

# **Chapter 2**

# **Network Models**

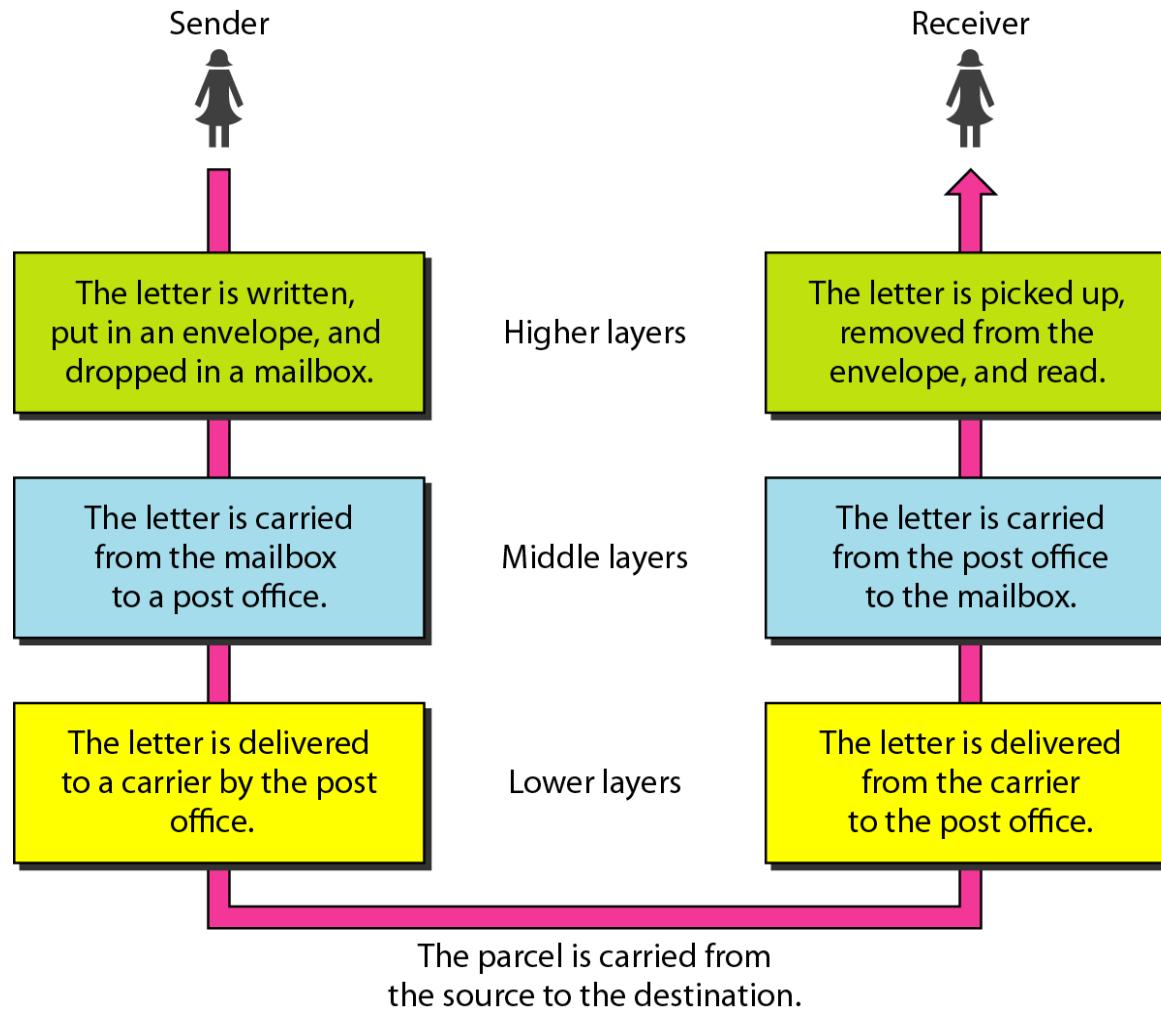
## 2-1 LAYERED TASKS

*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

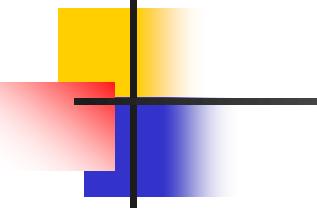
*Established in 1947, the International Standards Organization (**ISO**) is a multinational body dedicated to worldwide agreement on international standards. An ISO standard that covers all aspects of network communications is the Open Systems Interconnection (**OSI**) model. It was first introduced in the late 1970s.*

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

Layered Architecture

Peer-to-Peer Processes

Encapsulation



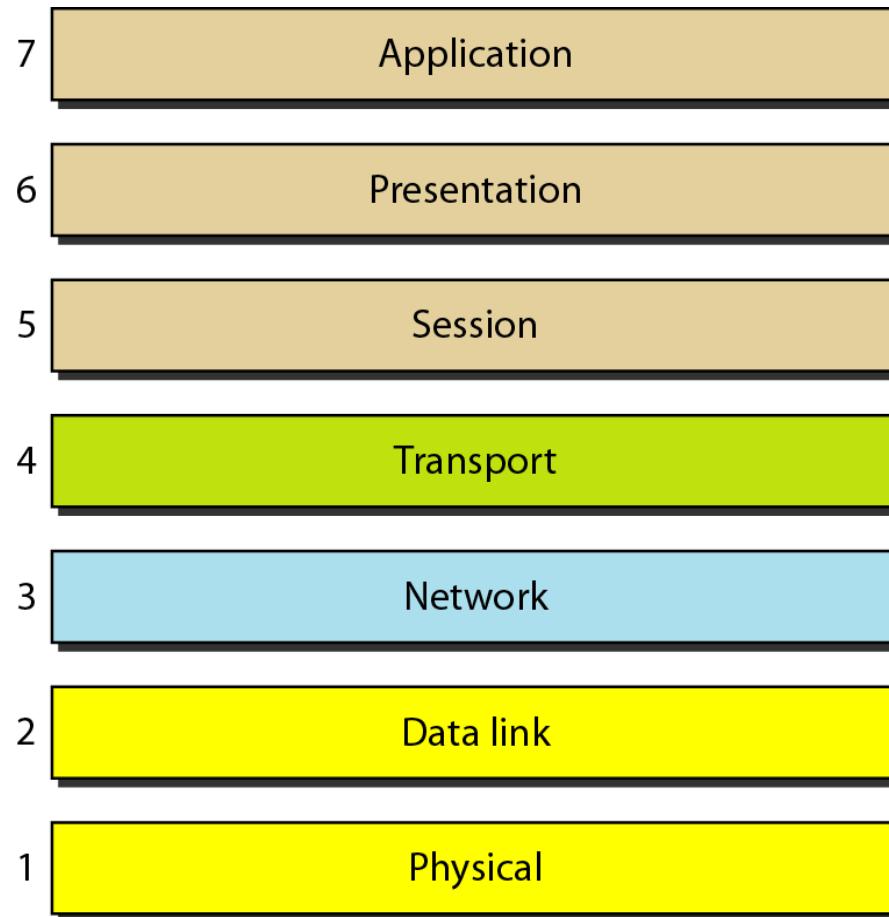
*Note*

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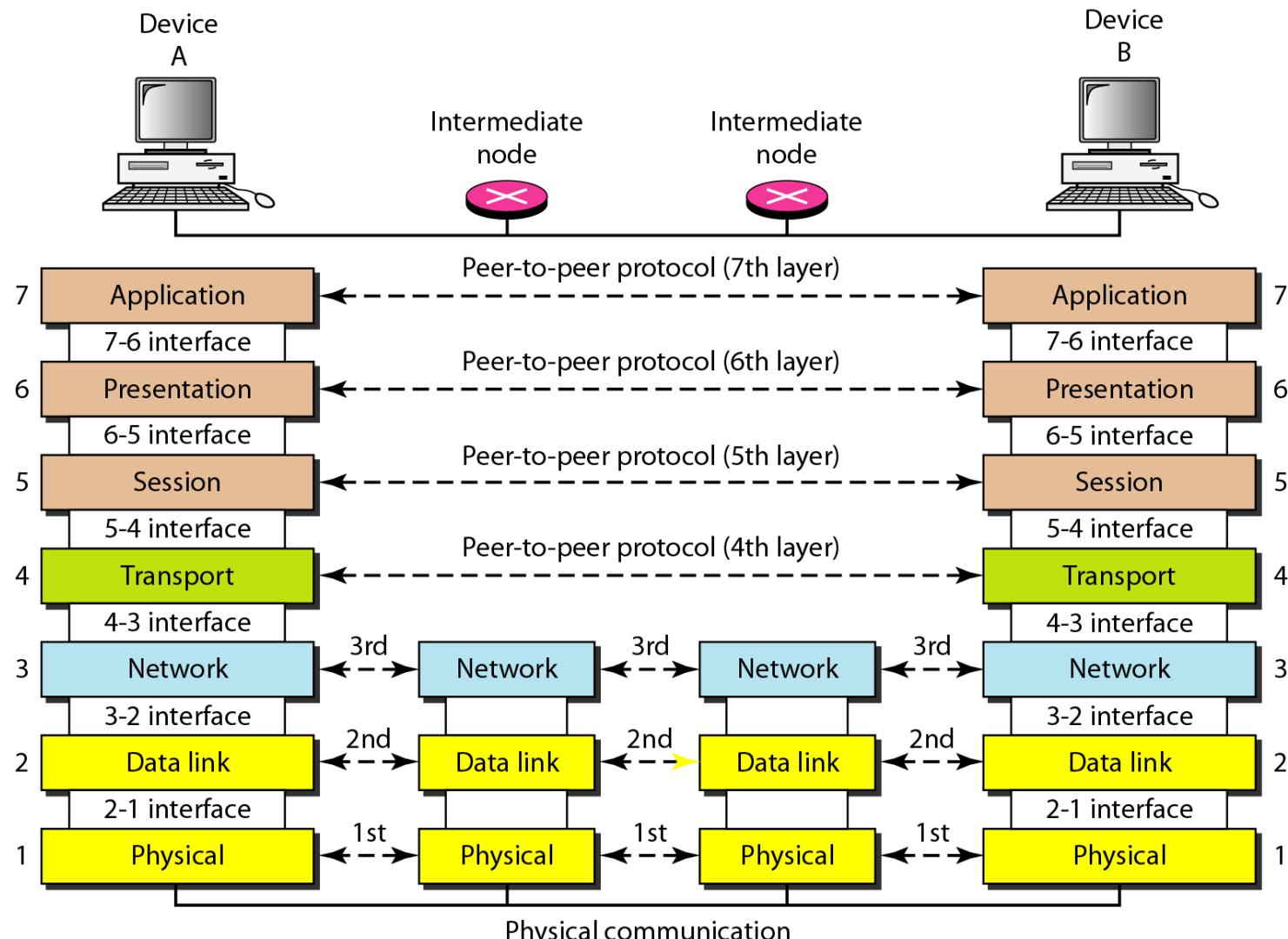
**ISO is the organization.  
OSI is the model.**

