Chapter 3:
Network Protocols and Communications

Introduction to Networks v5.1

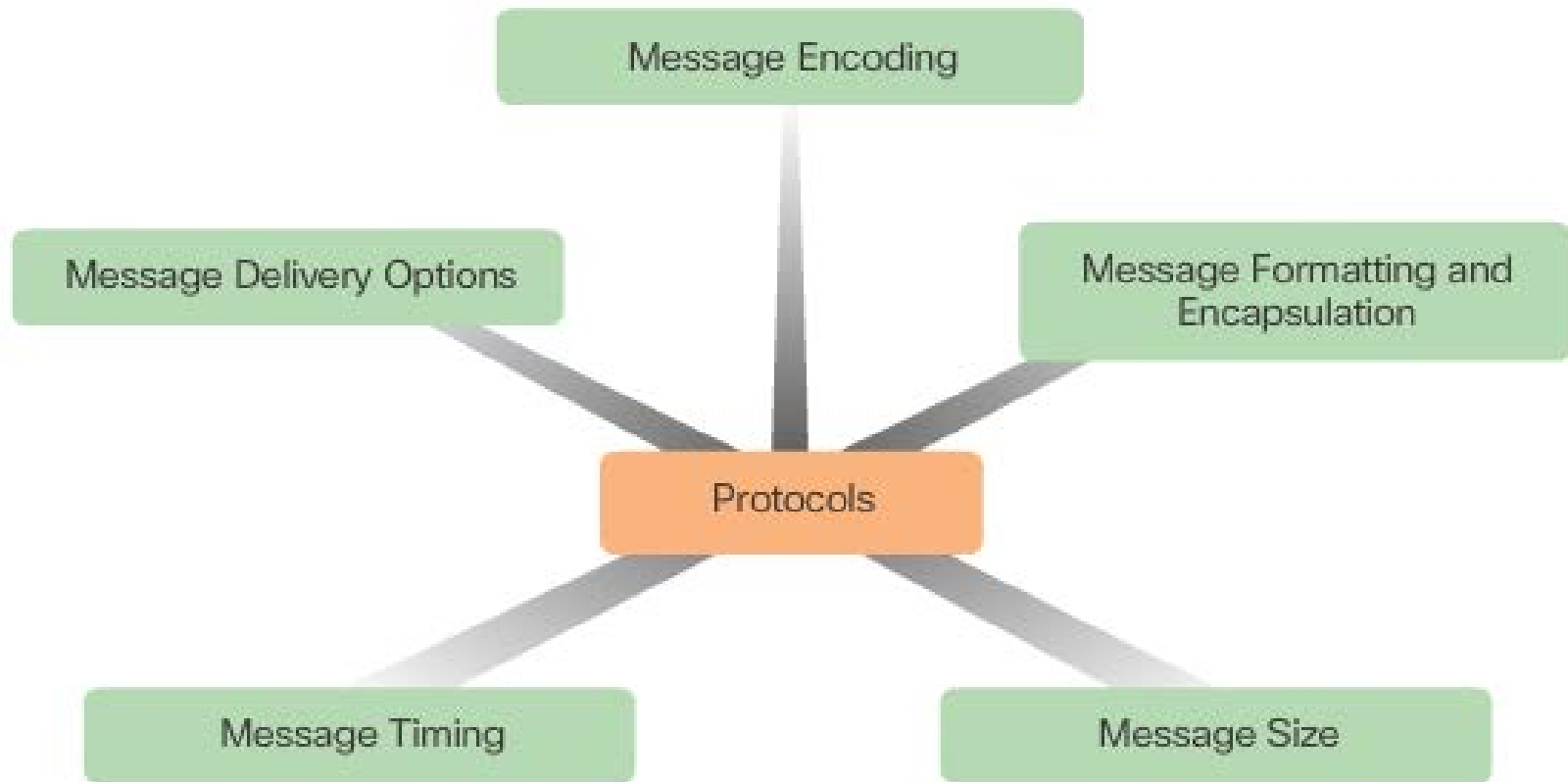# Chapter Outline

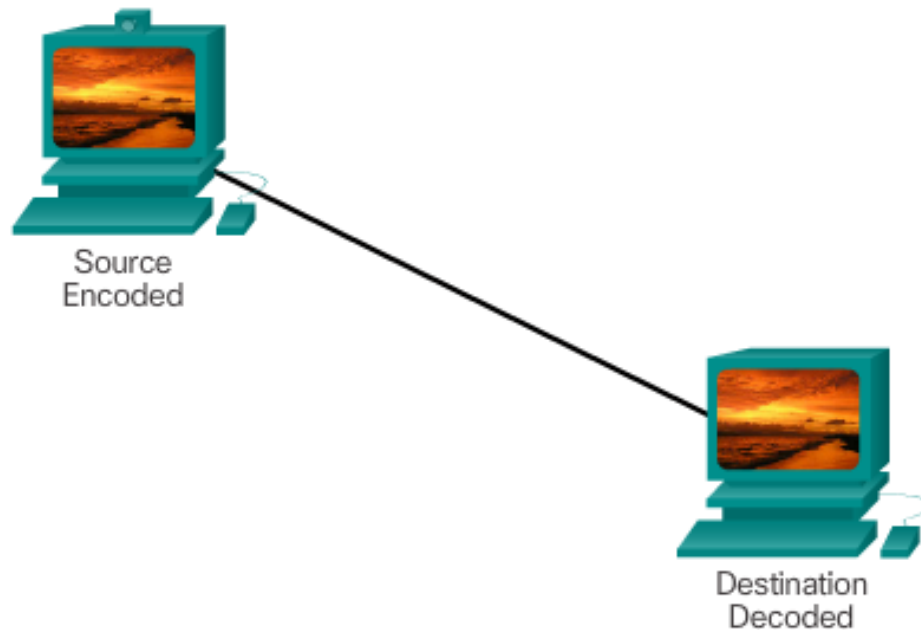# Communication Fundamentals (Cont.)

Computer Communication
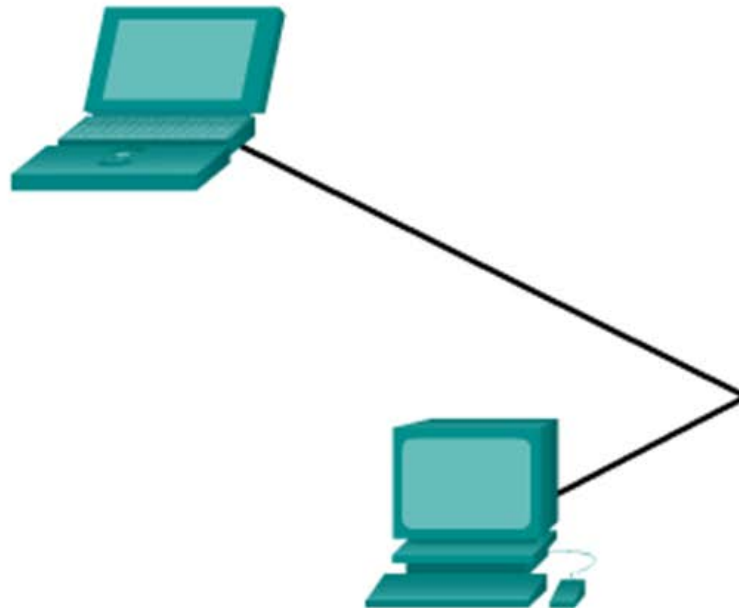
Rule Establishment (cont.)

Message Encoding (cont.)

Message Formatting and Encapsulation (cont.)

| Destination (physical / hardware address)	Source (physical / hardware address)	Start Flag (start of message indicator)	Recipient (destination identifier)	Sender (source identifier)	Encapsulated Data (bits)	End of Frame (end of message indicator)
Frame Addressing		Encapsulated Message				

Message Size

Computer Communication

- The source host breaks a long message into individual pieces or frames that meet both the minimum and maximum size requirements.

- Each frame will also have its own addressing information.

- At the receiving host, the pieces are reconstructed to be processed and interpreted.

Message Delivery Options (cont.)
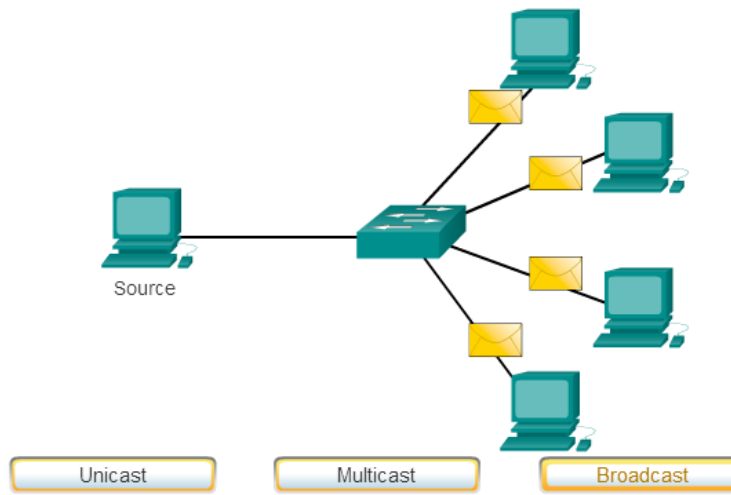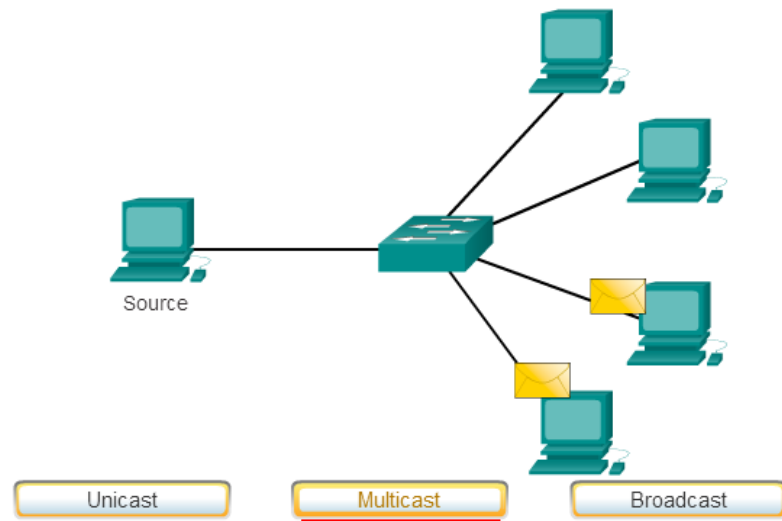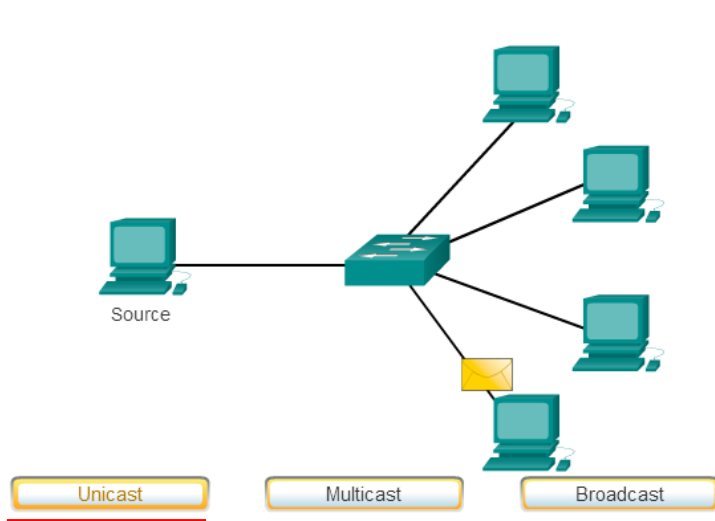
Test Question

Section 3.2:
Network Protocols and Standards

Upon completion of this section, you should be able to:

- Explain why protocols are necessary in communication.

