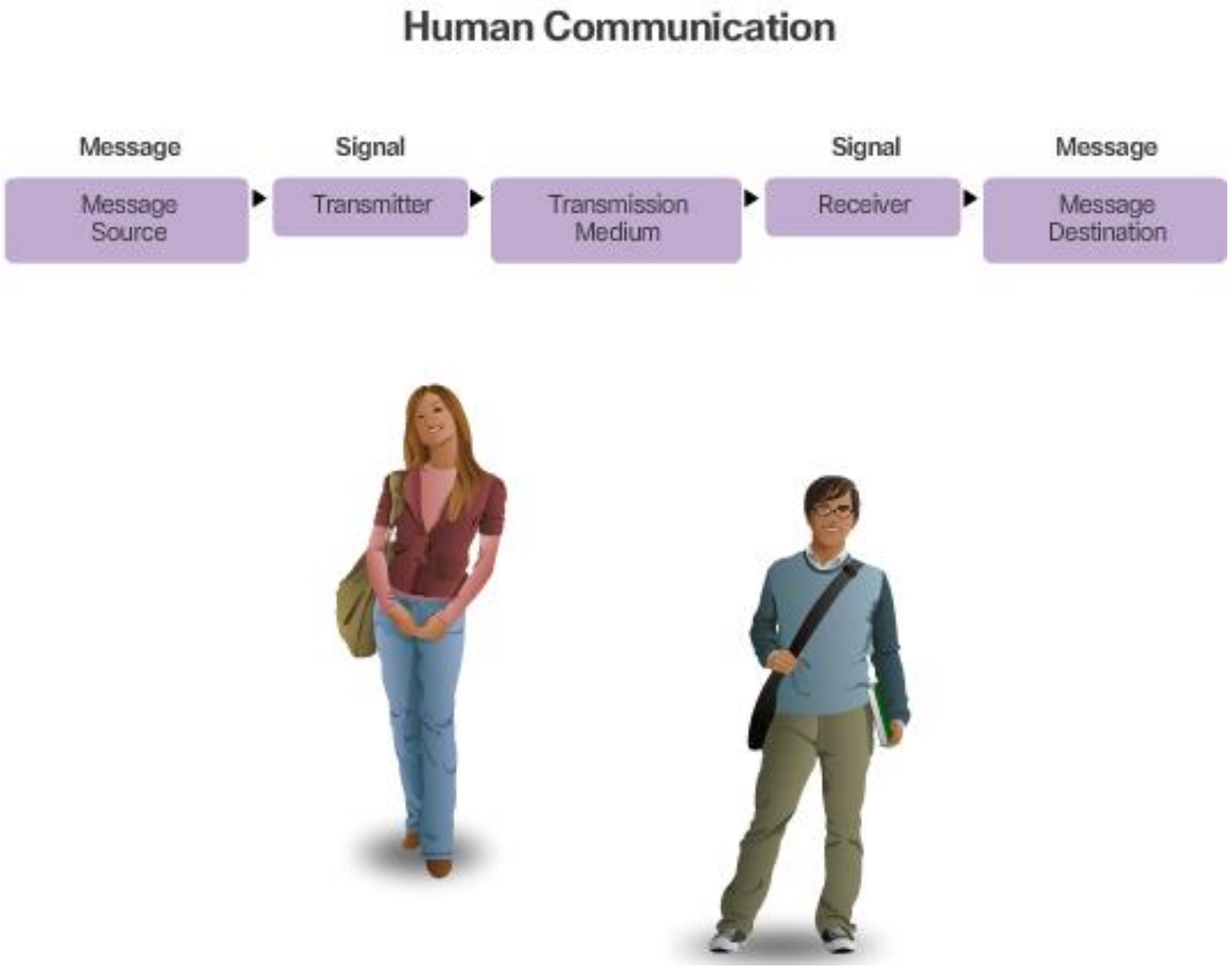
3.0.1.1 Chapter 3: Network Protocols and Communications

Class Activity - Designing a Communications System

Network Protocols and Standards make network communication easier.

3.1.1.1 Communication Fundamentals

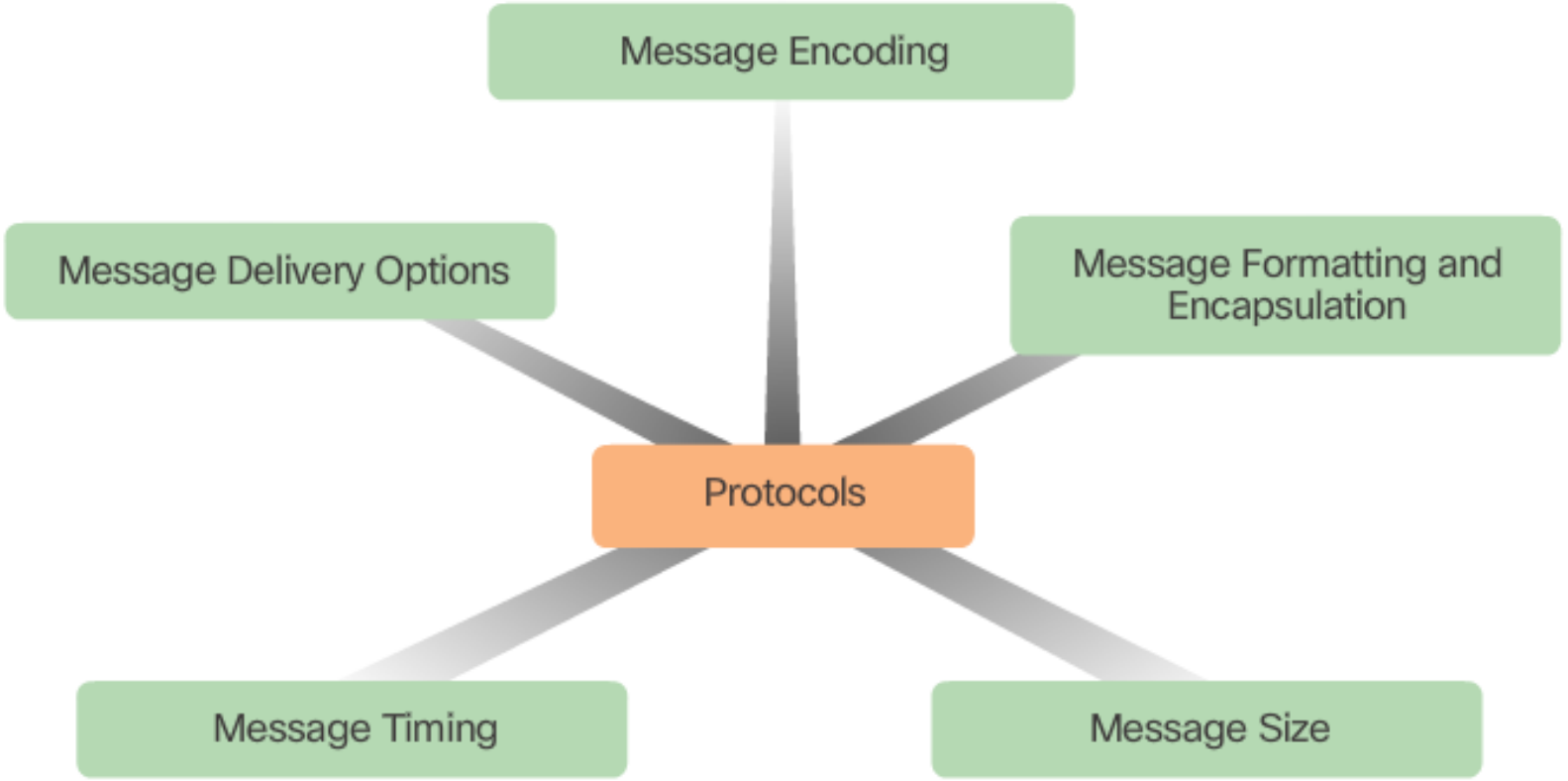


Communication Fundamentals

Communication begins with a message, or information, that must be sent from a source to a destination. The sending of this message, whether by face-to-face communication or over a network, is governed by rules called protocols. These protocols are specific to the type of communication method occurring. In our day-to-day personal communication, the rules we use to communicate over one medium, like a telephone call, are not necessarily the same as the protocols for using another medium, such as sending a letter

3.1.1.2 Rule Establishment

humans communication between govern rules. It is verydifficult tounderstand messages that are not correctly formatted and donot follow the established rules and protocols. A estrutura da gramatica, da lingua, da pontuacao e do sentance faz a configuracao humana compreensivel por muitos individuos diferentes.

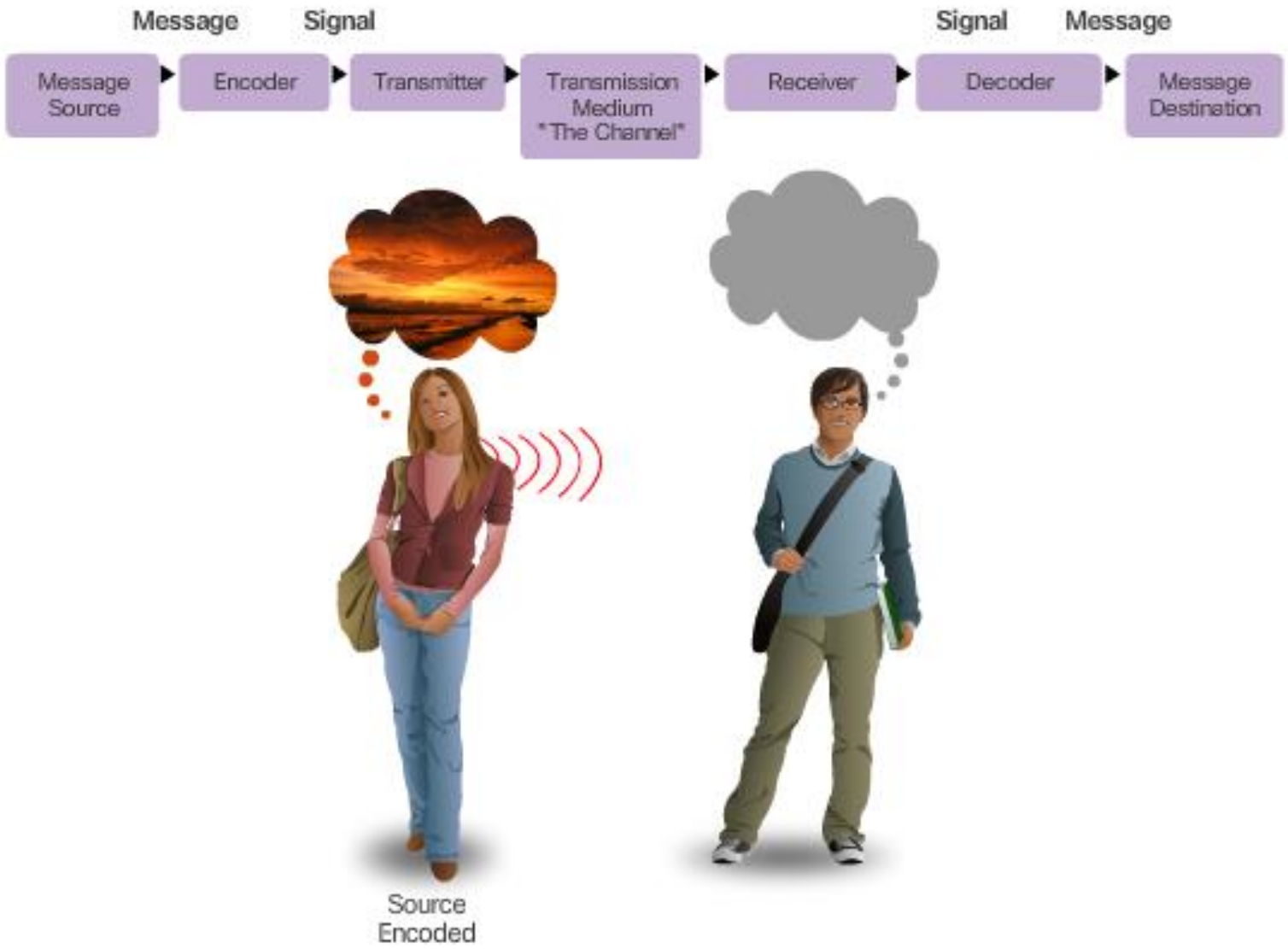


Rule Establishment

Protocols must account for the following requirements:

- An identified sender and receiver
- Common language and grammar
- Speed and timing of delivery
- Confirmation or acknowledgment requirements

3.1.1.3 Message Encoding



Message Encoding

One of the first steps to sending a message is encoding. Encoding is the process of converting information into another acceptable form, for transmission. Decoding reverses this process in order to interpret the information.

3.1.1.4 Message Formatting and Encapsulation

Recipient (destination) Location address	Sender (source) Location address	Salutation (start of message indicator)	Recipient (destination) identifier	Content of Letter (encapsulated data)	Sender (source) identifier	End of Frame (End of message indicator)
Envelope Addressing		Encapsulated Letter				
1400 Main Street Canton, Ohio 44203	4085 SE Pine Street Ocala, Florida 34471	Dear	Jane	I just returned from my trip. I thought you might like to see my pictures.	John	

Message Formatting and Encapsulation

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Letter writing is one of the most common forms of written human communication. For centuries, the agreed format for personal letters has not changed. In many cultures, a personal letter contains the following elements:

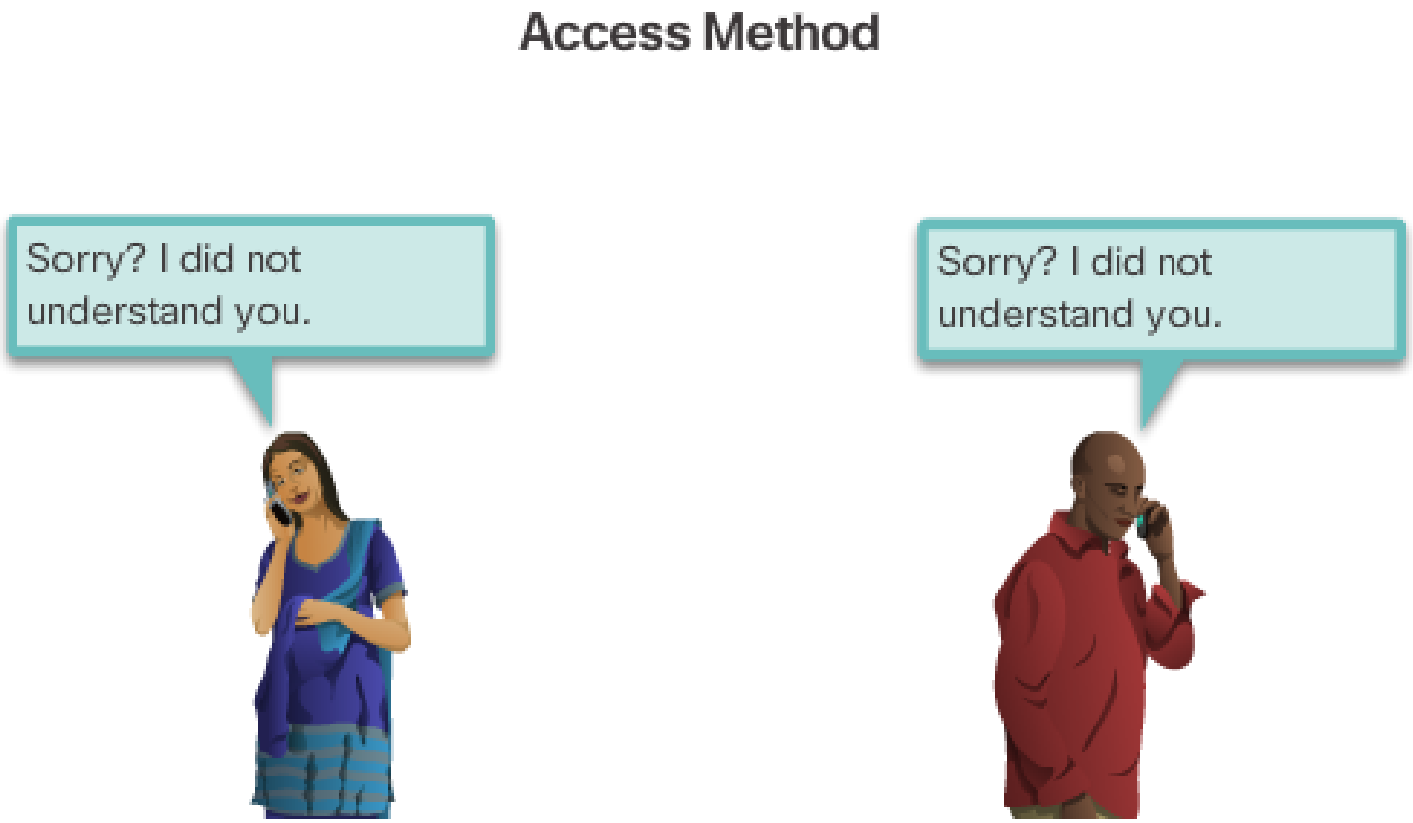
- An identifier of the recipient
- A salutation or greeting
- The message content
- A closing phrase
- An identifier of the sender

3.1.1.5 Message Size

Message Size

The size restrictions of frames require the source host to break a long message into individual pieces that meet both the minimum and maximum size requirements. The long message will be sent in separate frames, with each frame containing a piece of the original message. Each frame will also have its own addressing information. At the receiving host, the individual pieces of the message are reconstructed into the original message.