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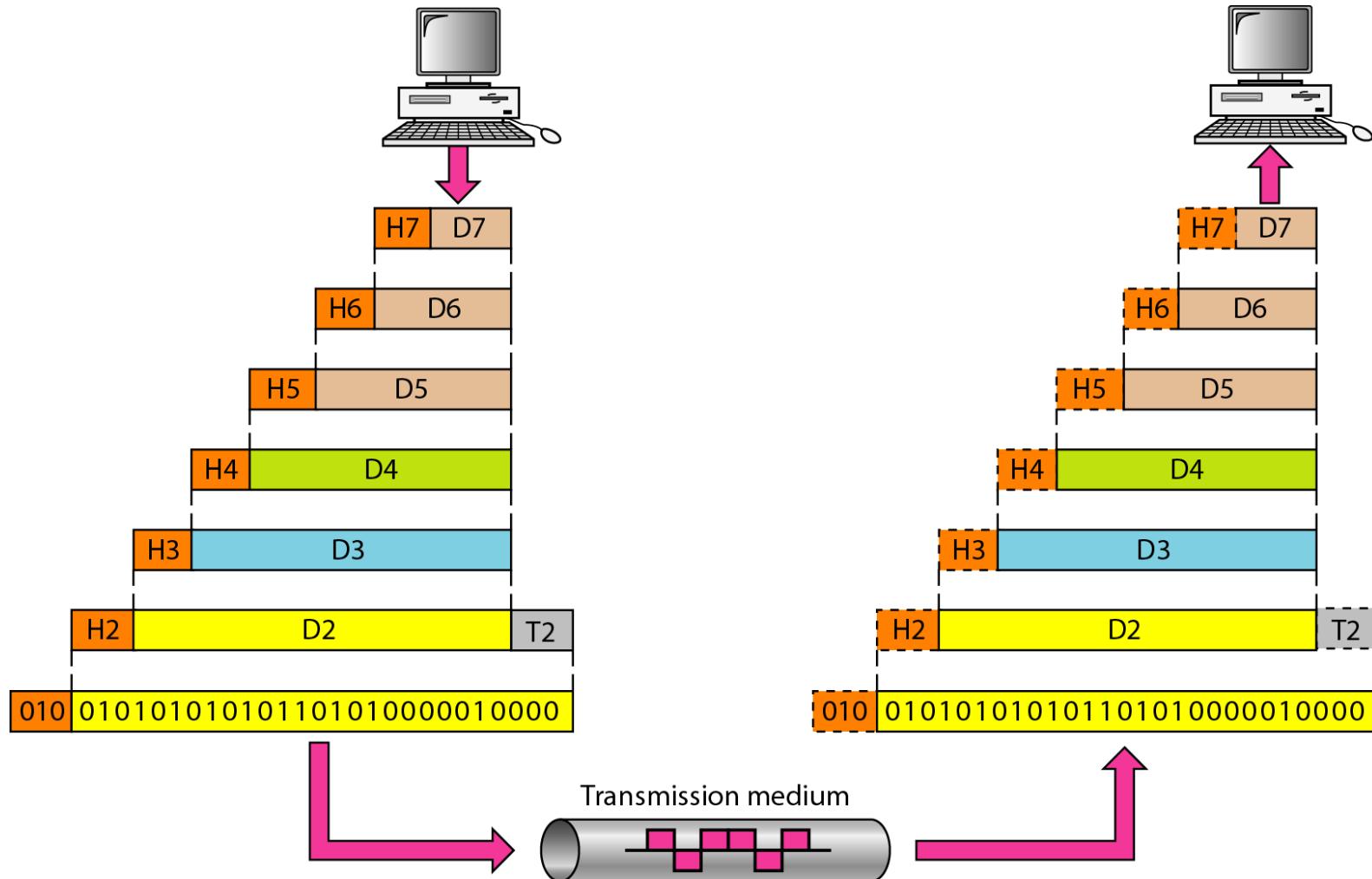
## Figure 2.2 Seven layers of the OSI model



