# DATA COMMUNICATIONS AND NETWORKING

## Network Models: Continue…

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**BIT 2nd Year, 1st Semester**

# Outline

- Layered Tasks
- Network Layer
- Transport Layer
- Session Layer
- Presentation Layer
- Application Layer
- TCP/IP Protocol Suite
- Addressing
- Summary: Lect2 & Lect3

# LAYERS IN THE OSI MODEL (continue…)

➢ Network Layer

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

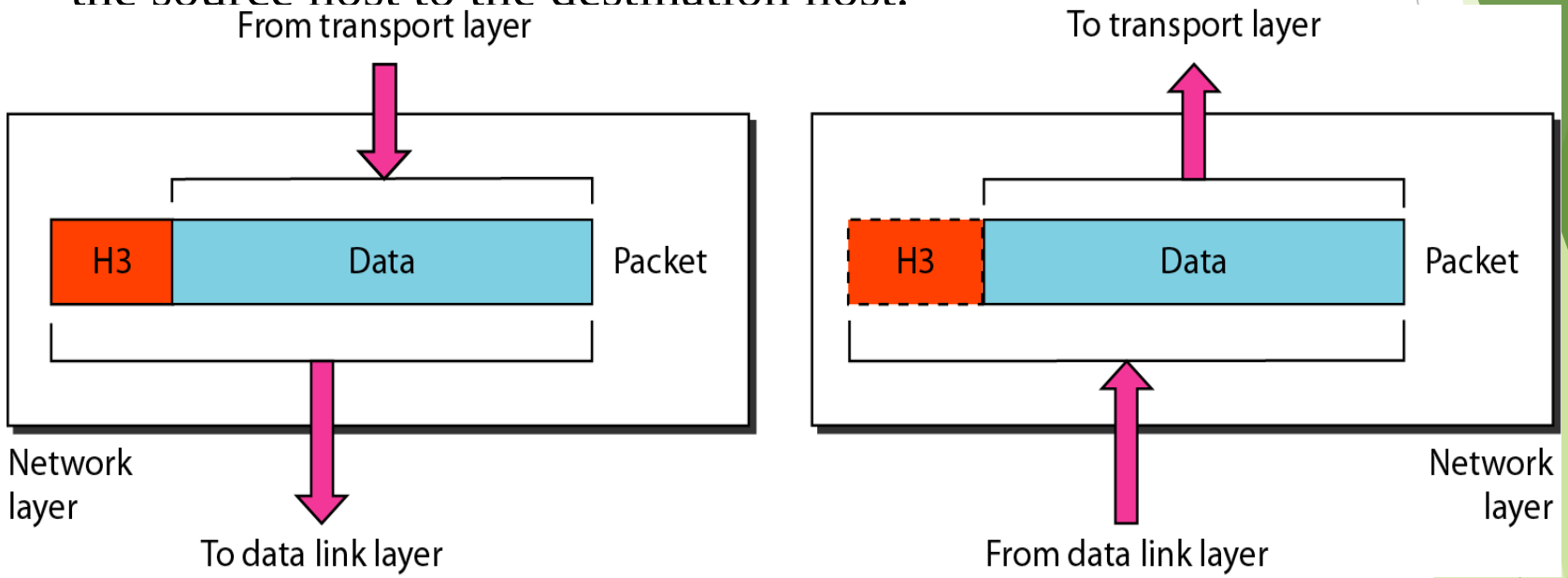


Figure 8. Network layer

- Other responsibilities of the network layer include the following:
- Logical addressing. The physical addressing implemented by the data link layer handles the addressing problem locally. If a packet passes the network boundary, we need another addressing system to help distinguish the source and destination systems.

# LAYERS IN THE OSI MODEL (continue…)

- Network Layer (continue…)
- Routing. When independent networks or links are connected to create intemetworks (network of networks) or a large network, the connecting devices (called routers or switches) route or switch the packets to their final destination. One of the functions of the network layer is to provide this mechanism.

