Chapter 3: Network Protocols and Communications

Introduction to Networks

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Chapter 3: Objectives

After completing this chapter, you will be able to:

- Explain how rules are used to facilitate communication.
- Explain the role of protocols and standards organizations in facilitating interoperability in network communications.
- Explain how devices on a LAN access resources in a small to medium-sized business network.

Chapter 3

3.1 Rules of Communication

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The Rules

What is Communication?

Human Communication

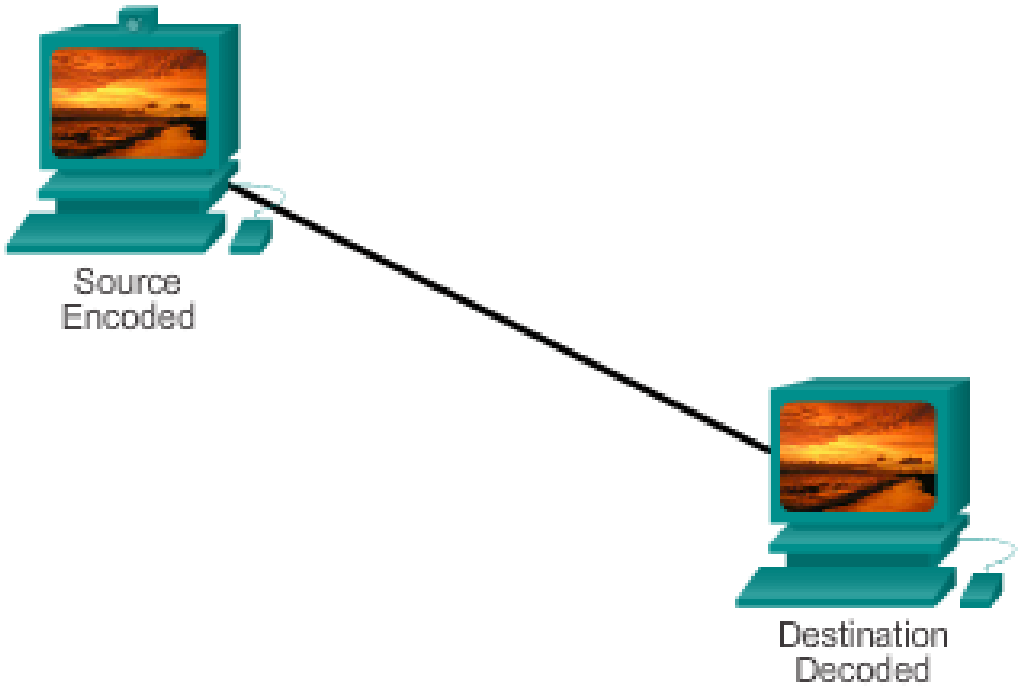
Message	Signal		Signal	Message
Message Source	Transmitter	Transmission Medium	Receiver	Message Destination

Establishing the Rules

- An identified sender and receiver
- Agreed upon method of communicating (face-to-face, telephone, letter, photograph)
- Common language and grammar
- Speed and timing of delivery
- Confirmation or acknowledgment requirements

The Rules

Message Encoding



Message Formatting and Encapsulation

Example: Personal letter contains the following elements:

- Identifier of the recipient's location
- Identifier of the sender's location
- Salutation or greeting
- Recipient identifier
- The message content
- Source identifier
- End of message indicator

Message Size

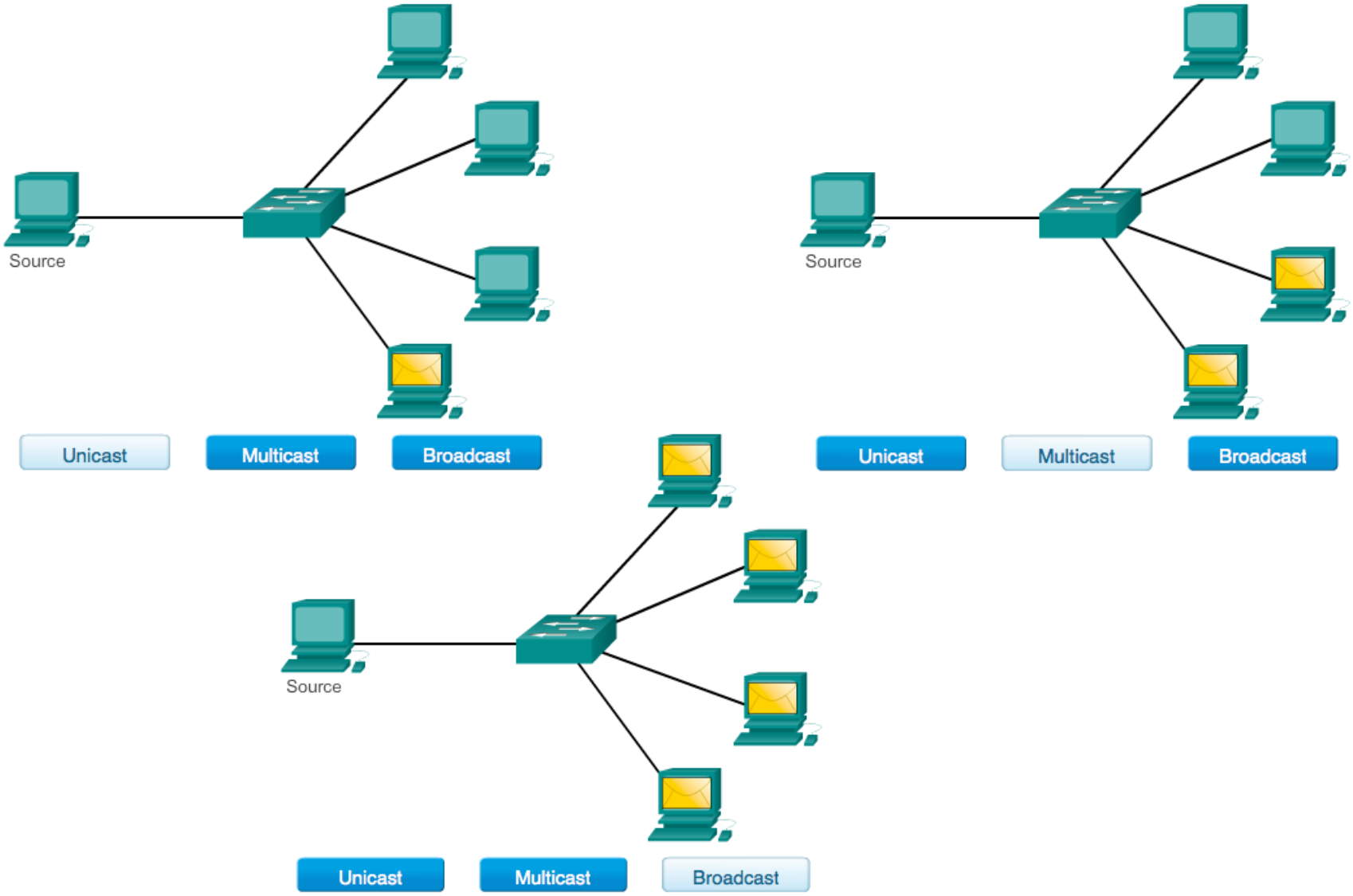
An overview of the segmenting process:

- The size restrictions of frames require the source host to break a long message into individual pieces (or segments) that meet both the minimum and maximum size requirements.
- Each segment is encapsulated in a separate frame with the address information, and is sent over the network.
- At the receiving host, the messages are de-encapsulated and put back together to be processed and interpreted.