- Explain the purpose of adhering to a protocol suite.

- Explain the role of standards organizations in establishing protocols for network interoperability.

- Explain how the TCP/IP model and the OSI model are used to facilitate standardization in the communication process.

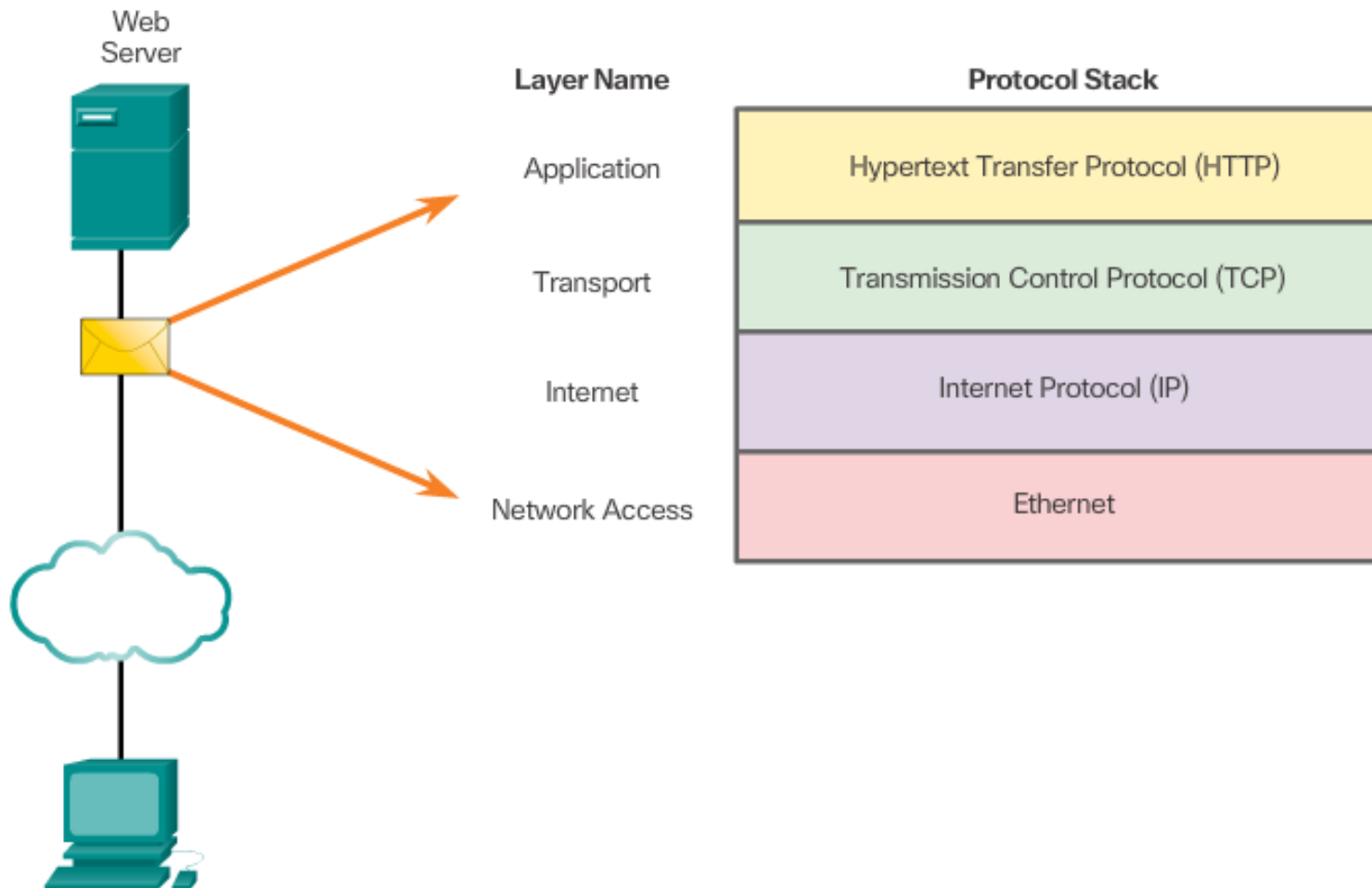# Topic 3.2.1:
Protocols

Network Protocols

- The role of protocols

- How the message is formatted or structured

- The process by which networking devices share information about pathways with other networks

- How and when error and system messages are passed between devices

- The setup and termination of data transfer sessions

Protocol Interaction

Interaction of protocols in communication between a web server and web client.

Web Server

Layer Name	Protocol Stack
Application	Hypertext Transfer Protocol (HTTP)
Transport	Transmission Control Protocol (TCP)
Internet	Internet Protocol (IP)
Network Access	Ethernet

Topic 3.2.2:
Protocol Suites

Protocol Suites and Industry Standards

TCP/IP Protocol Suite
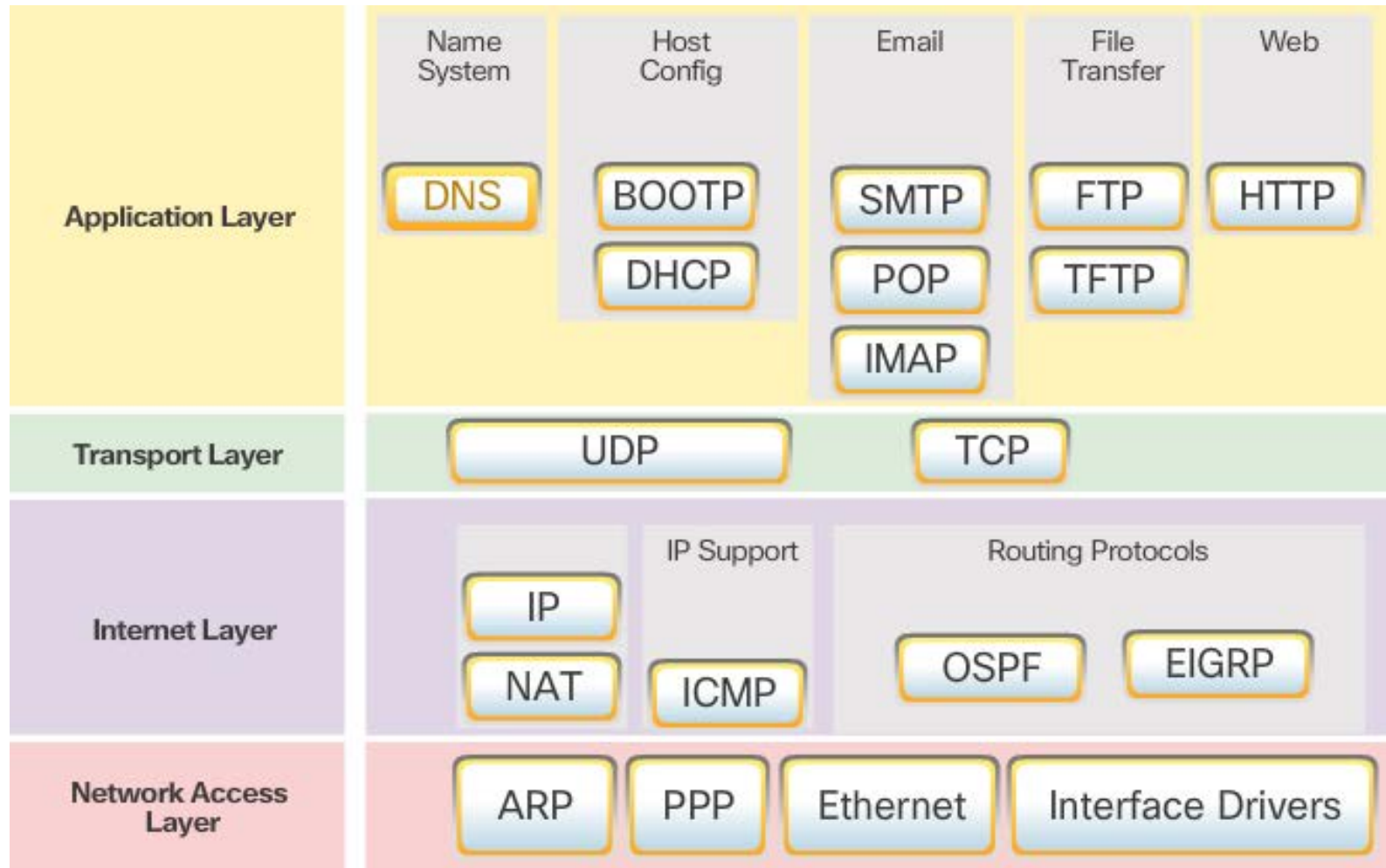
TCP/IP Communication Process
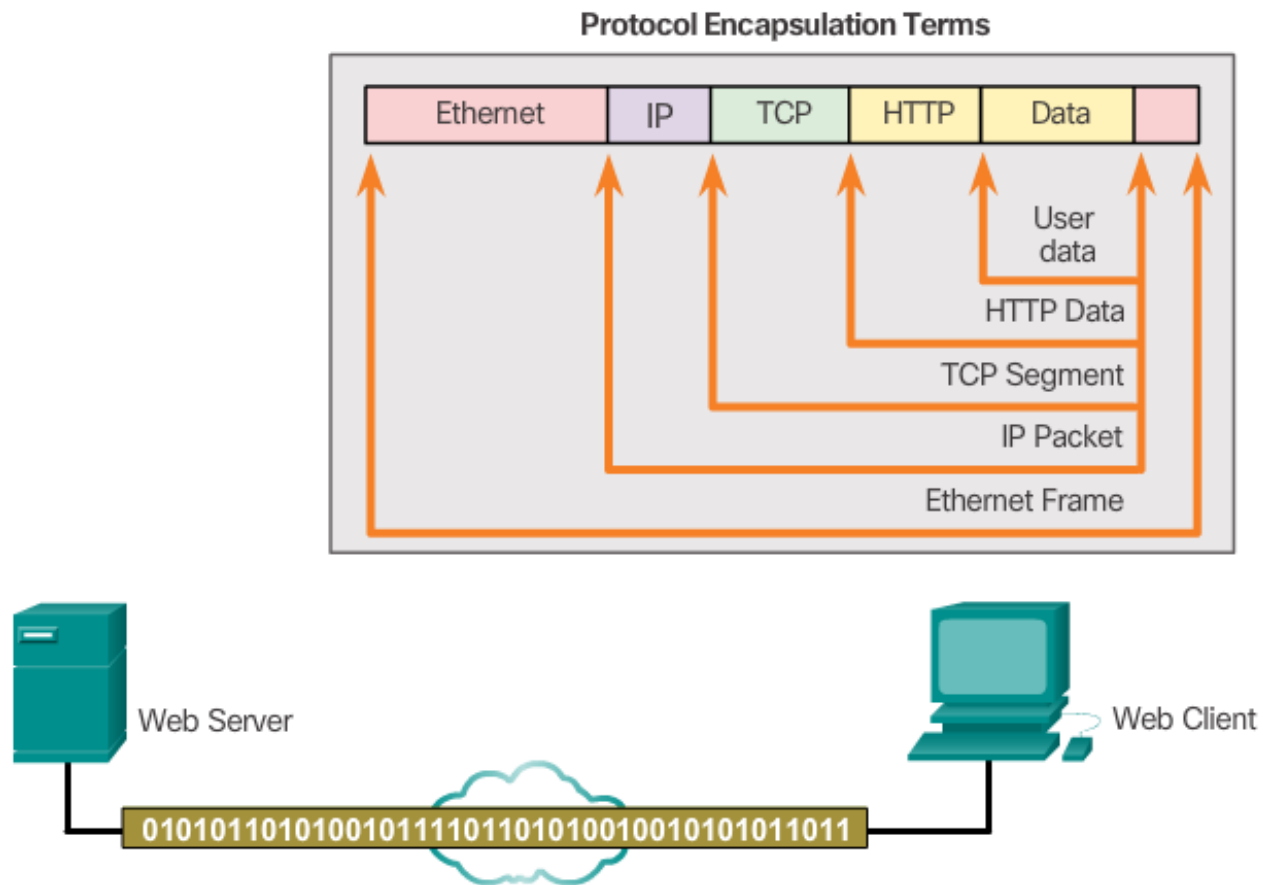
Protocol Operation - Sending a Message
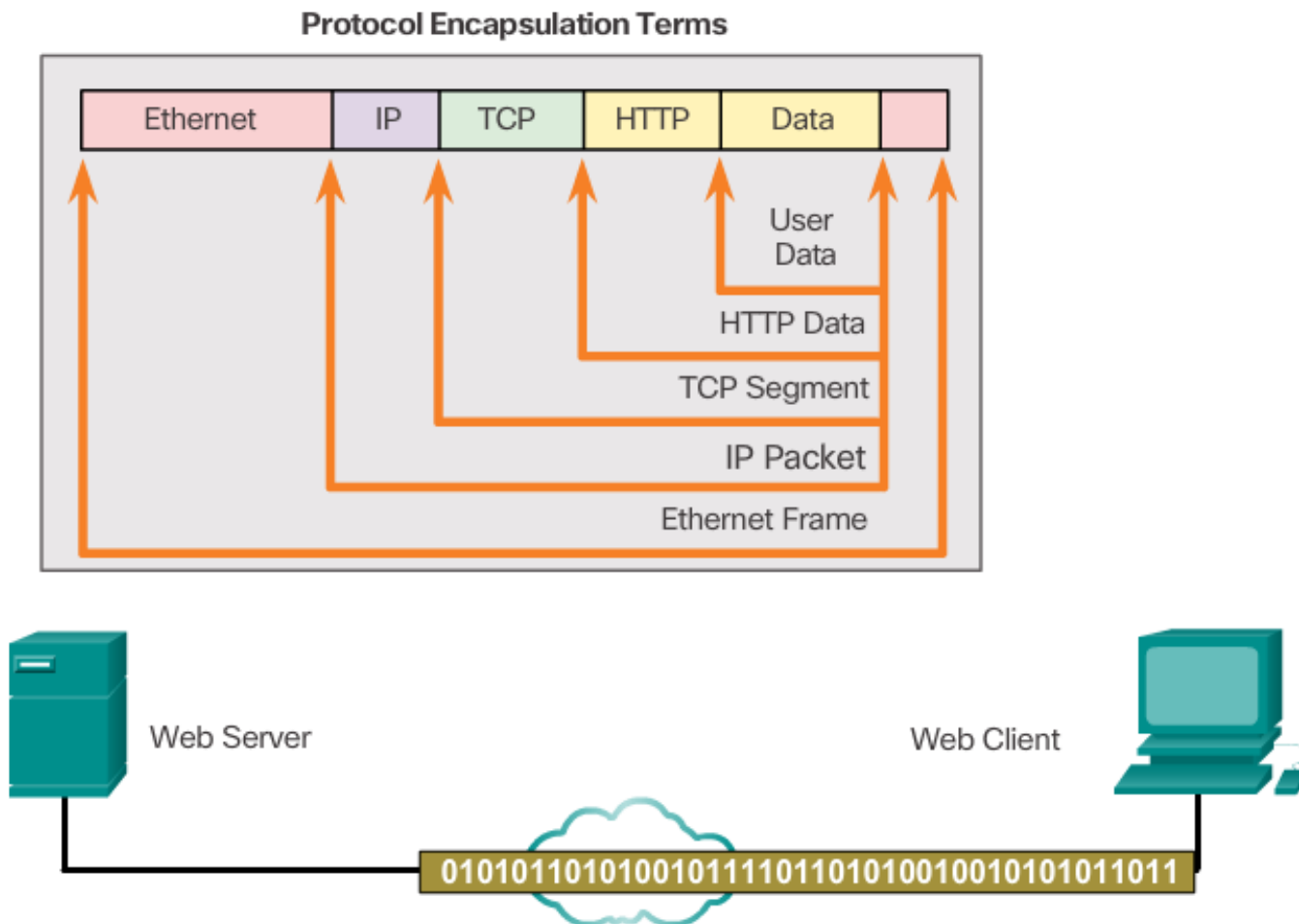
TCP/IP Communication Process