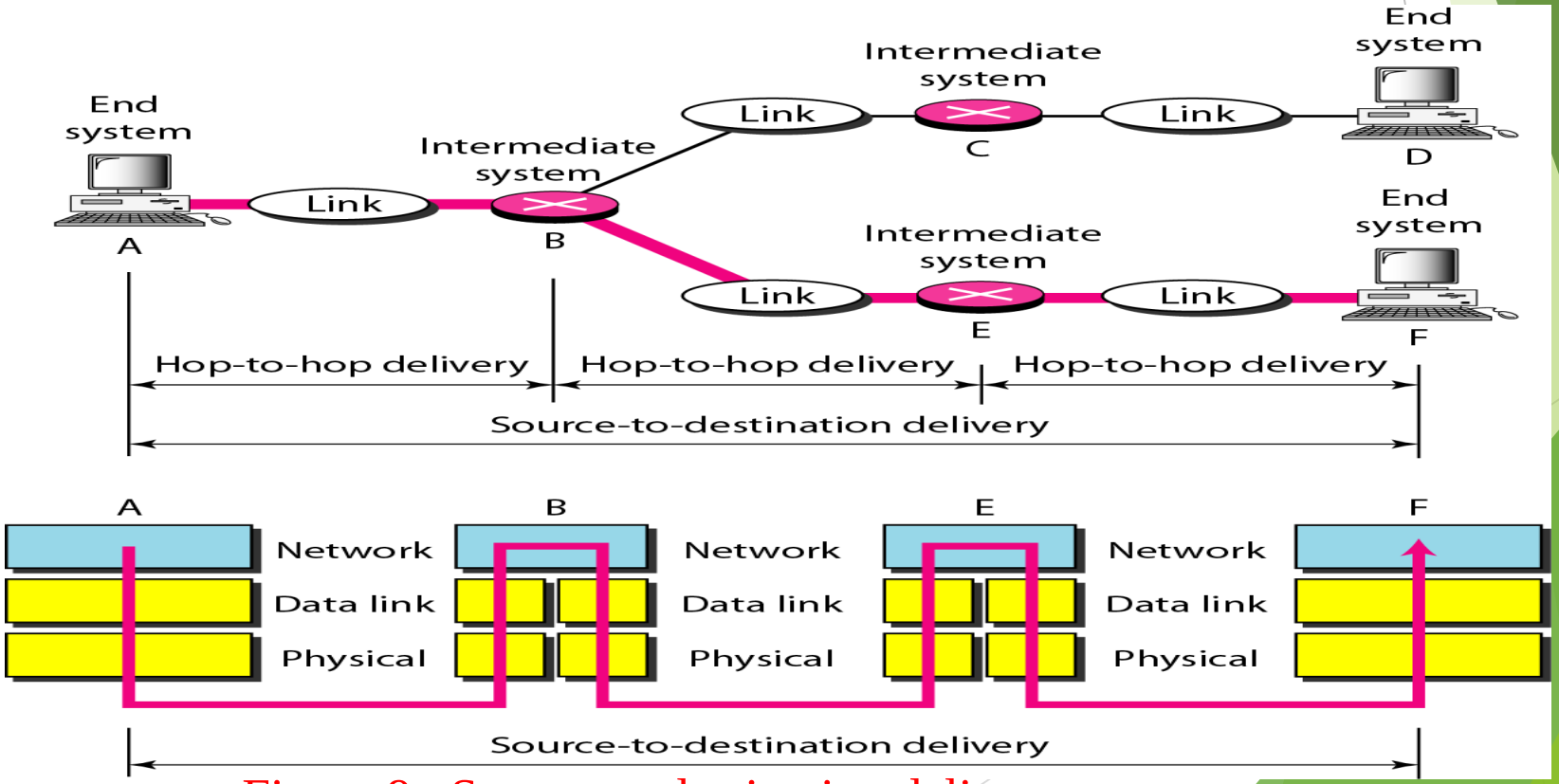


Figure 9. Source-to-destination delivery

# LAYERS IN THE OSI MODEL (continue…)

## Network Layer (continue…)

- The network layer at A sends the packet to the network layer at B. When the packet arrives at router B, the router makes a decision based on the final destination (F) of the packet. Router B uses its routing table to find that the next hop is router E. The network layer at B, therefore, sends the packet to the network layer at E. The network layer at E, in tum, sends the packet to the network layer at F.

## Transport Layer

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

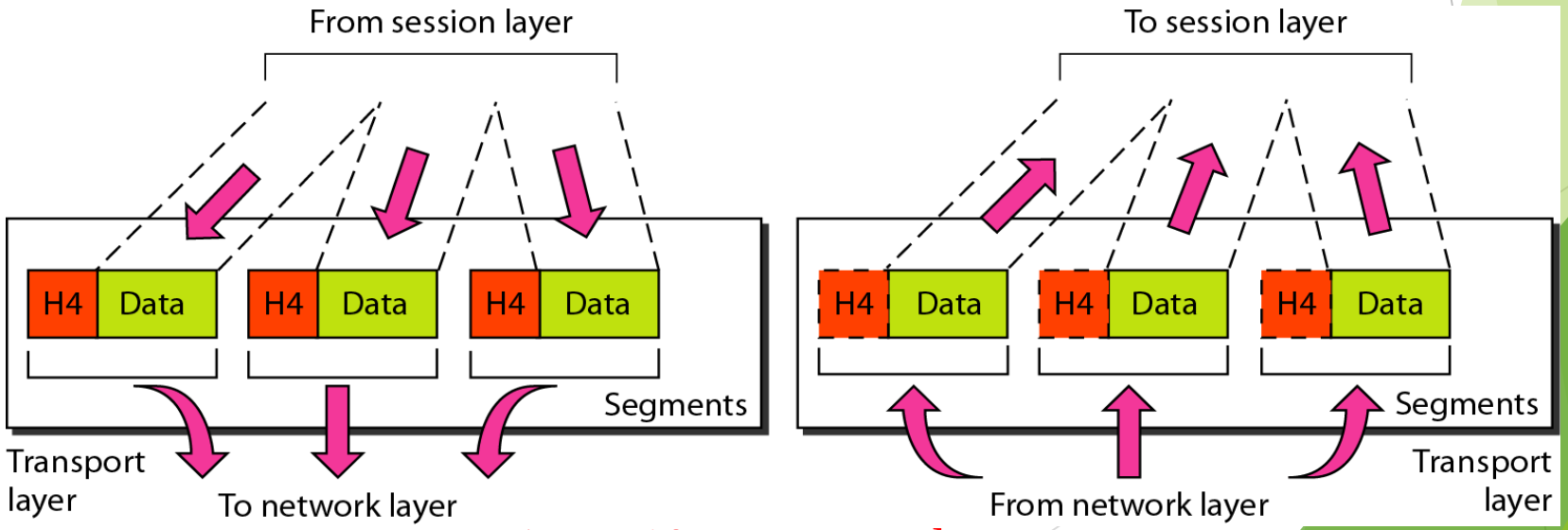


Figure 10. Transport layer

# LAYERS IN THE OSI MODEL (continue…)

## ➢ Transport Layer (continue…)

- Other responsibilities of the transport layer include the following:
- Service-point addressing. Computers often run several programs at the same time. For this reason, source-to-destination delivery means delivery not only from one computer to the next but also from a specific process (running program) on one computer to a specific process (running program) on the other. The transport layer header must therefore include a type of address called a service-point address (or port address). The network layer gets each packet to the correct computer; the transport layer gets the entire message to the correct process on that computer.
- Segmentation and reassembly. A message is divided into transmittable segments, with each segment containing a sequence number. These numbers enable the transport layer to reassemble the message correctly upon arriving at the destination and to identify and replace packets that were lost in transmission.

# LAYERS IN THE OSI MODEL (continue…)

➢ Transport Layer (continue…)

- Connection control. The transport layer can be either connectionless or connection oriented. A connectionless transport layer treats each segment as an independent packet and delivers it to the transport layer at the destination machine. A connection oriented transport layer makes a connection with the transport layer at the destination machine first before delivering the packets. After all the data are transferred, the connection is terminated.
- Flow control. Like the data link layer, the transport layer is responsible for flow control. However, flow control at this layer is performed end to end rather than across a single link.
- Error control. Like the data link layer, the transport layer is responsible for error control. However, error control at this layer is performed process-to process rather than across a single link. The sending transport layer makes sure that the entire message arrives at the receiving transport layer without error (damage, loss, or duplication). Error correction is usually achieved through retransmission.