Message Timing

- Access Method
- Flow Control
- Response Timeout

Message Delivery Options



3.2 Network Protocols and Standards

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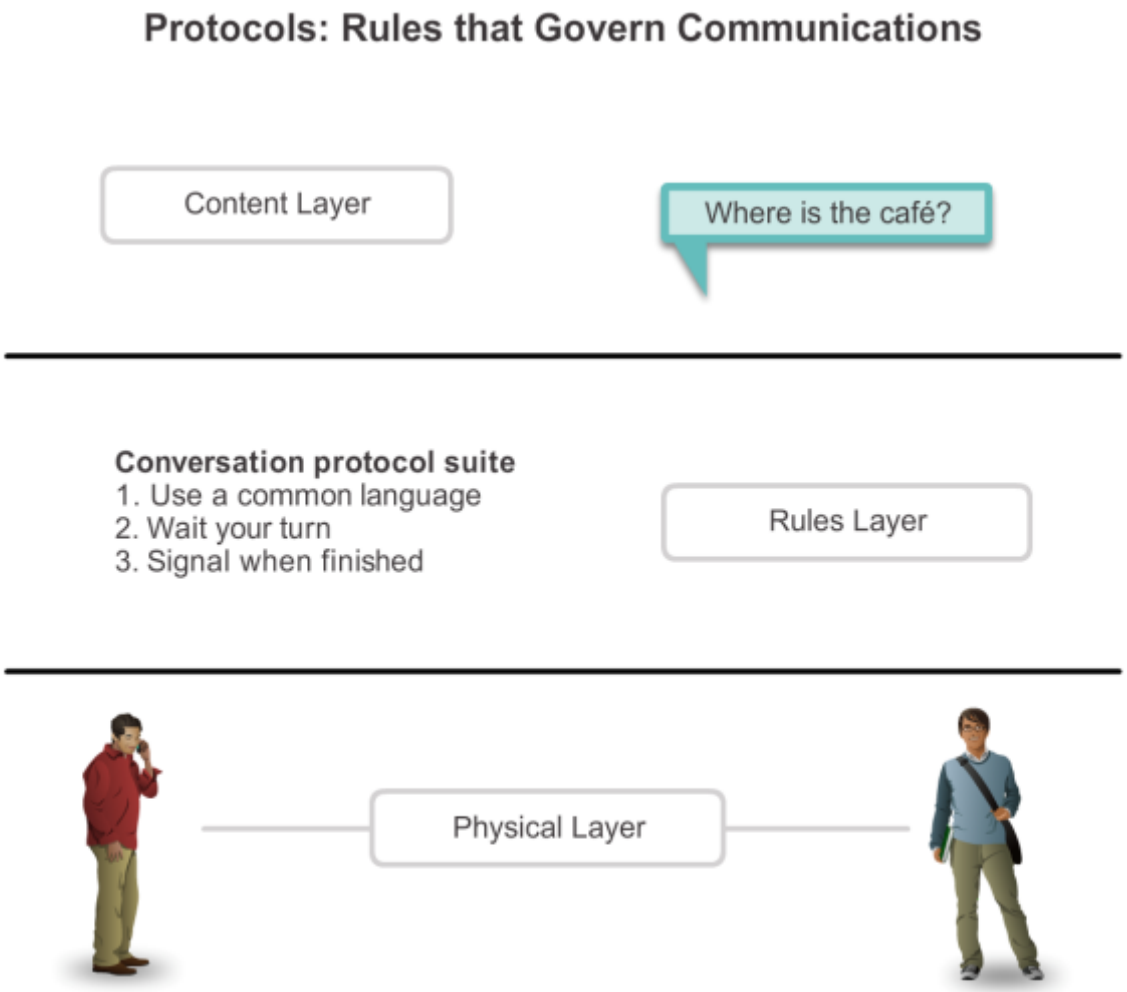
Rules that Govern Communications



Protocol suites are sets of rules that work together to help solve a problem.

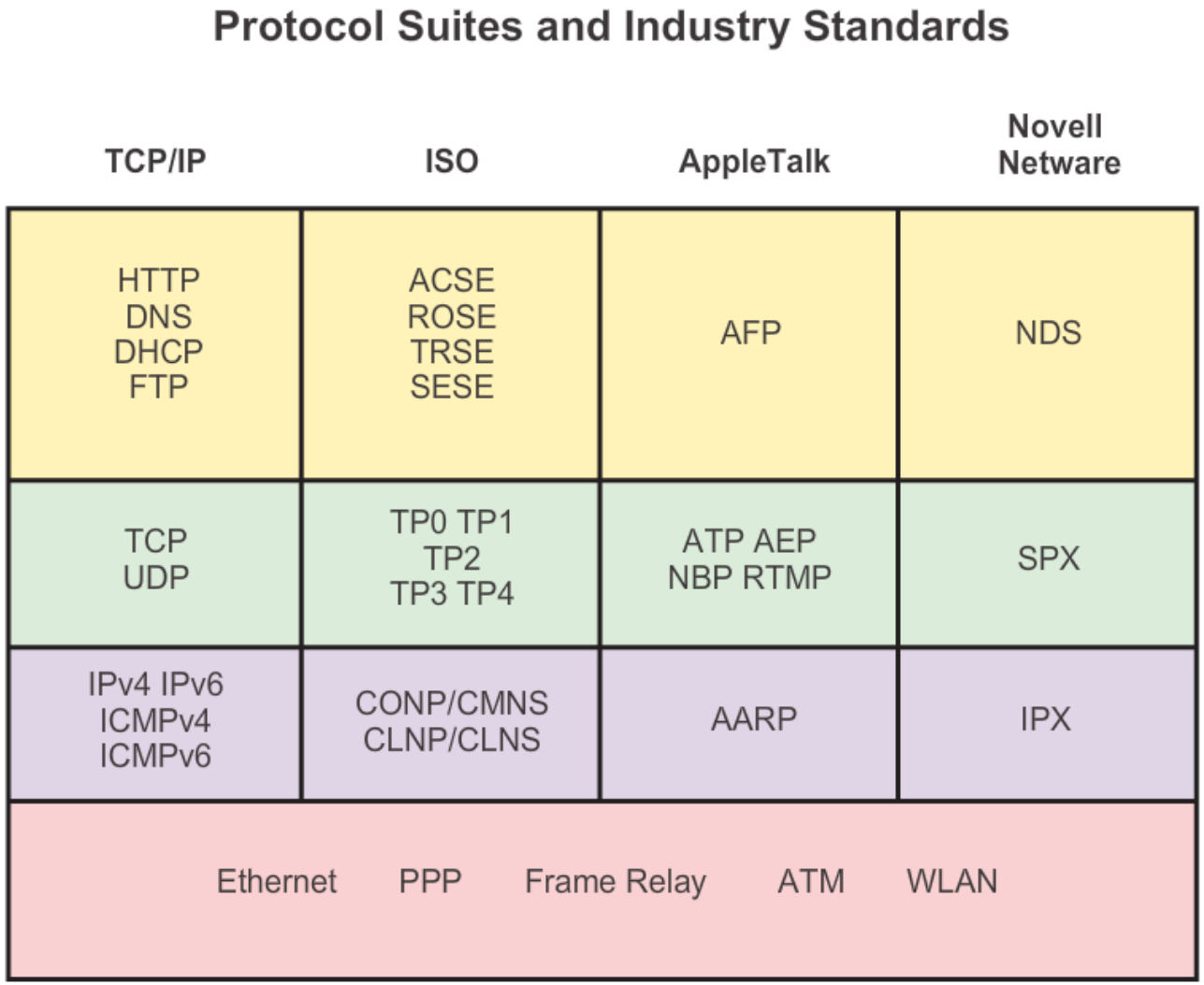
Network Protocols

- 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

Interaction of Protocols

- Application Protocol – Hypertext Transfer Protocol (HTTP)
- Transport Protocol – Transmission Control Protocol (TCP)
- Internet Protocol – Internet Protocol (IP)
- Network Access Protocols – Data link & physical layers