3.1.1.6 Message Timing



Message Timing

These are the rules of engagement for message timing.

Access Method

Access method determines when someone is able to send a message. If two people talk at the same time, a collision of information occurs and it is necessary for the two to back off and start again

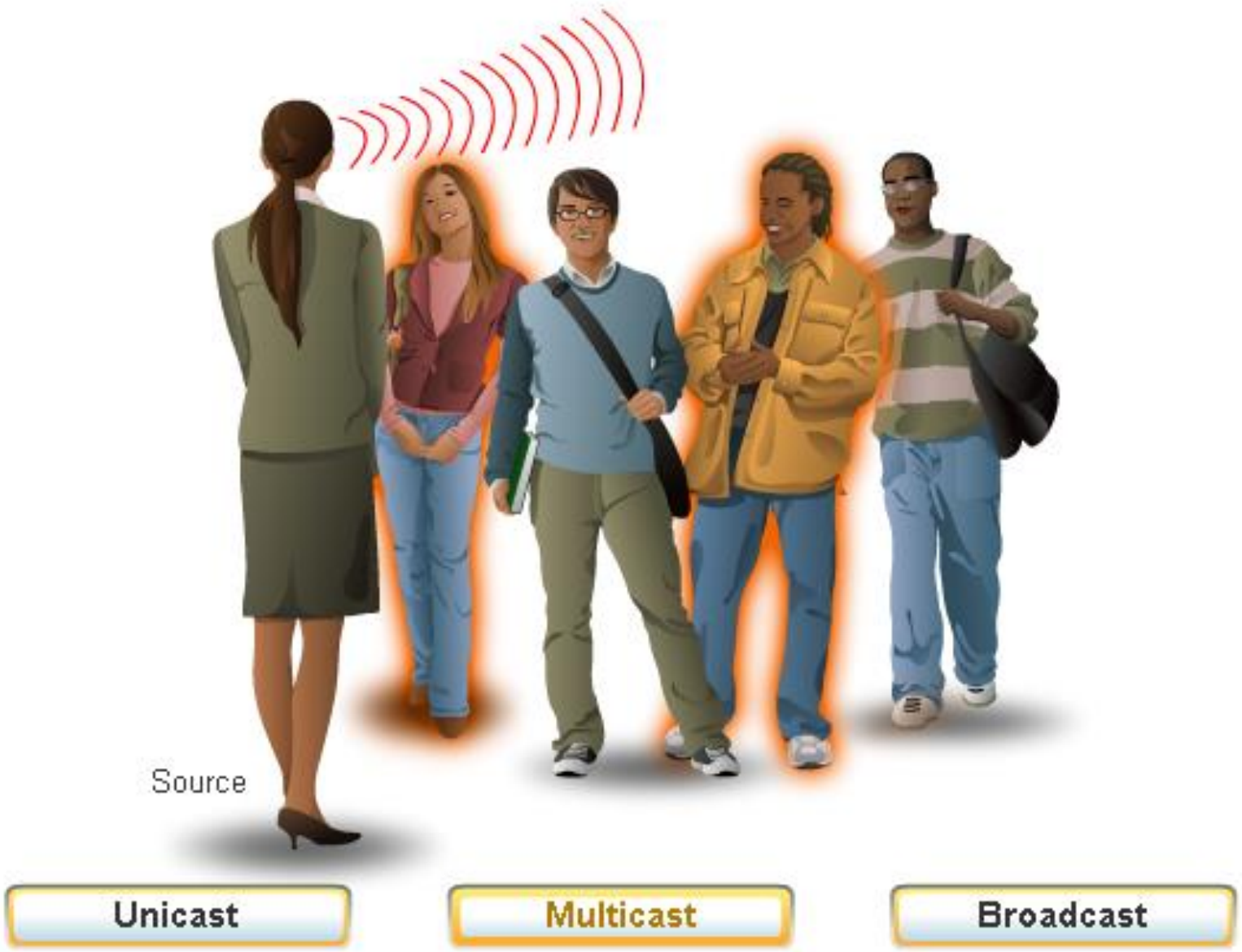
Flow Control

Timing also affects how much information can be sent and the speed that it can be delivered

Response Timeout

If a person asks a question and does not hear a response within an acceptable amount of time, the person assumes that no answer is coming and reacts accordingly

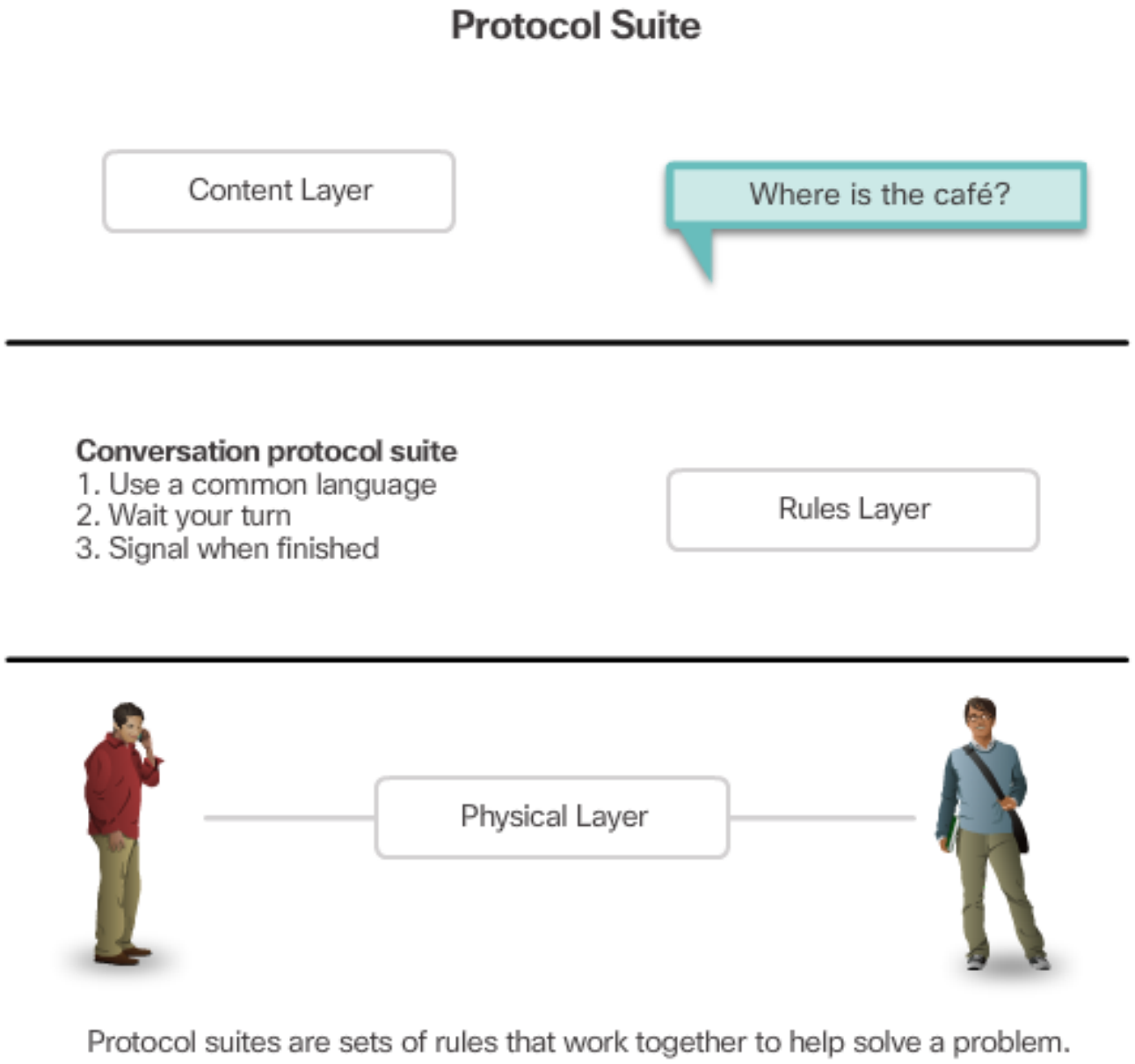
3.1.1.7 Message Delivery Options



Message Delivery Options

A message can be delivered in different ways, as shown in Figure 1. Sometimes, a person wants to communicate information to a single individual. At other times, the person may need to send information to a group of people at the same time, or even to all people in the same area.

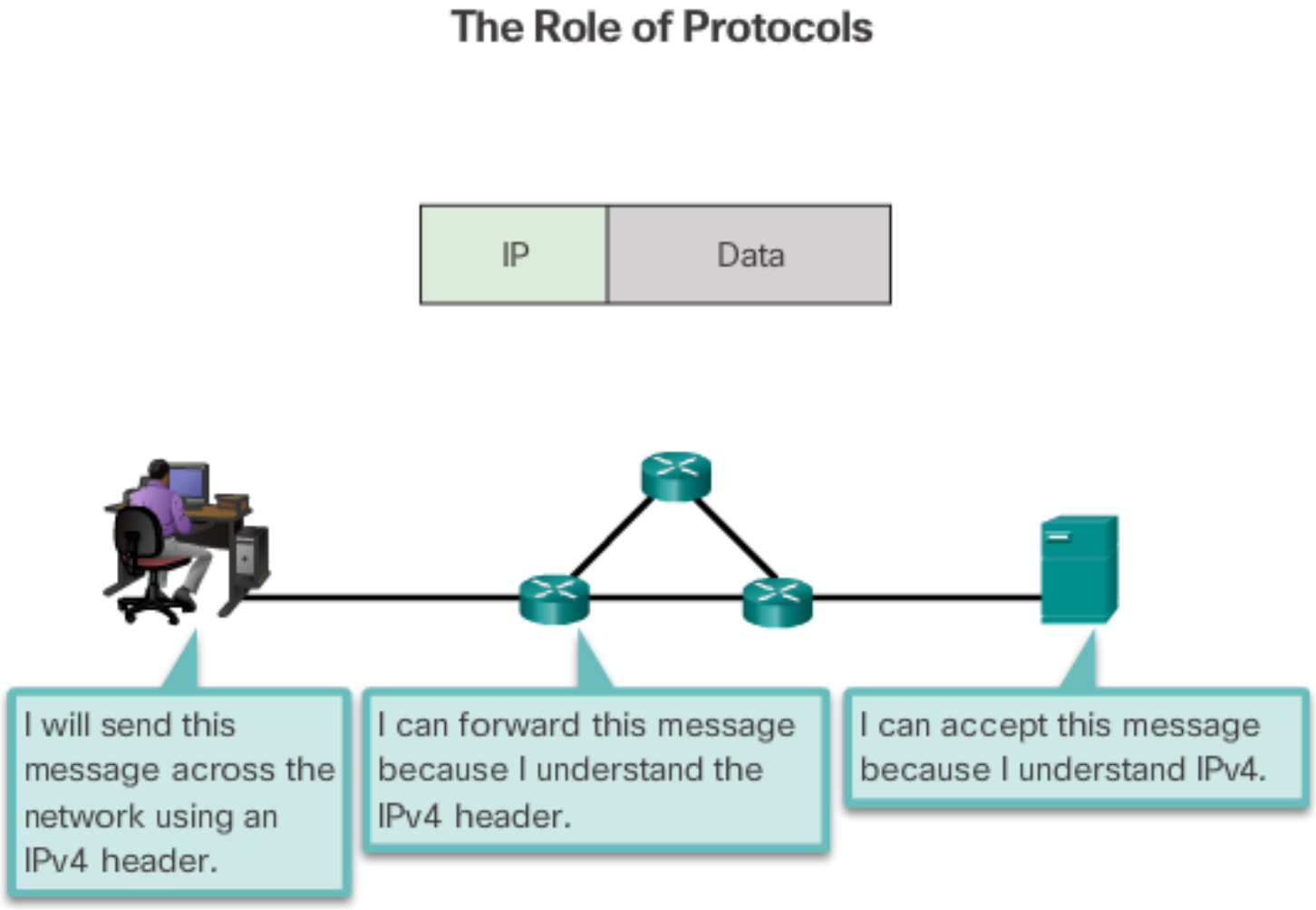
3.2.1.1 Rules that Govern Communications



Rules that Govern Communications

A group of inter-related protocols necessary to perform a communication function is called a protocol suite. Protocol suites are implemented by hosts and networking devices in software, hardware or both.

3.2.1.2 Network Protocols



The figures illustrate networking protocols that describe the following processes:

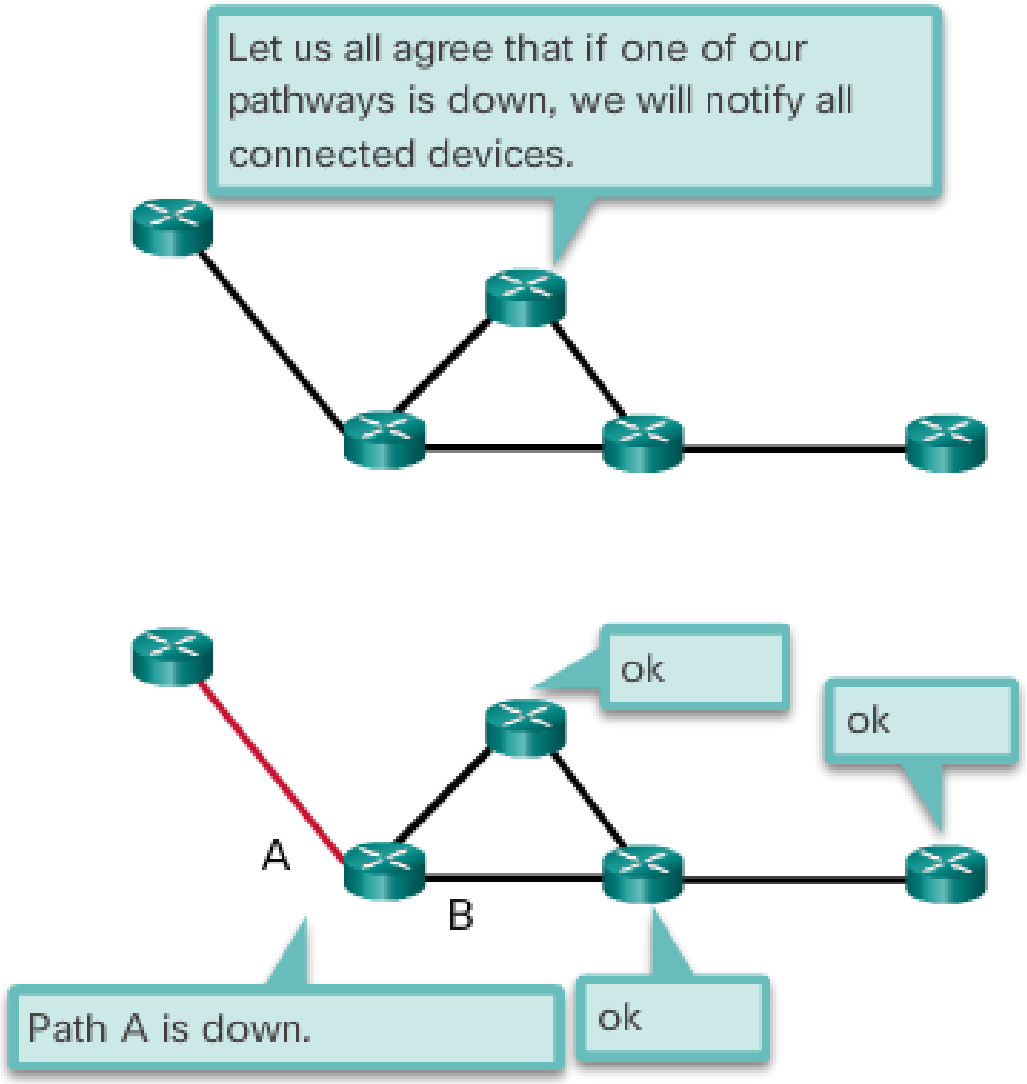
- How the message is formatted or structured, as shown in Figure 1

Network Protocols

At the human level, some communication rules are formal and others are simply understood based on custom and practice. For devices to successfully communicate, a network protocol suite must describe precise requirements and interactions.