Protocol Operation – Receiving a Message

Topic 3.2.3:
Standard Organizations

Electronics and Communications Standard Organizations

Institute of Electrical and Electronics Engineers (IEEE)

IEEE 802 Working Groups and Study Groups

- 802.1 Higher Layer LAN Protocols Working Group
- 802.3 Ethernet Working Group
- 802.11 Wireless LAN Working Group
- 802.15 Wireless Personal Area Network (WPAN) Working Group
- 802.16 Broadband Wireless Access Working Group
- 802.18 Radio Regulatory TAG
- 802.19 Wireless Coexistence Working Group
- 802.21 Media Independent Handover Services Working Group
- 802.22 Wireless Regional Area Networks
- 802.24 Smart Grid TAG

Electronics and Communications Standard Organizations (cont.)

EIA/TIA Standards
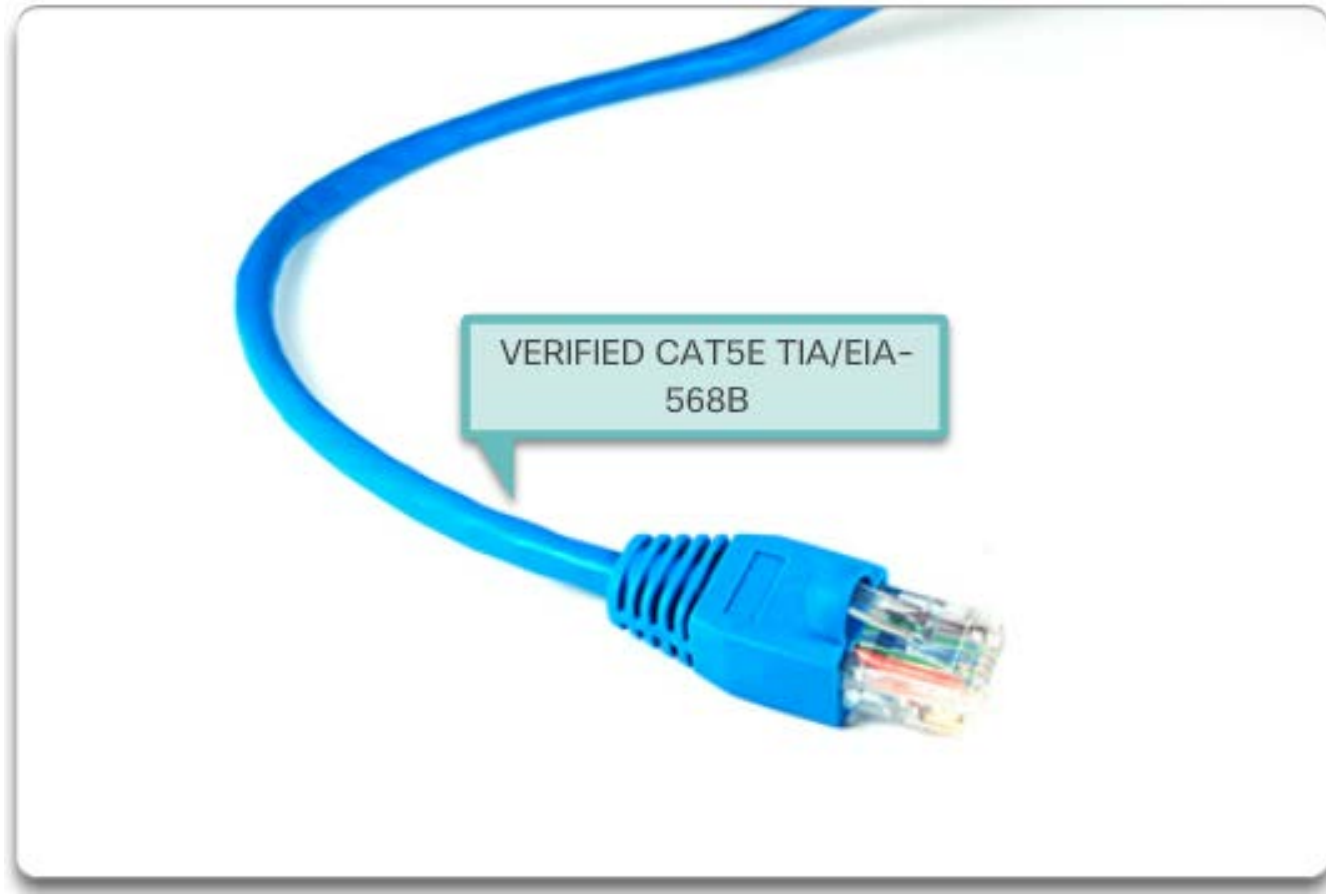
Topic 3.2.4:
Reference Models

The Benefits of Using a Layered Model

A networking model is only a representation of a network operation. The model is not the actual network.