Protocol Suites and Industry Standards

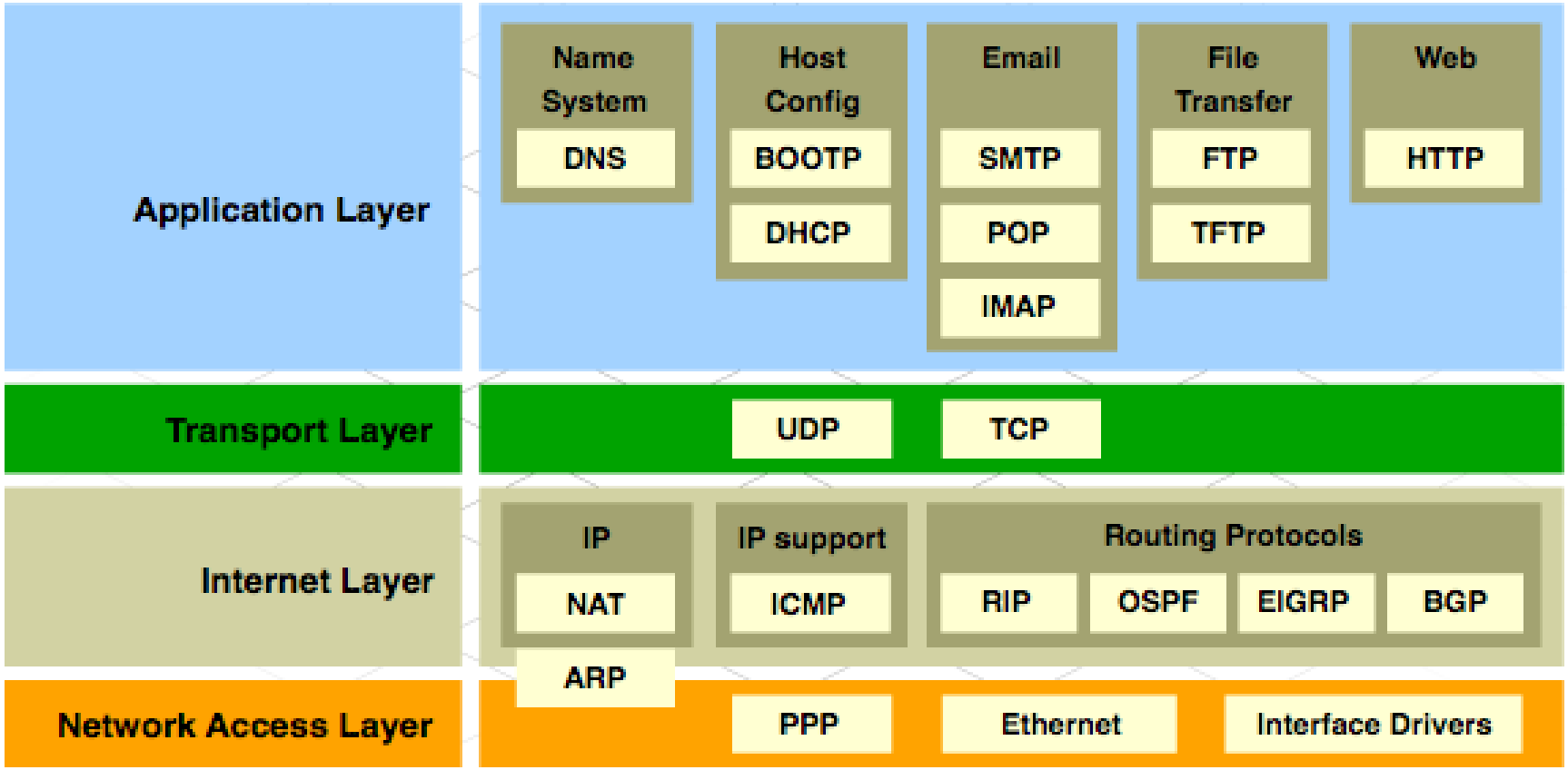


Creation of Internet, Development of TCP/IP

- The first packet switching network and predecessor to today's Internet was the Advanced Research Projects Agency Network (ARPANET), which came to life in 1969 by connecting mainframe computers at four locations.
- ARPANET was funded by the U.S. Department of Defense for use by universities and research laboratories. Bolt, Beranek and Newman (BBN) was the contractor that did much of the initial development of the ARPANET, including creating the first router known as an Interface Message Processor (IMP).
- In 1973, Robert Kahn and Vinton Cerf began work on TCP to develop the next generation of the ARPANET. TCP was designed to replace ARPANET's current Network Control Program (NCP).
- In 1978, TCP was divided into two protocols: TCP and IP. Later, other protocols were added to the TCP/IP suite of protocols including Telnet, FTP, DNS, and many others.

Protocol Suites

TCP/IP Protocol Suite and Communication

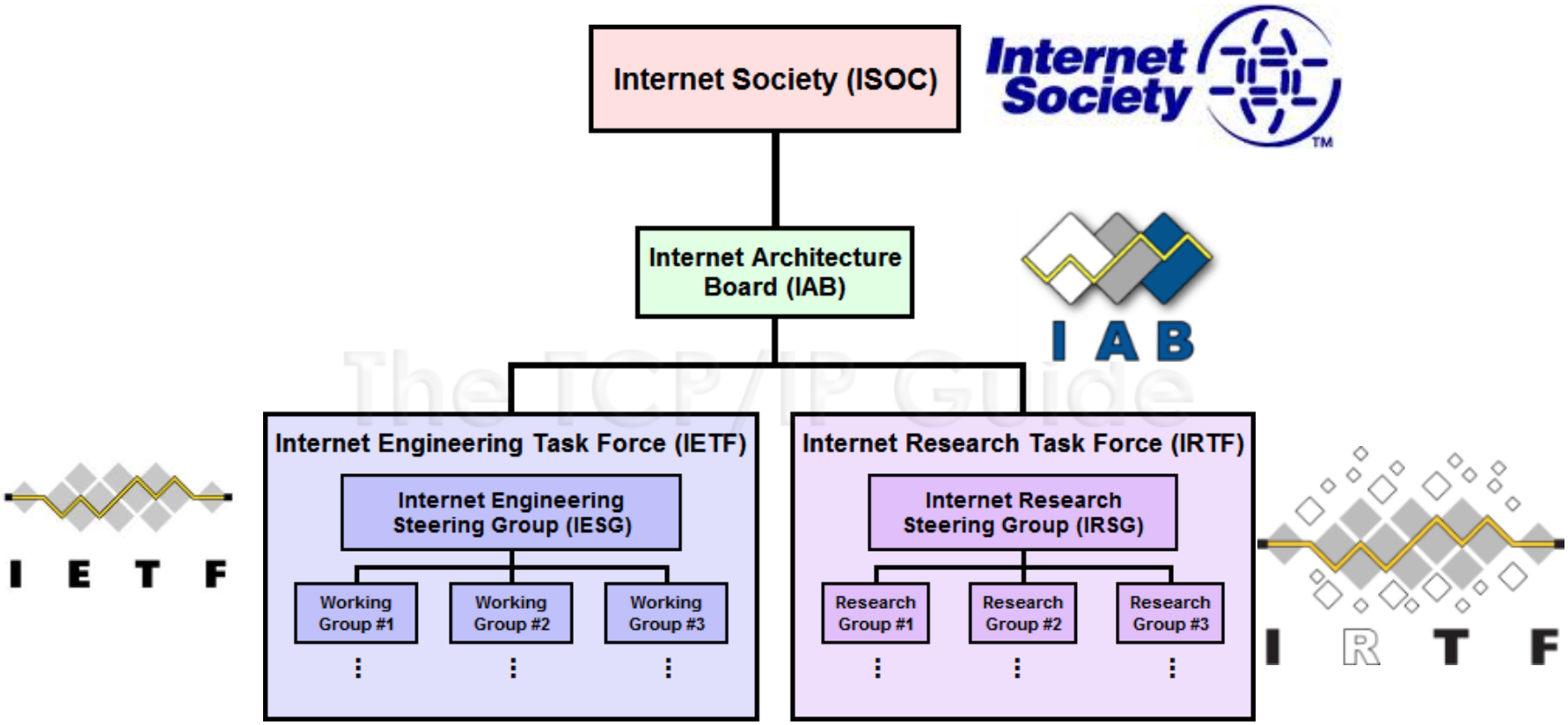


Open Standards

- The Internet Society (ISOC)
- The Internet Architecture Board (IAB)
- The Internet Engineering Task Force (IETF)
- Institute of Electrical and Electronics Engineers (IEEE)
- The International Organization for Standards (ISO)

Standards Organizations

ISOC, IAB, and IETF



Standards Organizations

IEEE

- 38 societies
- 130 journals
- 1,300 conferences each year
- 1,300 standards and projects
- 400,000 members
- 160 countries
- IEEE 802.3
- IEEE 802.11