**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**

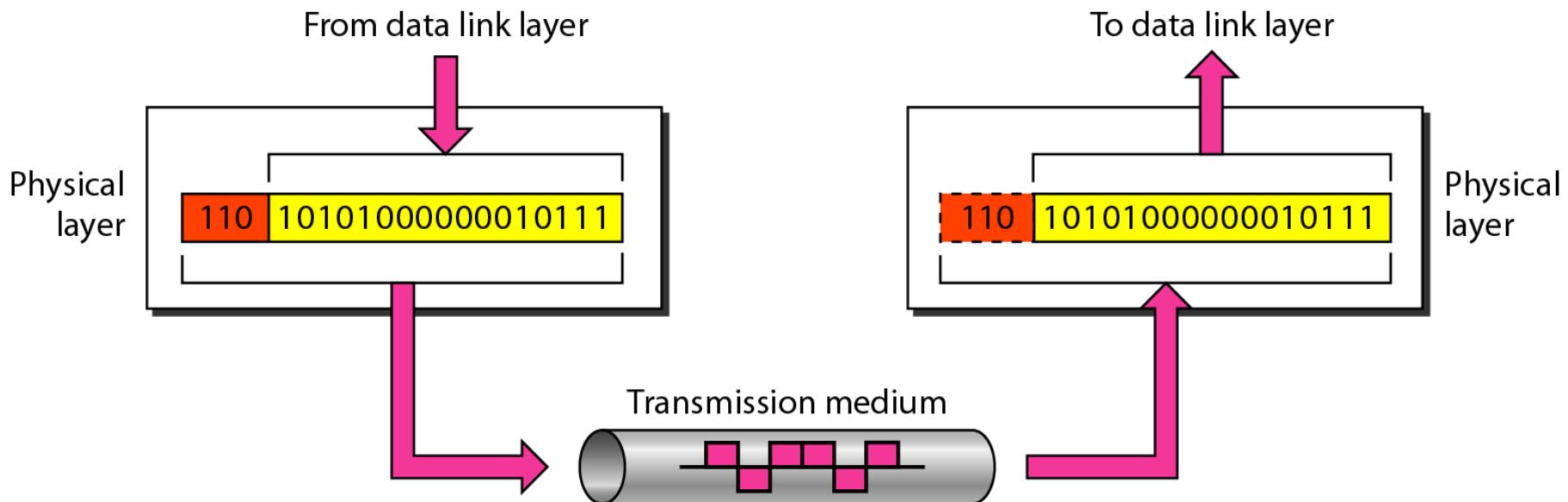
**Transport Layer**

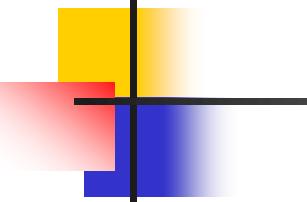
**Session Layer**

**Presentation Layer**

**Application Layer**

**Figure 2.5 Physical layer**

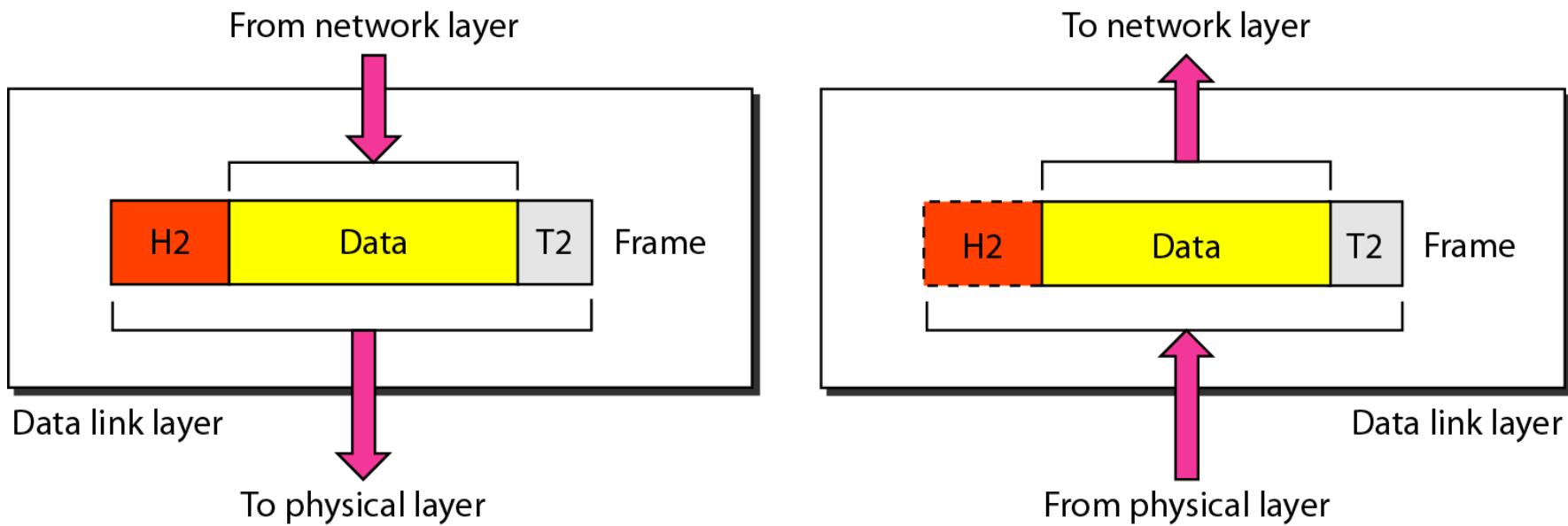


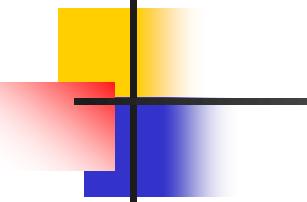


## **Note**

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

**Figure 2.6 Data link layer**





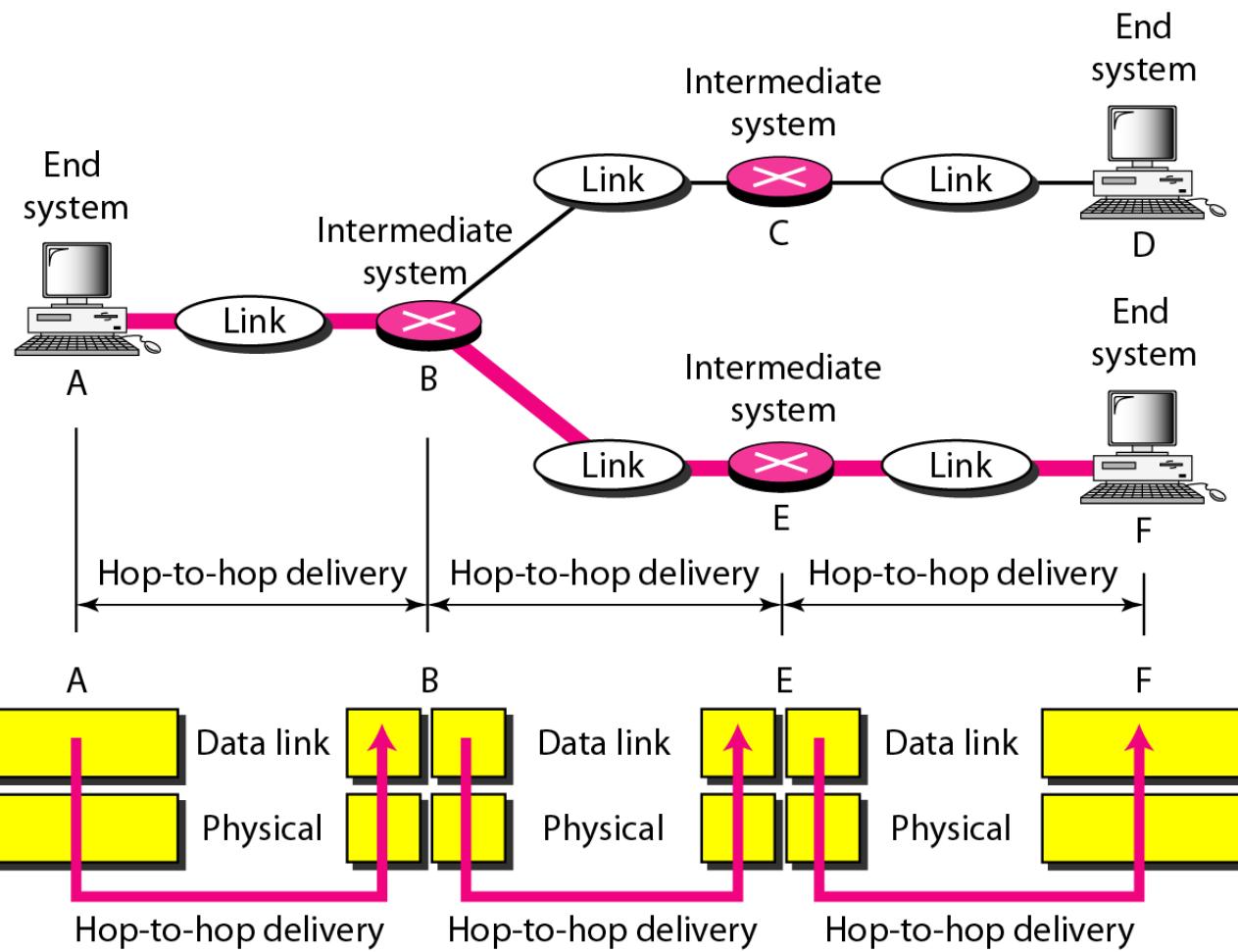
## ***Note***

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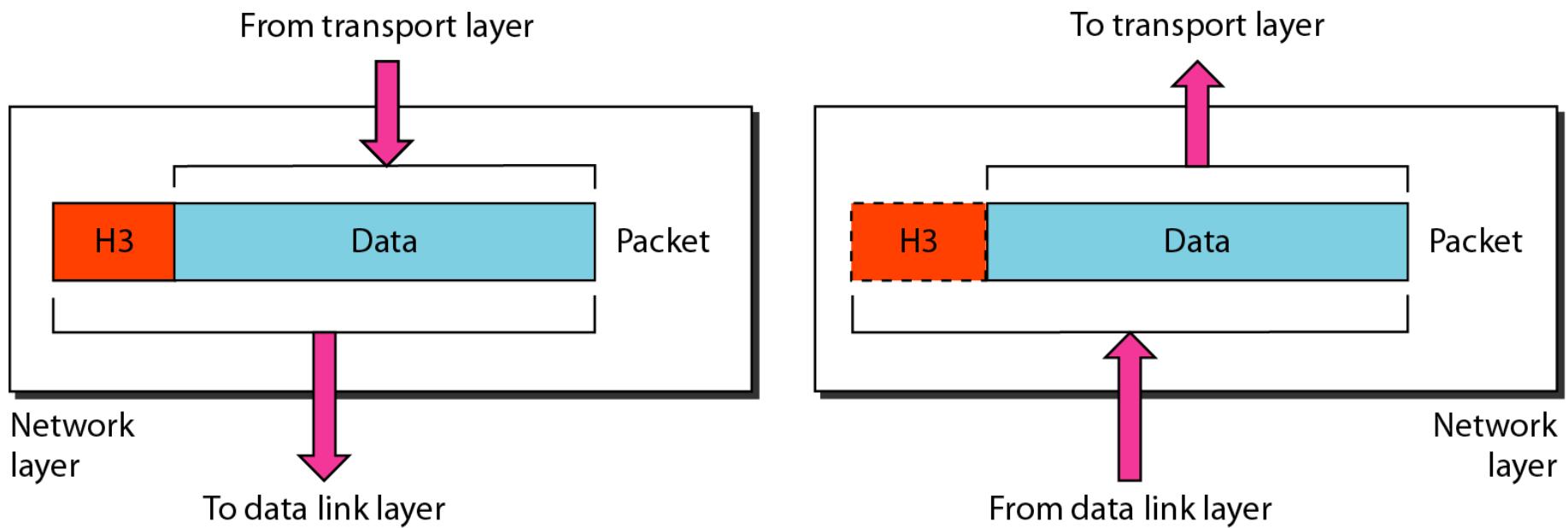
**The data link layer is responsible for moving frames from one hop (node) to the next.**

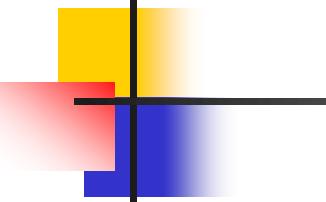
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## Figure 2.7 Hop-to-hop delivery