# LAYERS IN THE OSI MODEL (continue…)

- Transport Layer (continue…)

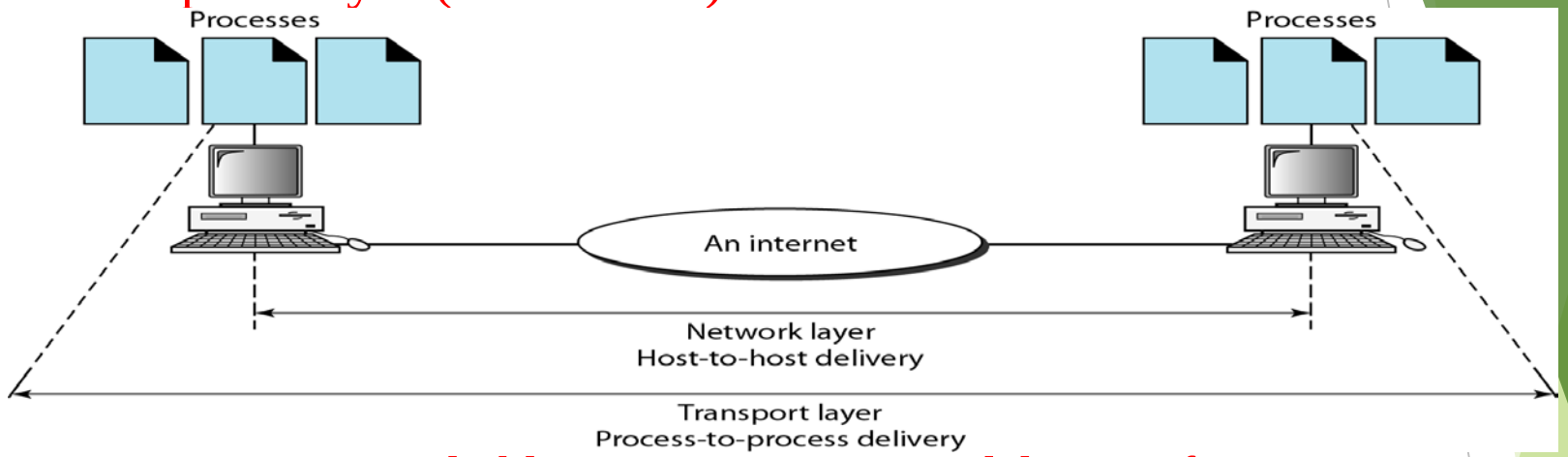


Figure 11. Reliable process-to-process delivery of a message

- Session Layer

Session layer is responsible for dialog control and synchronization.

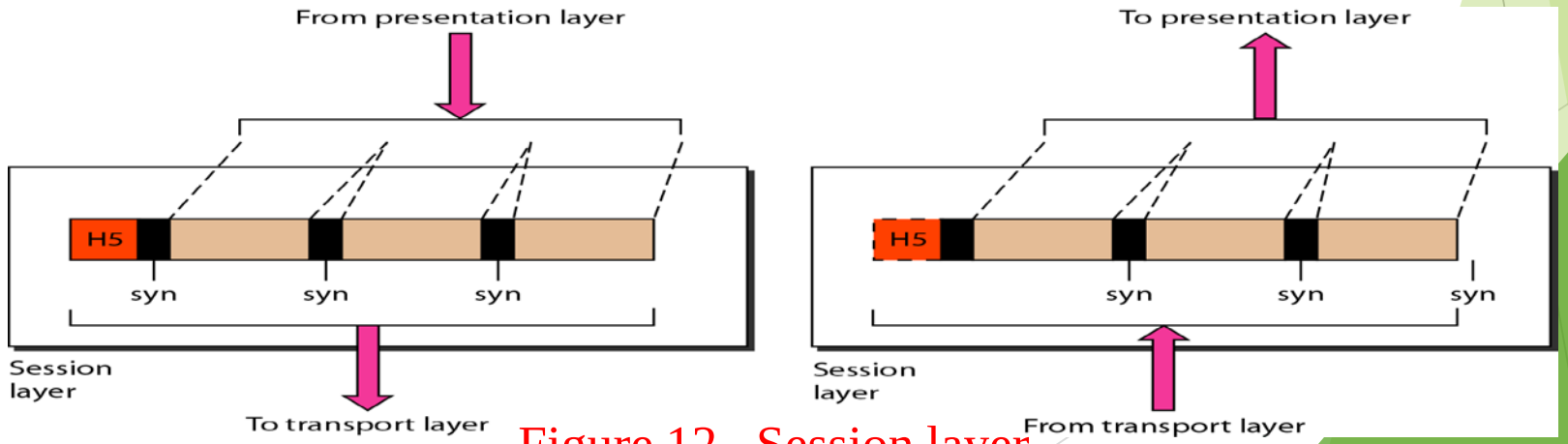


Figure 12. Session layer

# LAYERS IN THE OSI MODEL (continue…)

➢ Session Layer (continue…)

- Specific responsibilities of the session layer include the following:
- Dialog control. The session layer allows two systems to enter into a dialog. It allows the communication between two processes to take place in either half-duplex (one way at a time) or full-duplex (two ways at a time) mode.
- Synchronization. The session layer allows a process to add checkpoints, or synchronization points, to a stream of data. For example, if a system is sending a file of 2000 pages, it is advisable to insert checkpoints after every 100 pages to ensure that each 100-page unit is received and acknowledged independently. In this case, if a crash happens during the transmission of page 523, the only pages that need to be resent after system recovery are pages 501 to 523. Pages previous to 501 need not be resent. Figure 12. illustrates the relationship of the session layer to the transport and presentation layers.

# LAYERS IN THE OSI MODEL (continue…)

➢ Presentation layer

- Presentation layer is responsible for translation, compression, and encryption.