Networking protocols define a common format and set of rules for exchanging messages between devices. Some common networking protocols are Hypertext Transfer Protocol (HTTP), Transmission Control Protocol (TCP), and Internet Protocol (IP).

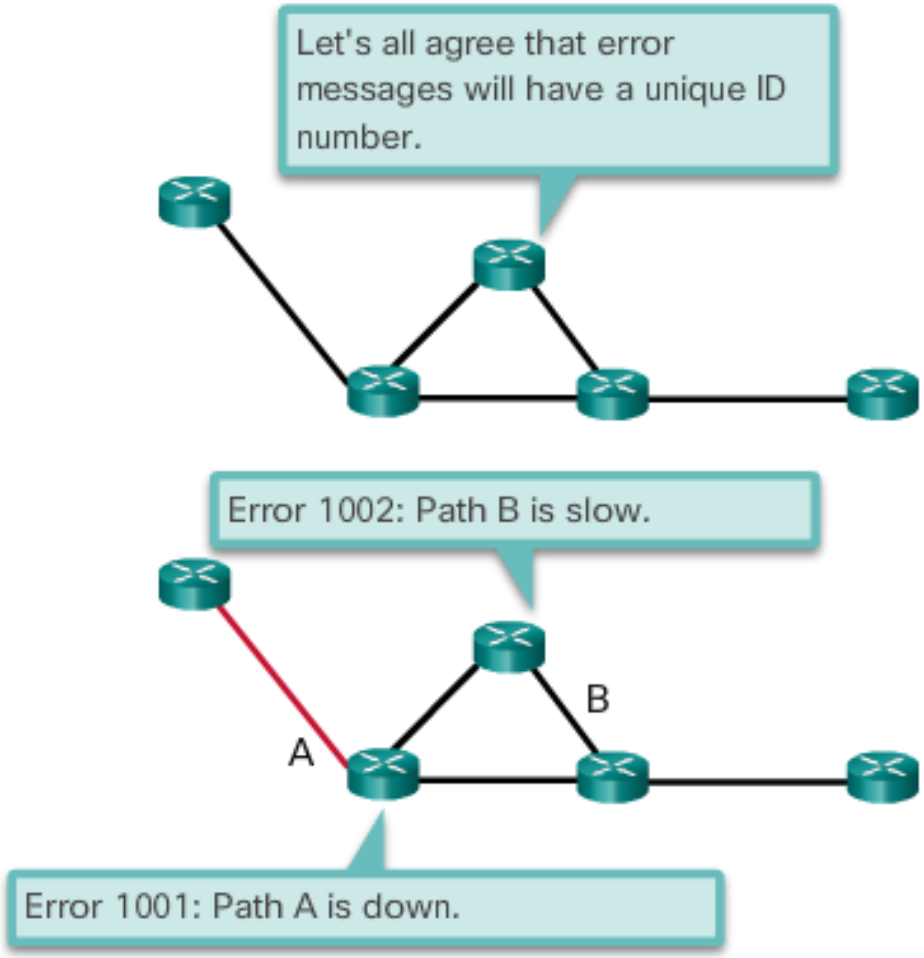
3.2.1.2 Network Protocols



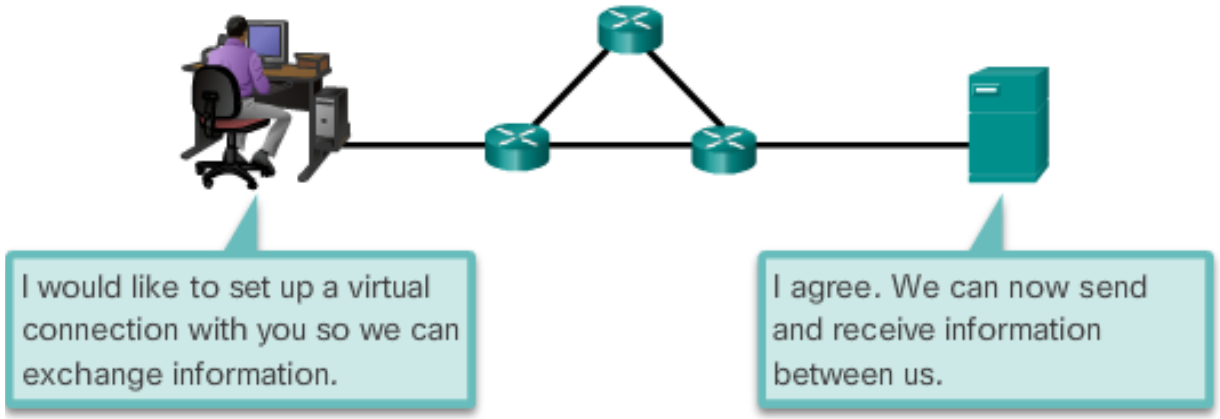
The process by which networking devices share information about pathways to other networks

- The process by which networking devices share information about pathways with other networks, as shown in Figure 2

3.2.1.2 Network Protocols



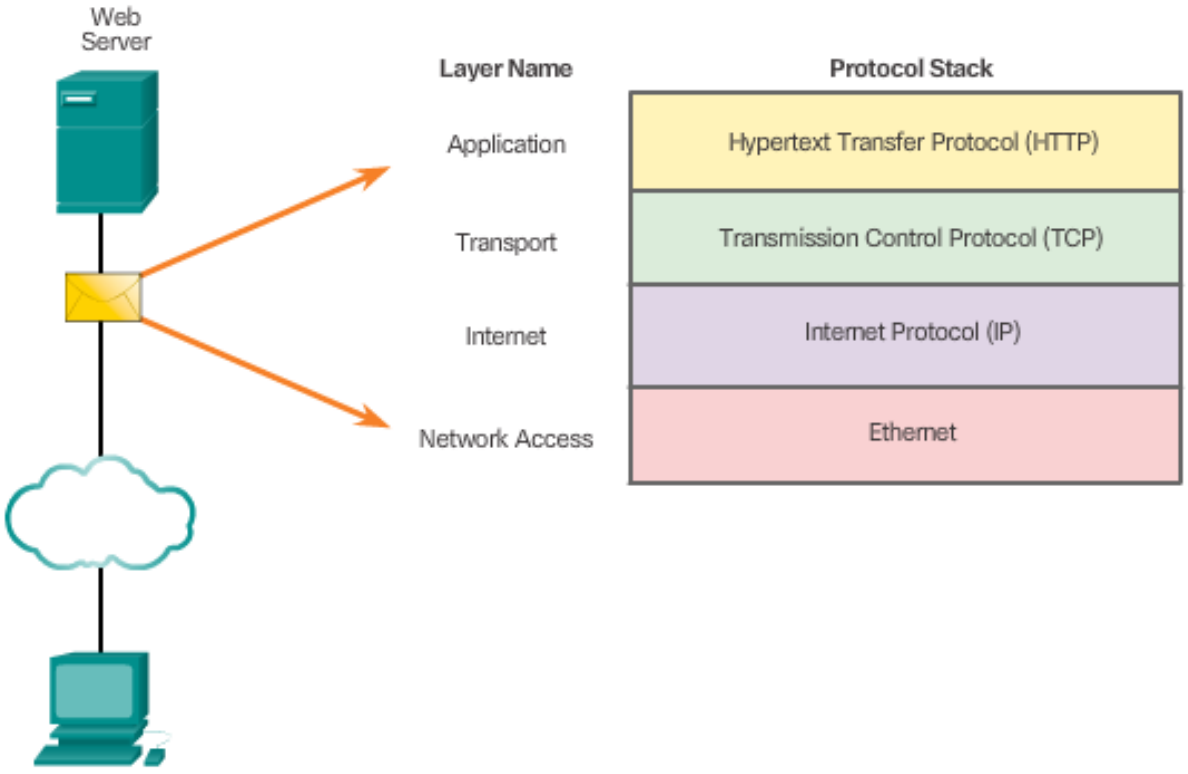
How and when error and system messages are passed between devices



The setting up and termination of data transfer sessions

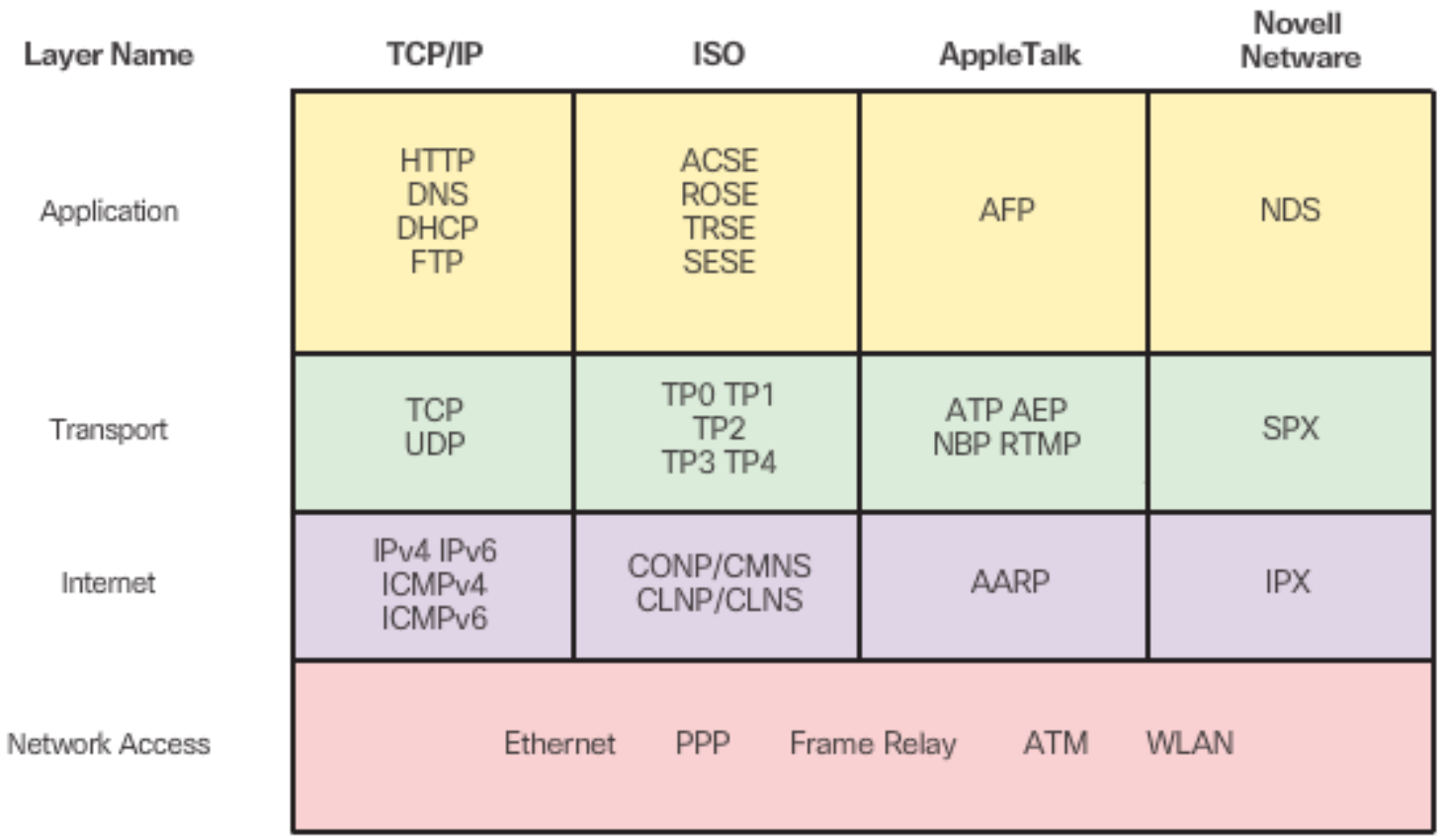
- How and when error and system messages are passed between devices, as shown in Figure 3
- The setup and termination of data transfer sessions, as shown in Figure 4.

3.2.1.3 Protocol Interaction



- **HTTP -** is an application protocol that governs the way a web server and a web client interact. HTTP defines the content and formatting of the requests and responses that are exchanged between the client and server.
- **TCP** - is the transport protocol that manages the individual conversations. TCP divides the HTTP messages into smaller pieces, called segments.
  IP - is responsible for taking the formatted segments from TCP, encapsulating them into packets, assigning them the appropriate addresses, and delivering them to the destination host.
- **Ethernet** - is a network access protocol that describes two primary functions: communication over a data link and the physical transmission of data on the network media.