**Figure 2.8 Network layer**

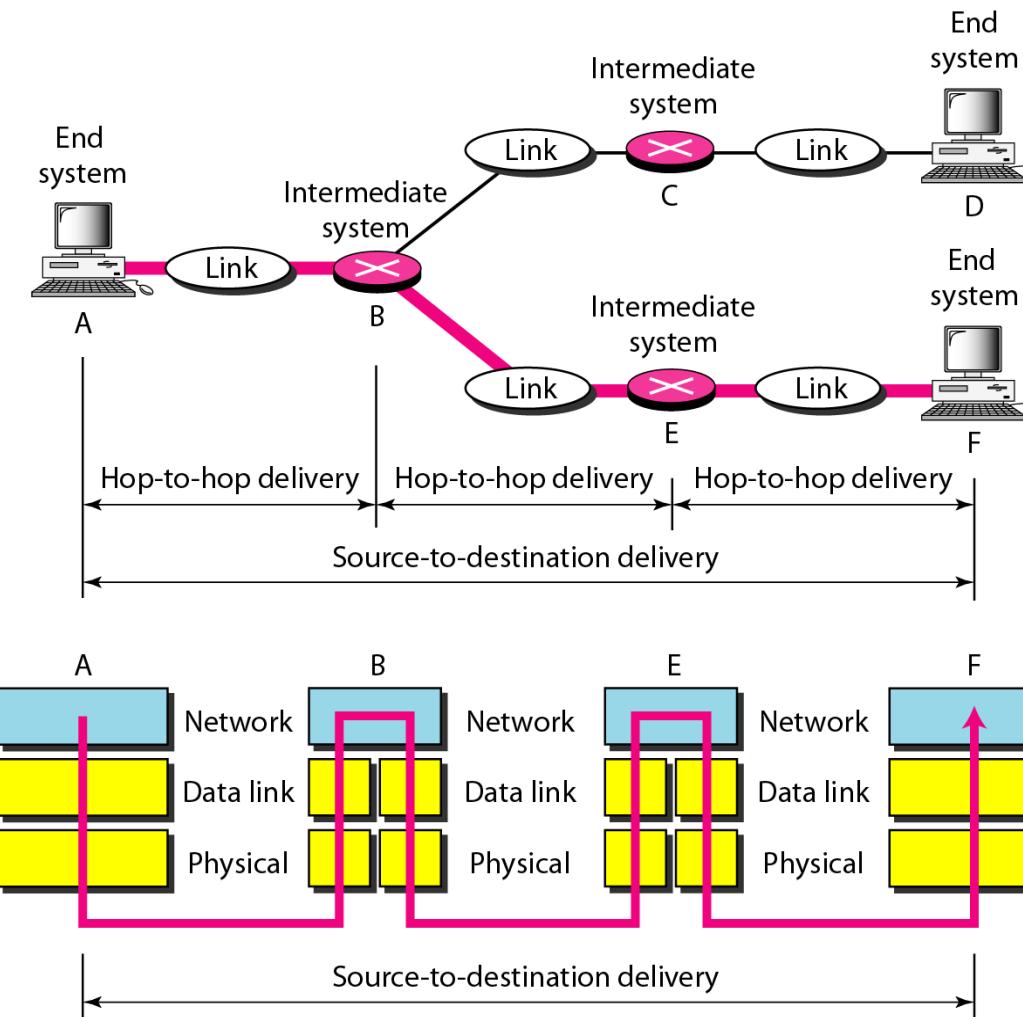




## **Note**

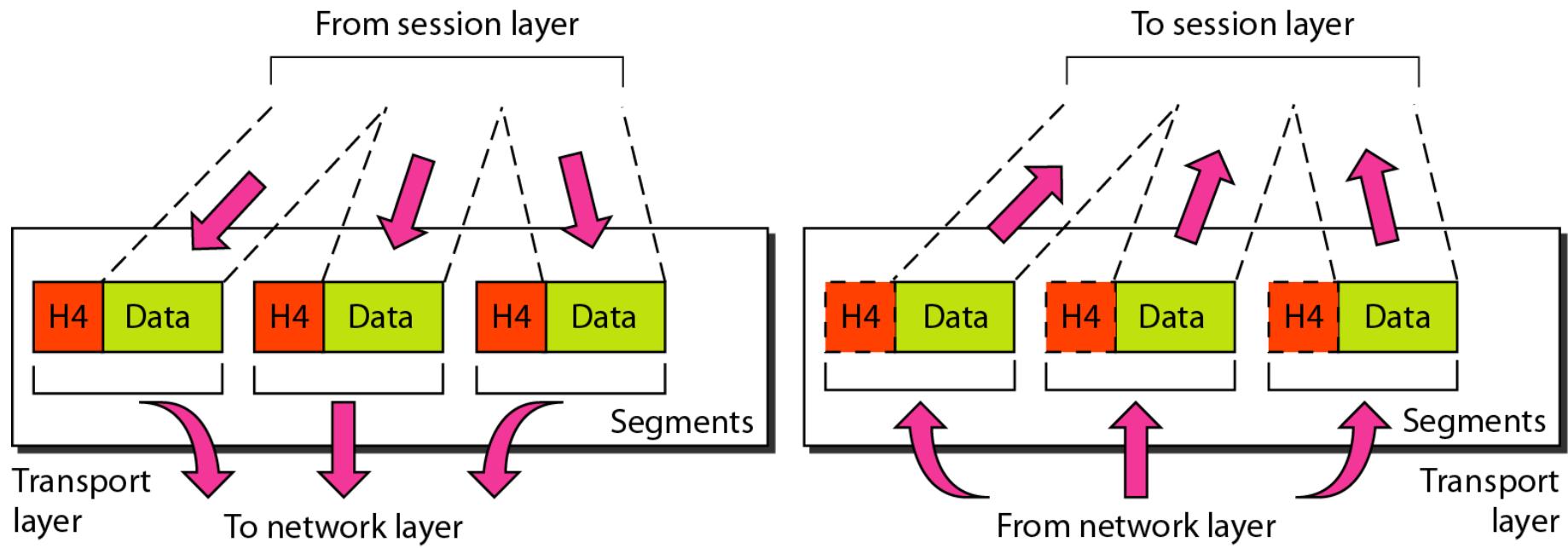
**The network layer is responsible for the delivery of individual packets from the source host to the destination host.**

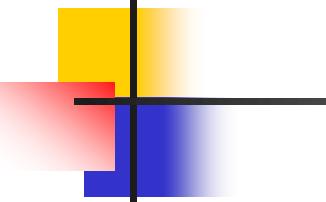
## Figure 2.9 Source-to-destination delivery



**Figure 2.10 Transport layer**

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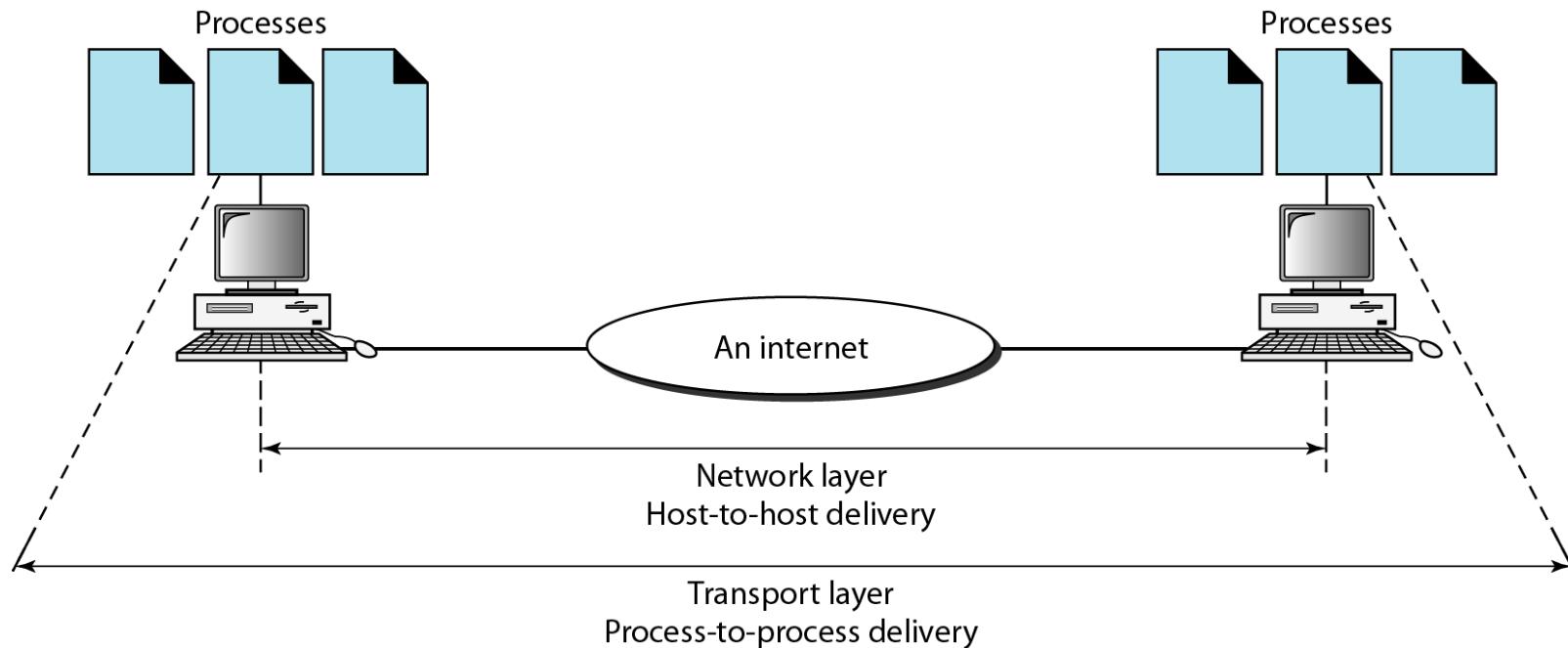