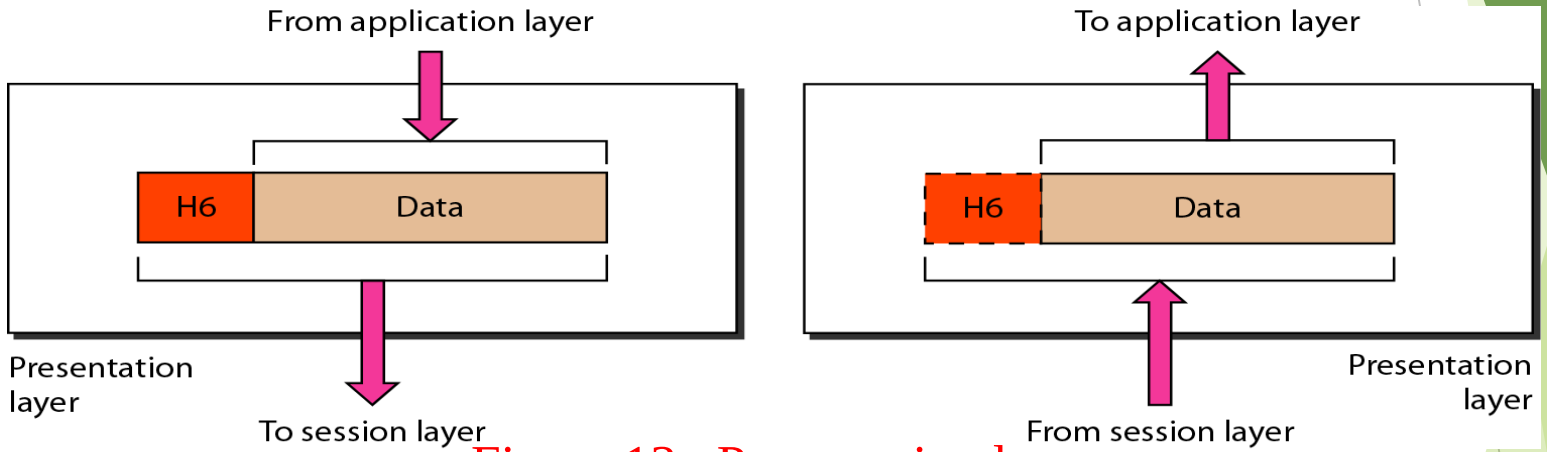


Figure 13. Presentation layer

- Specific responsibilities of presentation layer include the following:
- Translation. The processes (running programs) in two systems are usually exchanging information in the form of character strings, numbers, and so on. The information must be changed to bit streams before being transmitted. Because different computers use different encoding systems, the presentation layer is responsible for interoperability between these different encoding methods.

# LAYERS IN THE OSI MODEL (continue…)

- Presentation layer (continue…)
- Encryption. To carry sensitive information, a system must be able to ensure privacy. Encryption means that the sender transforms the original information to another form and sends the resulting message out over the network. Decryption reverses the original process to transform the message back to its original form.
- Compression. Data compression reduces the number of bits contained in the information. Data compression becomes particularly important in the transmission of multimedia such as text, audio, and video.
- Application Layer
- Application layer is responsible for providing services to the user

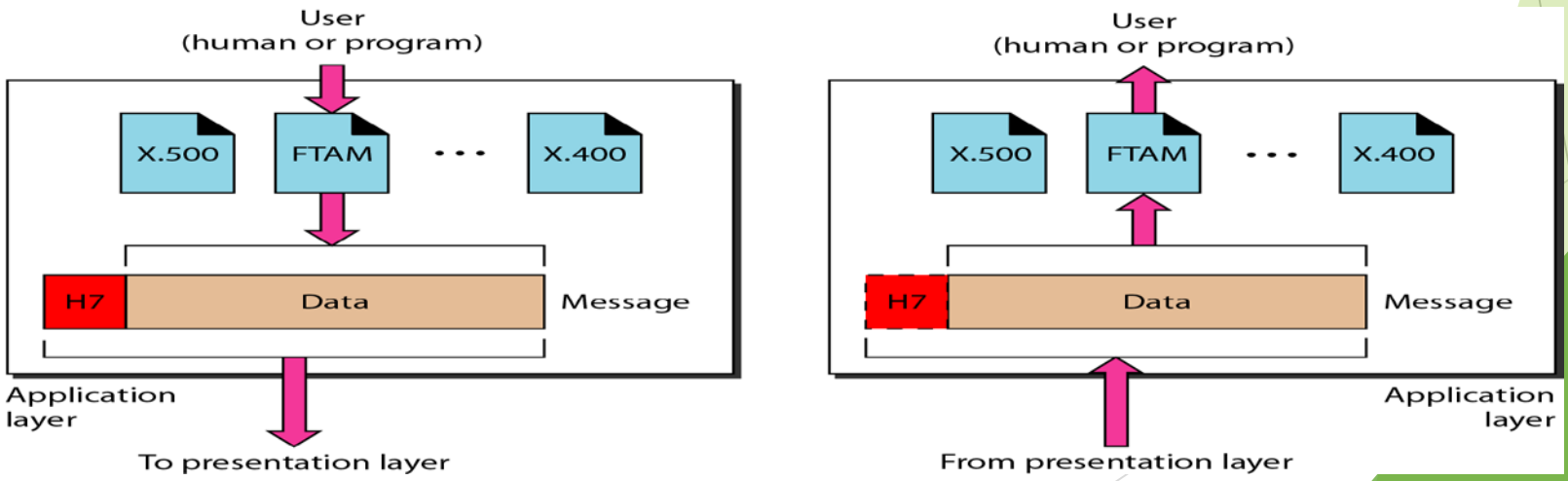


Figure 14. Application layer

# LAYERS IN THE OSI MODEL (continue…)

➢ Application Layer

- It provides user interfaces and support for services such as electronic mail, remote file access and transfer, shared database management, and other types of distributed information services.
- Specific services provided by the application layer include the following:
- Network virtual terminal. A network virtual terminal is a software version of a physical terminal, and it allows a user to log on to a remote host. To do so, the application creates a software emulation of a terminal at the remote host.
- File transfer, access, and management. This application allows a user to access files in a remote host (to make changes or read data), to retrieve files from a remote computer for use in the local computer, and to manage or control files in a remote computer locally.
- Mail services. This application provides the basis for e-mail forwarding and storage.
- Directory services. This application provides distributed database sources and access for global information about various objects and services.