OSI Model	TCP/IP Protocol Suite	TCP/IP Model
Application	HTTP, DNS, DHCP, FTP	Application
Presentation		
Session		
Transport	TCP, UDP	Transport
Network	IPv4, IPv6, ICMPv4, ICMPv6	Internet
Data Link	PPP, Frame Relay, Ethernet	Network Access
Physical		
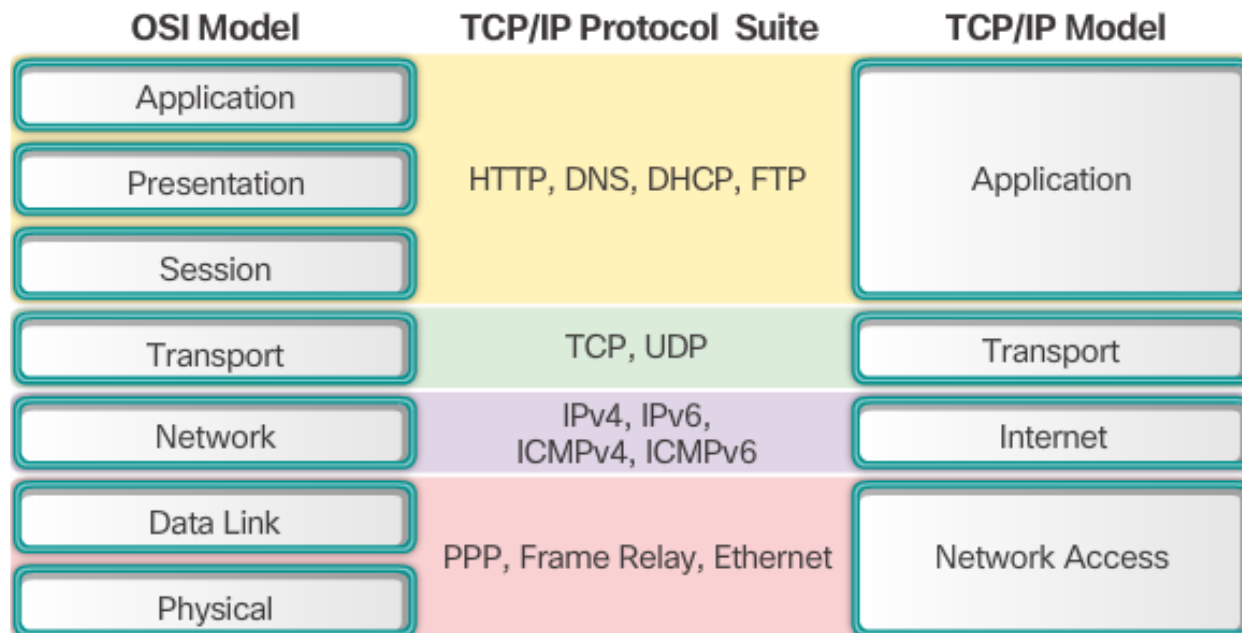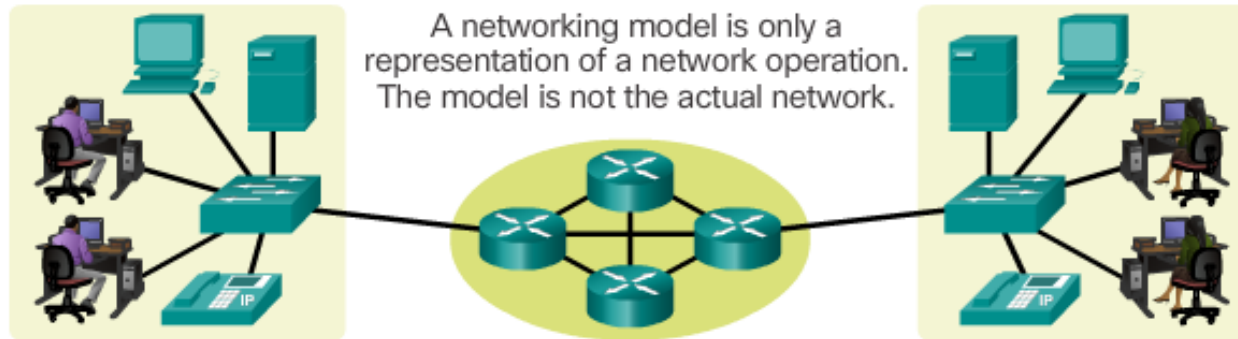
The OSI Reference Model

All People Seem To Need Data Processing.

OSI Model

7. Application
6. Presentation
5. Session
4. Transport
3. Network
2. Data Link
1. Physical

The TCP/IP Protocol Model

TCP/IP Model

Application	Represents data to the user, plus encoding and dialog control.
Transport	Supports communication between diverse devices across diverse networks.
Internet	Determines the best path through the network.
Network Access	Controls the hardware devices and media that make up the network.
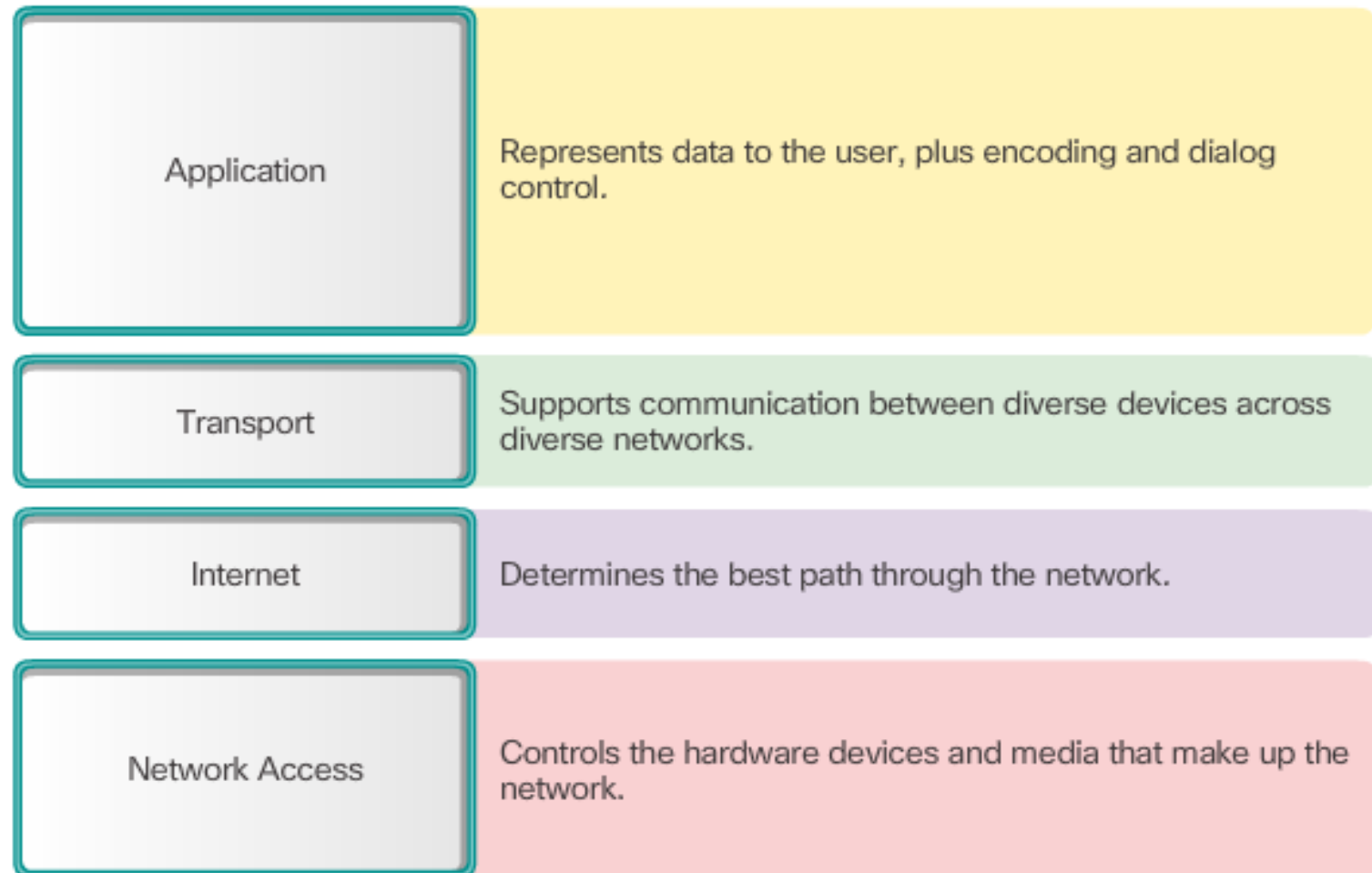
OSI Model and TCP/IP Model Comparison
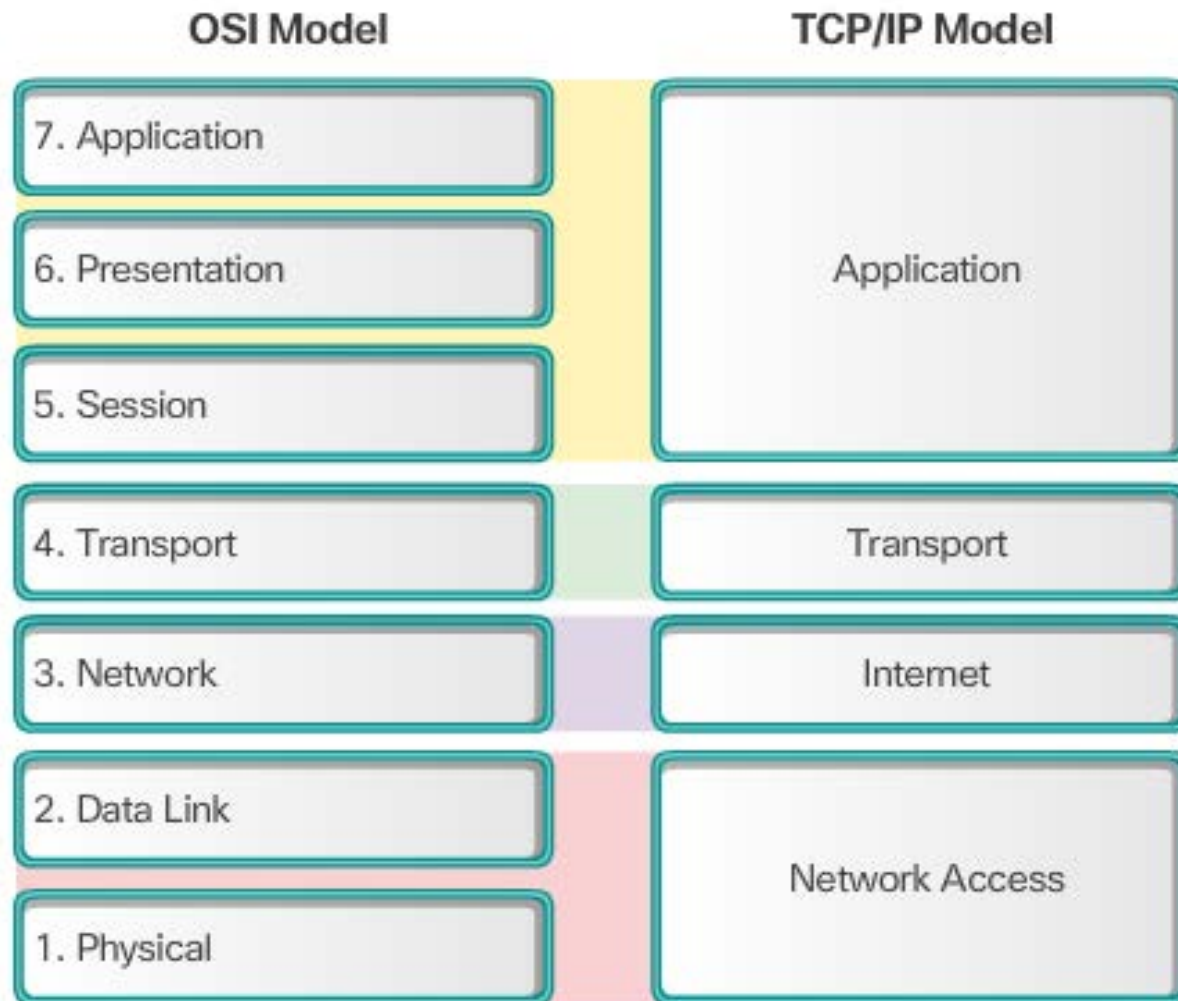
TCP/IP vs. OSI Model