## **Note**

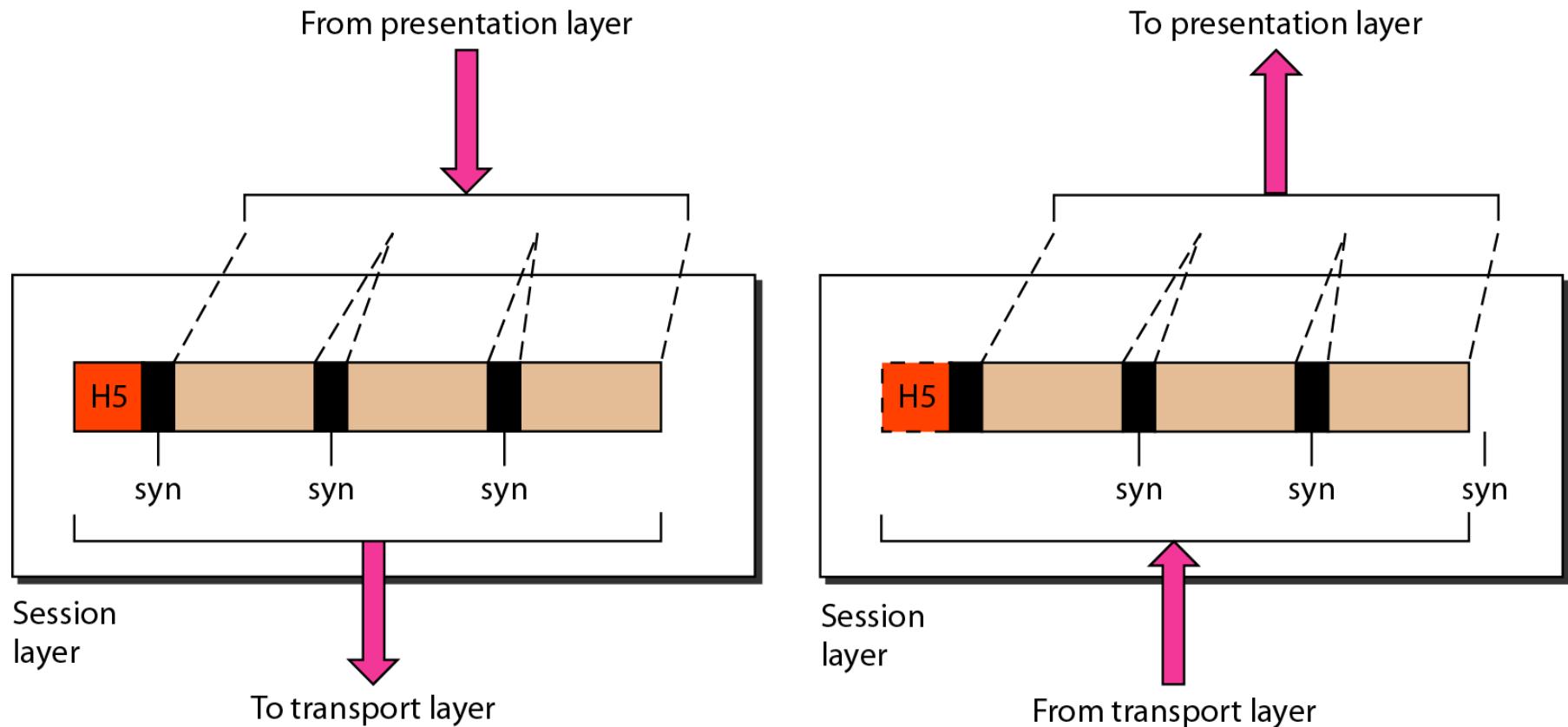
**The transport layer is responsible for the delivery  
of a message from one process to another.**

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

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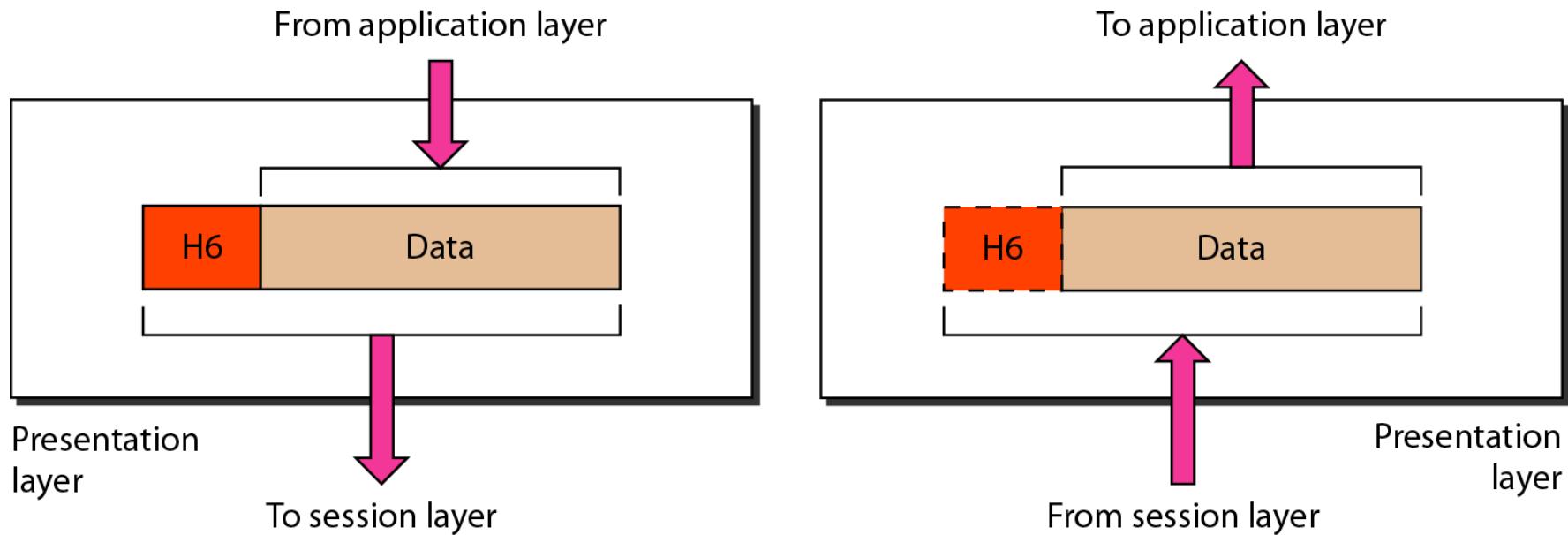
**Figure 2.12 Session layer**

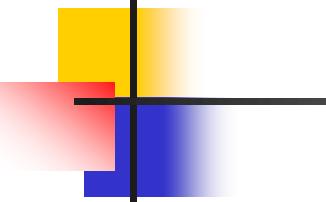


**Note**

The session layer is responsible for dialog control and synchronization.