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

Standards Organizations

ISO

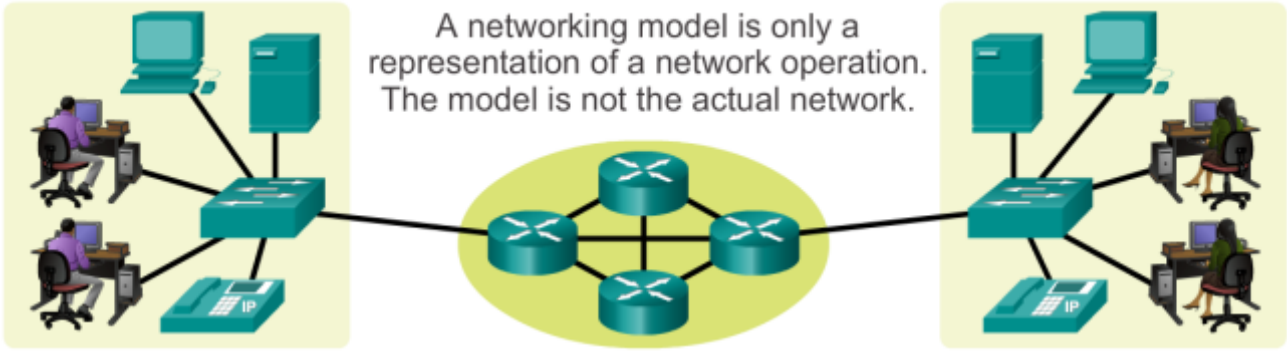
OSI Model

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

Other Standards Organization

- The Electronic Industries Alliance (EIA)
- The Telecommunications Industry Association (TIA)
- The International Telecommunications Union – Telecommunications Standardization Sector (ITU-T)
- The Internet Corporation for Assigned Names and Numbers (ICANN)
- The Internet Assigned Numbers Authority (IANA)

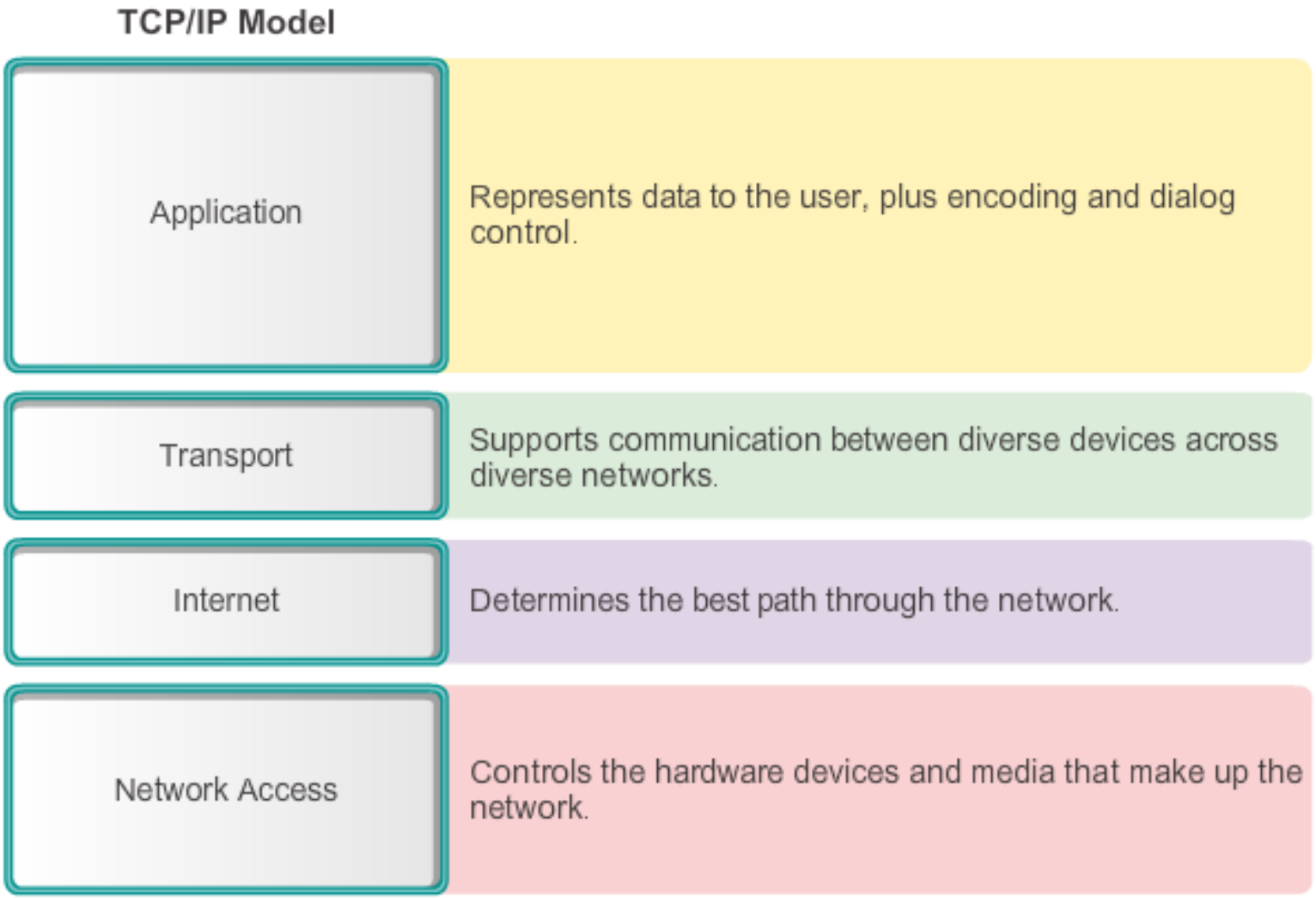
Benefits of Using a Layered Model



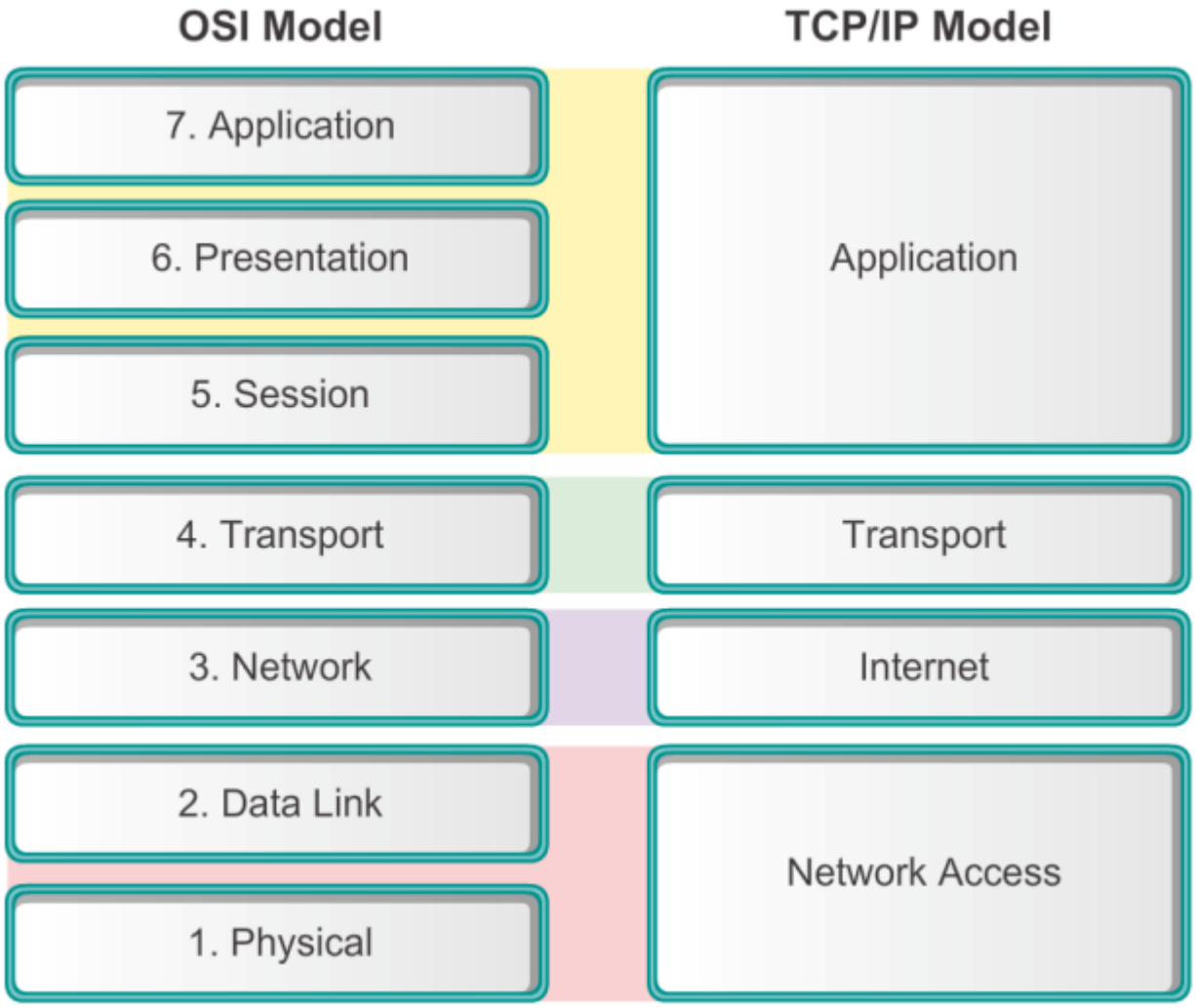
OSI Model	TCP/IP Protocol Suite	TCP/IP Model
Application	HTTP, DNS, DHCP, FTP	Application
Presentation		
Session		
Transport	TCP, UDP	Transport
Network	IPv4, IPv6, ICMPv4, ICMPv6	Internet
Data Link	PPP, Frame Relay, Ethernet	Network Access
Physical		