TCP/IP	OSI
Application	Application
	Presentation
	Session
Transport	Transport
Internet	Network
Network Access (Network Interface)	Data Link
	Physical

TCP/IP Communications Example

Application Layer	HTTP
Transport Layer	TCP
Internet Layer	IP
Data Link Layer	Eth
Physical Layer	

Client Browser · Hub · Switch · Router · Hub · Web Server
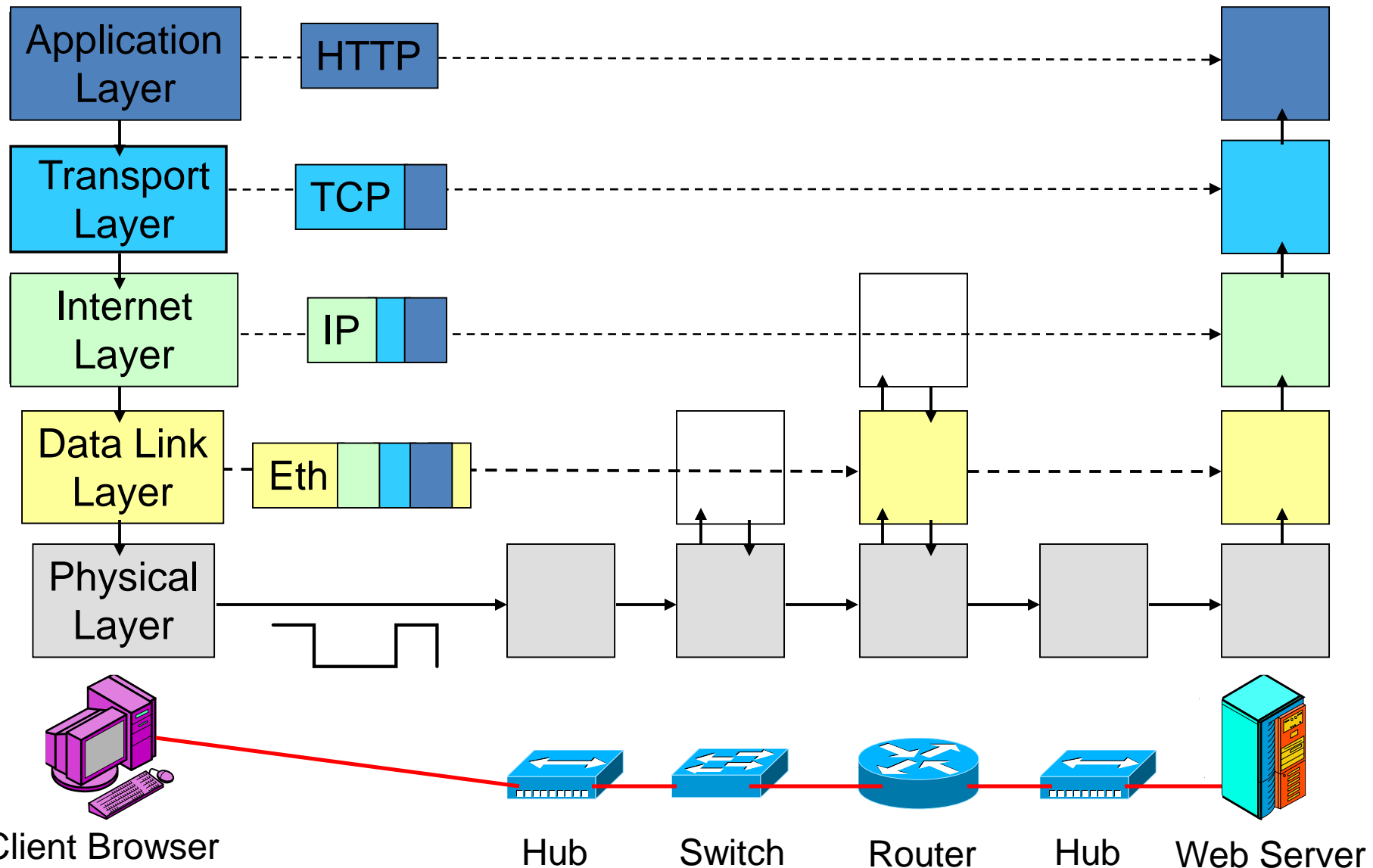
Section 3.3:
Data Transfer in the Network
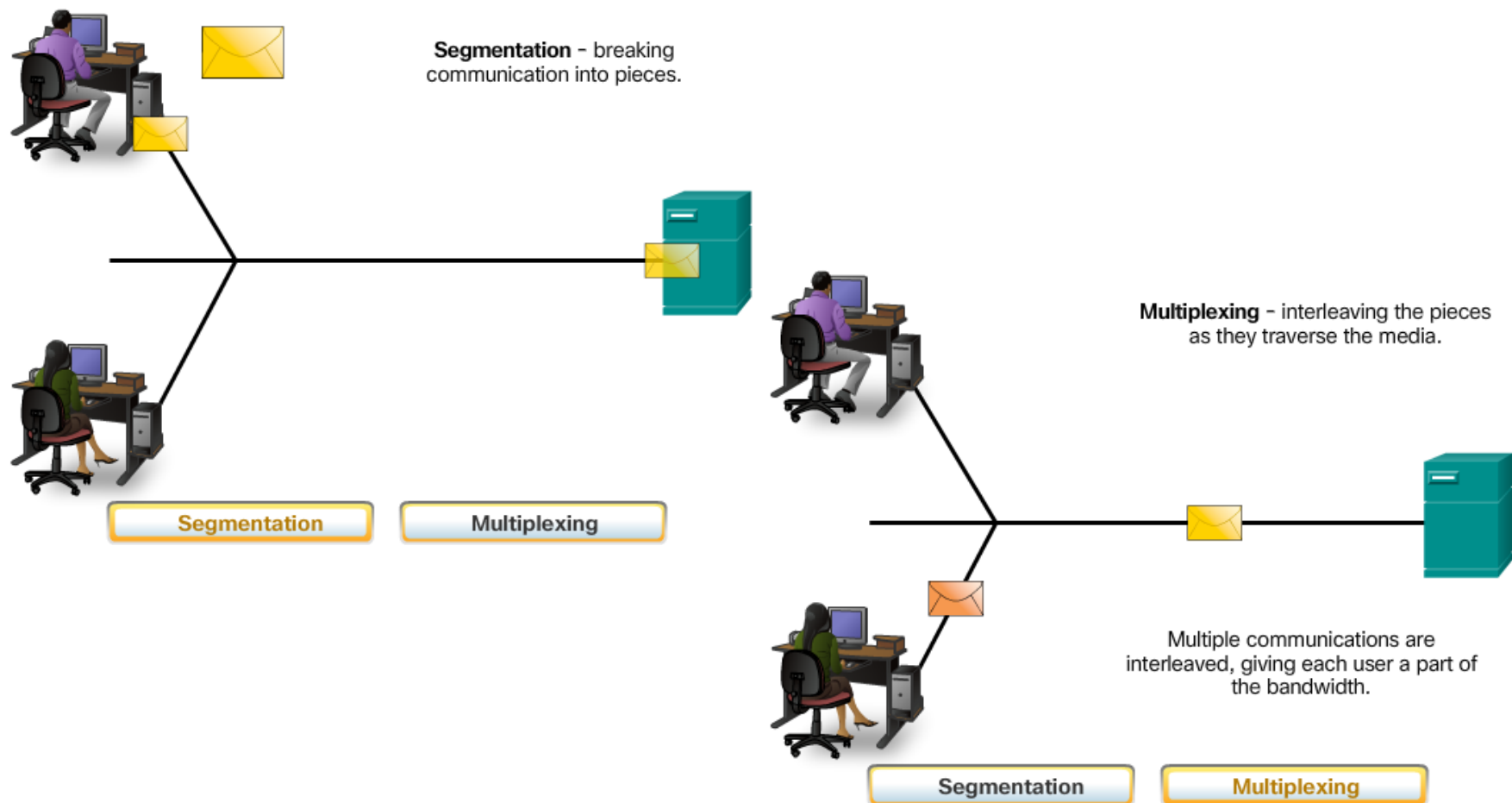
Upon completion of this section, you should be able to:

- Explain how data encapsulation allows data to be transported across the network.

- Explain how local hosts access local resources on a network.
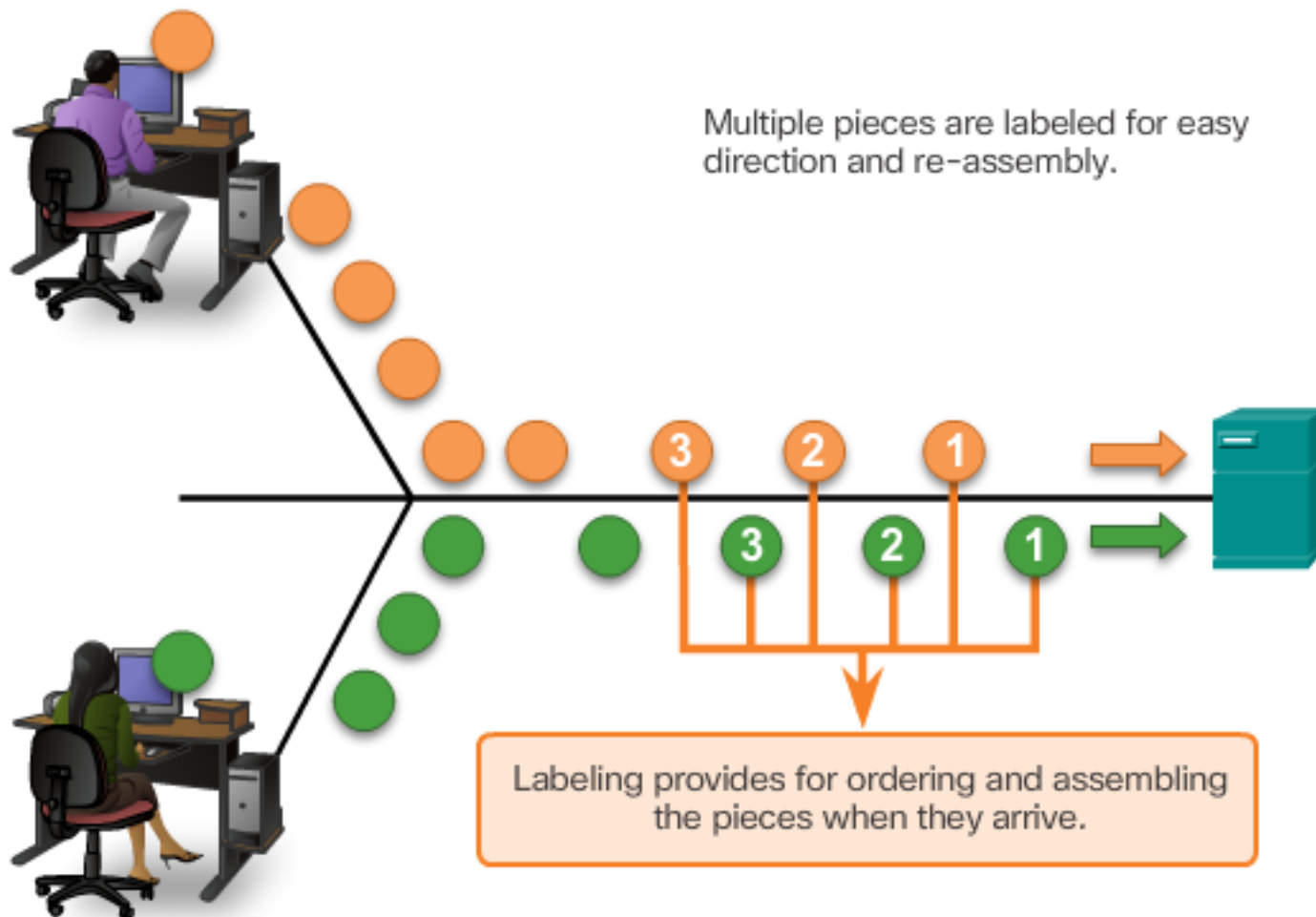
Topic 3.3.1:
Data Encapsulation

Message Segmentation

Communicating the Message

Segmentation – breaking communication into pieces.