**Figure 2.13** *Presentation layer*

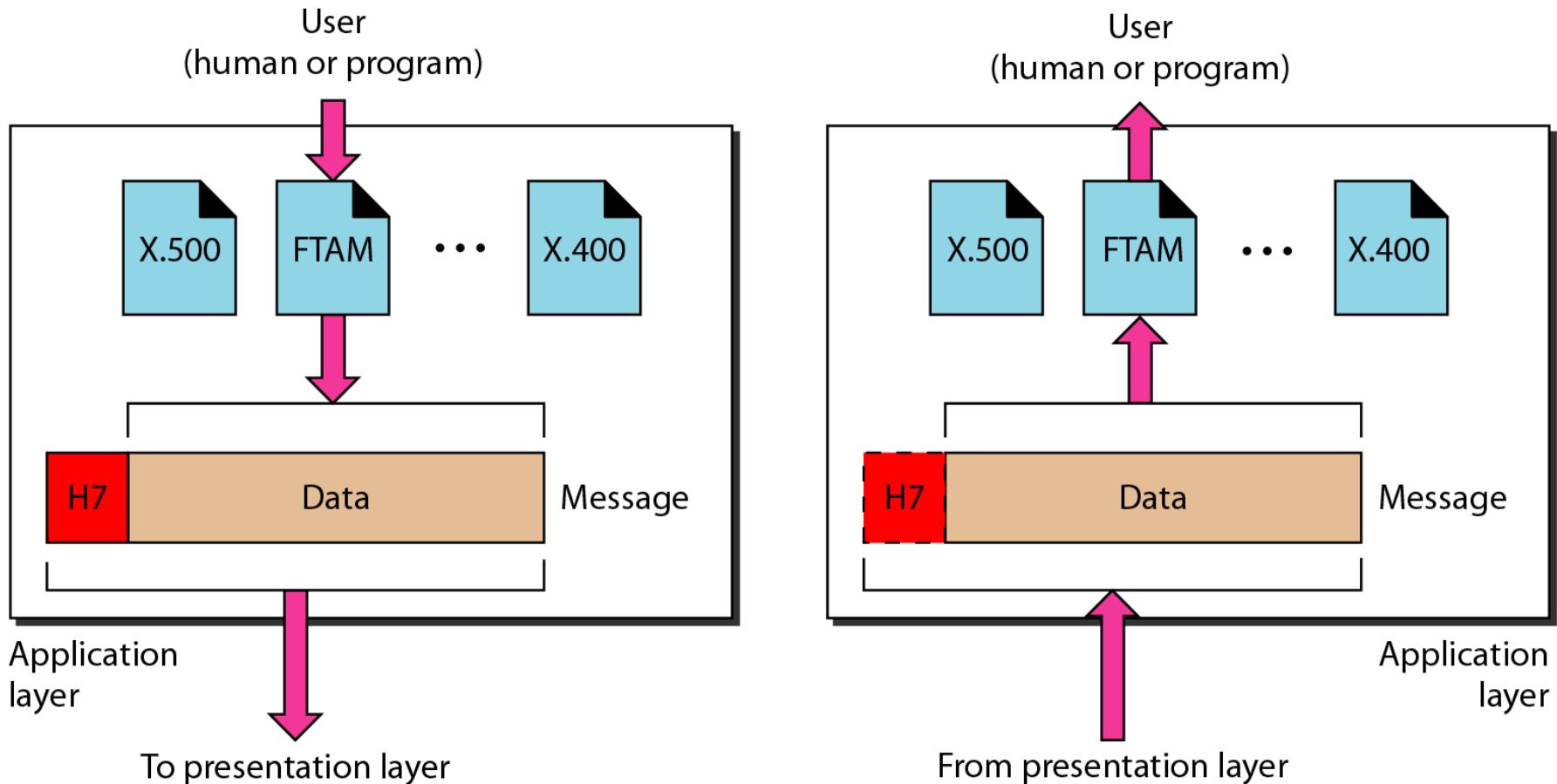


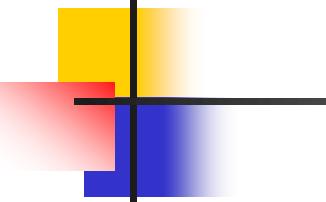


## **Note**

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

## Figure 2.14 Application layer



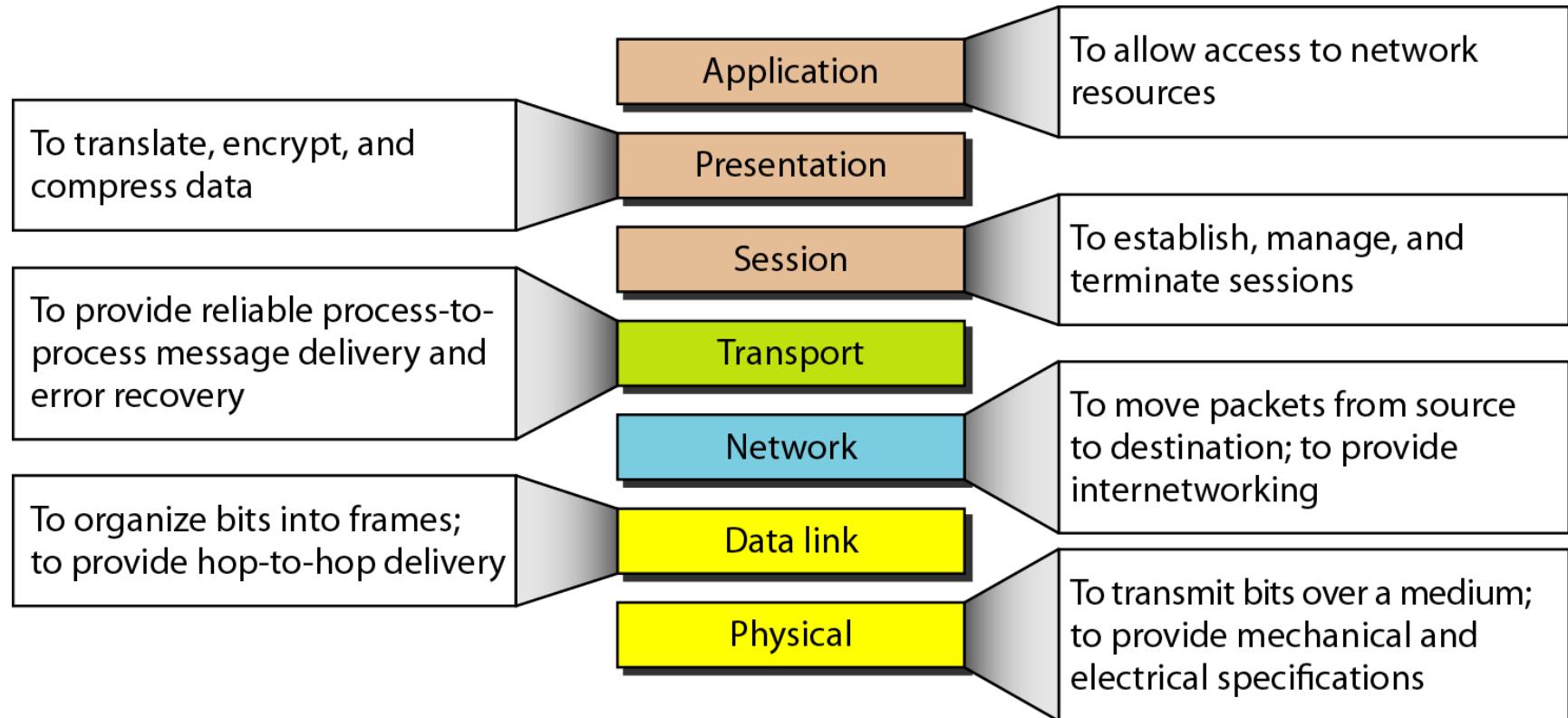


## *Note*

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

## Figure 2.15 Summary of layers

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## 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:**

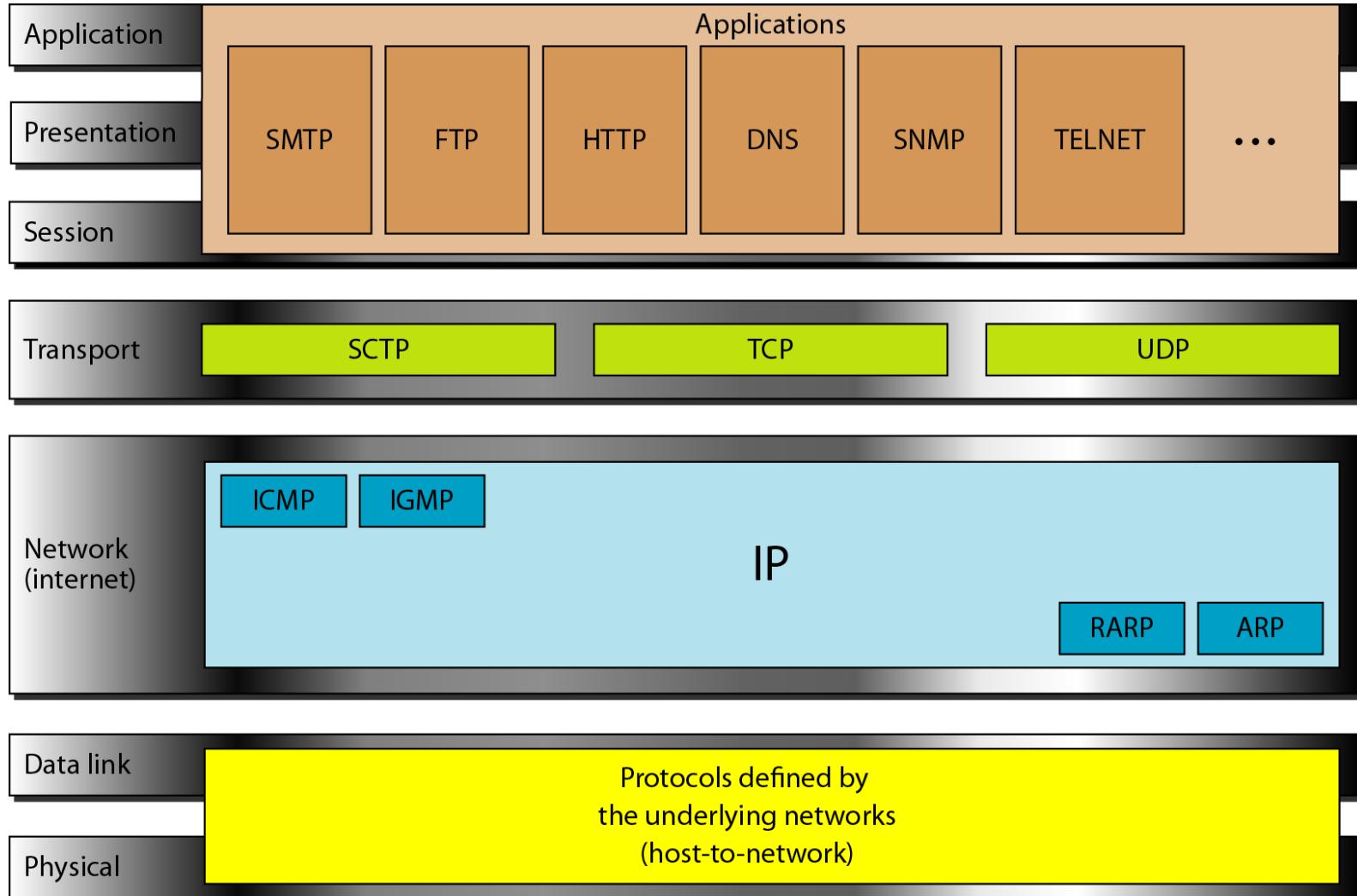
**Physical and Data Link Layers**

**Network Layer**

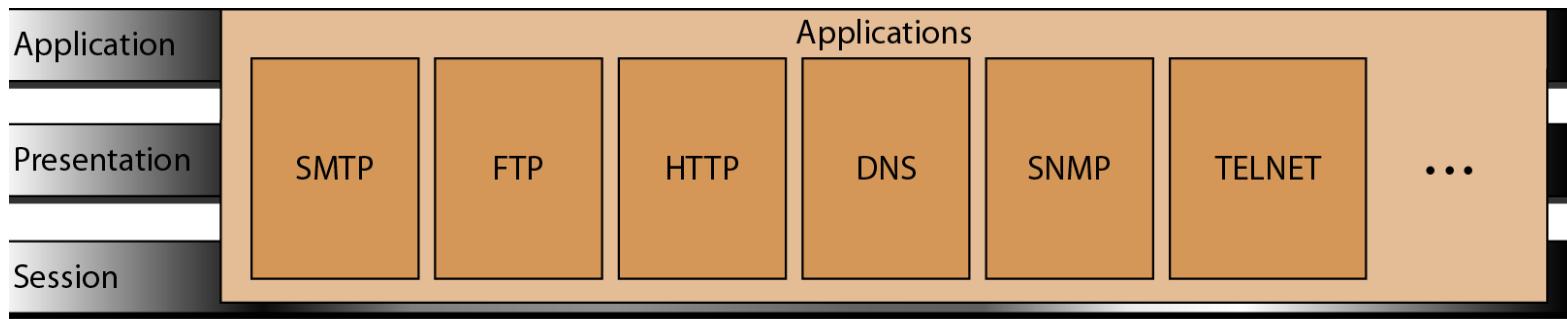
**Transport Layer**

**Application Layer**

## Figure 2.16 TCP/IP and OSI model



## Figure 2.16 TCP/IP and OSI model



- **SMTP (Simple Mail Transfer Protocol)** is an application layer protocol used to send, relay, and route email messages between mail servers.
- **FTP (File Transfer Protocol)** is a standard network protocol used to transfer files between a client and a server over a TCP/IP network.
- **HTTP (HyperText Transfer Protocol)** is an application-layer protocol used for transmitting hypermedia documents, such as HTML, over the web.
- **DNS (Domain Name System)** is an application-layer protocol that translates human-readable domain names (like www.example.com) into IP addresses used by computers to locate services and devices on a network.
- **TELNET (Terminal Network)** is an application-layer protocol that allows users to remotely access and manage devices or servers over a network via a text-based command-line interface.