# LAYERS IN THE OSI MODEL (continue…)

- Summary of Layers

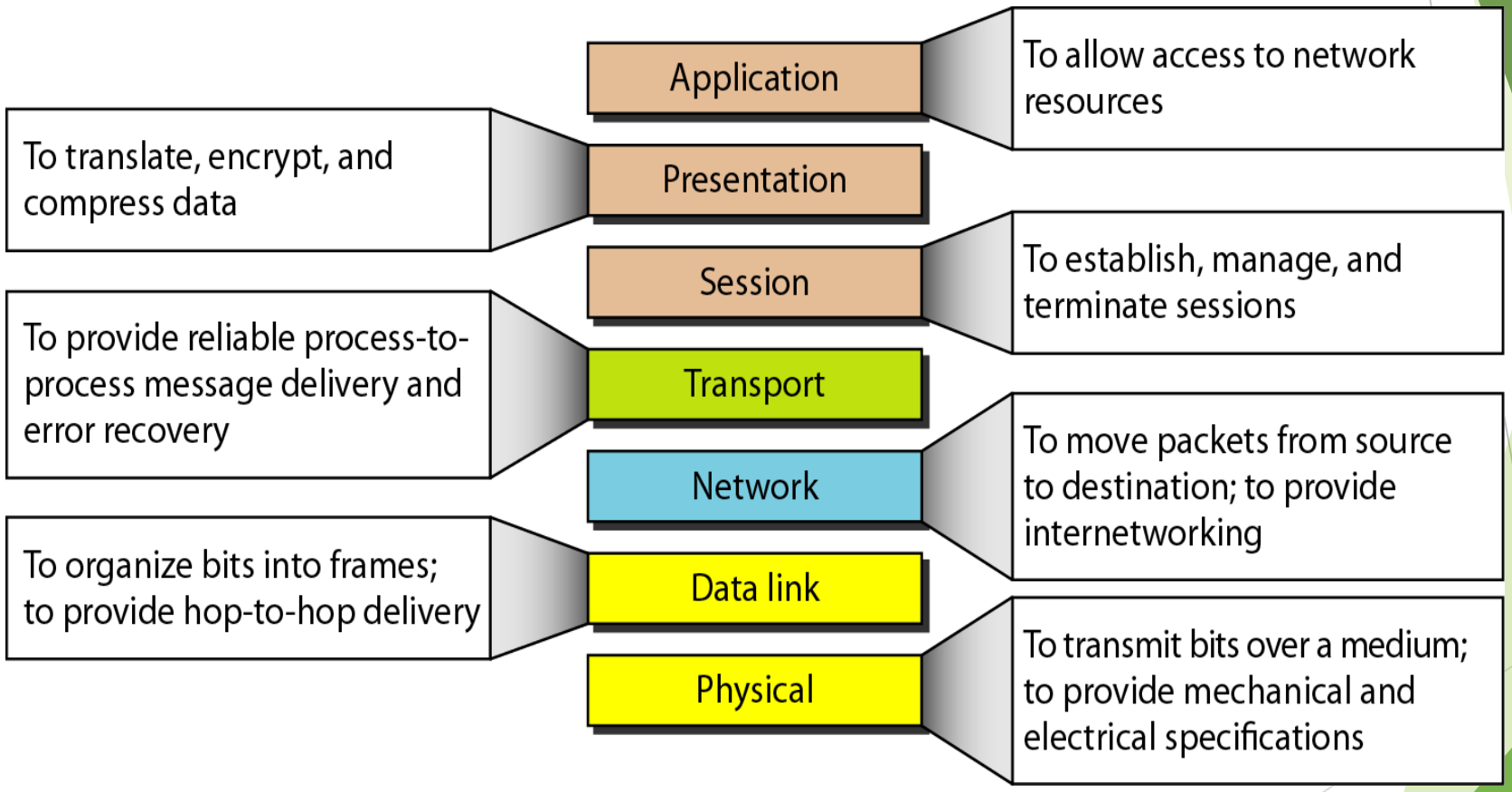


Figure 15. Summary of layers

# 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.

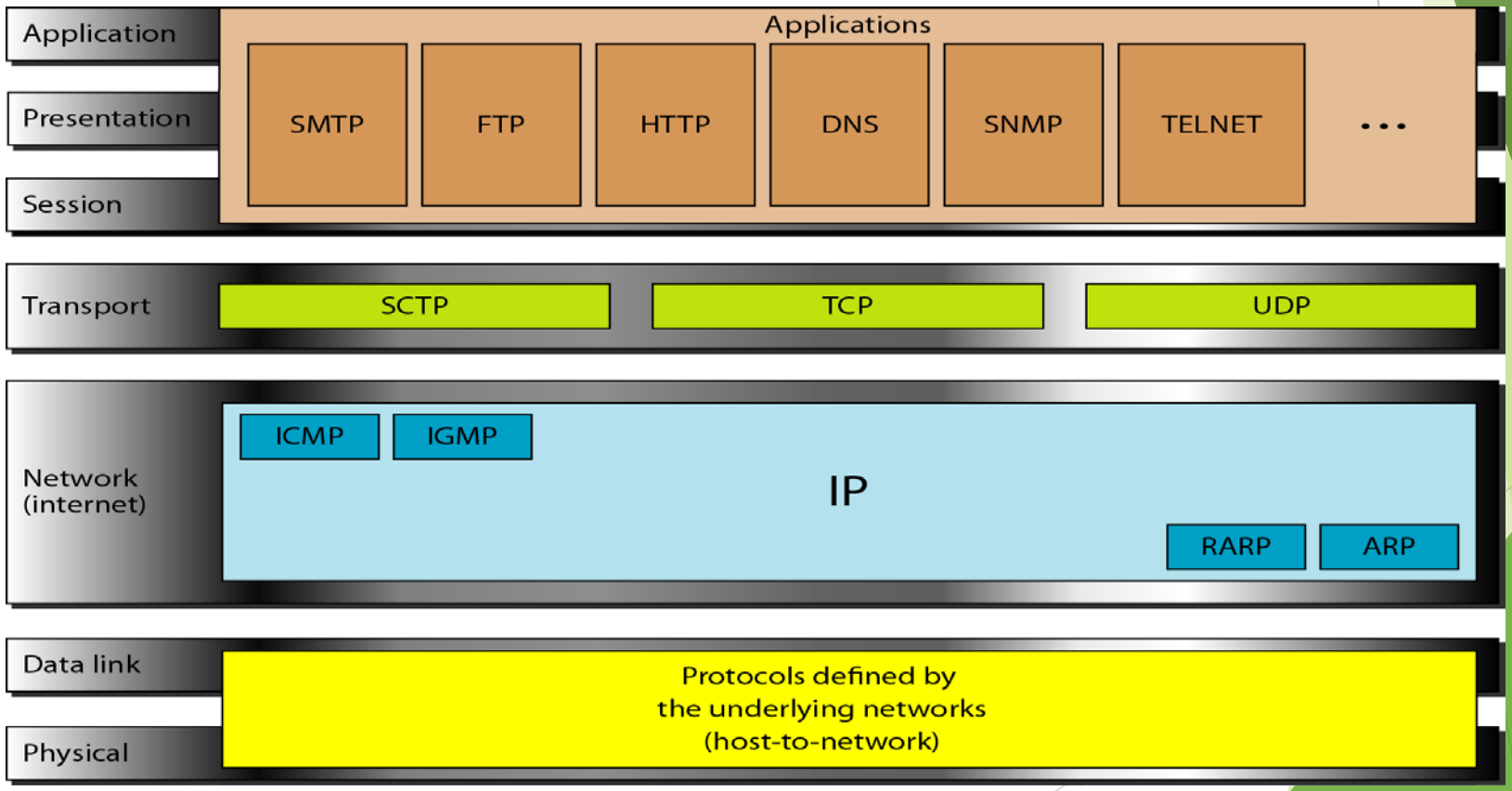


Figure 16. TCP/IP and OSI model

# TCP/IP PROTOCOL SUITE (continue…)

- Host-to-network : Physical and data link layer
- No specific protocol

- Network layer
- IP(Internet Protocl), ARP(Address Resolution Protocol), RARP(Reverse ARP), ICMP(Internet Control Message Protocol), IGMP(Internet Group Message Protocol)

- Transport layer