The OSI Reference Model

The TCP/IP Reference Model



Comparing the OSI and TCP/IP Models



3.3 Moving Data in the Network

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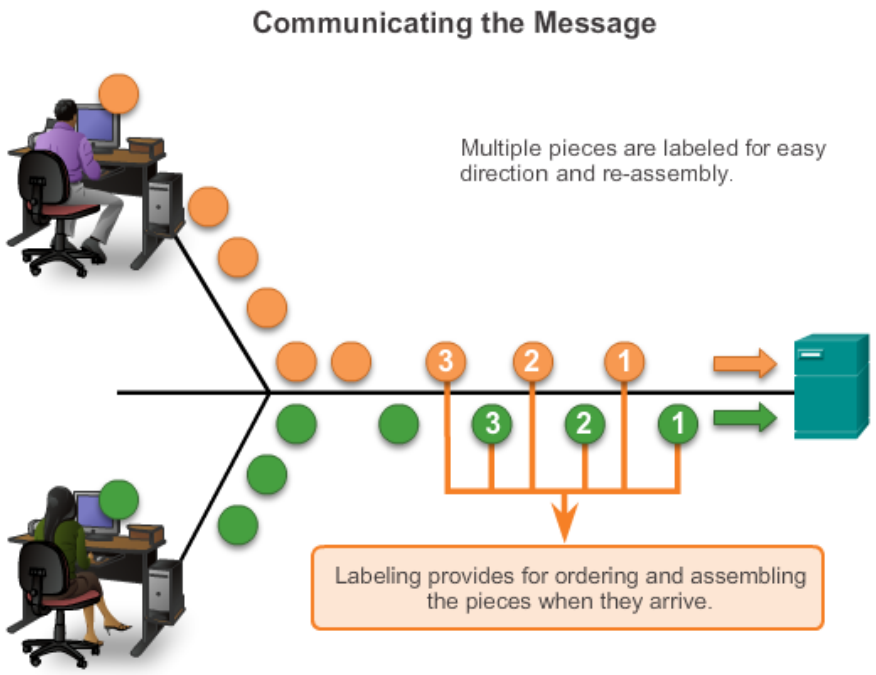
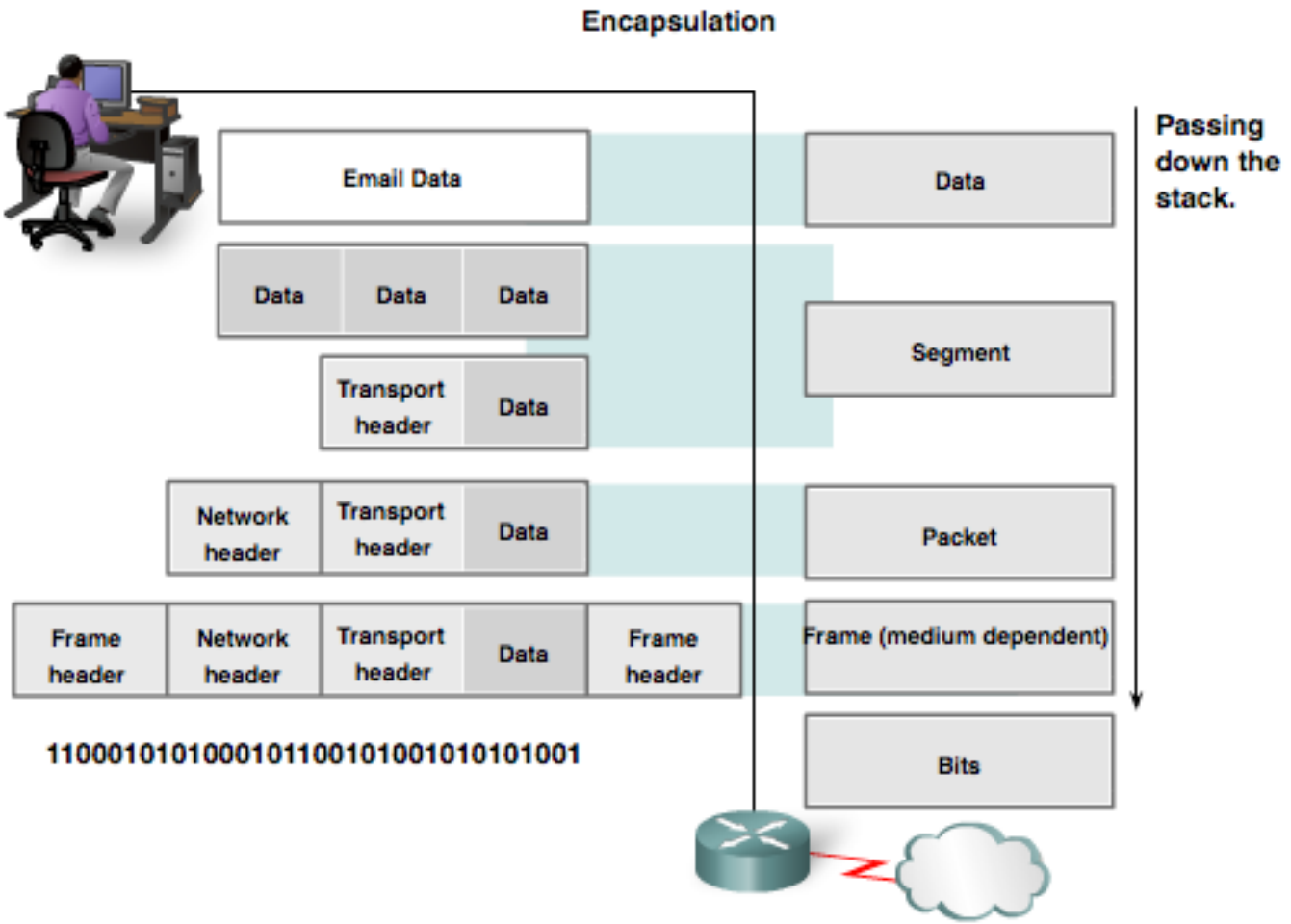
Communicating the Messages

- Segmenting message benefits
  - Different conversations can be interleaved
  - Increased reliability of network communications
- Segmenting message disadvantage
  - Increased level of complexity

