Chapter 3:

Network Protocols & Communication

Chapter 3 - Scope

3.1 Rules of Communication

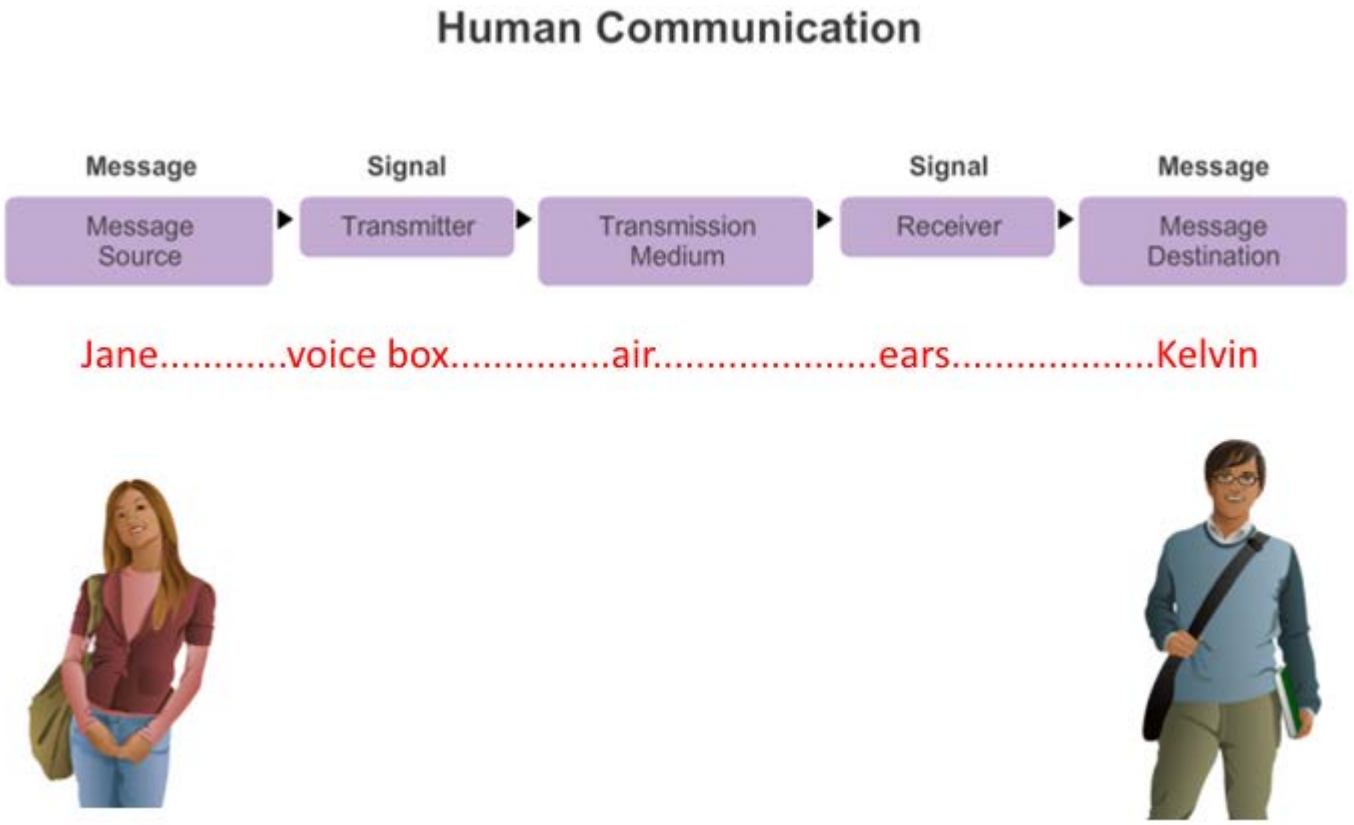
3.2 Network Protocols and Standards

3.3 Moving Data in the Network

3.4 Summary

What is Communication?