- TCP(Transmission Control Protocol), UDP(User Datagram Protocl), SCTP(Stream Control Transmission Protocol),

- Application Layer
- Combined session, presentation, and application layers

# ADDRESSING

Four levels of addresses in TCP/IP protocols Physical (link), logical (IP, network), port, and specific addresses

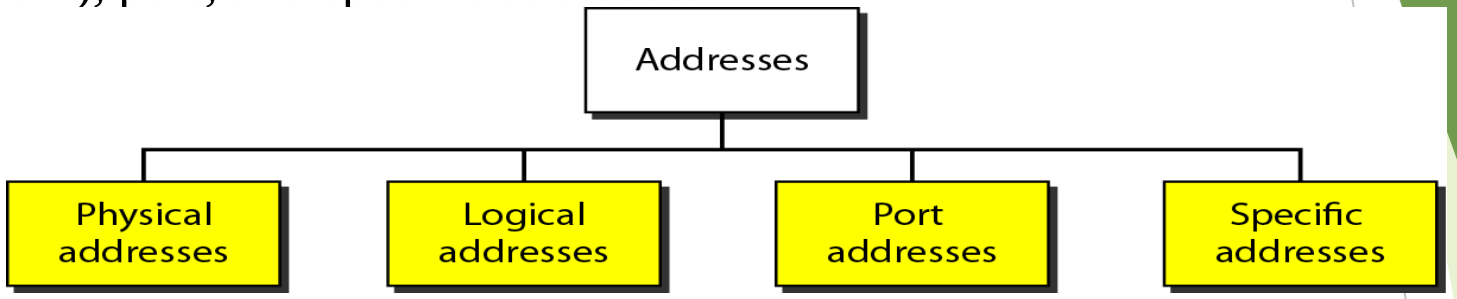


Figure 17. Addresses in TCP/IP

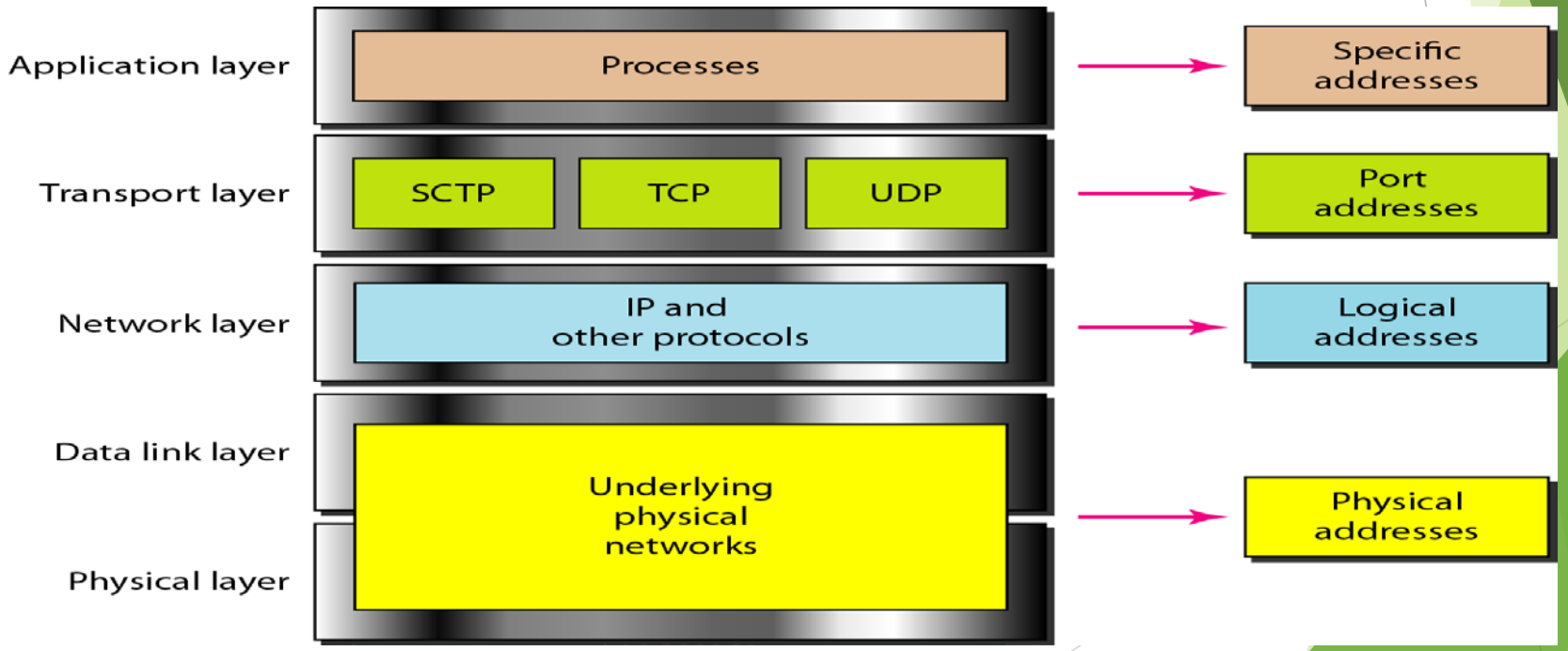


Figure 18. Relationship of layers and addresses in TCP/IP

# ADDRESSING (continue…)

- Physical addresses

In Figure 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.

