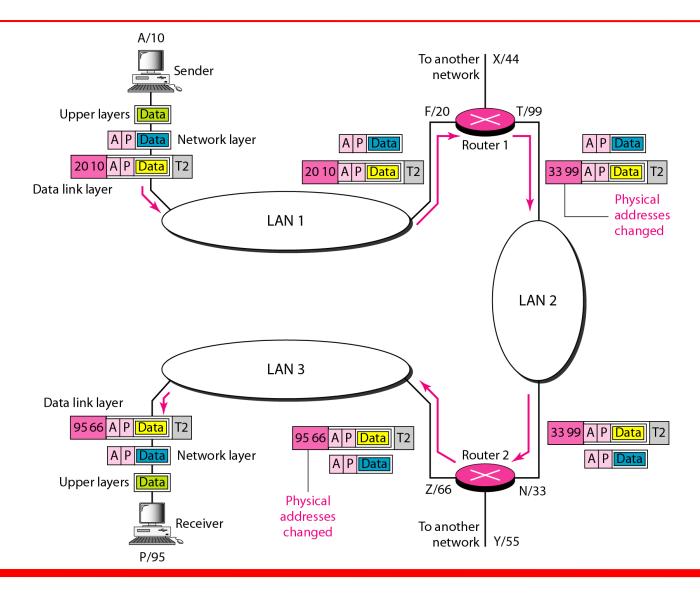
07:01:02:01:2C:4B

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.

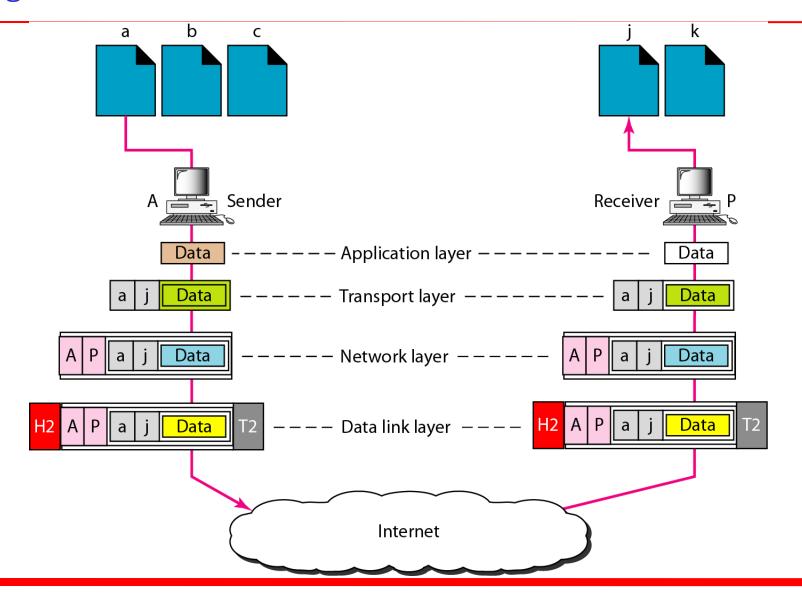
### Figure 2.20 IP addresses



## 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 i 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.

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.