## Figure 2.16 TCP/IP and OSI model

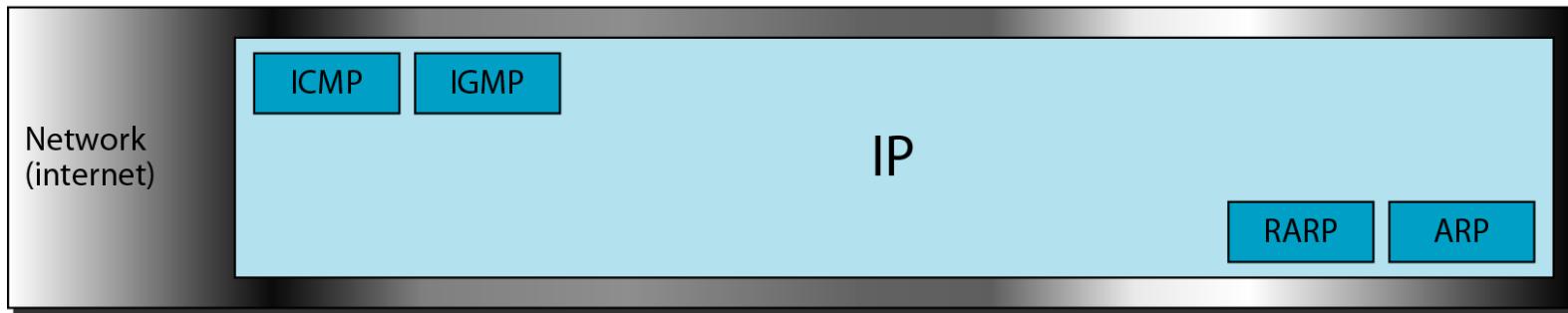
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- **SCTP (Stream Control Transmission Protocol)** is a connection-oriented transport-layer protocol that supports multi-streaming and multi-homing, making it reliable and fault-tolerant.
- **TCP (Transmission Control Protocol)** is a connection-oriented protocol that provides reliable, ordered, and error-checked delivery of a stream of bytes between applications.
- **UDP (User Datagram Protocol)** is a connectionless transport-layer protocol that offers fast but unreliable data delivery with no guarantee of order or error correction.

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

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**ICMP (Internet Control Message Protocol)** used for error reporting and diagnostics in IP networks. For example, ping and traceroute use ICMP to detect reachability and network issues.

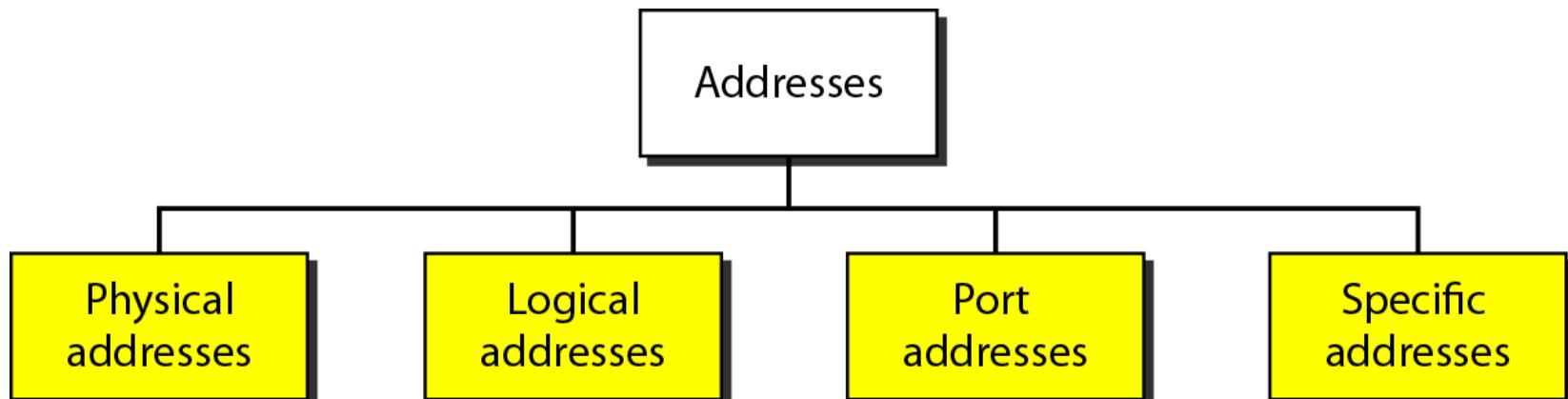
**IGMP (Internet Group Management Protocol)** supports multicast communication by allowing hosts and routers to manage group memberships.

RARP (Reverse Address Resolution Protocol) used by a device to discover its IP address when it knows only its MAC address.