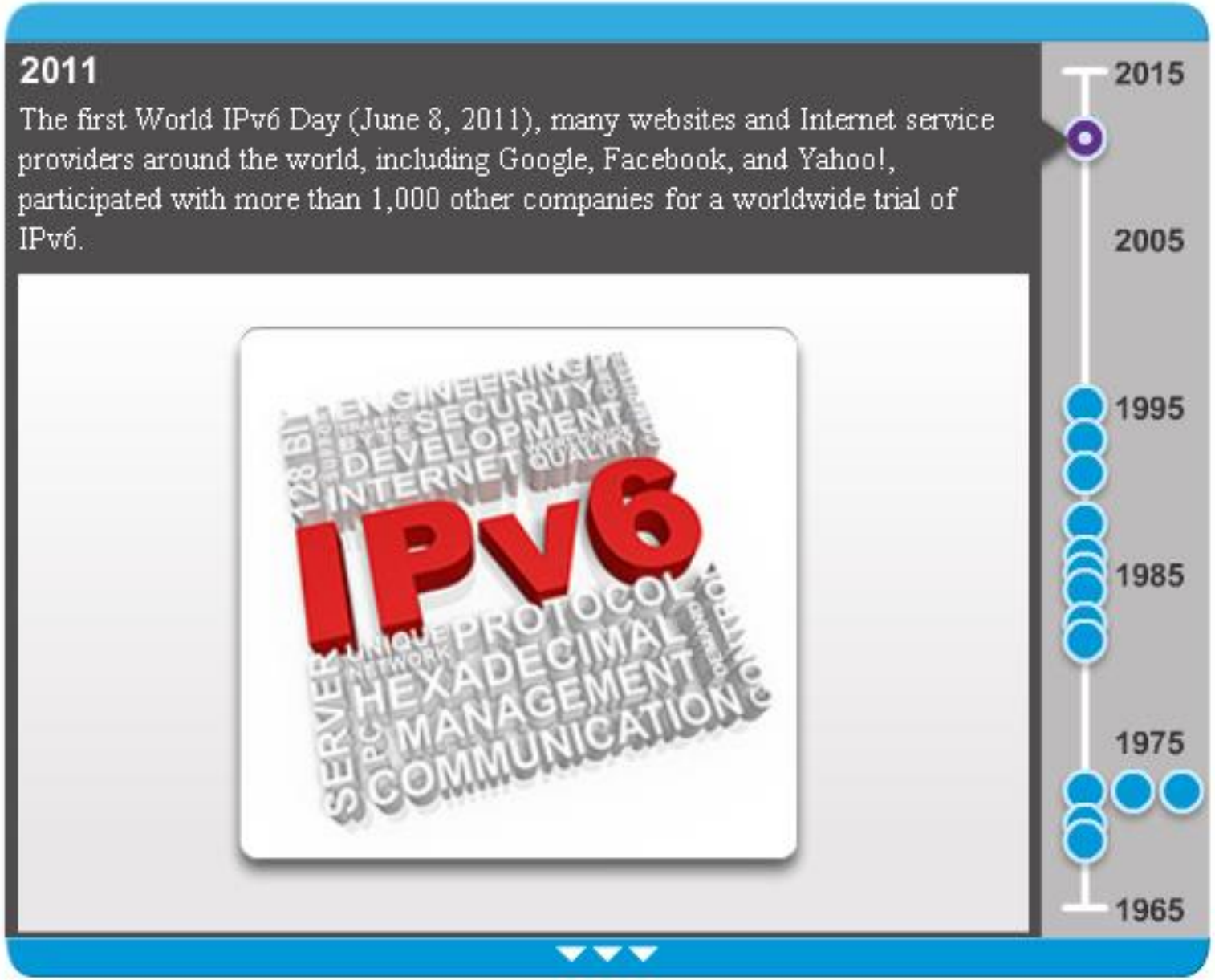
3.2.2.1 Protocol Suites and Industry Standards



Protocol Suites and Industry Standards

A protocol suite is a set of protocols that work together to provide comprehensive network communication services. A protocol suite may be specified by a standards organization or developed by a vendor. Protocol suites, like the four shown in the figure, can be a bit overwhelming. However, this course will only cover the protocols of the TCP/IP protocol suite.

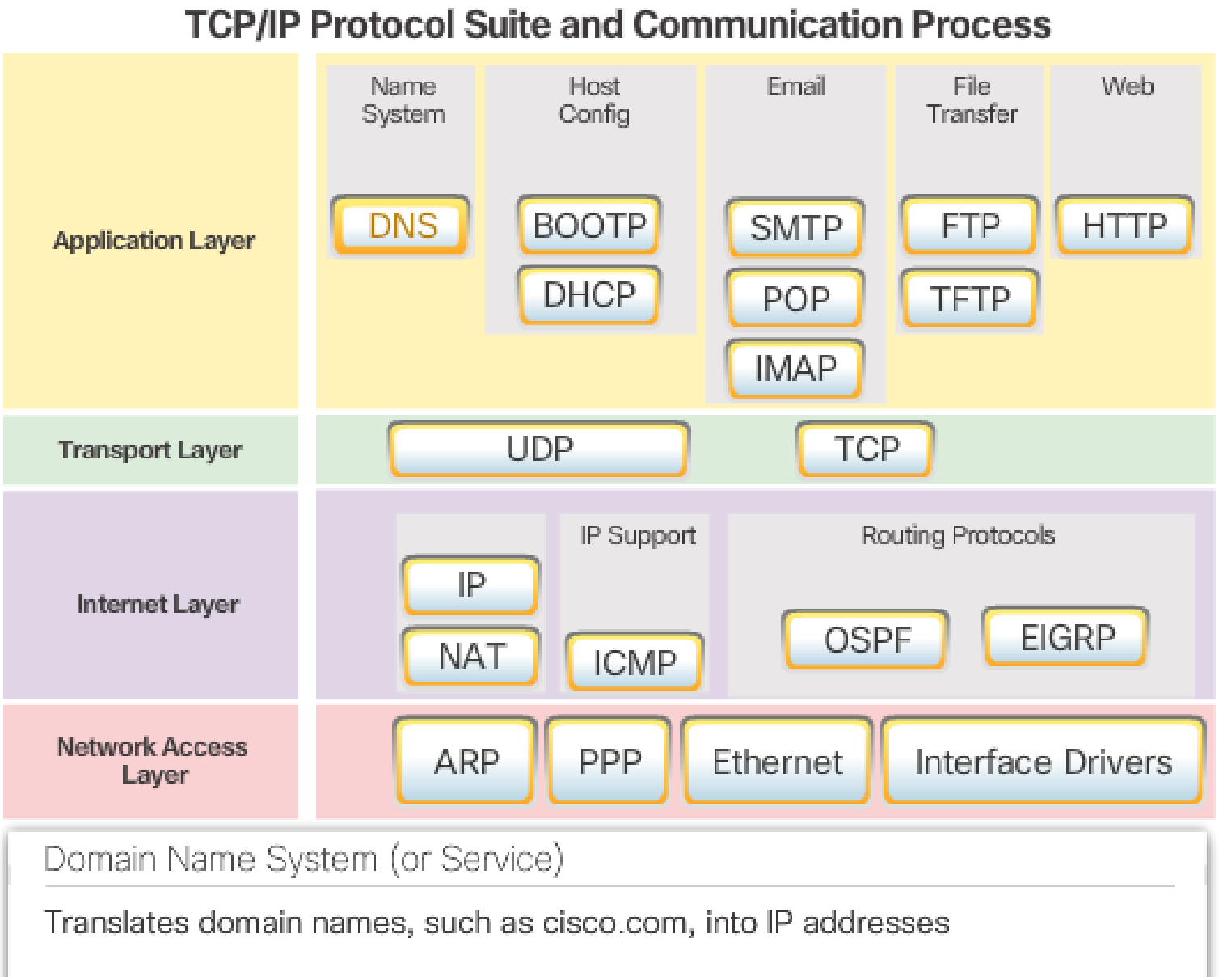
3.2.2.2 Development of TCP/IP



Development of TCP/IP

The first packet switching network and predecessor to today's Internet was the Advanced Research Projects Agency Network (ARPANET)

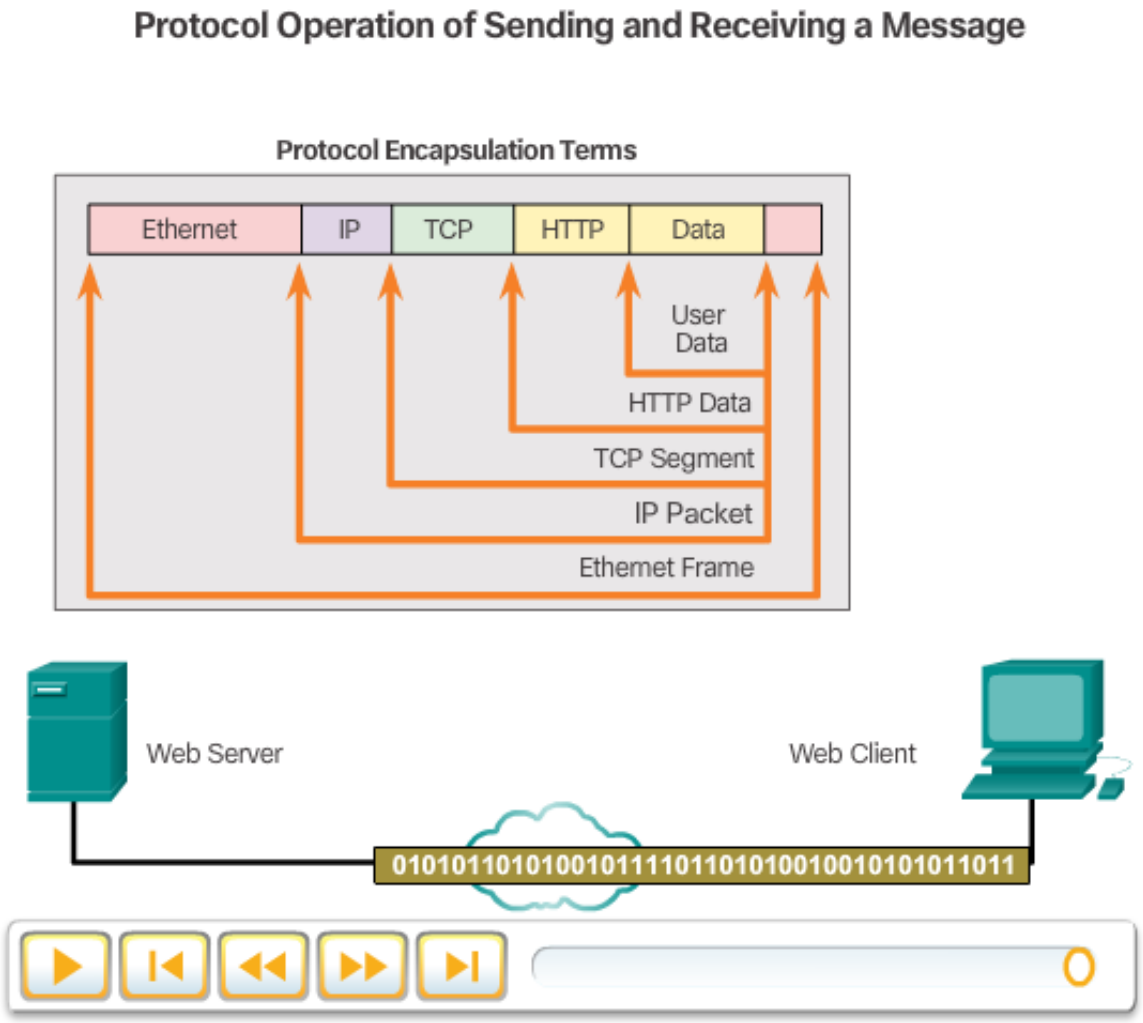
3.2.2.3 TCP/IP Protocol Suite



TCP/IP Protocol Suite

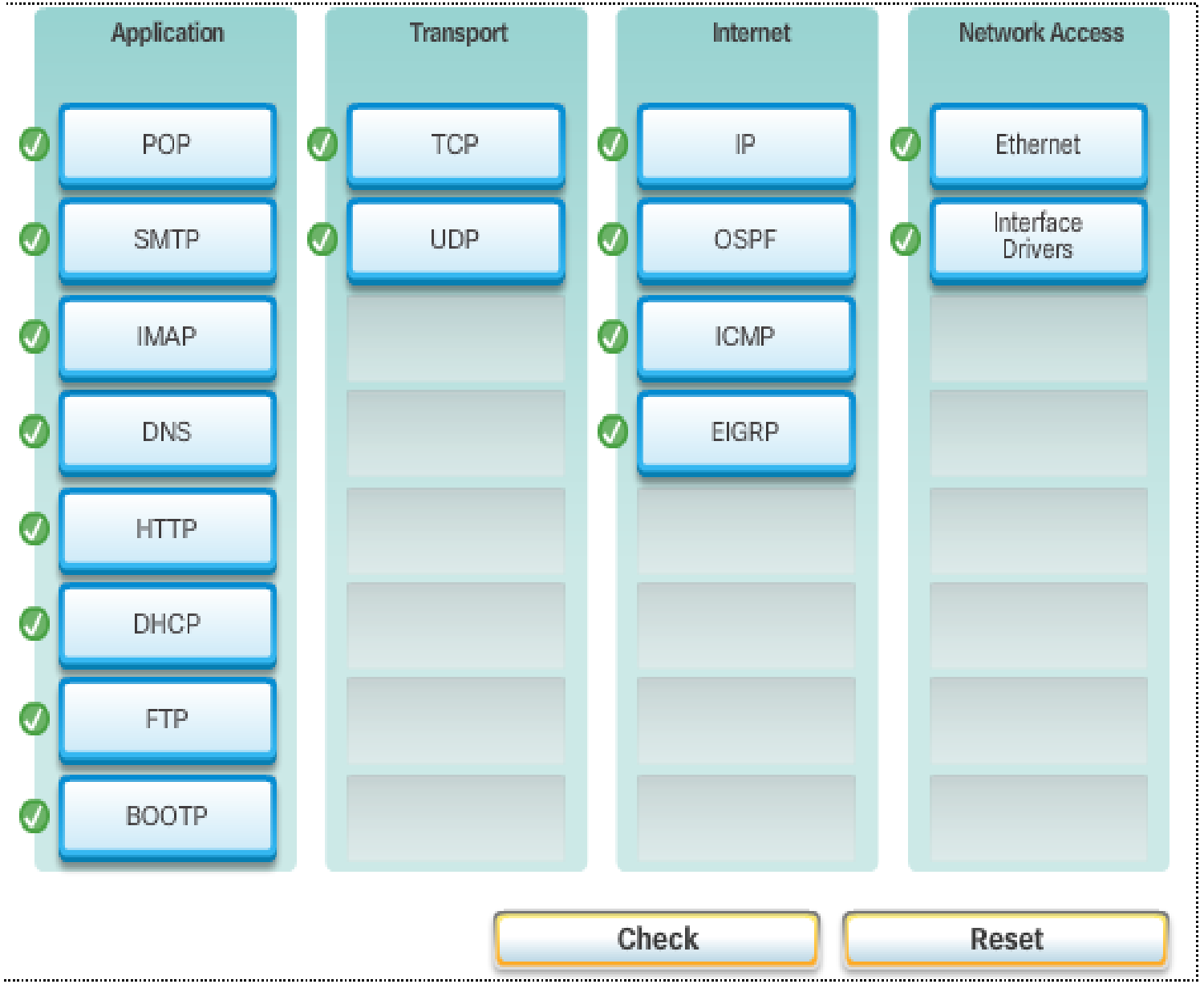
Today, the TCP/IP protocol suite includes many protocols, as shown in the figure

3.2.2.4 TCP/IP Communication Process



1. In Figure 1 the web server preparing the Hypertext Markup Language (HTML) page as data to be sent.
2. The application protocol HTTP header is added to the front of the HTML data..
3. The HTTP application layer protocol delivers the HTML-formatted web page data to the transport layer.
4. Next, the IP information is added to the front of the TCP information. IP assigns the appropriate source and destination IP addresses
5. The Ethernet protocol adds information to both ends of the IP packet, known as a data link frame. **6**. This data is now transported through the internetwork, which consists of media and intermediary devices.
7. In Figure 2, the animation begins with the client receiving the data link frames that contain the data
8. The web page information is then passed on to the client's web browser software.