Multiplexing – interleaving the pieces as they traverse the media.

Multiple communications are interleaved, giving each user a part of the bandwidth.

Segmentation

Multiplexing

Segmentation

Multiplexing

Message Segmentation (cont.)

Communicating the Message

Multiple pieces are labeled for easy direction and re-assembly.

Labeling provides for ordering and assembling the pieces when they arrive.

Communicating the Message

Segmenting Messages:

- Allows many different conversations to be interleaved

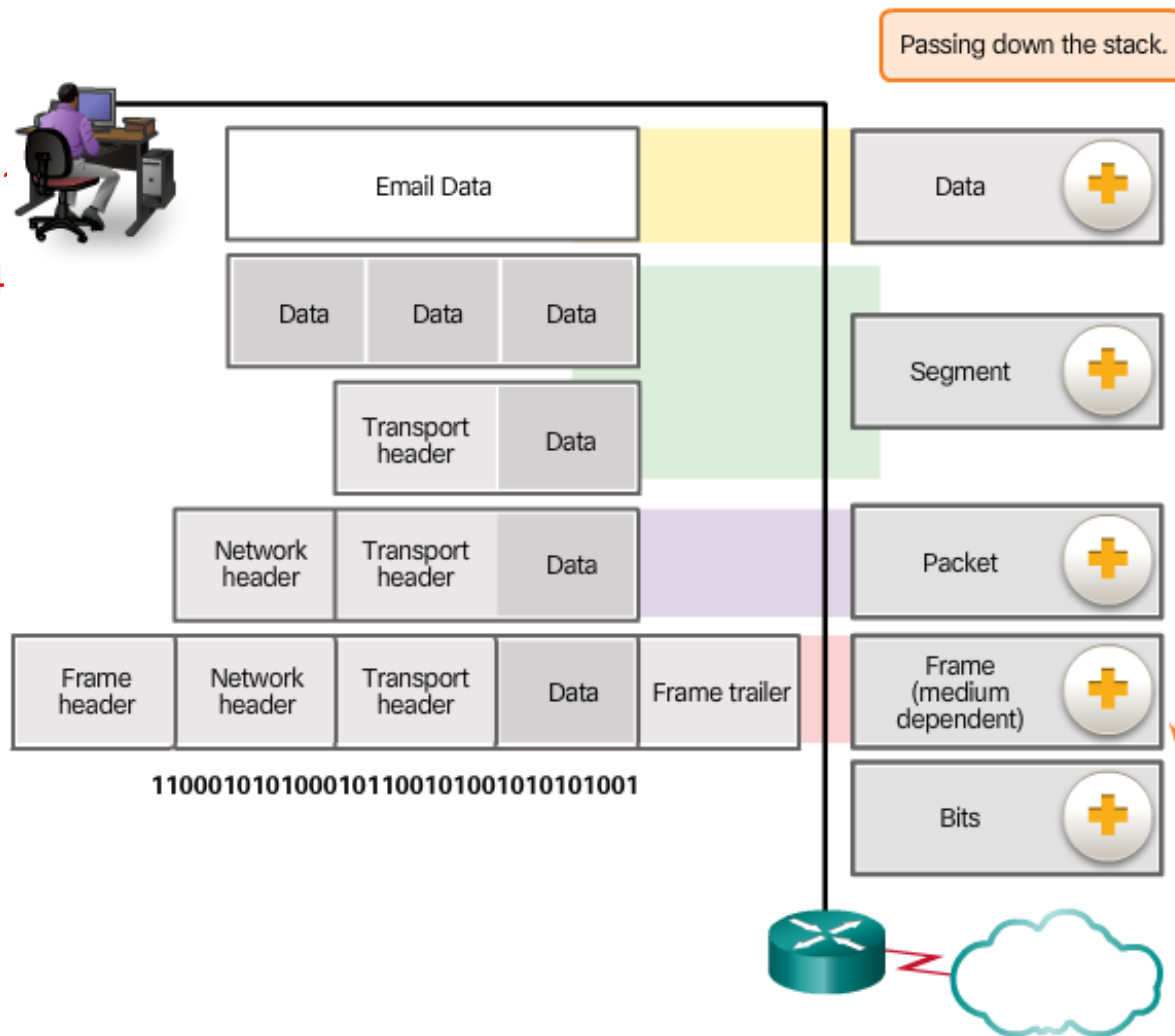- Increases the efficiency of network communications

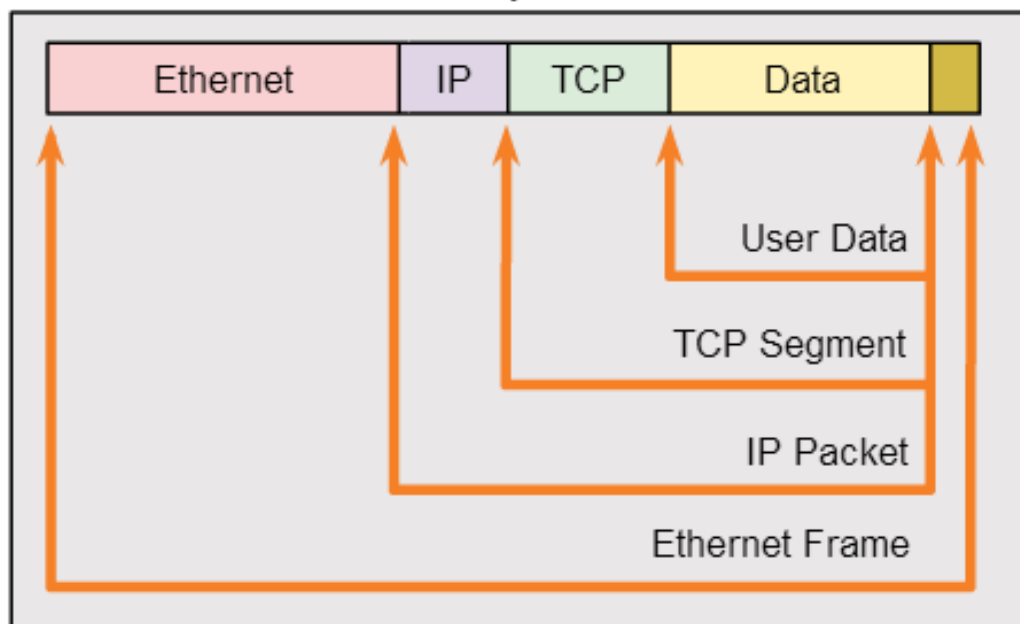- Adds complexity

Protocol Data Units (PDU)

Encapsulation

- Data Layer 5, 6, 7
- Segment Layer 4
- Packet Layer 3
- Frame Layer 2
- Bits   Layer 1

Good to know!

Passing down the stack.

Email Data

Data | Data | Data

Transport header | Data

Network header | Transport header | Data

Frame header | Network header | Transport header | Data | Frame trailer

11000101010001011001010010101001

Data

Segment

Packet

Frame (medium dependent)