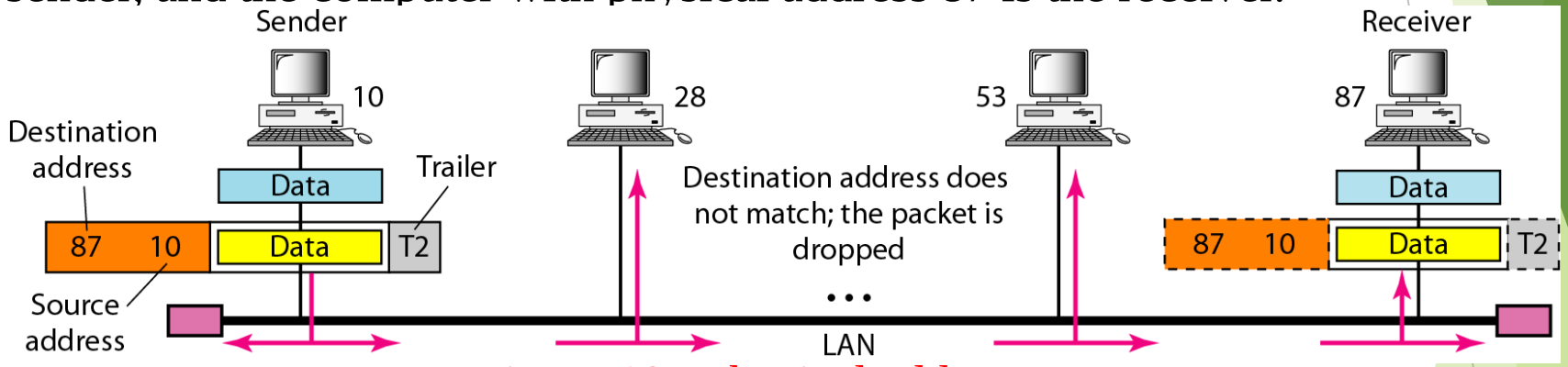


Figure 19. Physical addresses

- Most local-area networks use a 48-bit (6-byte) physical address written as 12 hexadecimal digits; every byte (12 hexadecimal digits) is separated by a colon, as shown below:

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

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

# ADDRESSING (continue…)

- Logical (IP) Addresses

Figure 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.

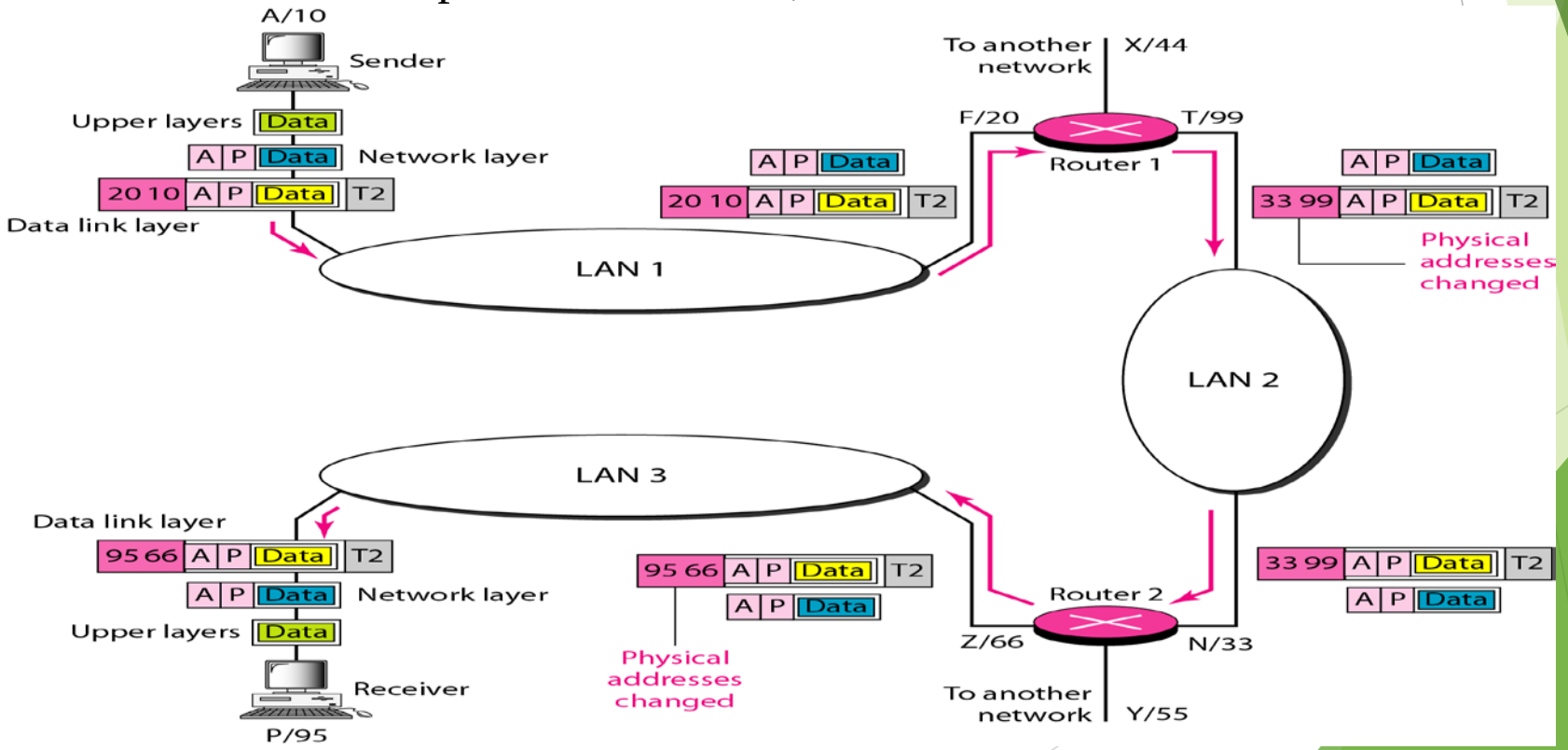


Figure 20. IP addresses

# ADDRESSING (continue…)

- Port Addresses

Figure 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.