3.2.2.5 Activity - Mapping the Protocols of the TCP/IP Suite



3.2.3.1 Open Standards

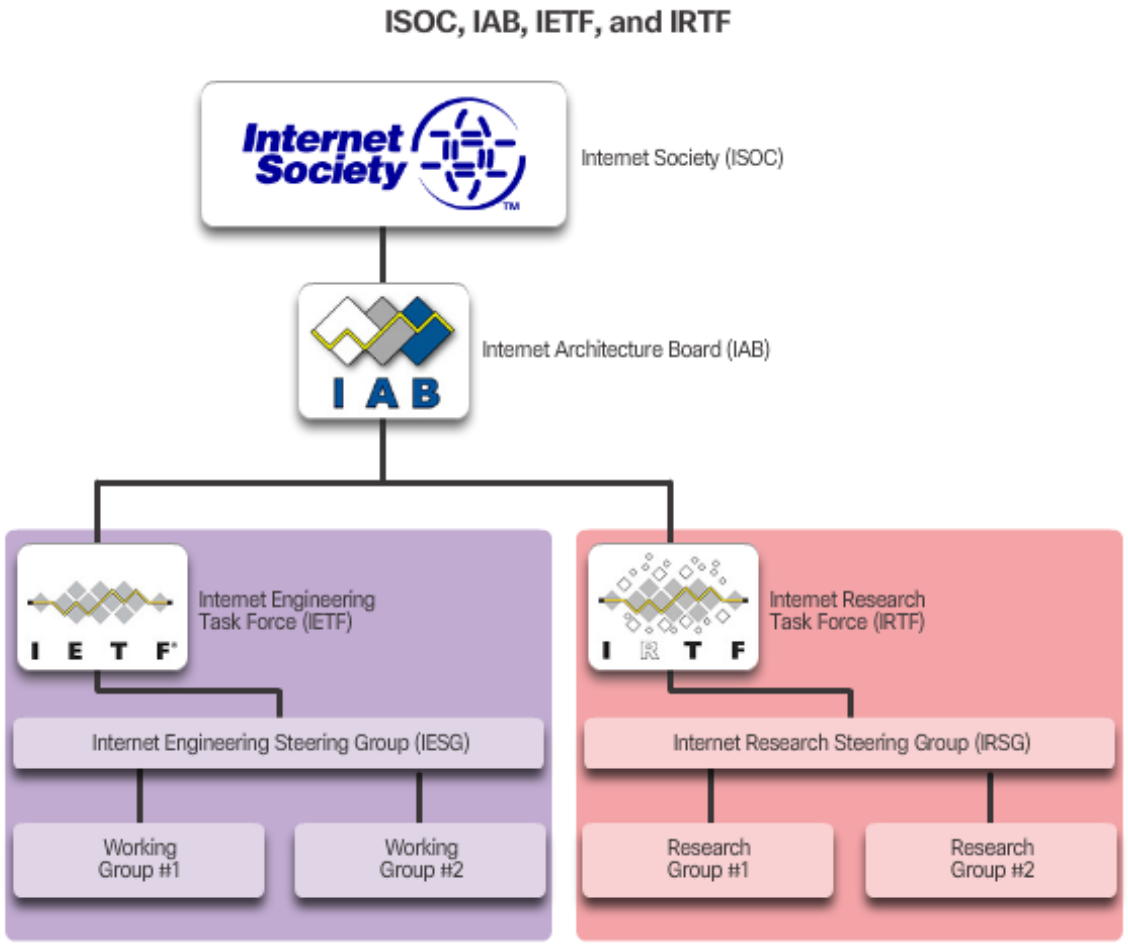
Open Standards

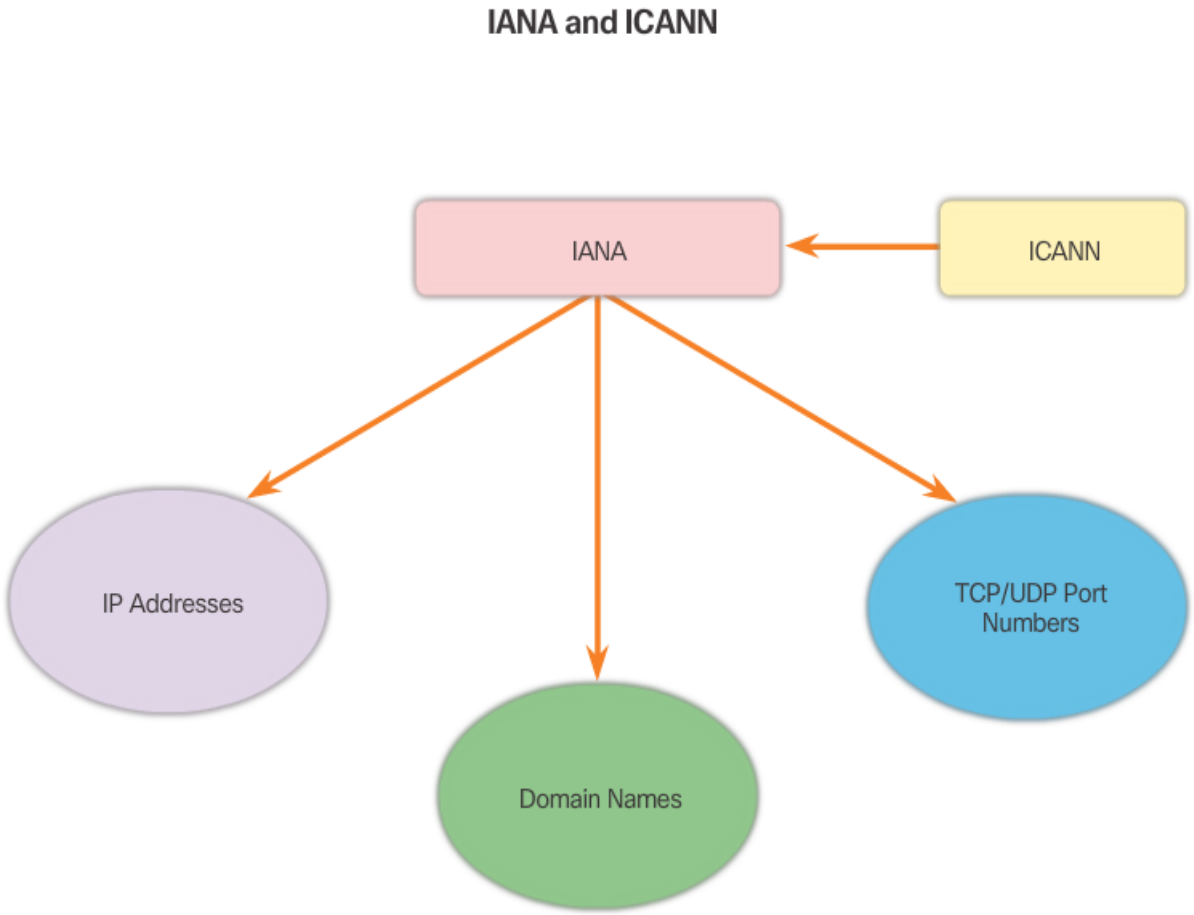
Open standards encourage interoperability, competition, and innovation. They also guarantee that no single company's product can monopolize the market, or have an unfair advantage over its competition. A good example of this is when purchasing a wireless router for the home. There are many different choices available from a variety of vendors, all of which incorporate standard protocols such as IPv4, DHCP, 802.3 (Ethernet), and 802.11 (Wireless LAN). These open standards

3.2.3.2 Internet Standards

Internet Standards

Standards organizations are usually vendor-neutral, non-profit institutions established to develop and promote the concept of open standards. Various organizations have different responsibilities for promoting and creating standards for the TCP/IP protocol.





3.2.3.3 Electronics and Communications Standard Organizations

Institute of Electrical and Electronics Engineers (IEEE)

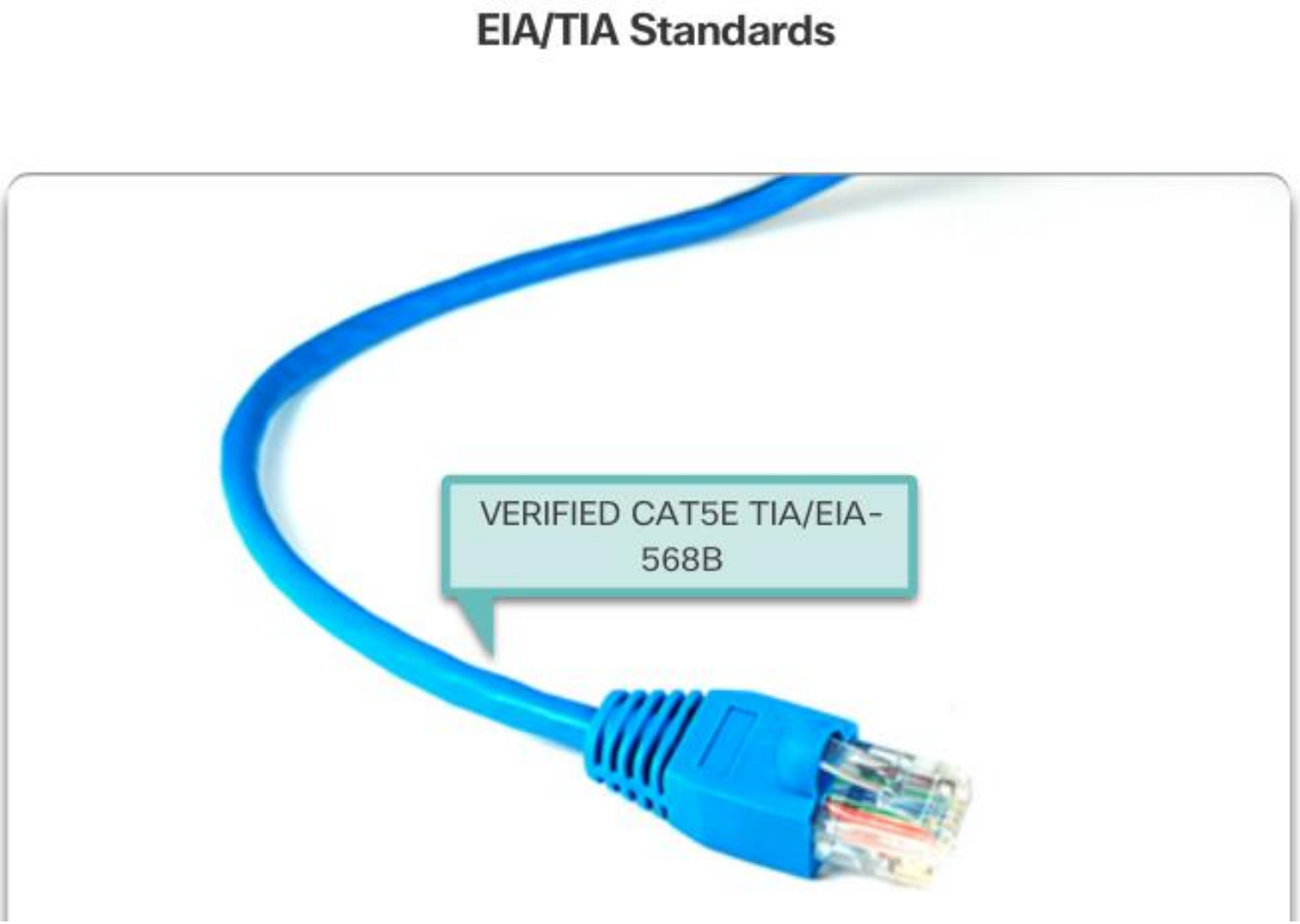
IEEE 802 Working Groups and Study Groups

- 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

Other standard organizations have responsibilities for promoting and creating the electronic and communication standards used to deliver the IP packets as electronic signals over a wired or wireless medium.

3.2.3.3 Electronics and Communications Standard Organizations



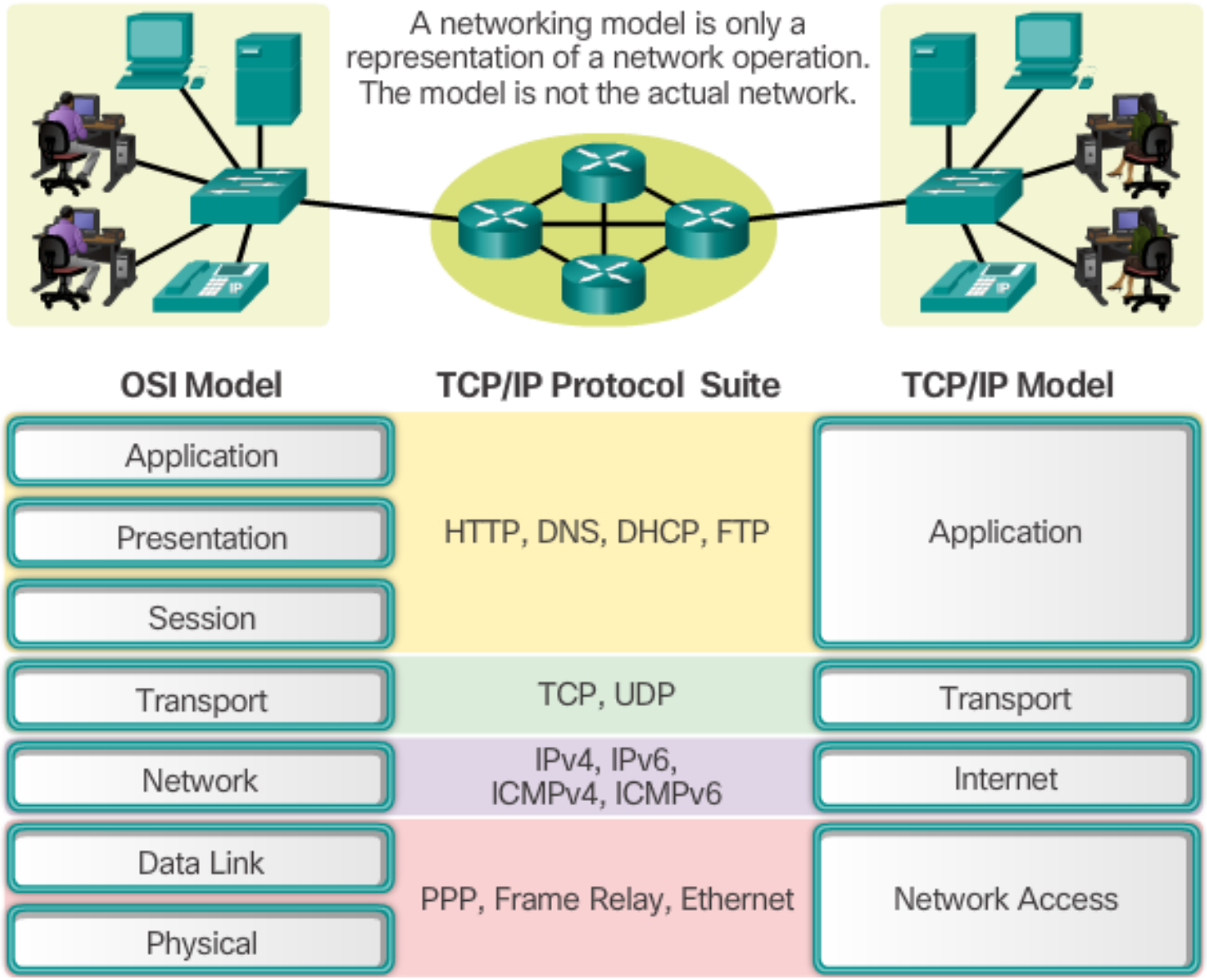
Other standard organizations have responsibilities for promoting and creating the electronic and communication standards used to deliver the IP packets as electronic signals over a wired or wireless medium

3.2.3.4 Lab - Researching Networking Standards

In this lab, you will complete the following objectives:

- Part 1: Research Networking Standards Organizations
- Part 2: Reflect on Internet and Computer Networking Experience