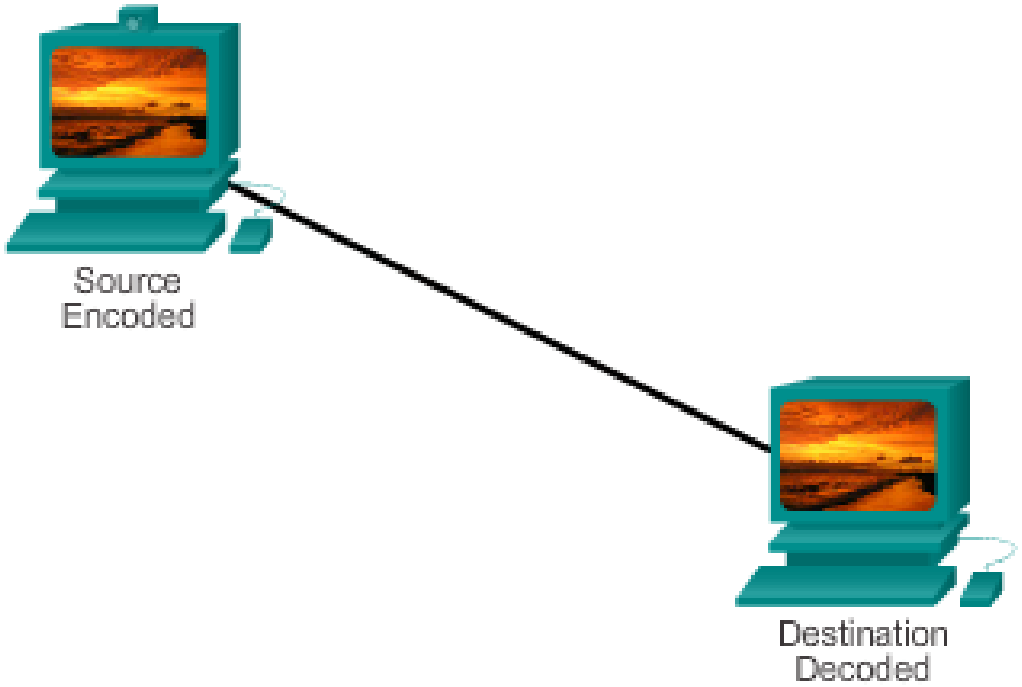
Communication is exchange of information through a medium.



Rules for Communication

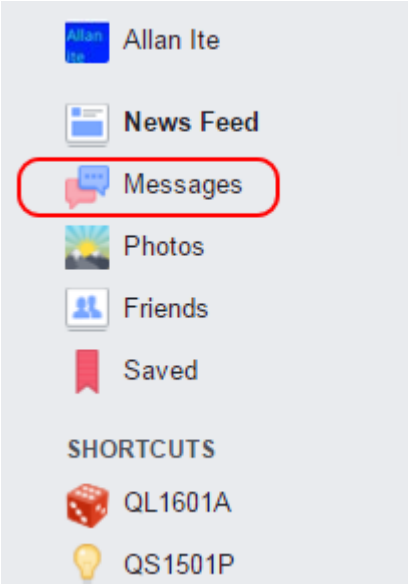
- There must be a sender and receiver
- Method of communicating must be agreed, eg
  - face-to-face,
  - telephone,
  - letter,
  - photograph, etc.
- There must be common language and grammar
- Speed and timing of delivery must be specified
- Confirmation or acknowledgment requirements must be decided on

Machine Communication



Message Formatting and Encapsulation

- Before being sent, a message must be formatted and encapsulated.
- Encapsulation means binding together the data and functions that manipulate the data, and keeping them safe from outside interference and misuse.



Message Formatting and Encapsulation

A message can contain the following elements:

- Identifier of the recipient's location (where)
- Identifier of the sender's location (where)
- Salutation or greeting ("Hello")
- Recipient identifier ("Peter")
- The message content ("How are you")
- Source identifier
- End of message indicator