**ARP (Address Resolution Protocol)** translates an IP address into a MAC address in a local area network (LAN).

## 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:**

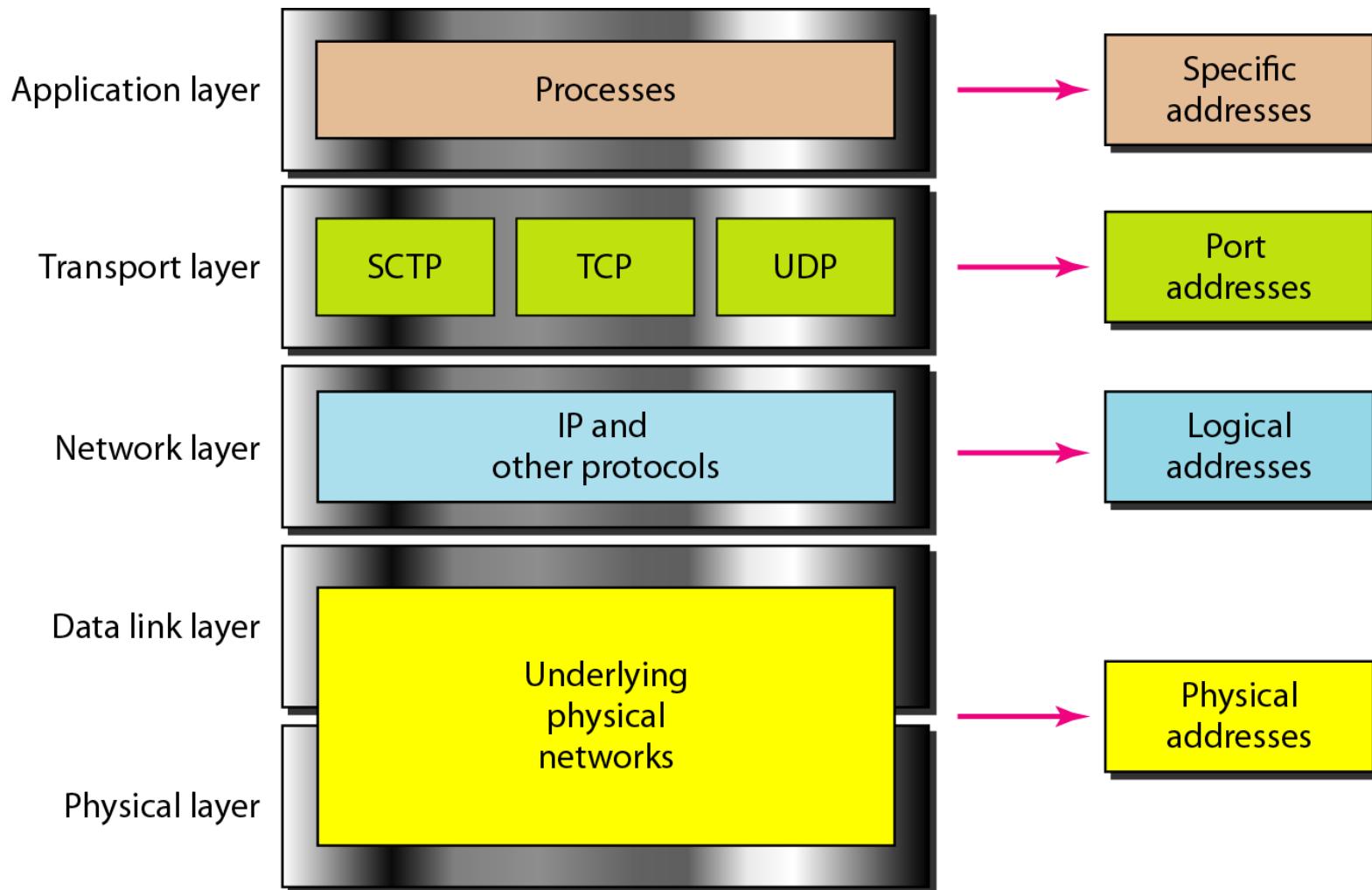
Physical Addresses

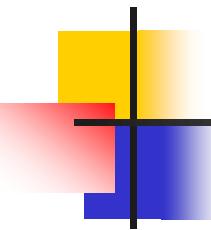
Logical Addresses

Port Addresses

Specific Addresses

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

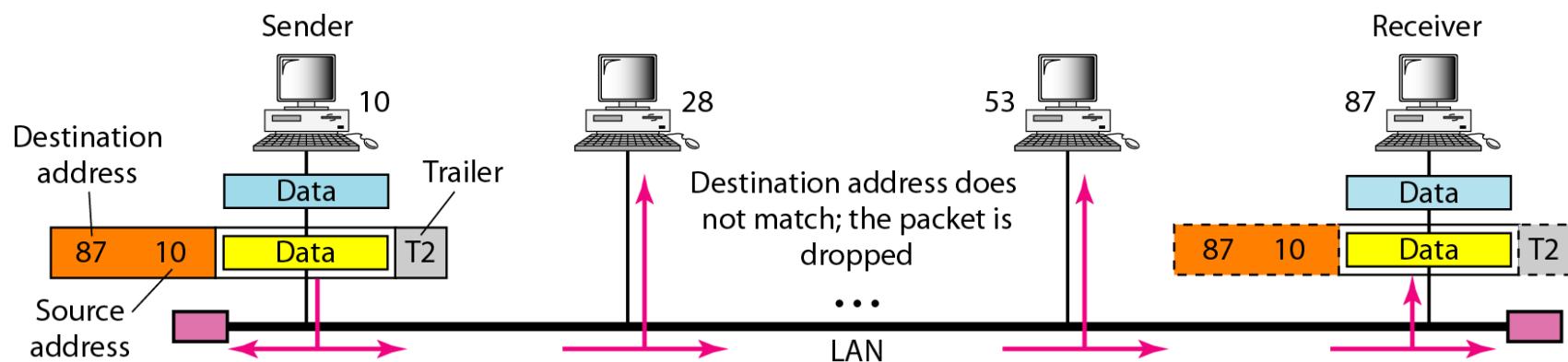


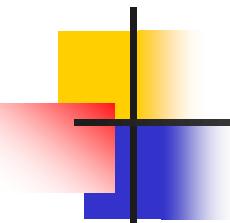


## *Example 2.1*

*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



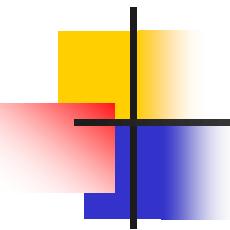


## *Example 2.2*

*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**

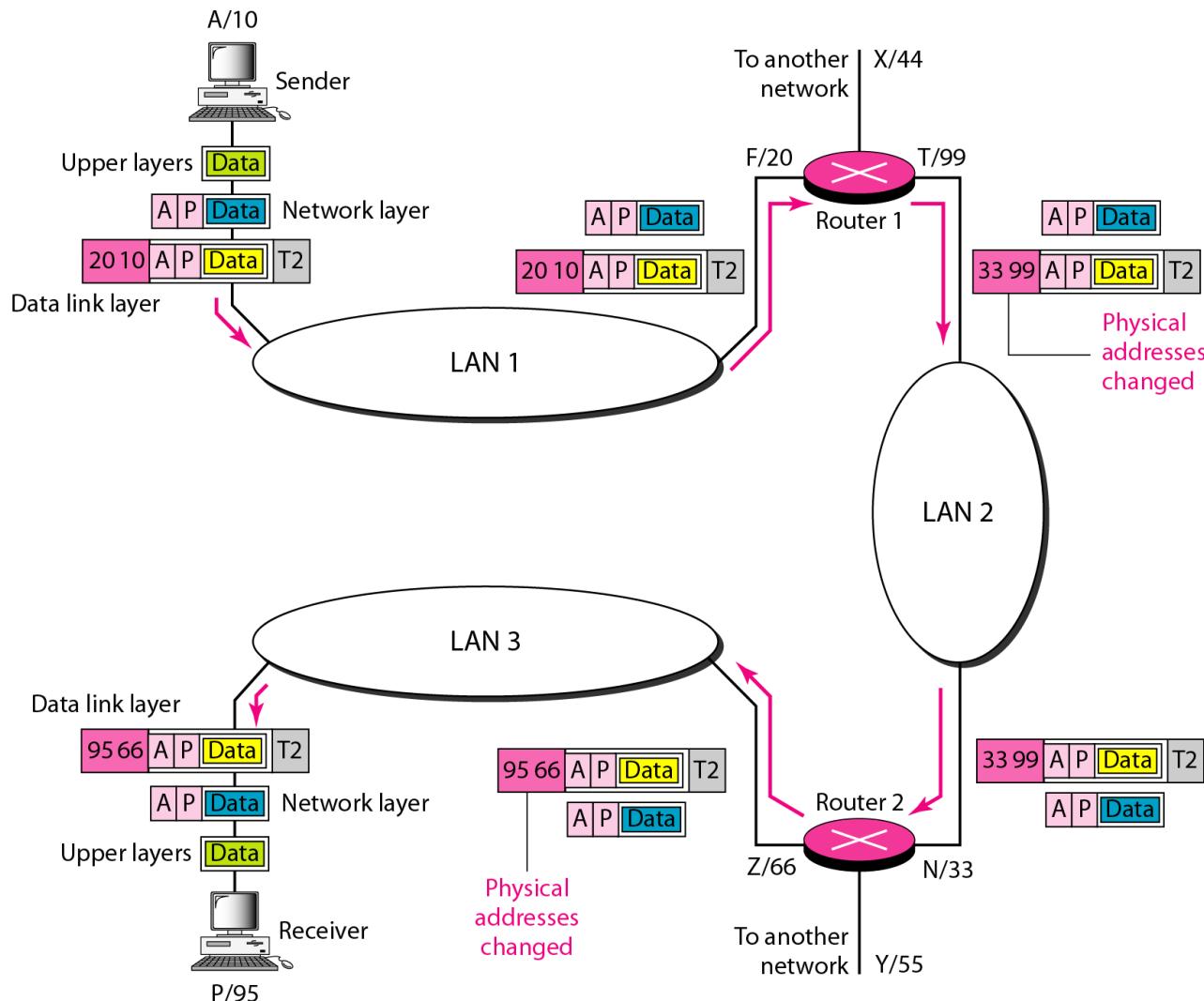
**A 6-byte (12 hexadecimal digits) physical address.**

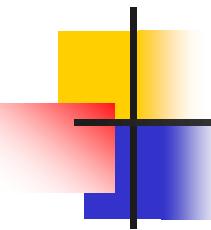


## *Example 2.3*

*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

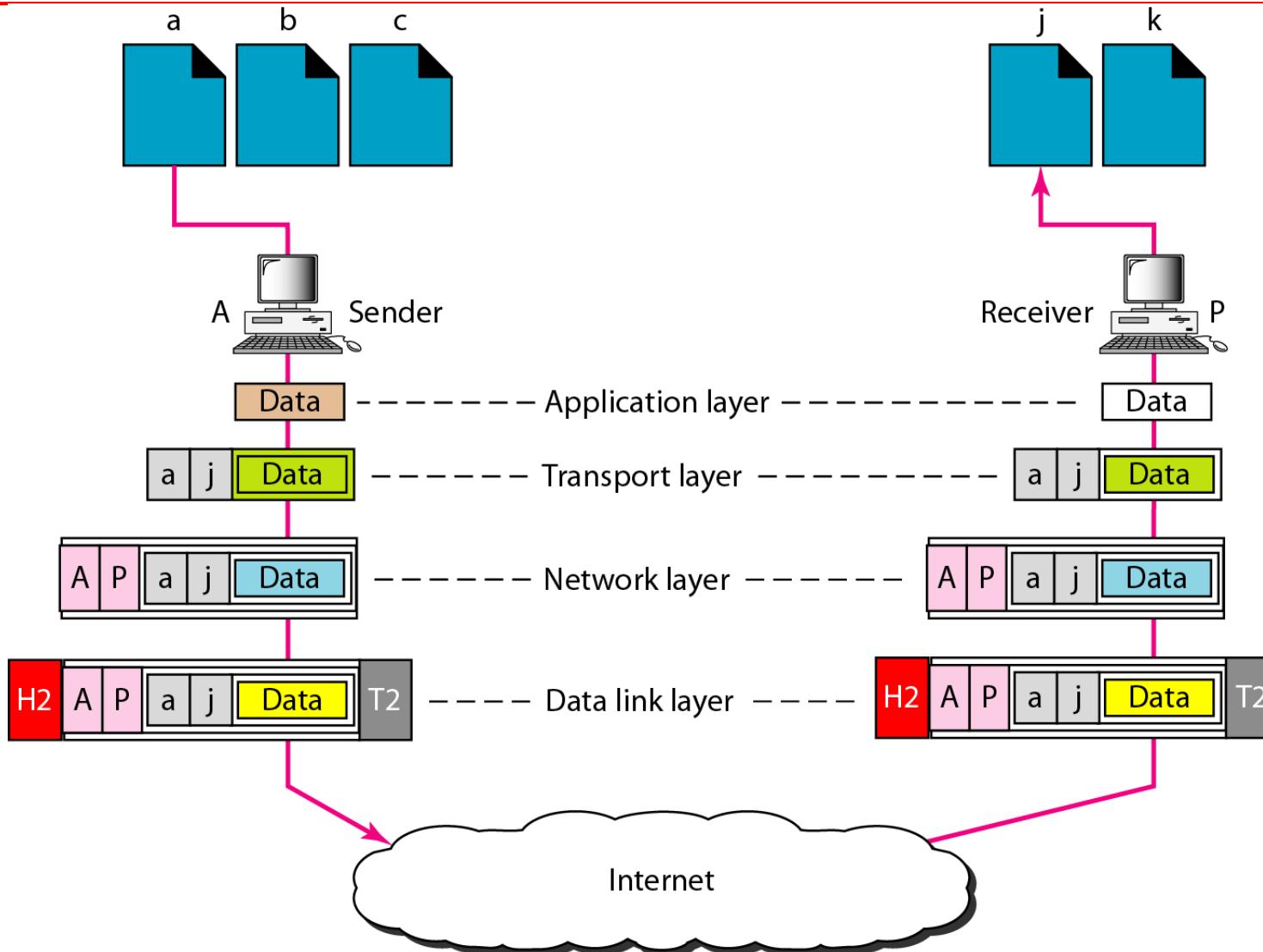


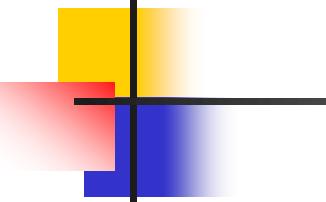


## *Example 2.4*

*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.*

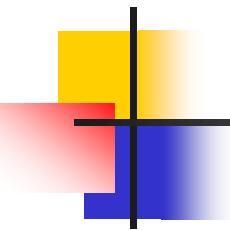
**Figure 2.21 Port addresses**





## **Note**

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

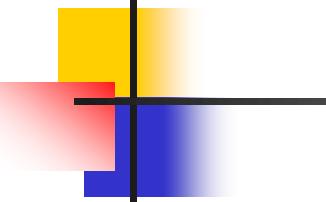


## *Example 2.5*

*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.**