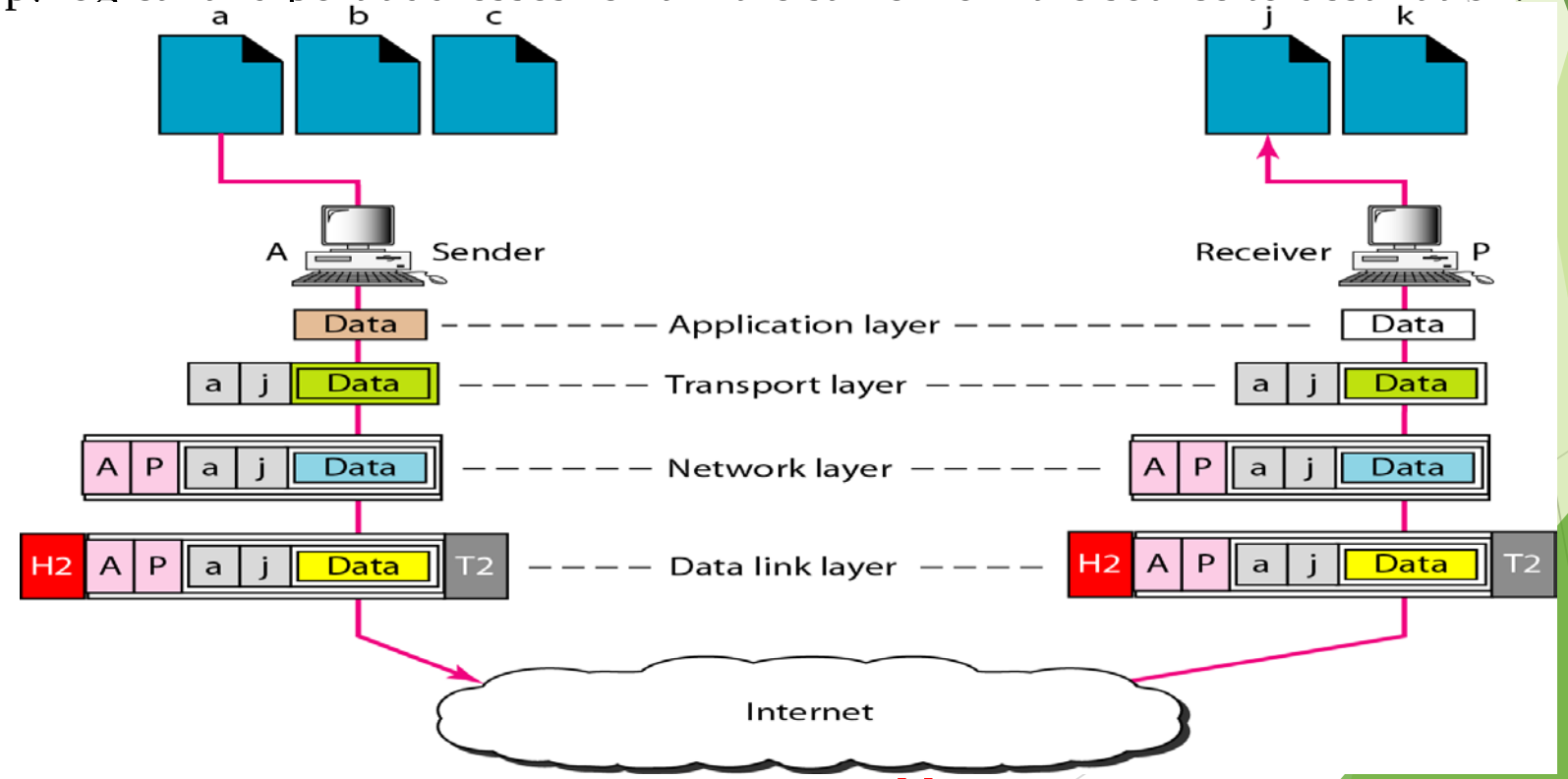


Figure 21. Port addresses

# ADDRESSING (continue…)

- Port Addresses (continue…)

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

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- Specific Addresses

Some application have user-friendly addresses that are designed for that specific address.

Example 1: e-mail address: kchung@kw.ac.kr

- Defines the recipient of an e-mail

Example 2: URL (Universal Resource Locator) : www.kbs.co.kr

- Used to find a document on the WWW

# Summary: Lect2 & Lect3

- The International Standards Organization created a model called the Open Systems Interconnection, which allows diverse systems to communicate.
- The seven-layer OSI model provides guidelines for the development of universally compatible networking protocols.
- The physical, data link, and network layers are the network support layers.
- The session, presentation, and application layers are the user support layers.
- The transport layer links the network support layers and the user support layers.
- The physical layer coordinates the functions required to transmit a bit stream over a physical medium.
- The data link layer is responsible for delivering data units from one station to the next without errors.
- The network layer is responsible for the source-to-destination delivery of a packet across multiple network links.
- The transport layer is responsible for the process-to-process delivery of the entire message.
- The session layer establishes, maintains, and synchronizes the interactions between communicating devices.

# Summary (continue…)

- The presentation layer ensures interoperability between communicating devices through transformation of data into a mutually agreed upon format.
- The application layer enables the users to access the network.
- TCP/IP is a five-layer hierarchical protocol suite developed before the OSI model.
- The TCP/IP application layer is equivalent to the combined session, presentation, and application layers of the OSI model.
- Four levels of addresses are used in an internet following the TCP/IP protocols: physical (link) addresses, logical (IP) addresses, port addresses, and specific addresses.
- The physical address, also known as the link address, is the address of a node as defined by its LAN or WAN.
- The IP address uniquely defines a host on the Internet.
- The port address identifies a process on a host.
- A specific address is a user-friendly address.