Message Size, segment, frame

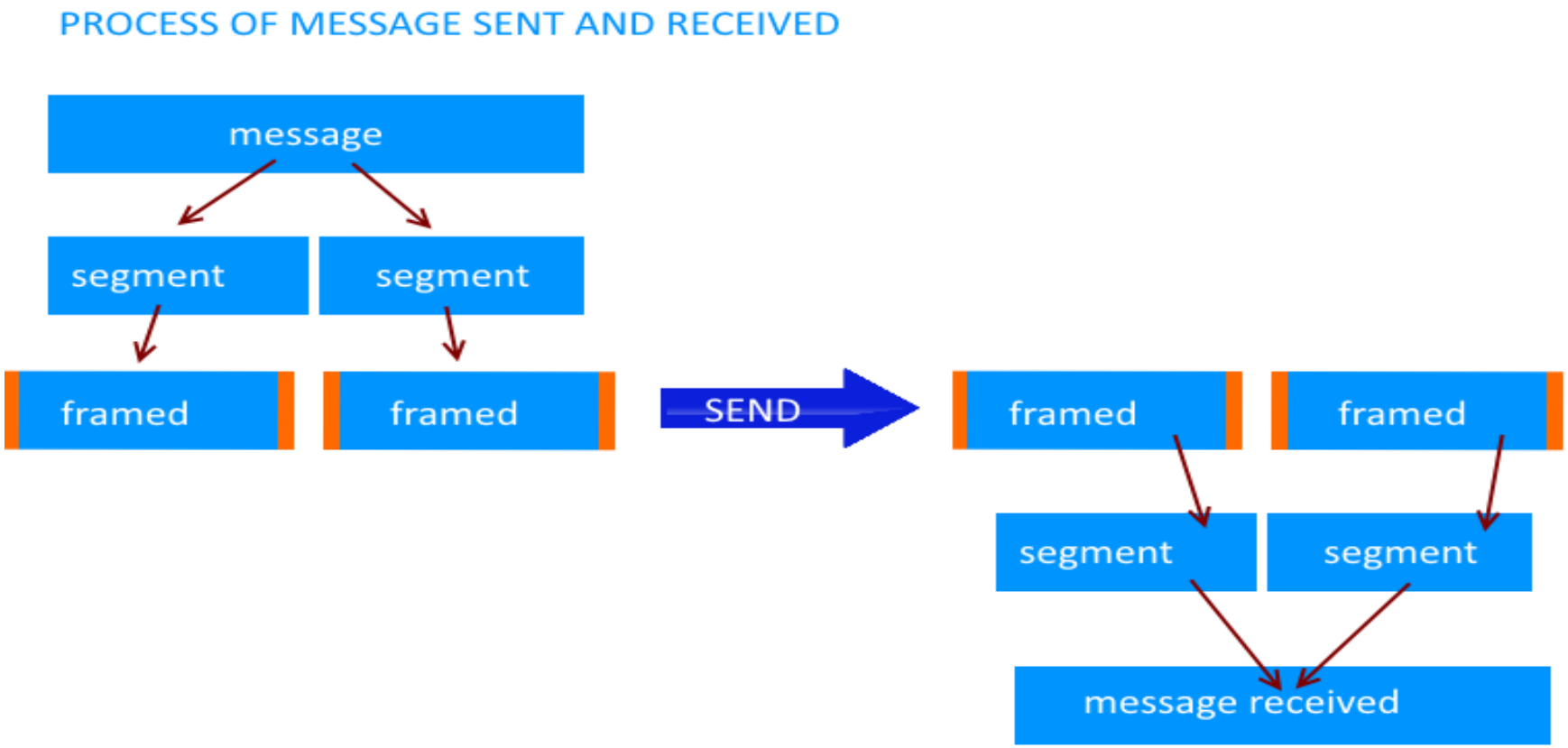
An overview of the segmenting process:

- A message has a minimum and maximum size.
- A message is broken into segments.
- Each segment is encapsulated in a separate frame with the address information. The size of one frame is usually limited.
- The frames are sent to the receiving host.
- At the receiving host, each frame is de-encapsulated and put back together as a message. It is then processed and interpreted.

The Rules

Message Sending process

- A message is broken into segments.
- Each segment is encapsulated in a separate frame with the address information, and is sent over the network.
- At the receiving host, the message is de-encapsulated and put back together to be processed and interpreted.



Message Timing

Access Method

Managing data on a **network** is a form of data traffic control.

- The set of rules that governs how **network** traffic is controlled is called the **access method**.
- Access Method determines when it is ready for a computer to send a message to avoid a collision of information.
- It is necessary for computers to define an access method.
- Hosts on a network need an access method to know when to begin sending messages and how to respond when errors occur.

Message Timing

- **Flow Control**
  Source and destination hosts use flow control to,

  - negotiate correct timing for successful communication

  - determine the amount of data to send,

  - determine the speed of sending.

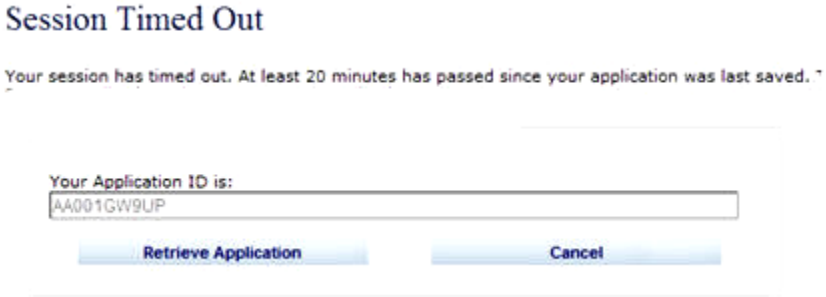
Message Timing

Response Timeout

When a message is sent, it can be received successfully.