3.2.4.1The Benefits of Using a Layered Model

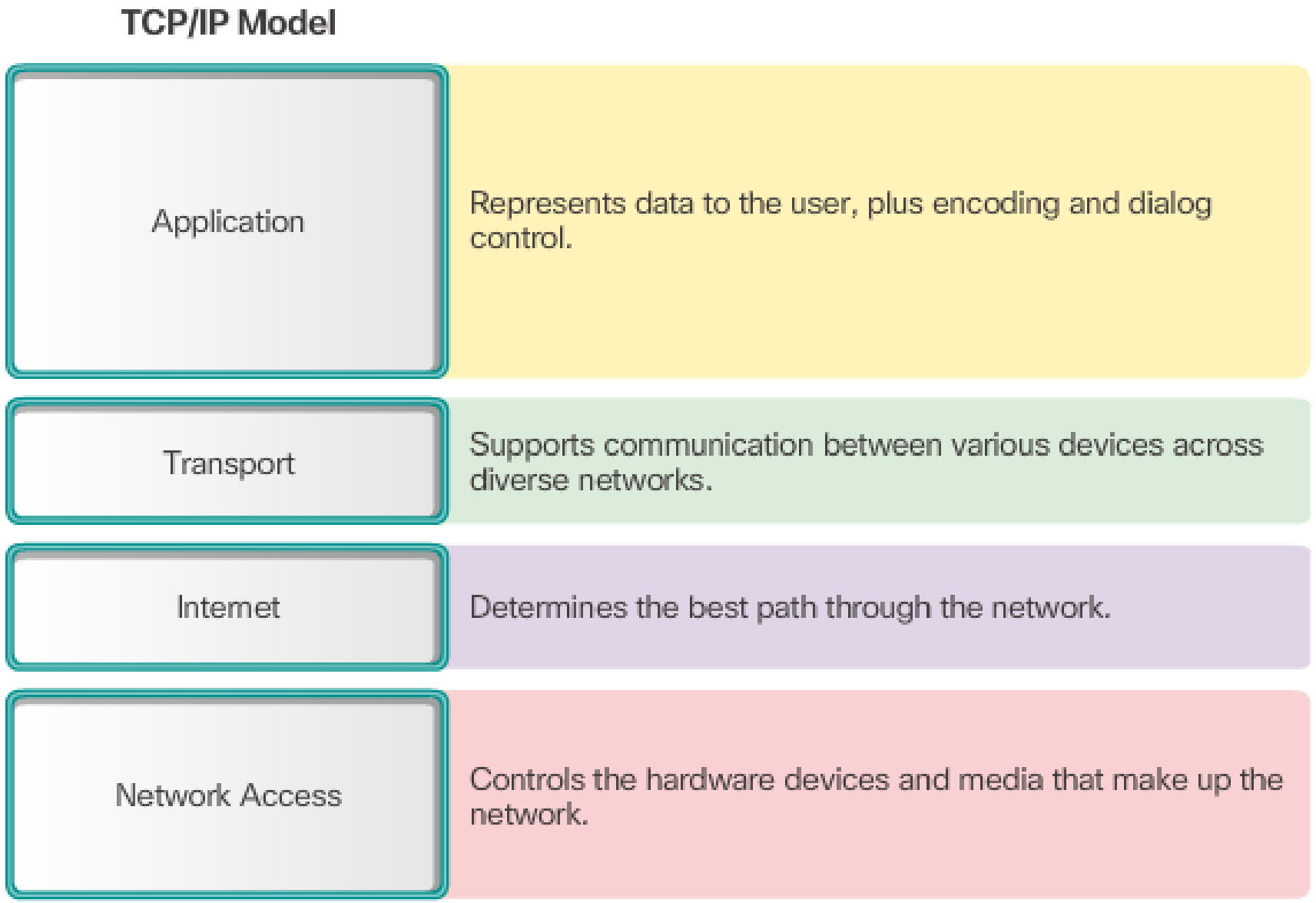


The benefits to using a layered model to describe network protocols and operations include:

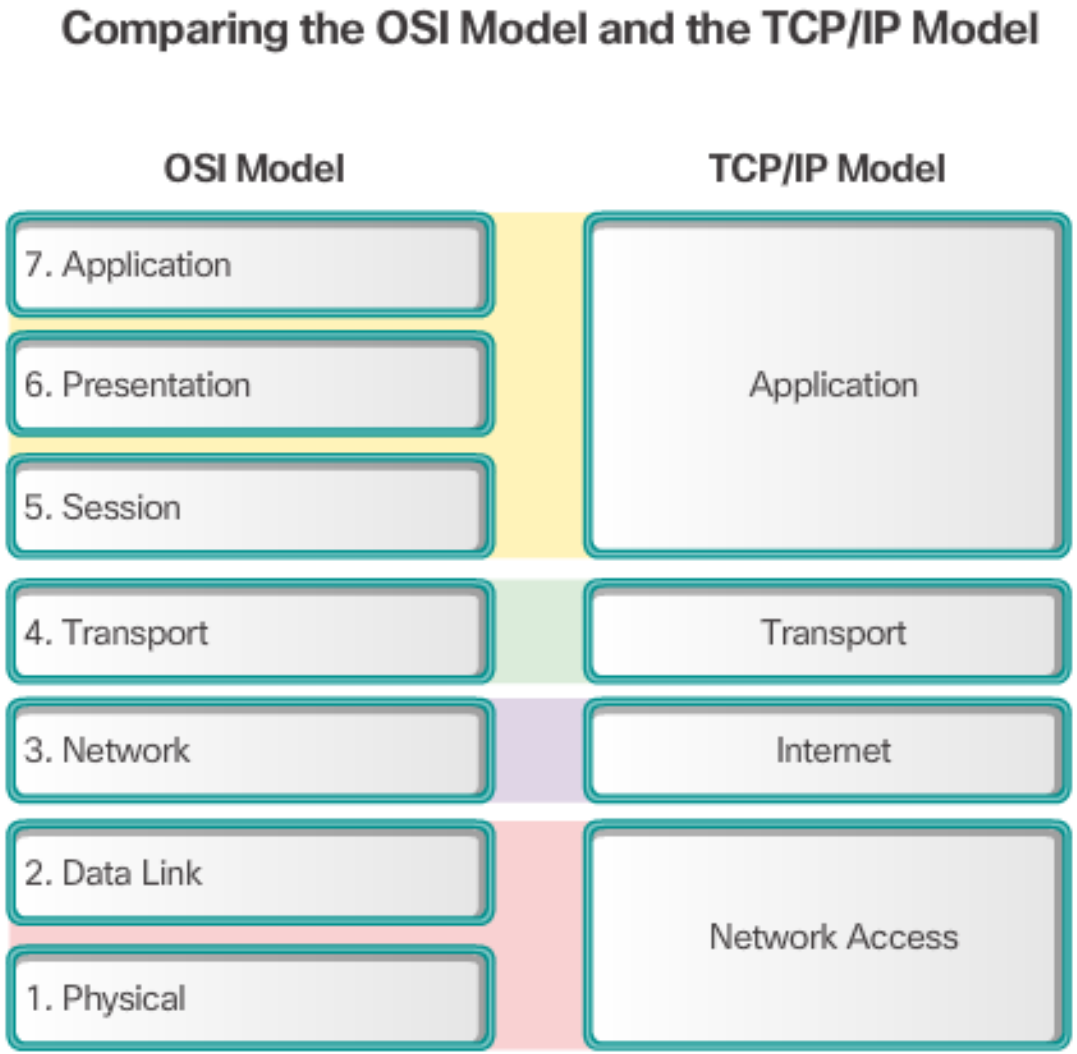
- Assisting in protocol design because protocols that operate at a specific layer have defined information that they act upon and a defined interface to the layers above and below.
- Fostering competition because products from different vendors can work together.
- Preventing technology or capability changes in one layer from affecting other layers above and below.
- Providing a common language to describe networking functions and capabilities.

3.2.4.2 The OSI Reference Model

3.2.4.3 The TCP/IP Protocol Model



3.2.4.4 OSI Model and TCP/IP Model Comparison

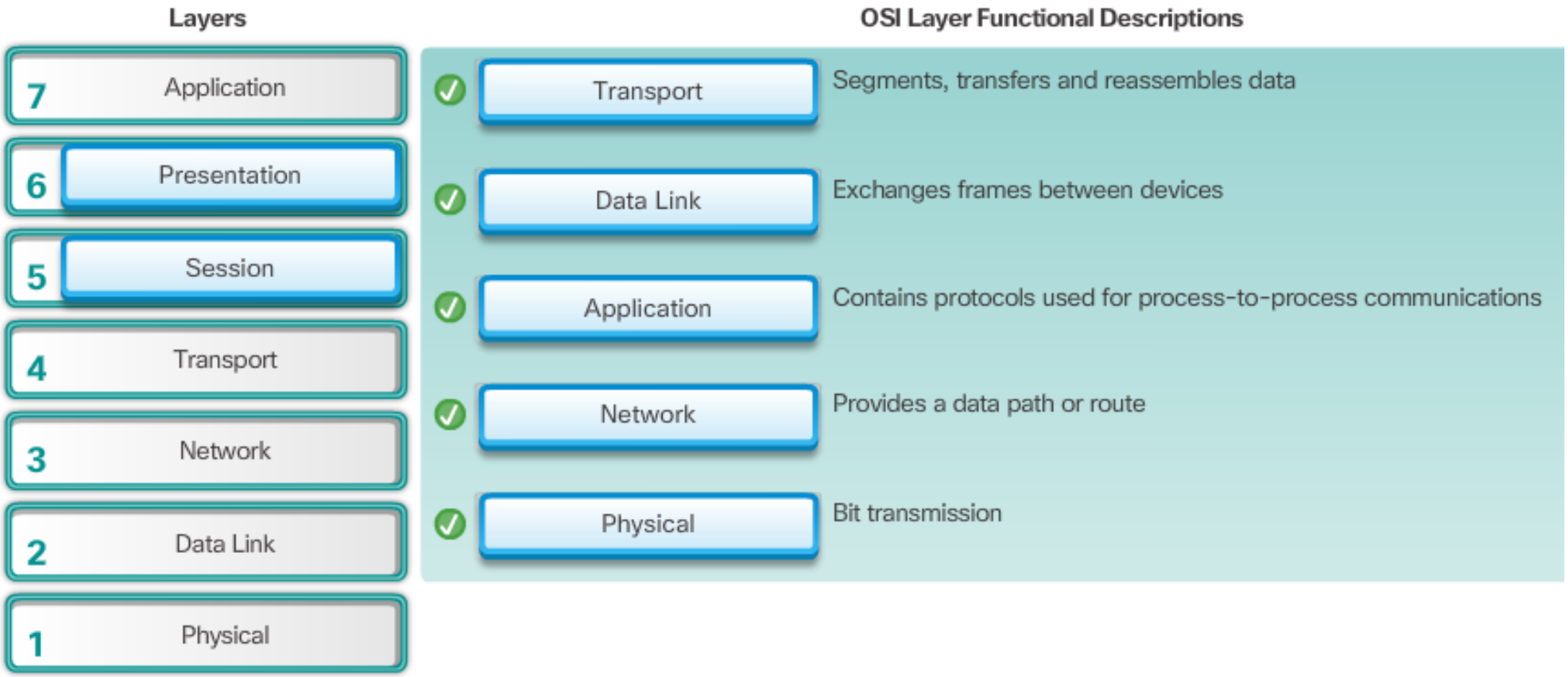


The key similarities are in the transport and network layers; however, the two models differ in how they relate to the layers above and below each layer.

3.2.4.5 Activity - Identify Layers and Functions

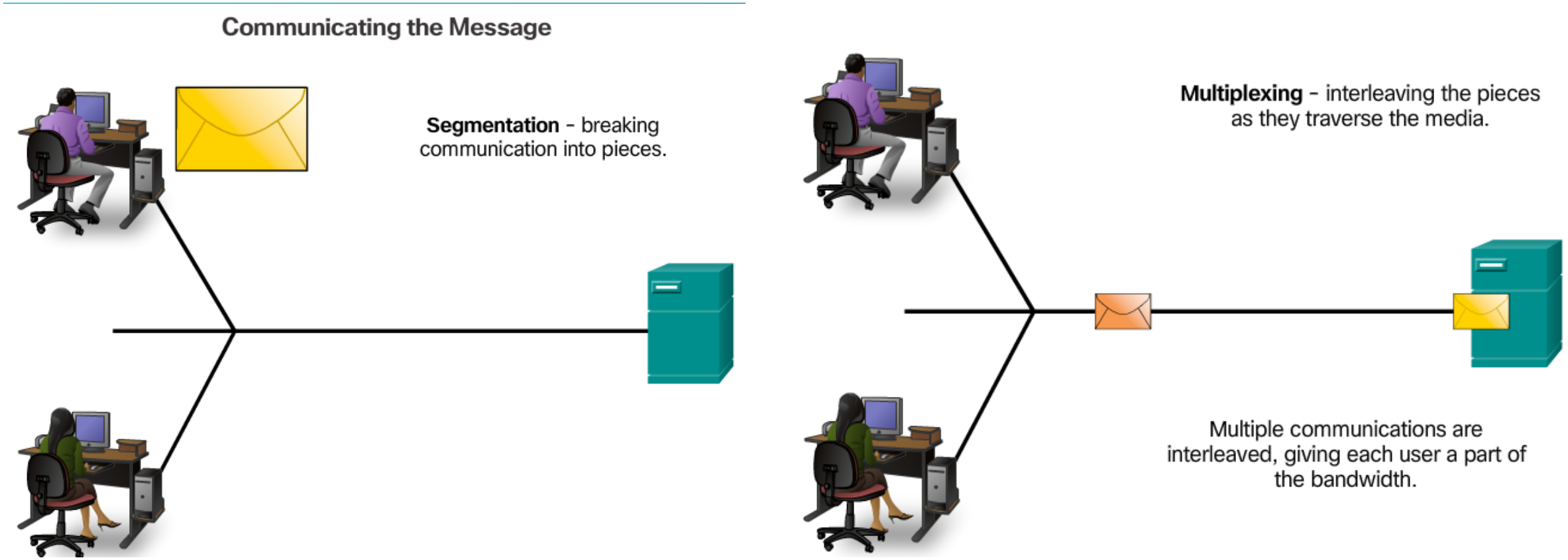
Activity - Part 1: OSI Layer Functions

Drag the OSI layer to its functional description.



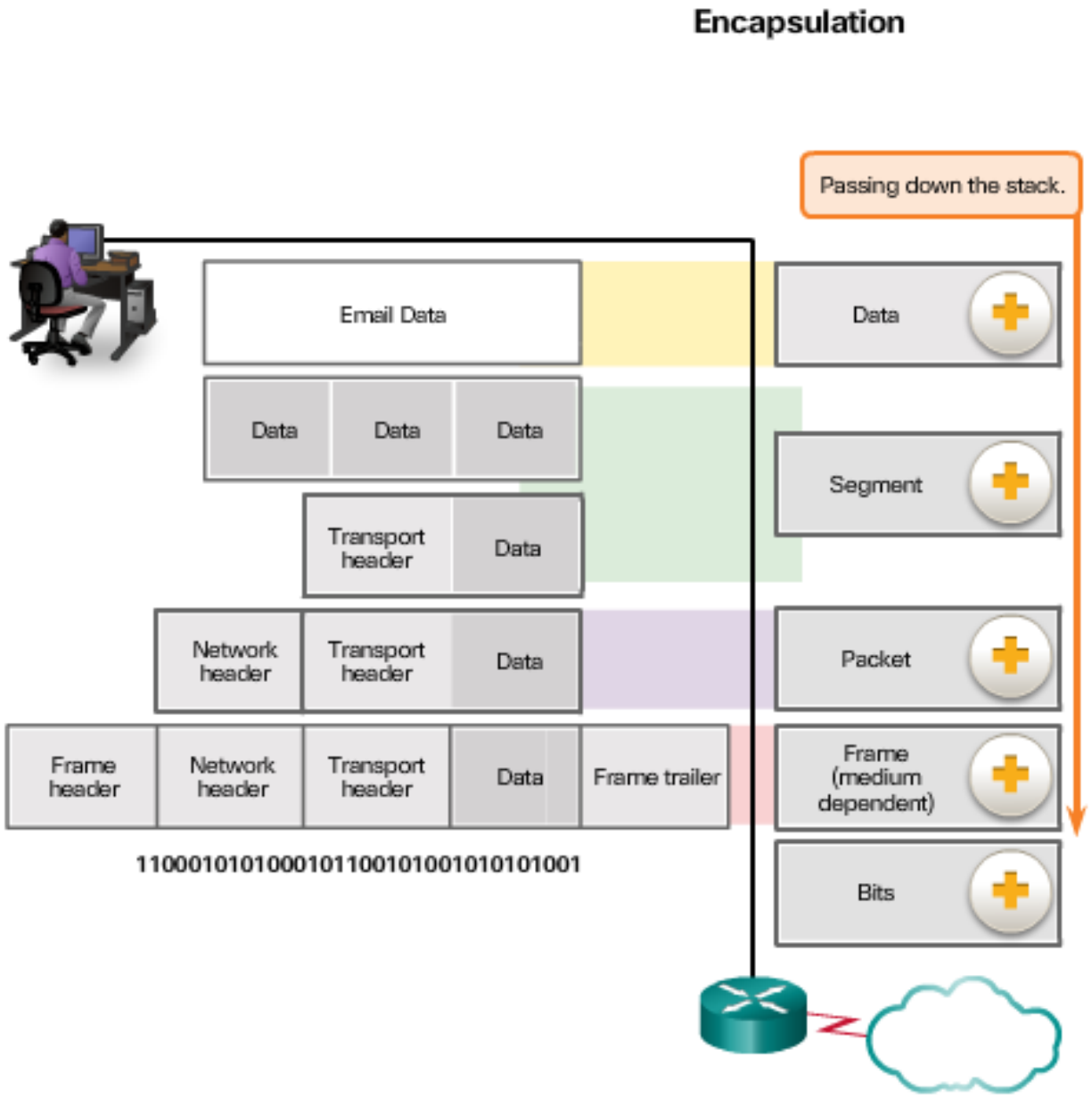
3.2.4.6 Packet Tracer - Investigating the TCP/IP and OSI Models in Action