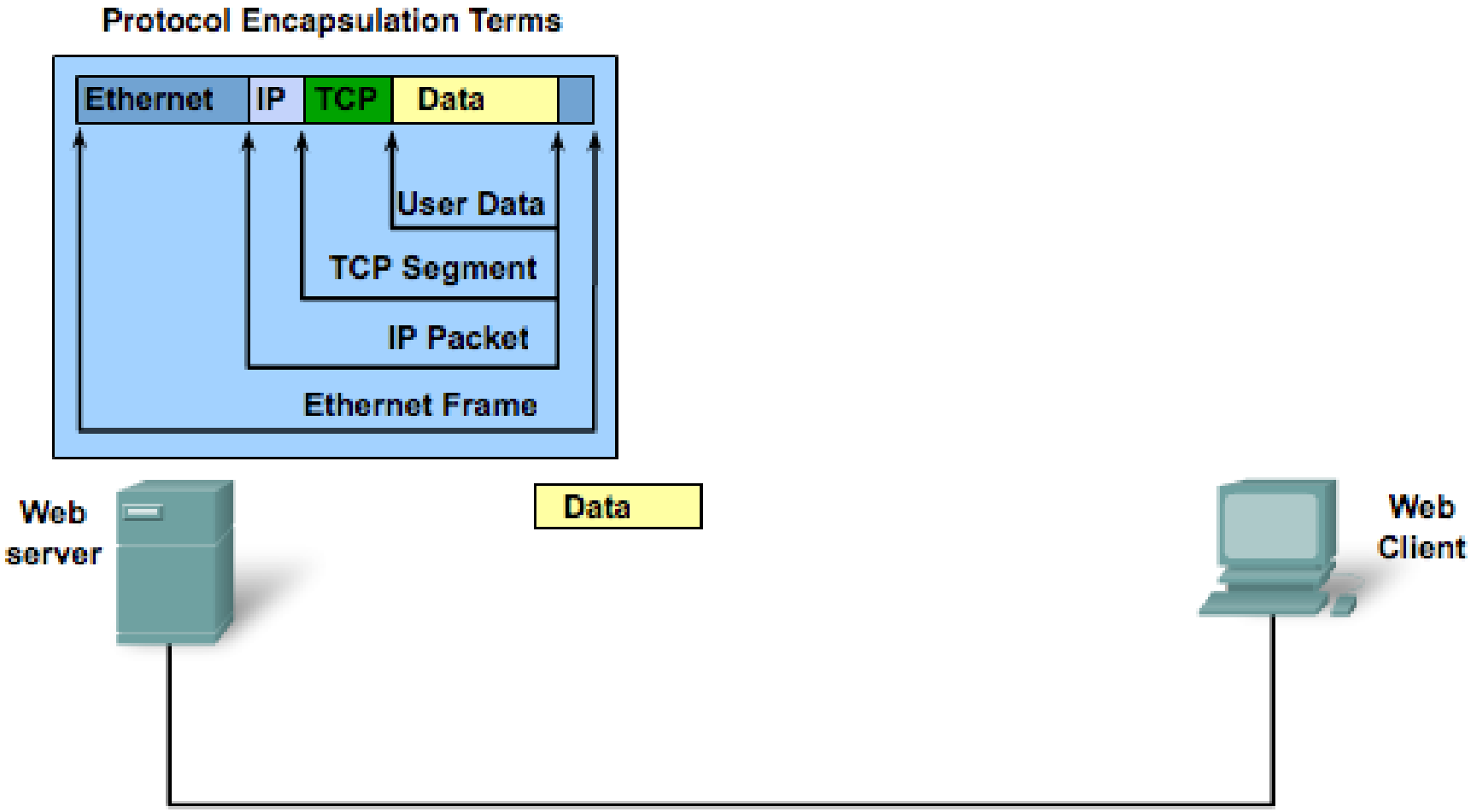


Protocol Data Units (PDUs)

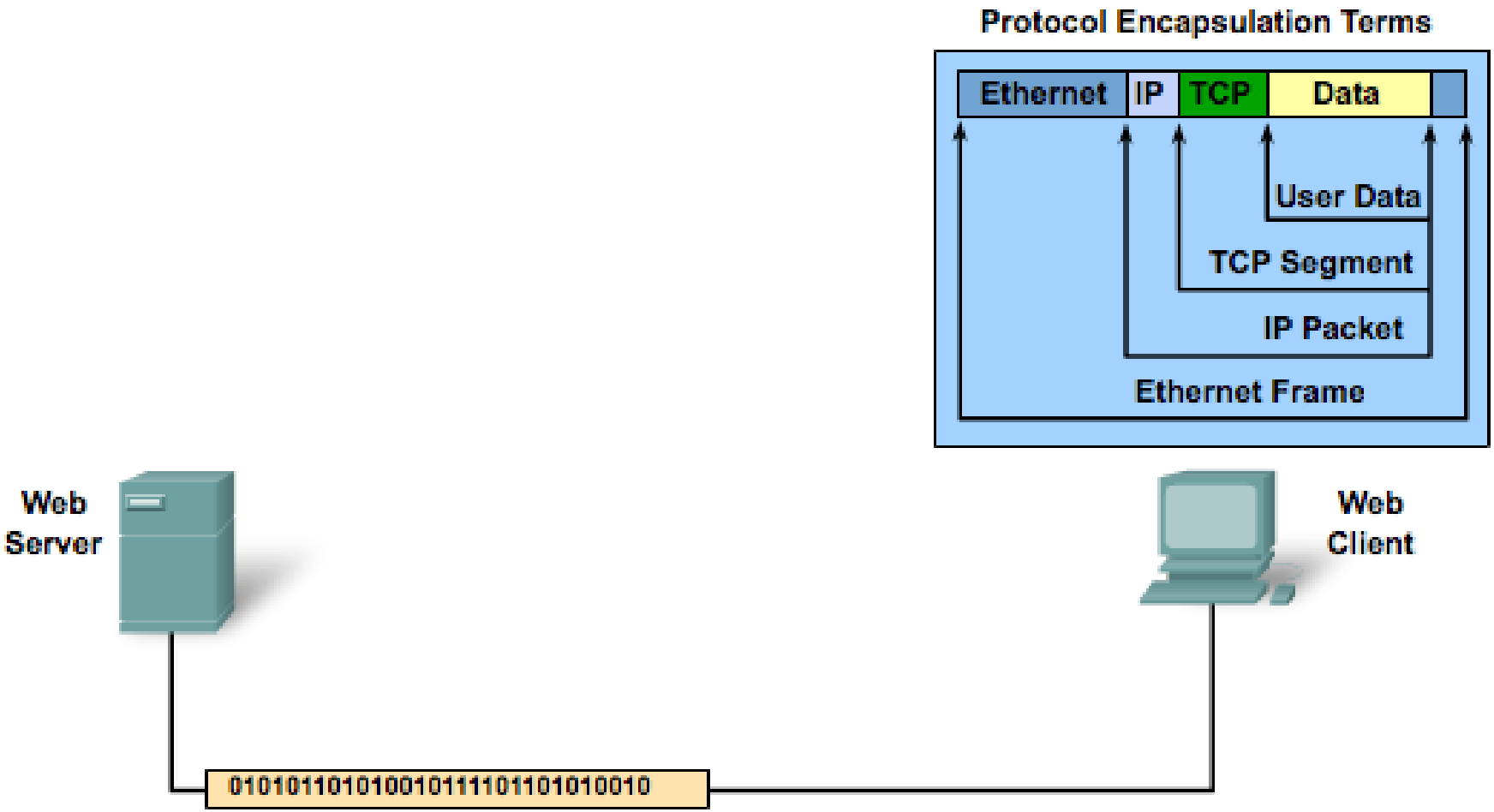
- Data
- Segment
- Packet
- Frame
- Bits