But sometimes, the receiver may take too long to do so. A time duration for timeout needs to be set. This is known as Response Timeout.

- Hosts on the network have rules that specify,
  - how long to wait for responses; after a pre-set time, the hosts will stop trying and issue a response timeout message
  - what action to take if a response timeout occurs.



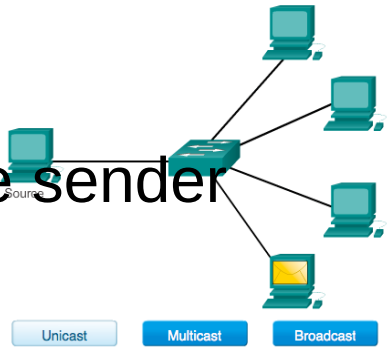
Message Delivery Options

3 ways of sending messages are:

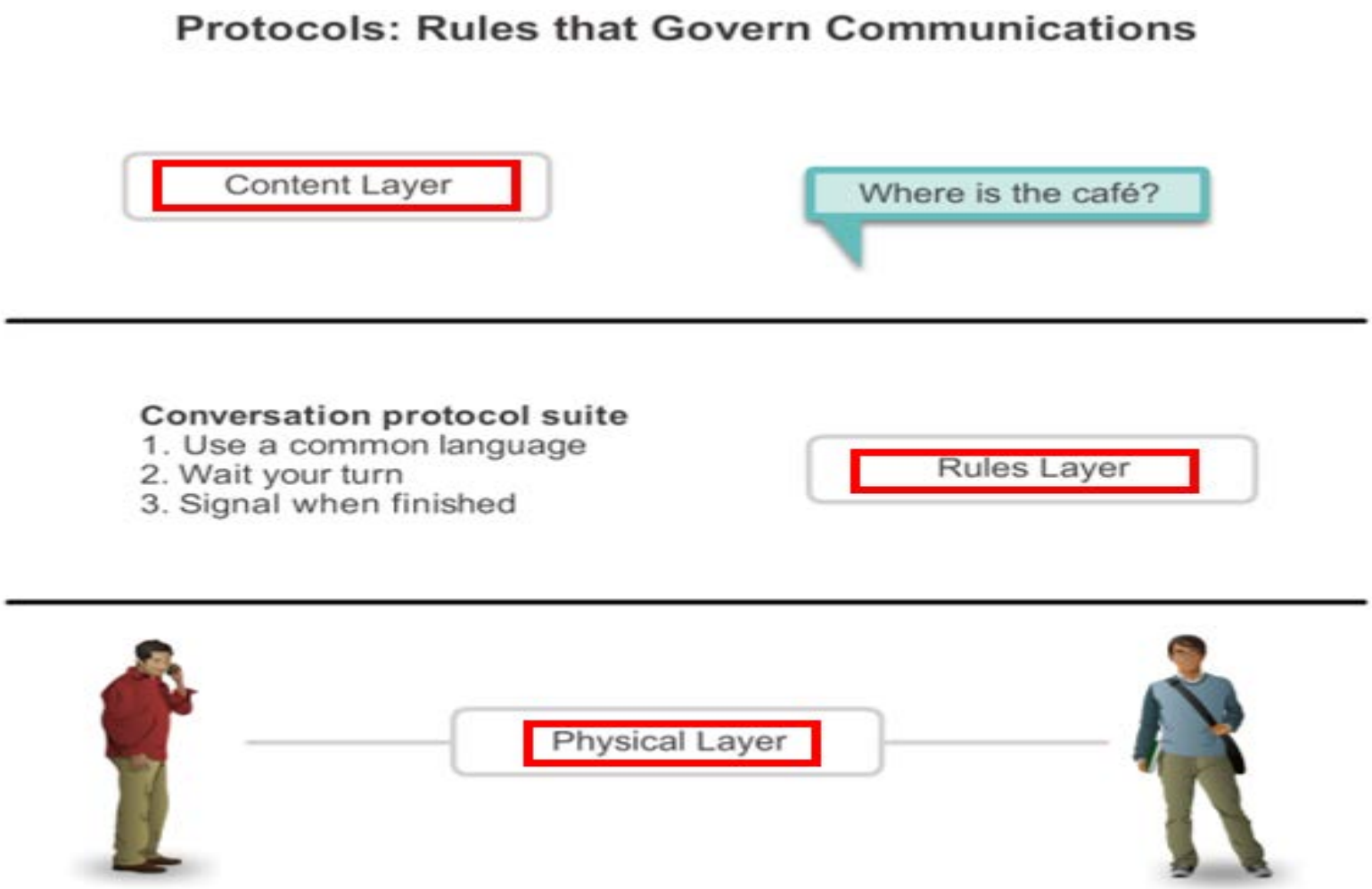
- Unicast (one-to-one)
  Unicast is communication between a single sender and a single receiver over a network.