3.3.1.1 Message Segmentation



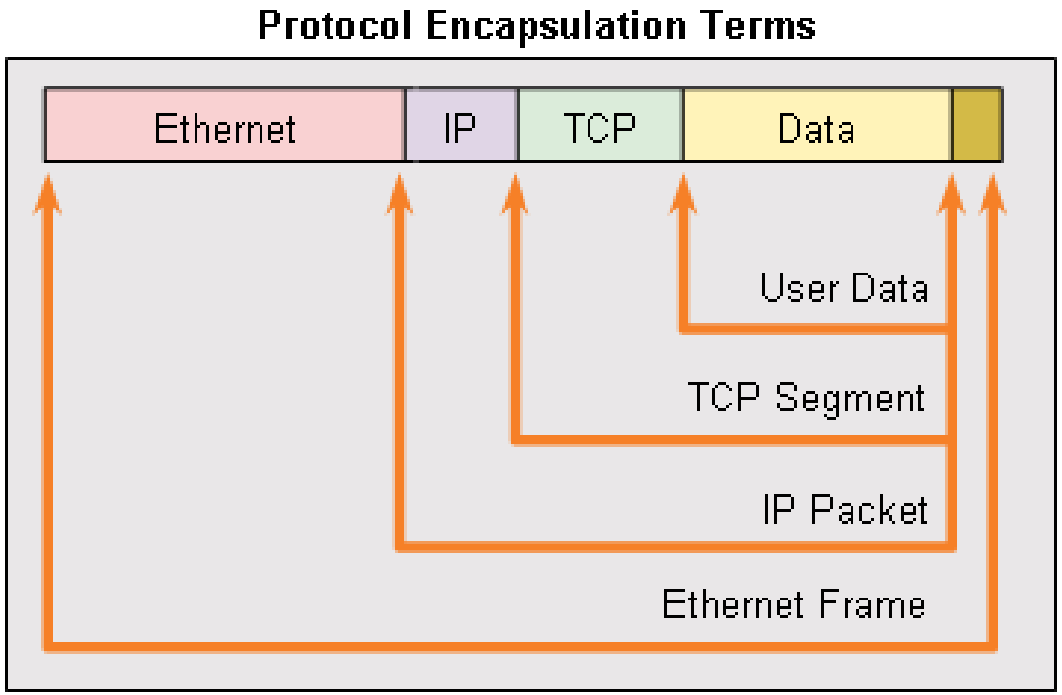
- By sending smaller individual pieces from source to destination, many different conversations can be interleaved on the network, called multiplexing. Click each button in Figure 1, and then click the Play button to view the animations of segmentation and multiplexing.
- Segmentation can increase the efficiency of network communications. If part of the message fails to make it to the destination, due to failure in the network or network congestion, only the missing parts need to be retransmitted.