Protocol Encapsulation

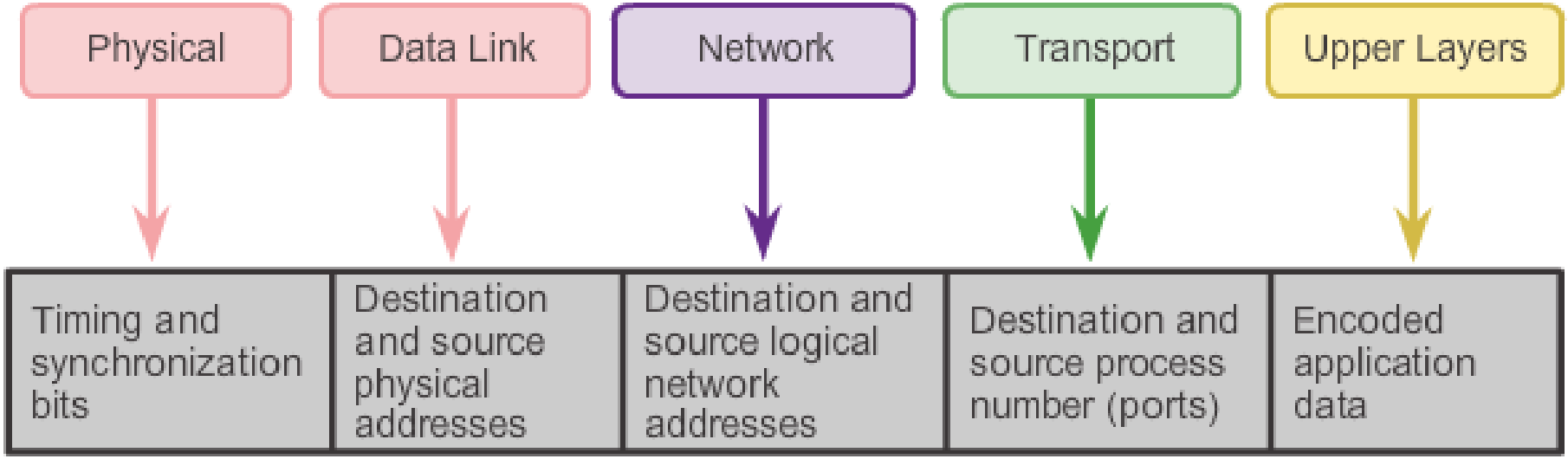


Protocol De-encapsulation

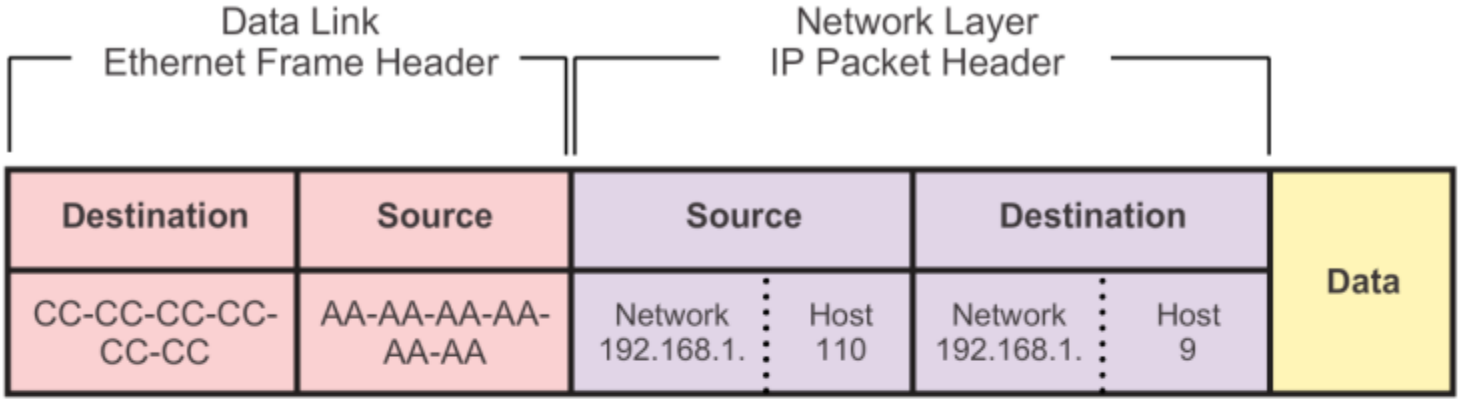


Accessing Local Resources

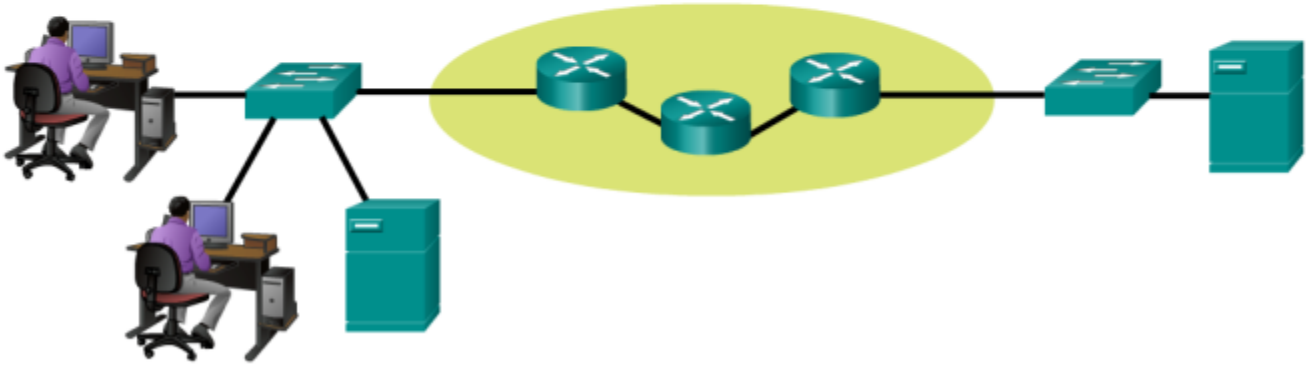
Network Addresses and Data Link Addresses