- Multicast (one-to-many)
  Multicast is communication between a single sender and many interested receivers over a network.

- Broadcast (one-to-all)
  Broadcast is communication between a single sender and ALL devices in a network.



Rules that Govern Communications



Network Protocols

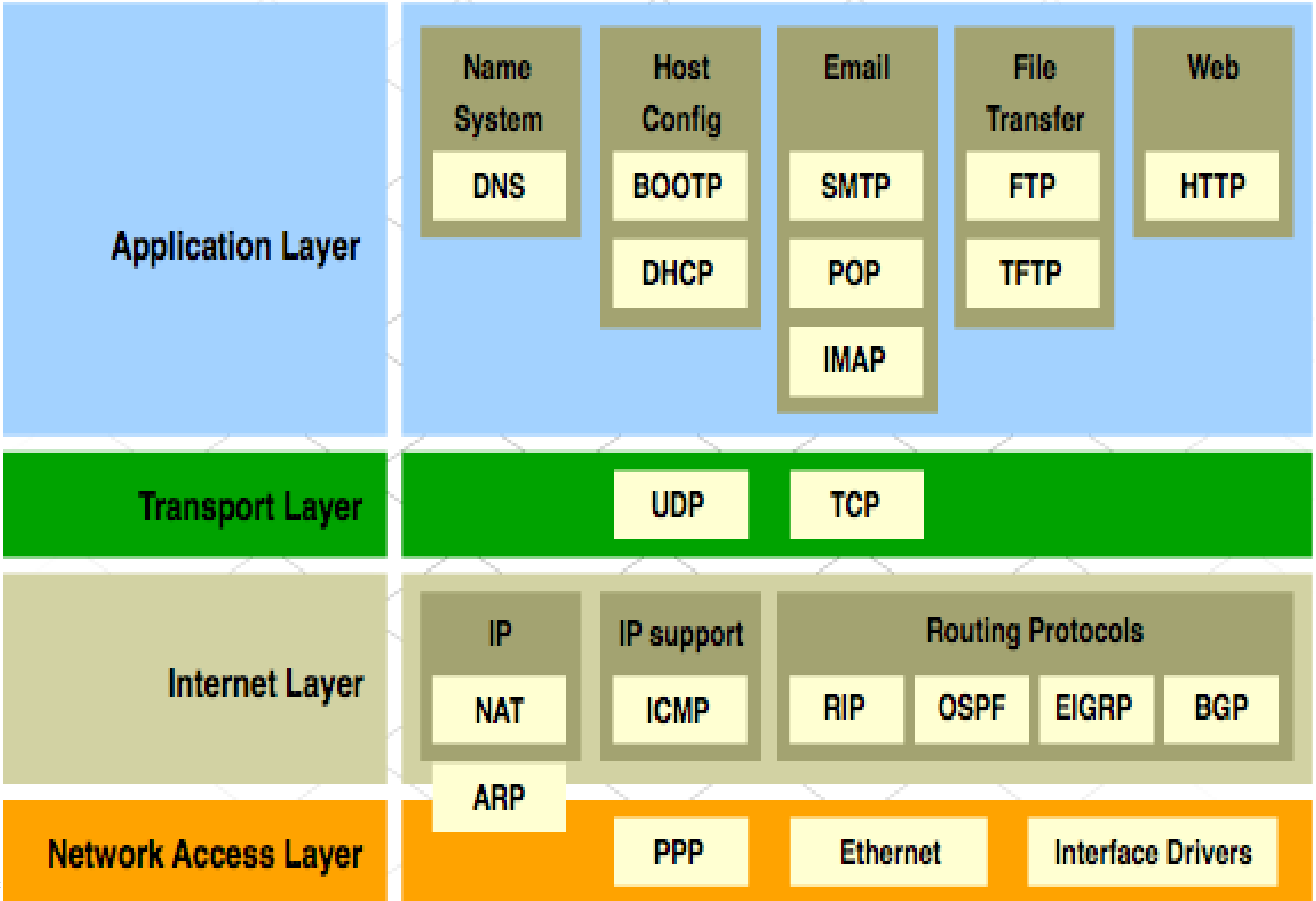
Communication in networks also need rules to govern:

- Message format or structure
- 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

4 Layers 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

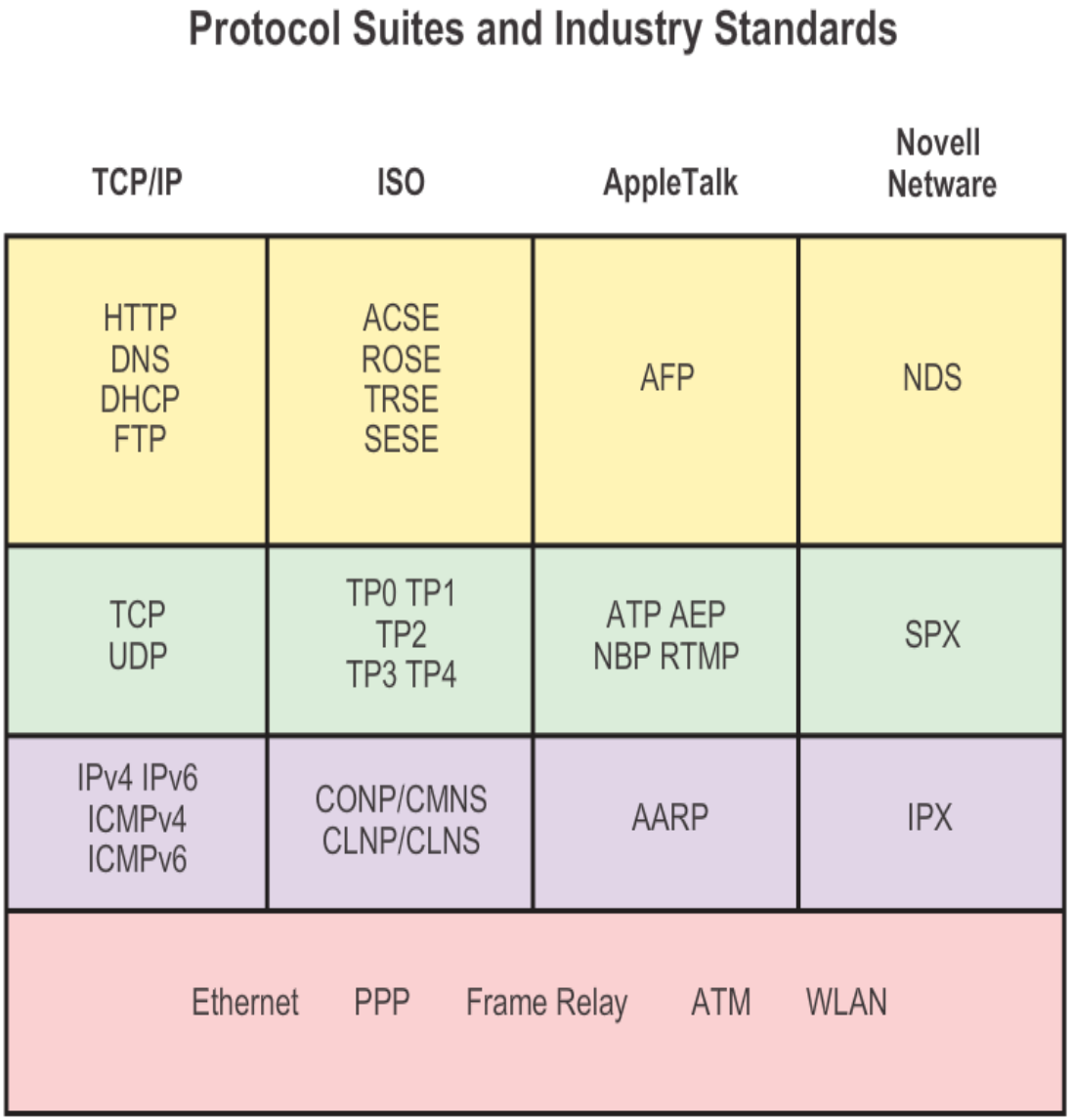
TCP/IP Protocol Suite and Communication



Protocol Suites and Industry Standards

Four protocol suites used in the Industry are:

- TCP/IP
- ISO
- Apple Talk
- Novell Netware



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)

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

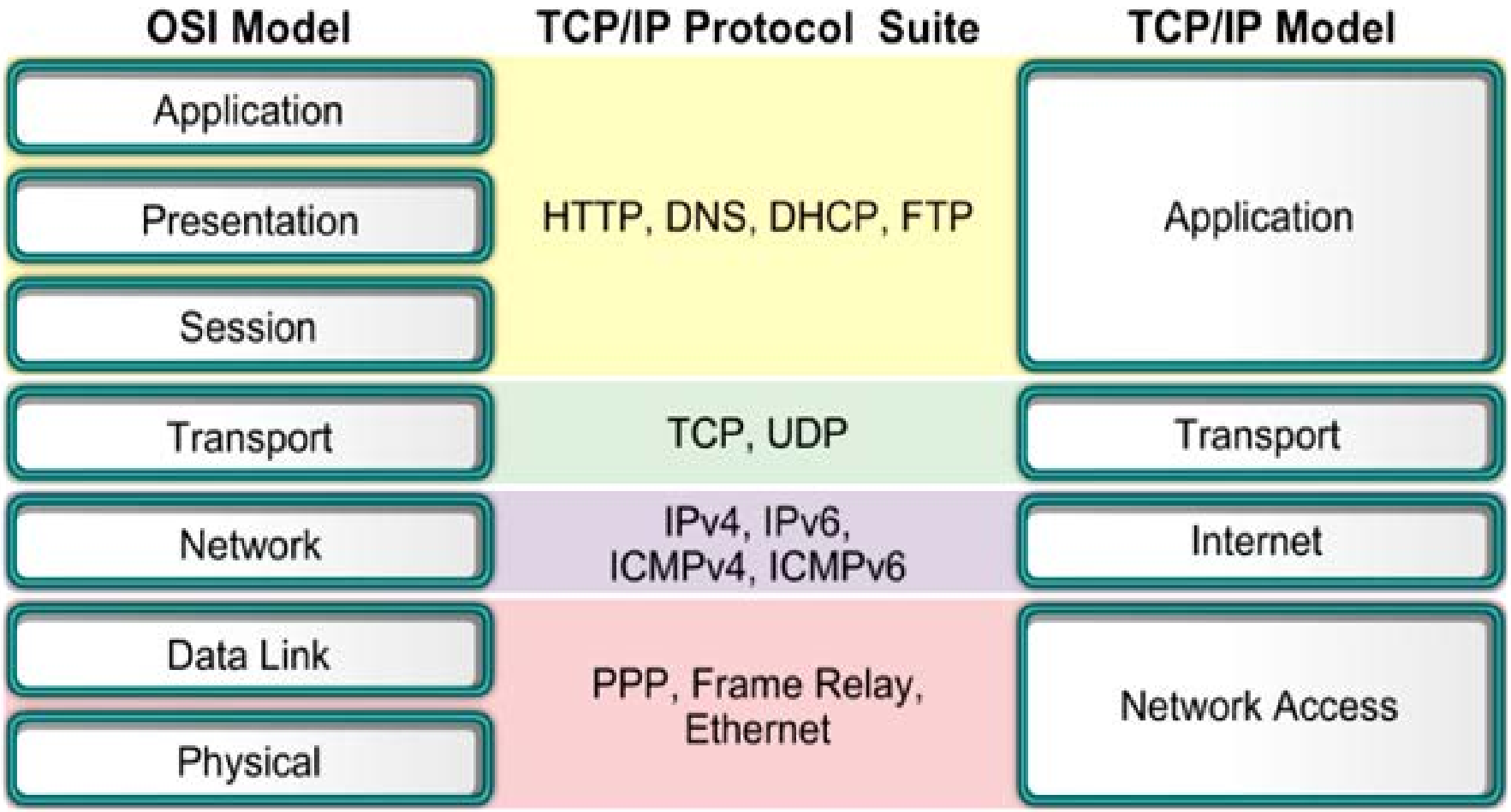
- 802.1 Higher Layer LAN Protocols Working Group
- 802.3 Ethernet Working Group
- 802.11 Wireless LAN Working Group
- 802.15 Wireless Personal Area Network (WPAN) Working Group
- 802.16 Broadband Wireless Access Working Group
- 802.18 Radio Regulatory TAG
- 802.19 Wireless Coexistence Working Group
-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

Open Systems Interconnection (OSI)

The Open Systems Interconnection model (OSI model) is a conceptual model that characterizes and standardizes the communication functions of a telecommunication or computing system.