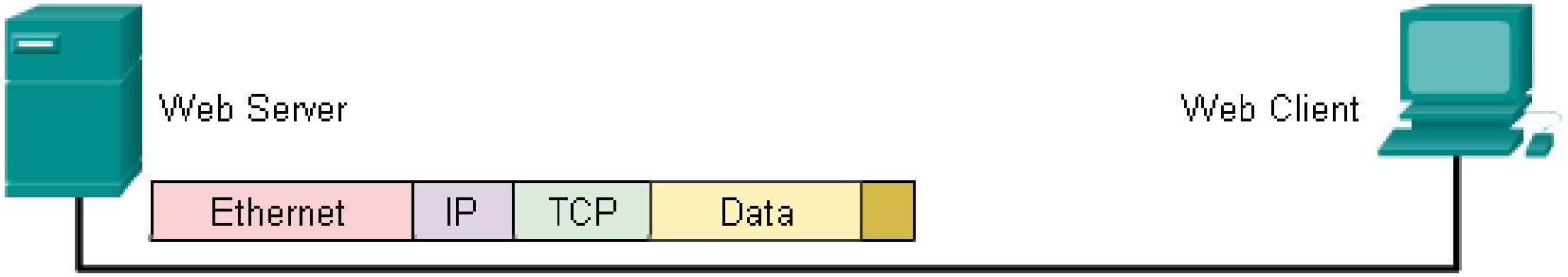
3.3.1.2 Protocol Data Units



3.3.1.3 Encapsulation Example

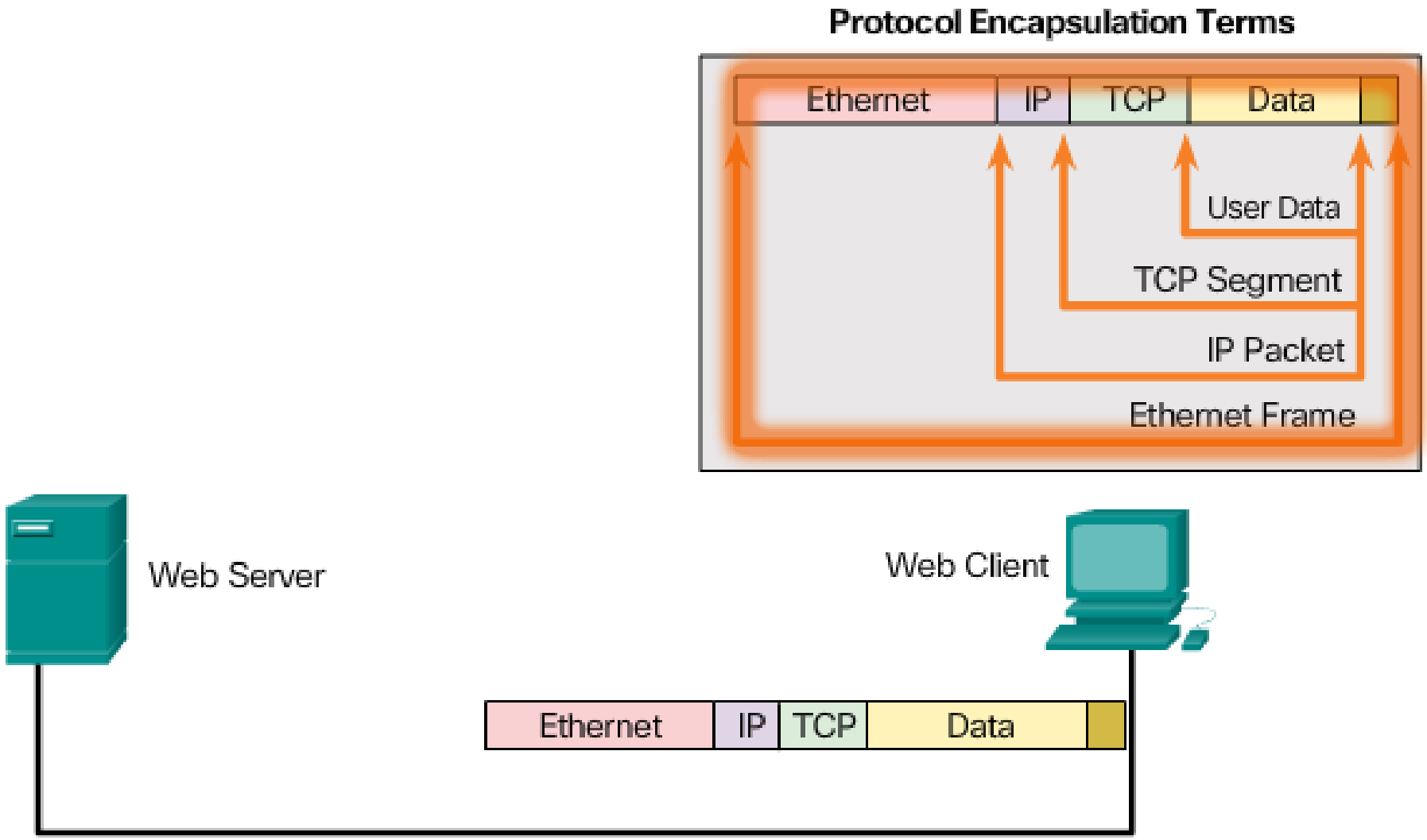
Protocol Operation of Sending a Message



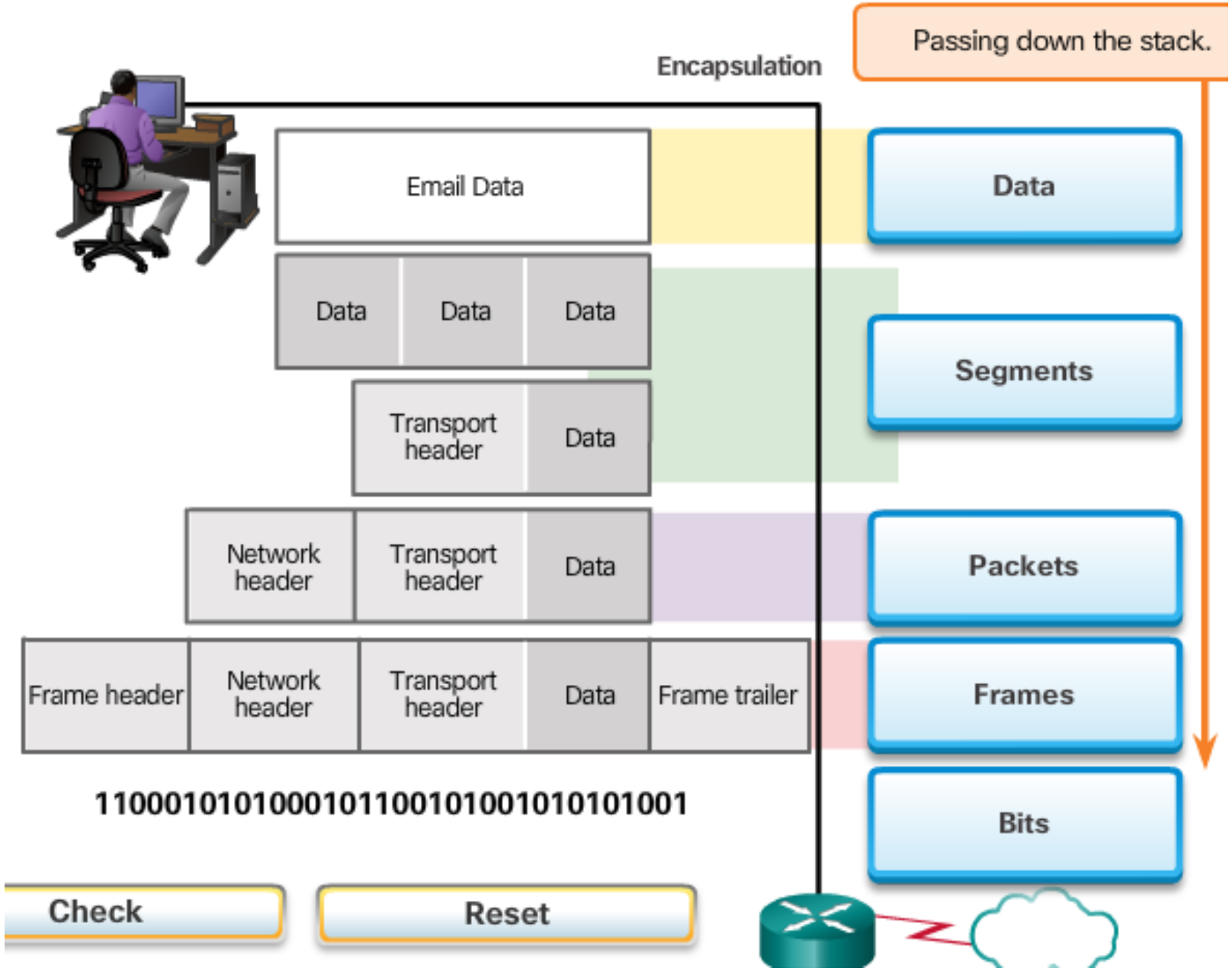


3.3.1.4 De-encapsulationncapsulation

Protocol Operation of Receiving a Message

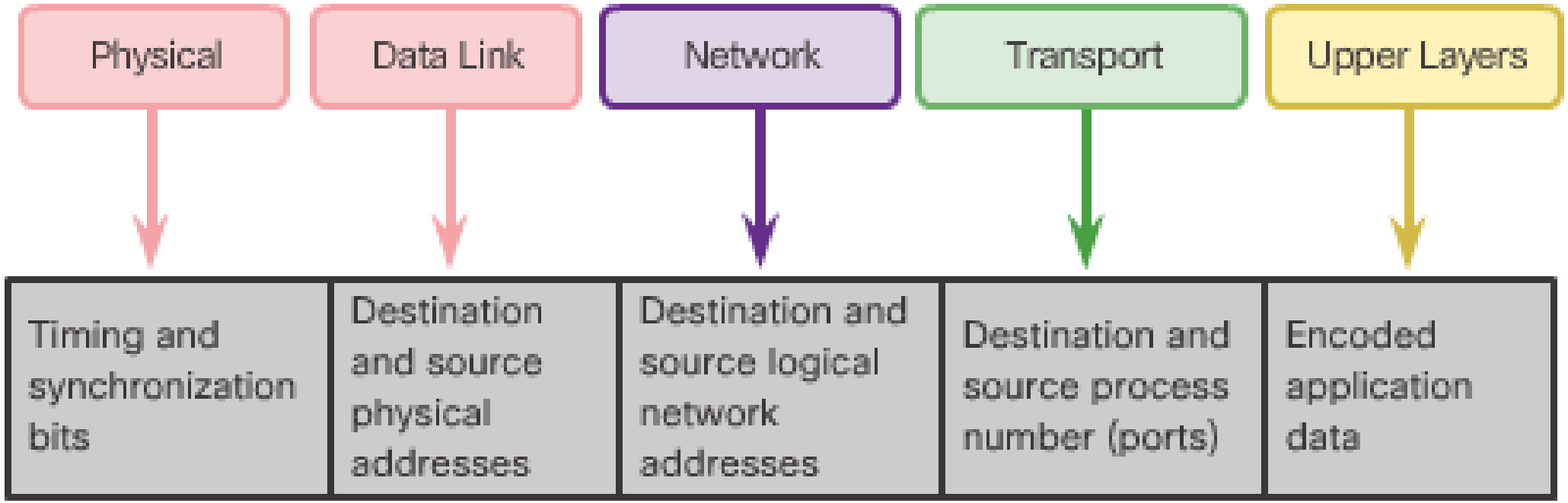


3.3.1.5 Activity - Identify the PDU Layer

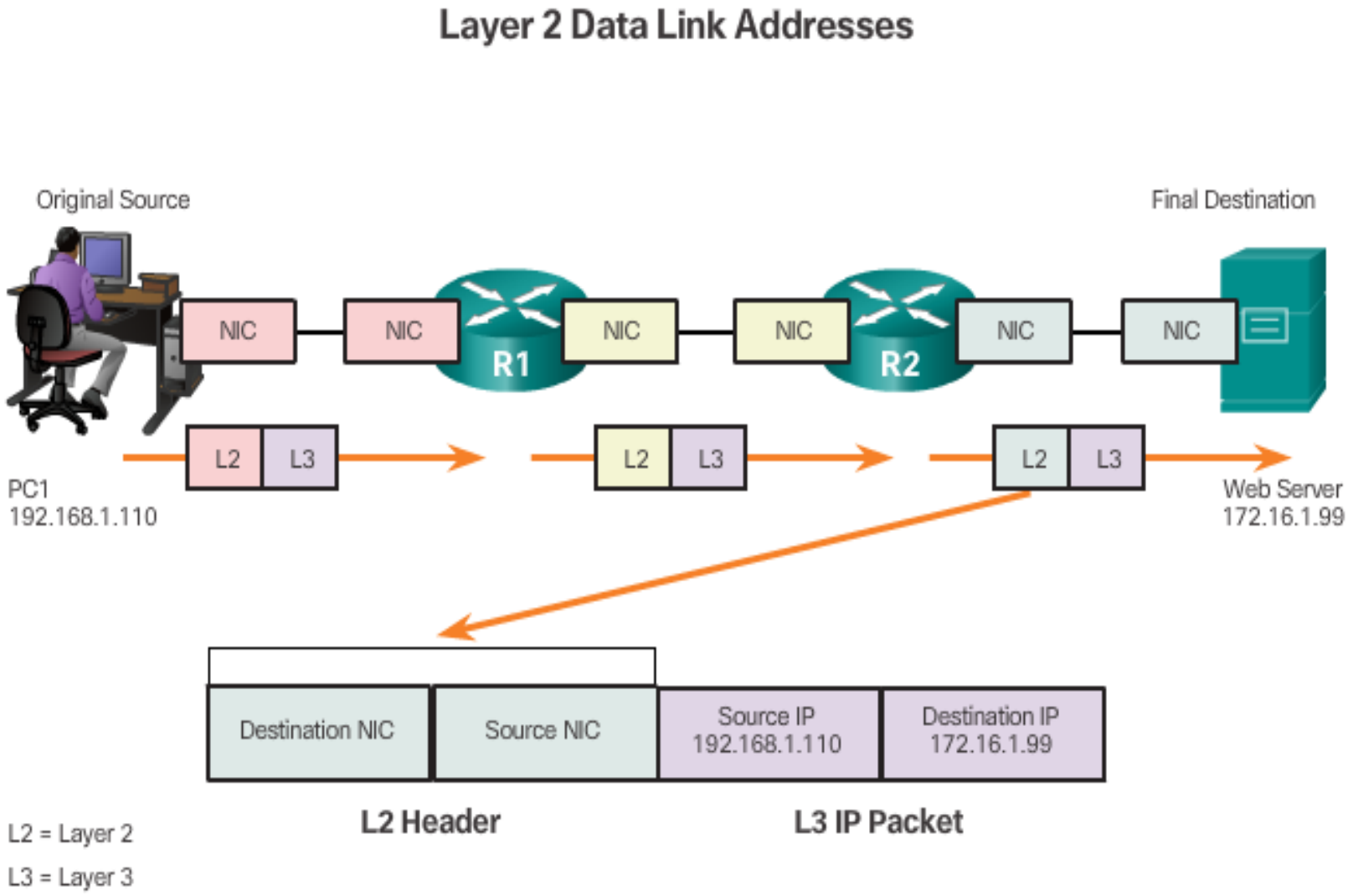


3.3.2.1 Network Addresses

Network Addresses and Data Link Addresses



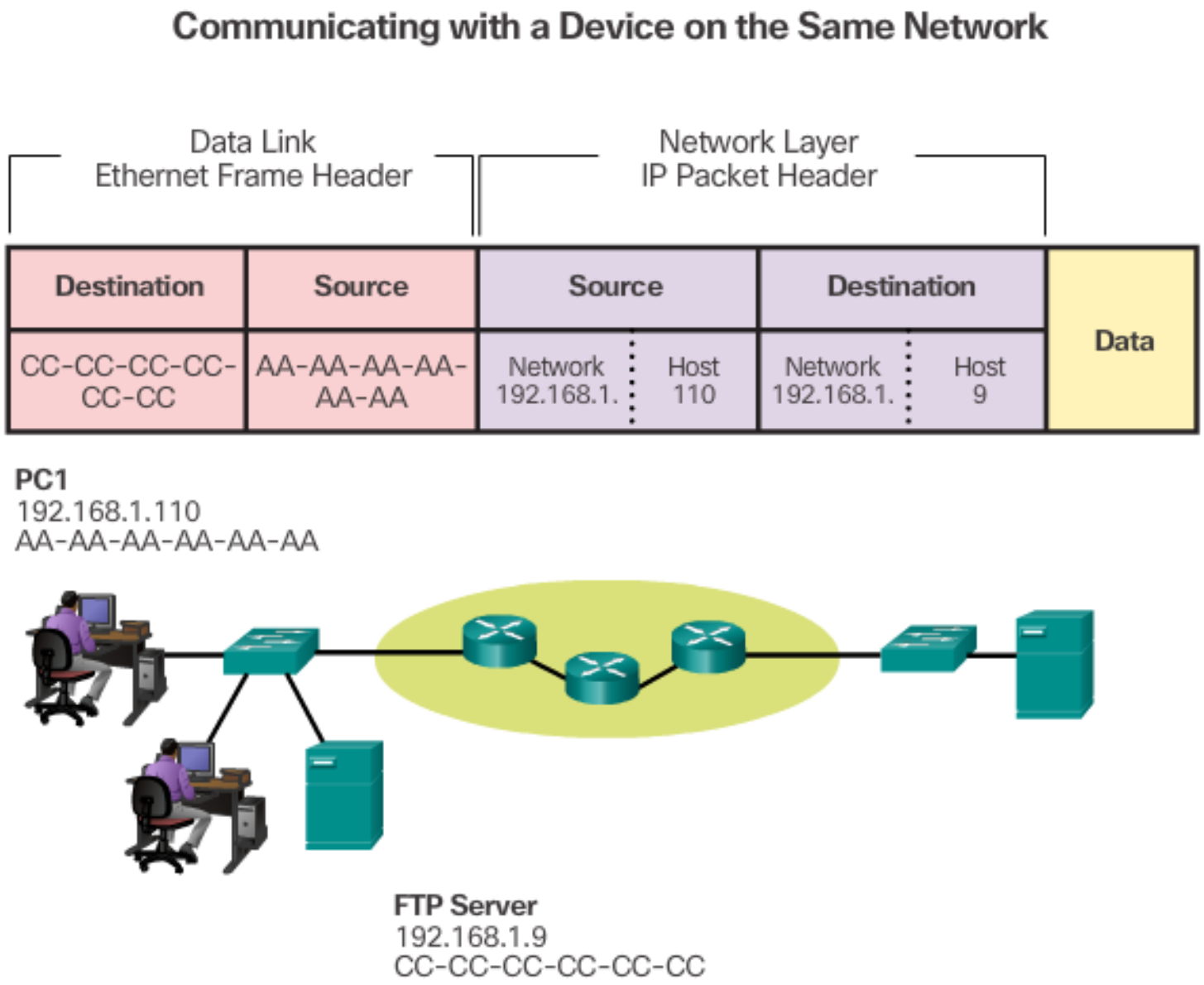
3.3.2.2 Data Link Addresses



The IP packet is encapsulated in a data link frame that contains data link information, including a:

- **Source data link address -** The physical address of the device's NIC that is sending the data link frame.
- **Destination data link address -** The physical address of the NIC that is receiving the data link frame. This address is either the next hop router or of the final destination device.

3.3.2.3 Devices on the Same Network

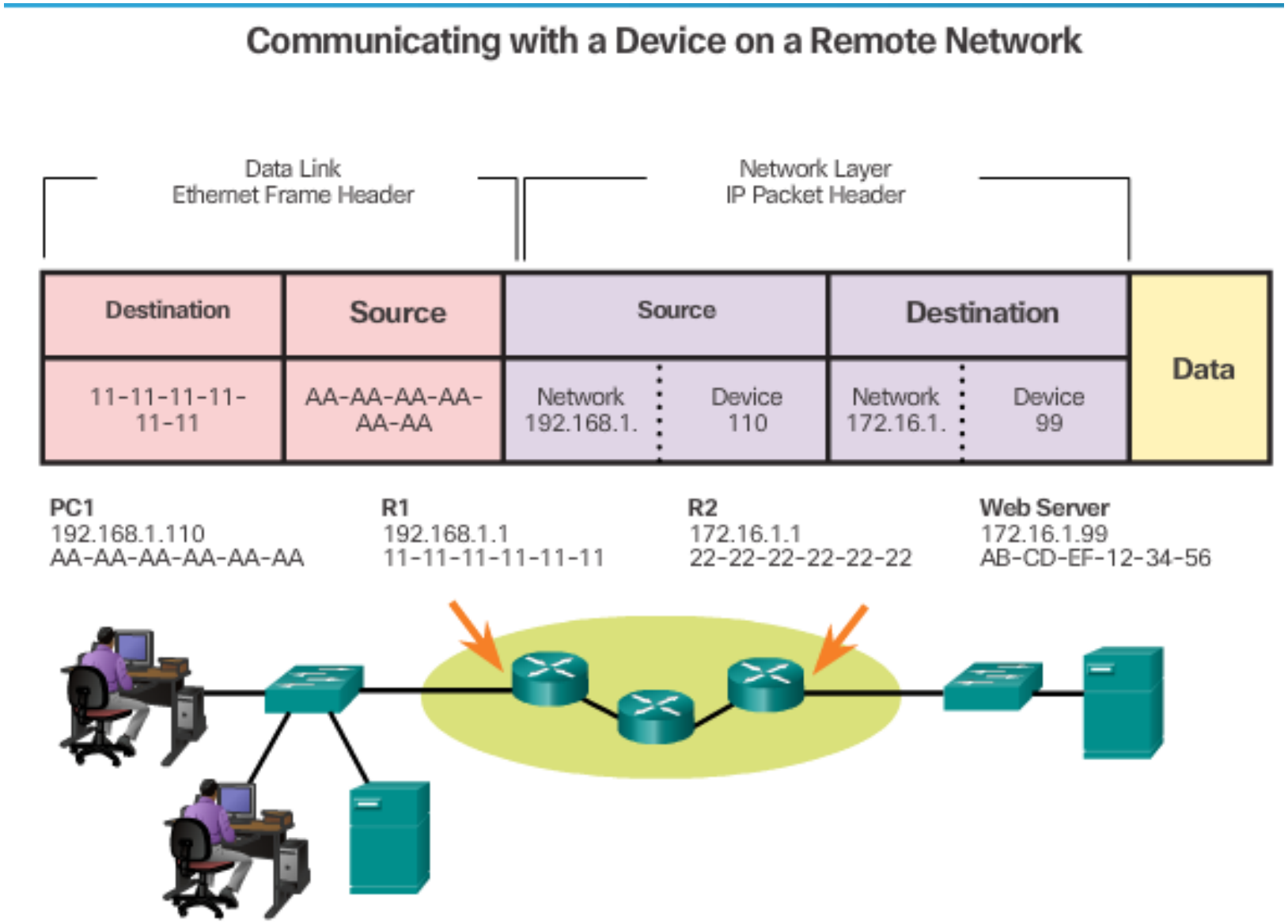


Role of the Network Layer Addresses

The network layer addresses, or IP addresses, indicate the original source and final destination. An IP address contains two parts:

- **Network portion** – The left-most part of the address that indicates which network the IP address is a member. All devices on the same network will have the same network portion of the address.
- **Host portion** – The remaining part of the address that identifies a specific device on the network. The host portion is unique for each device on the network.

3.3.2.4 Devices on a Remote Network



Role of the Network Layer Addresses

When the sender of the packet is on a different network from the receiver, the source and destination IP addresses will represent hosts on different networks. This will be indicated by the network portion of the IP address of the destination host.

- **Source IP address** - The IP address of the sending device, the client computer PC1: 192.168.1.110.
- **Destination IP address** - The IP address of the receiving device, the server, Web Server: 172.16.1.99.

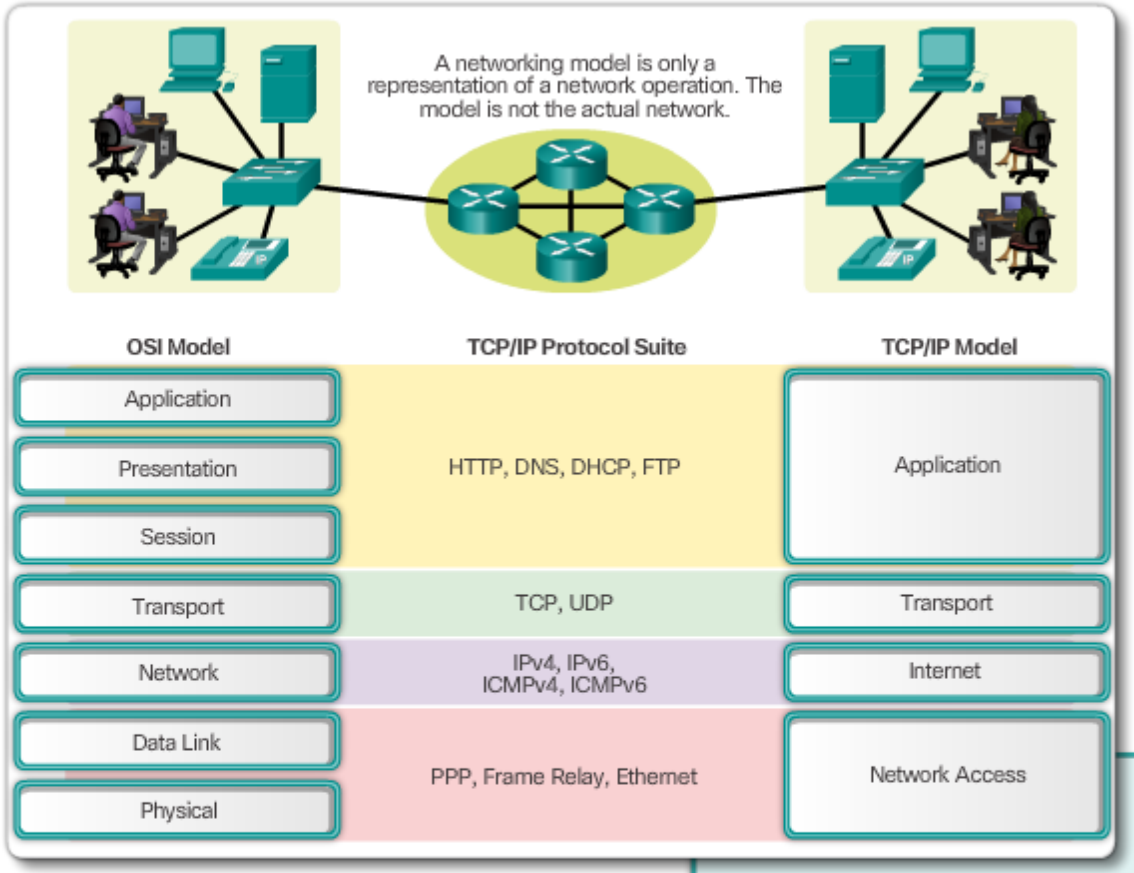
3.4.1.1 Lab - Installing Wireshark

Lab - Using Wireshark to View Network Traffic

In this lab, you will use Wireshark to capture and analyze traffic.

3.4.1.2 Lab - Using Wireshark to View Network Traffic

3.4.1.3 Class Activity - Guaranteed to Work!



Using network protocols and standards facilitates quality data delivery in a timely manner.

- Establishing a language to communicate
- Dividing the message into small steps, delivered a little at a time, to facilitate understanding of the problem
- Checking to see if the data has been delivered fully and correctly
- Timing needed to ensure quality data communication and delivery

3.4.1.4 Chapter 3: Network Protocols and Communications