Communicating with Device / Same Network

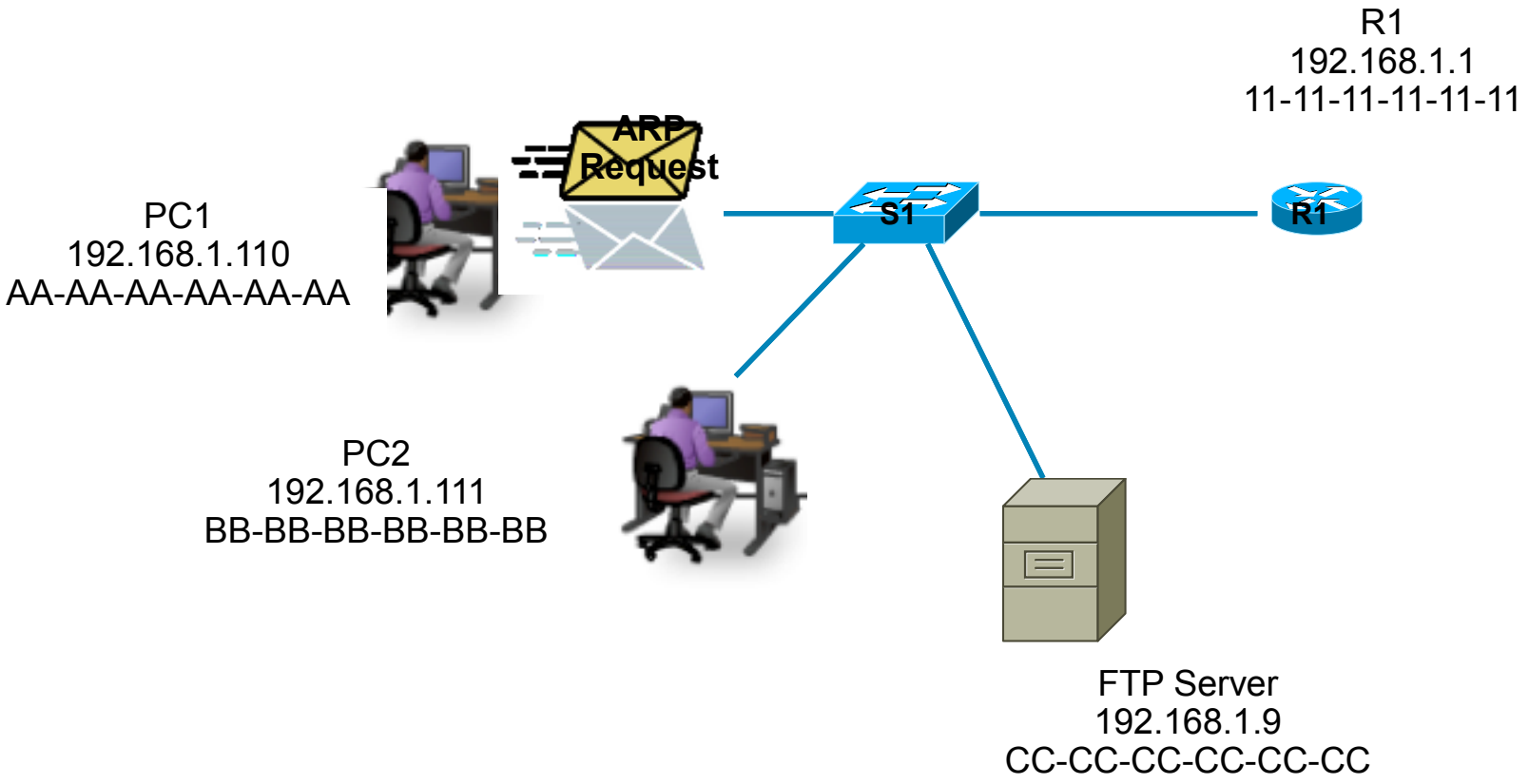


PC1
192.168.1.110
AA-AA-AA-AA-AA-AA

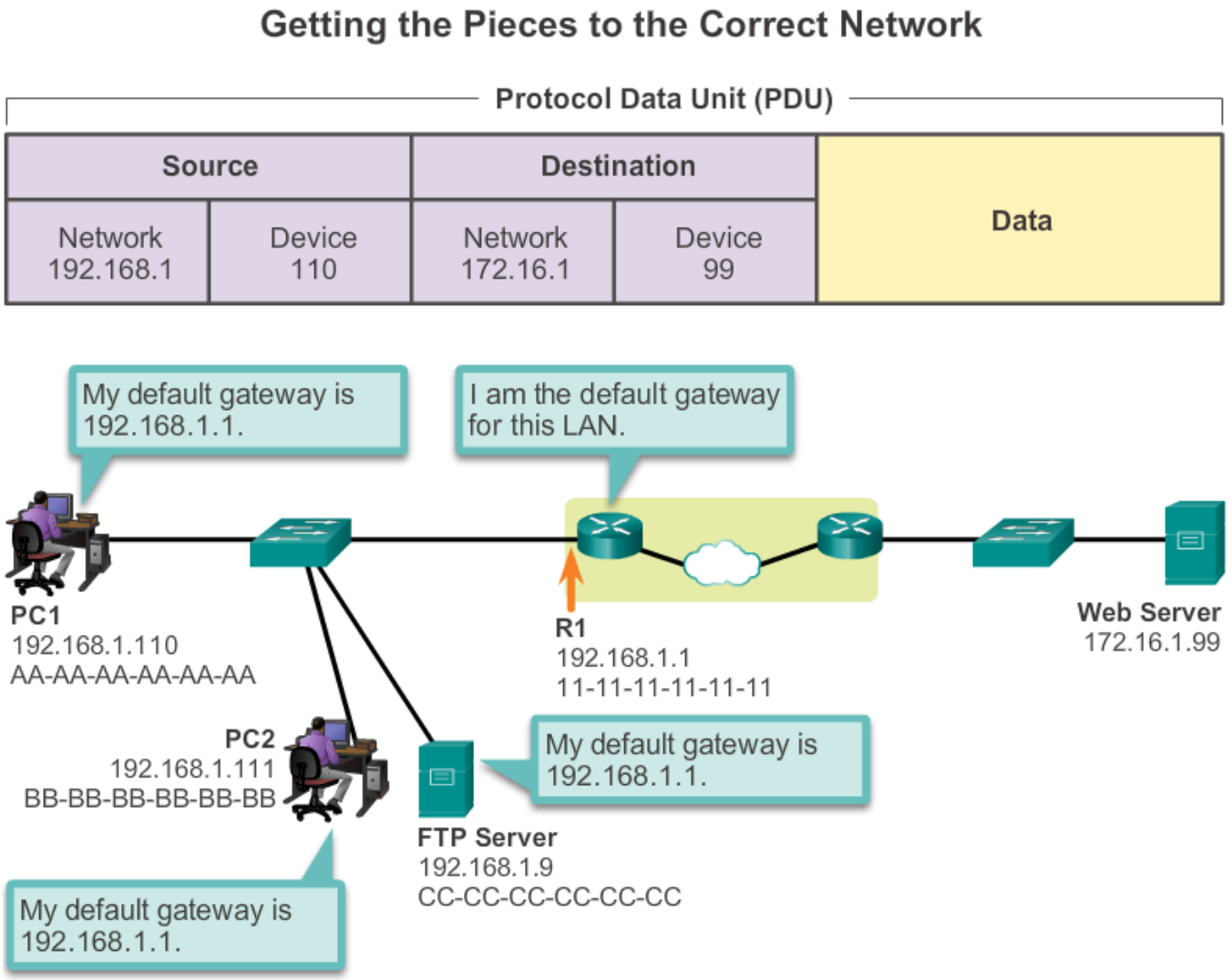


FTP Server
192.168.1.9
CC-CC-CC-CC-CC-CC

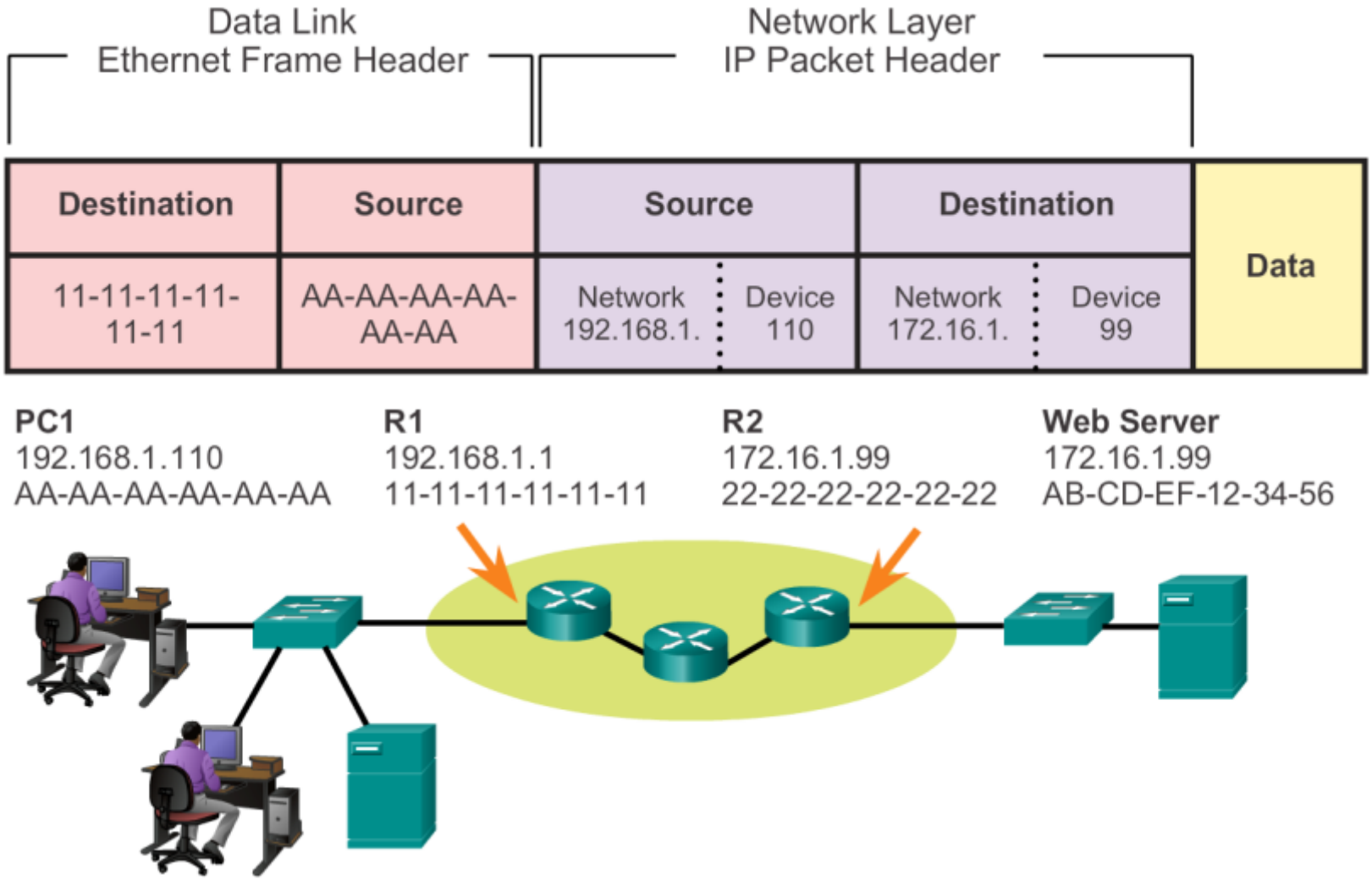
MAC and IP Addresses



Default Gateway



Communicating Device / Remote Network



Summary

In this chapter, you learned:

- Data networks are systems of end devices, intermediary devices, and the media connecting the devices. For communication to occur, these devices must know how to communicate.
- These devices must comply with communication rules and protocols. TCP/IP is an example of a protocol suite.
- Most protocols are created by a standards organization such as the IETF or IEEE.
- The most widely-used networking models are the OSI and TCP/IP models.
- Data that passes down the stack of the OSI model is segmented into pieces and encapsulated with addresses and other labels. The process is reversed as the pieces are de-encapsulated and passed up the destination protocol stack.

Summary (cont.)

In this chapter, you learned:

- The OSI model describes the processes of encoding, formatting, segmenting, and encapsulating data for transmission over the network.
- The TCP/IP protocol suite is an open standard protocol that has been endorsed by the networking industry and ratified, or approved, by a standards organization.
- The Internet Protocol Suite is a suite of protocols required for transmitting and receiving information using the Internet.
- Protocol Data Units (PDUs) are named according to the protocols of the TCP/IP suite: data, segment, packet, frame, and bits.
- Applying models allows individuals, companies, and trade associations to analyze current networks and plan the networks of the future.