Bits

Encapsulation Example

Protocol Encapsulation Terms

De-Encapsulation

Protocol Encapsulation Terms

Ethernet	IP	TCP	Data	

User Data

TCP Segment

IP Packet

Ethernet Frame

Web Server

Web Client
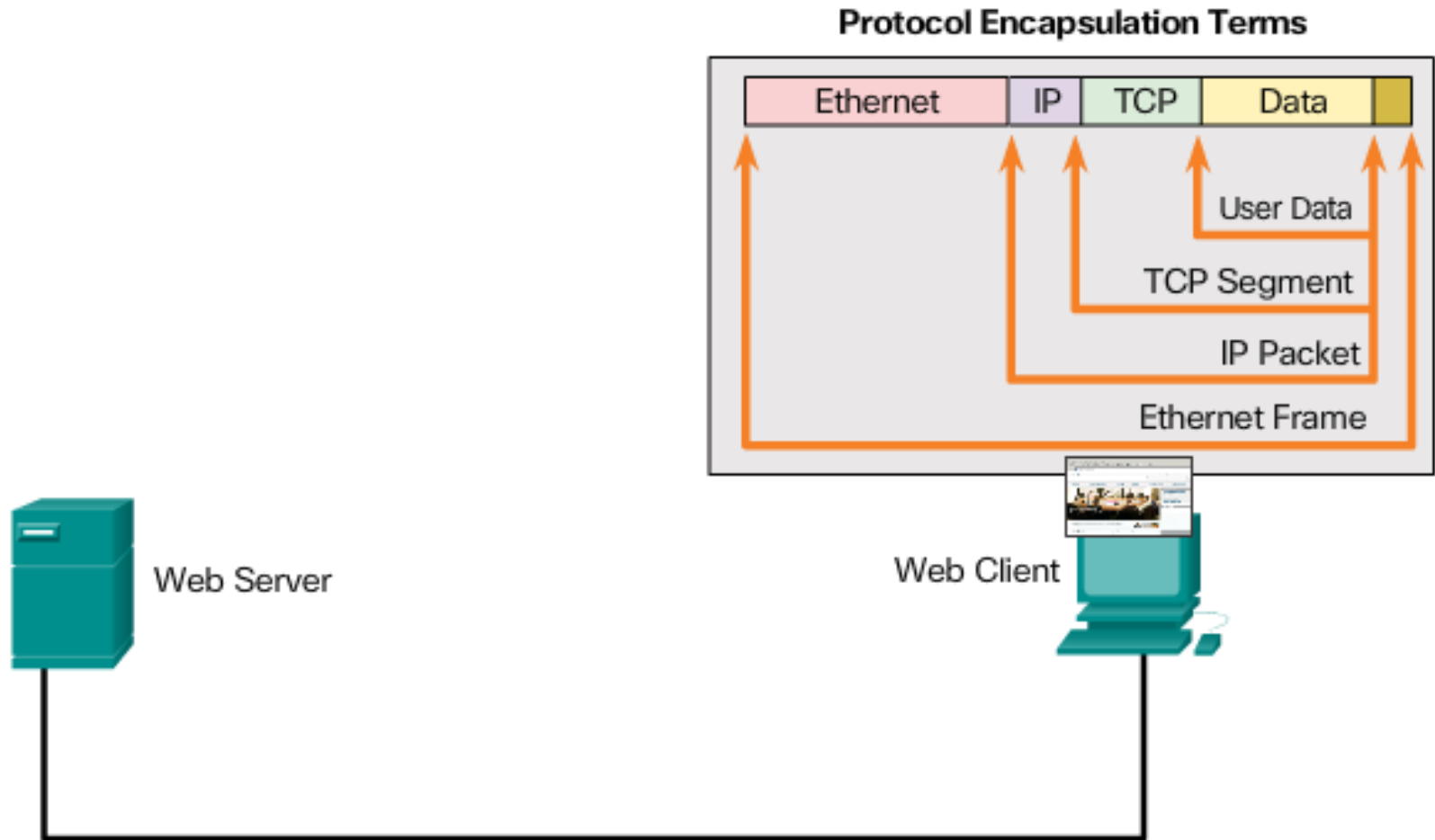
Topic 3.3.2:
Data Access

Network Addresses

Network Addresses and Data Link Addresses

Physical	Data Link	Network	Transport	Upper Layers
Timing and synchronization bits	Destination and source physical addresses	Destination and source logical network addresses	Destination and source process number (ports)	Encoded application data
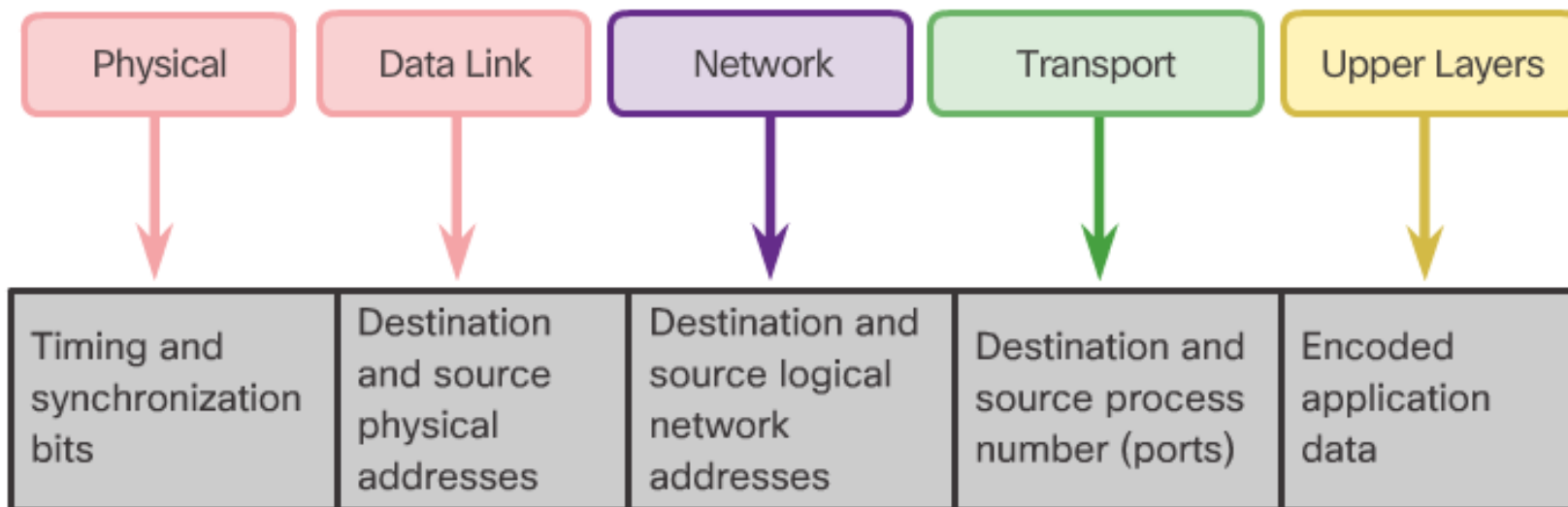
Network Addresses (cont.)

Layer 3 Network Addresses
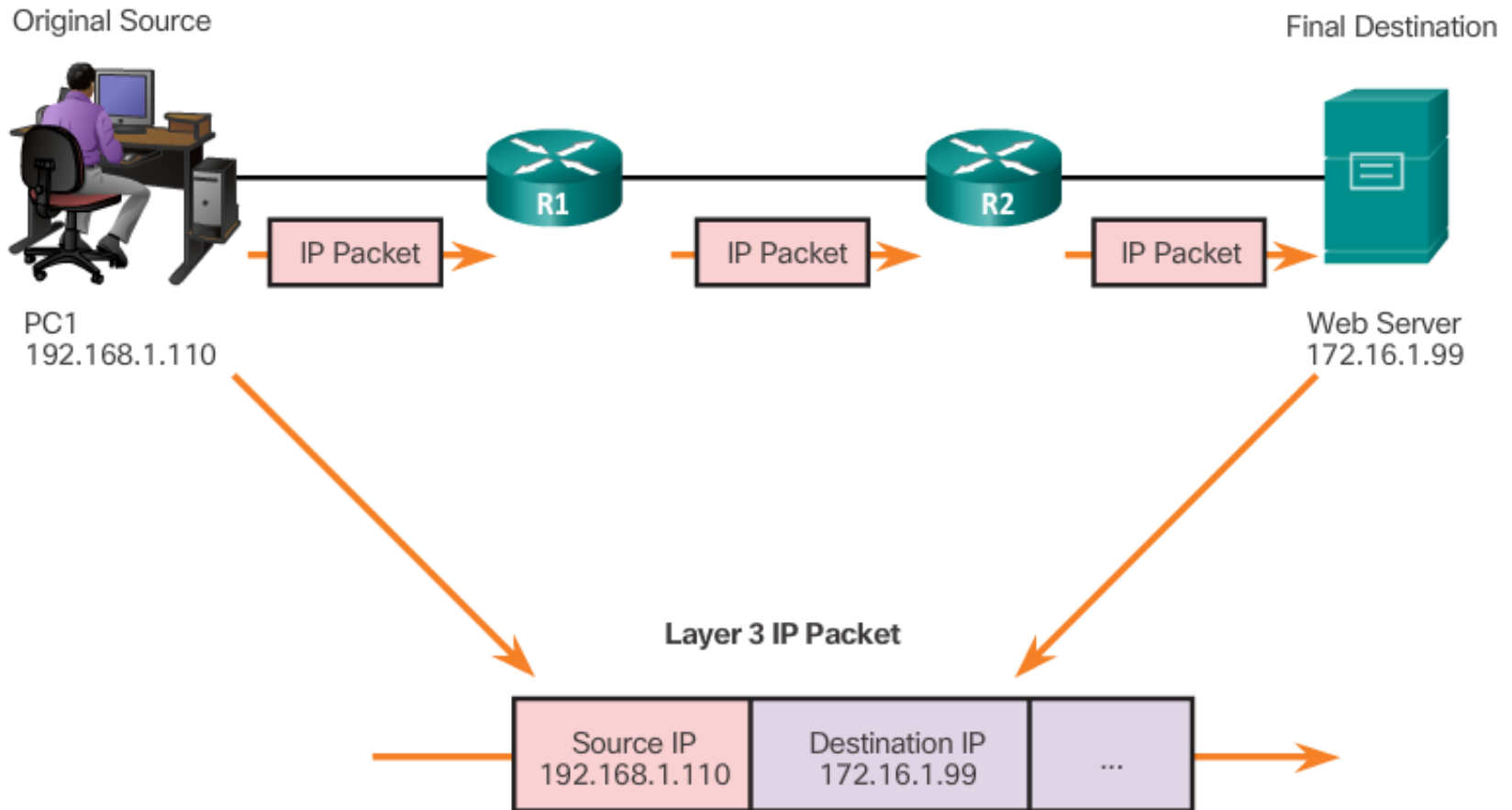
Data Link Addresses

Network Address

- Source IP address

- Destination IP address

- Responsible for delivering the IP packet from the original source to the final destination, either on the same network or to a remote network.

Data Link Address

- Source data link address

- Destination data link address

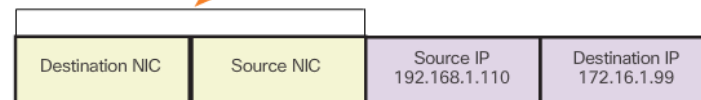- Responsible for delivering the data link frame from one network interface card (NIC) to another NIC on the same network
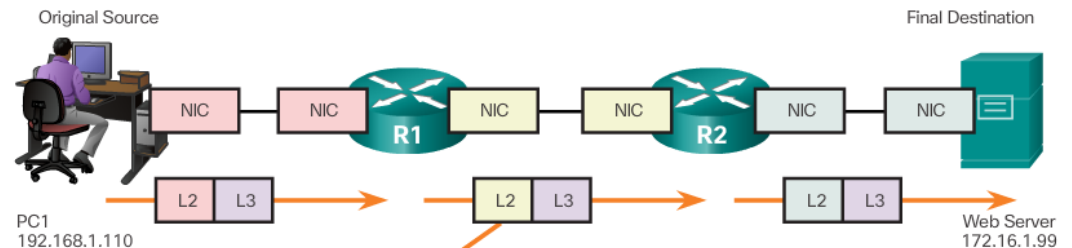
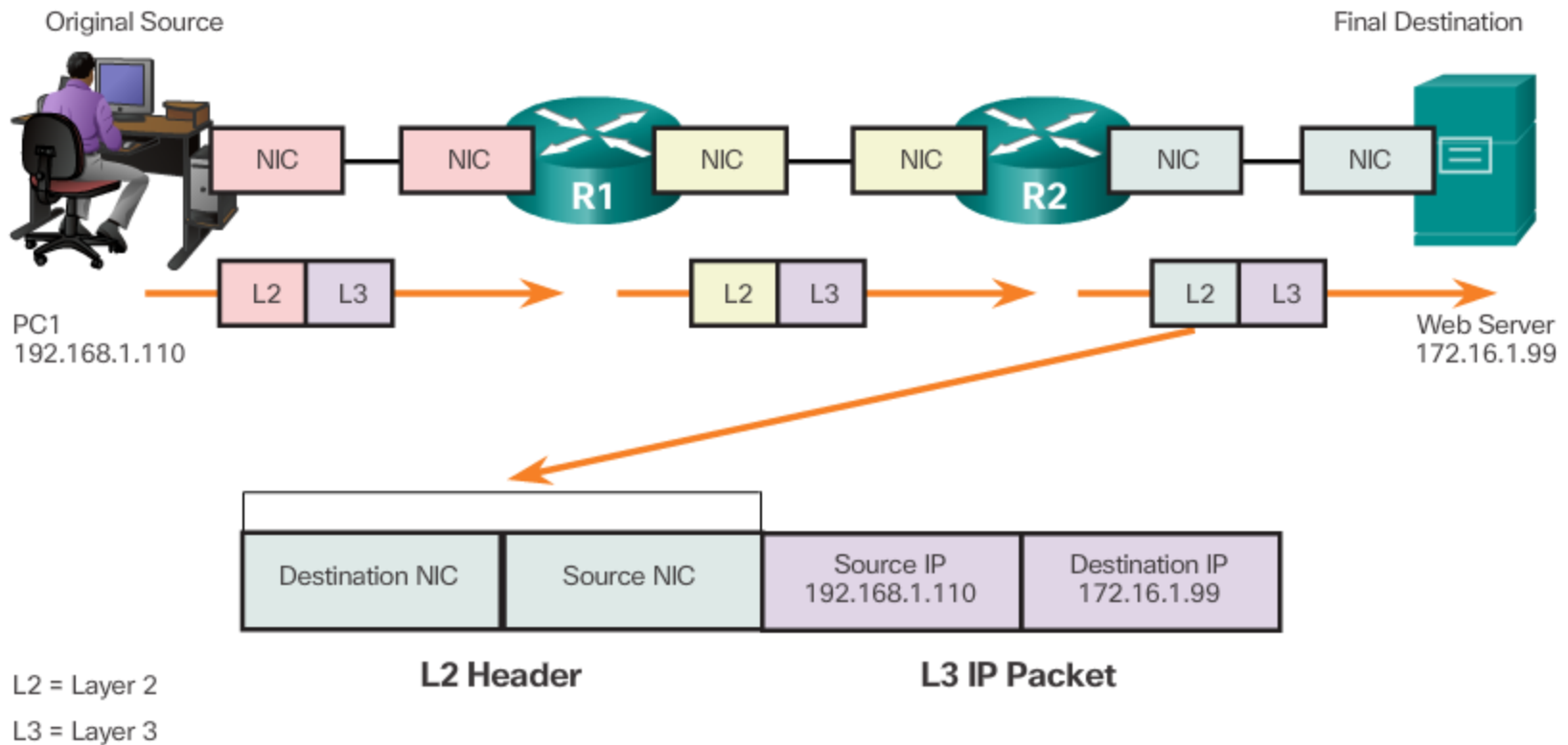# Data Link Address (cont.)
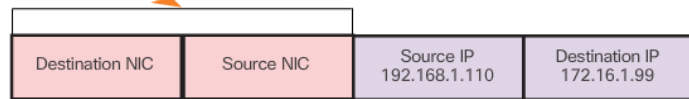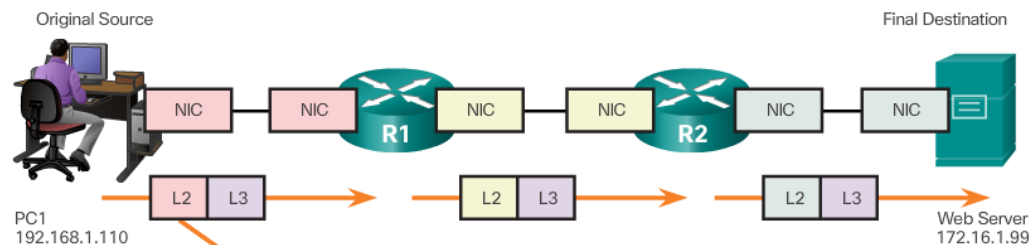
Layer 2 Data Link Addresses

Data Link Address (cont.)

Layer 2 Data Link Addresses

Devices on the Same Network
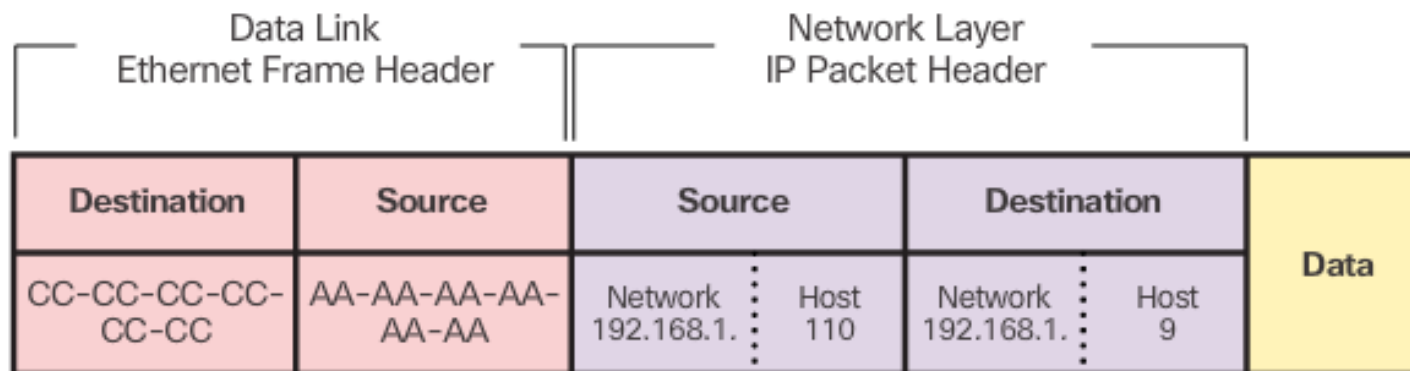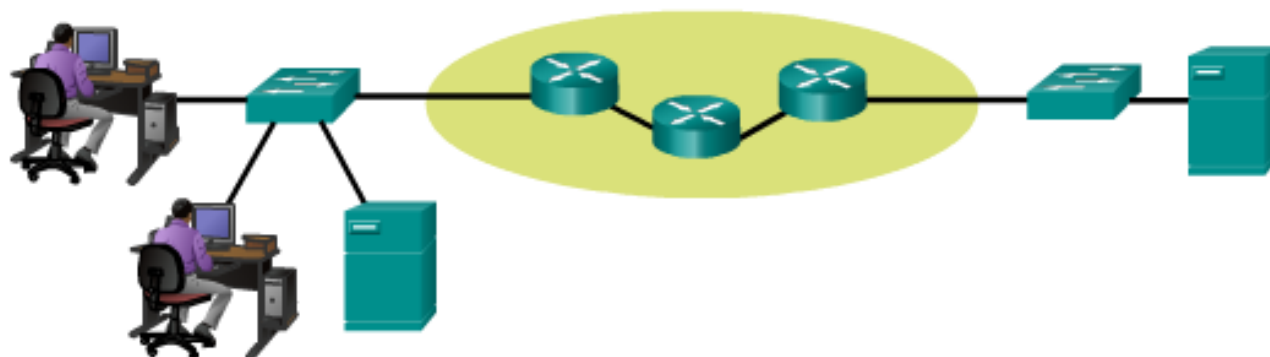
Devices on the Same Network (cont.)

- Role of the Network Layer Addresses

  Network portion of the IP Address – The left-most part of the address that indicates which network the IP address is a member.

  Host portion – The remaining part of the address that identifies a specific device on the network.
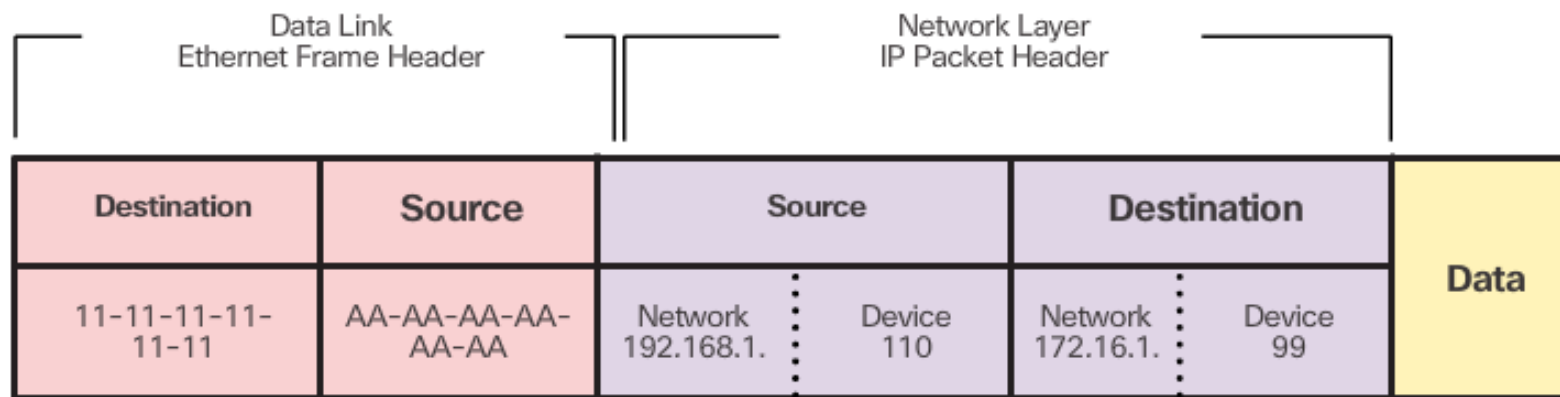
- Source IP address – The IP address of the sending device

- Destination IP address – The IP address of the receiving device

- Role of the Data Link Layer Addresses

  Source MAC address – This is the data link address, or the Ethernet MAC address, of the sending device.

  Destination MAC address – When the receiving device is on the same network as the sending device, this is the data link address of the receiving device.
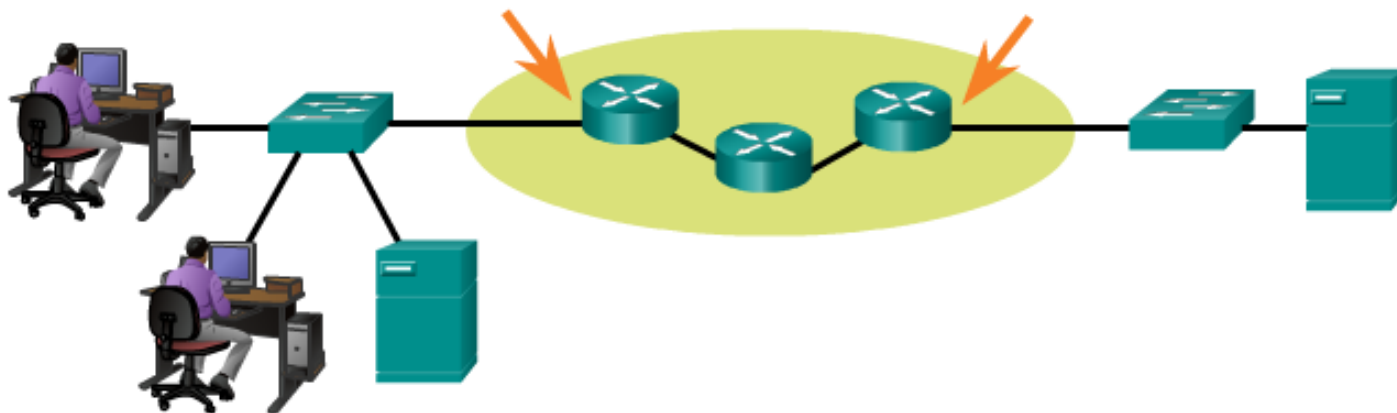
Devices on a Remote Network

Devices on a Remote Network (cont.)

Role of the Network Layer Addresses

- The source and destination IP addresses will represent hosts on different networks indicated by the different network portions of the source and destination addresses.

Role of the Data Link Layer Addresses

- Destination MAC address - When the receiving device is on a different network from the sending device, the sending device uses the Ethernet MAC address of the default gateway or router.

Thank you.

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