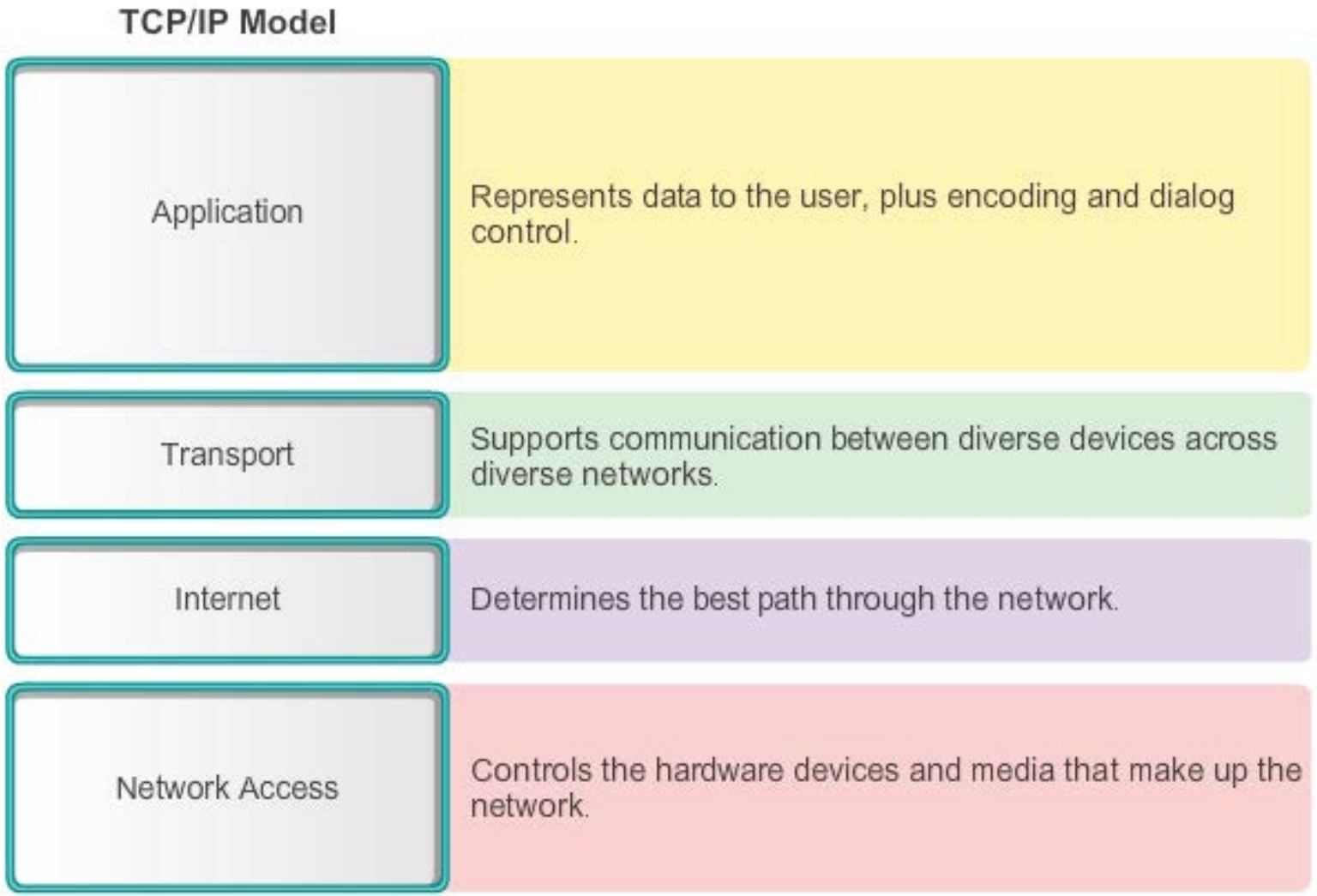
OSI Model has 7 layers; data packets will travel through these layers.

Models Compared

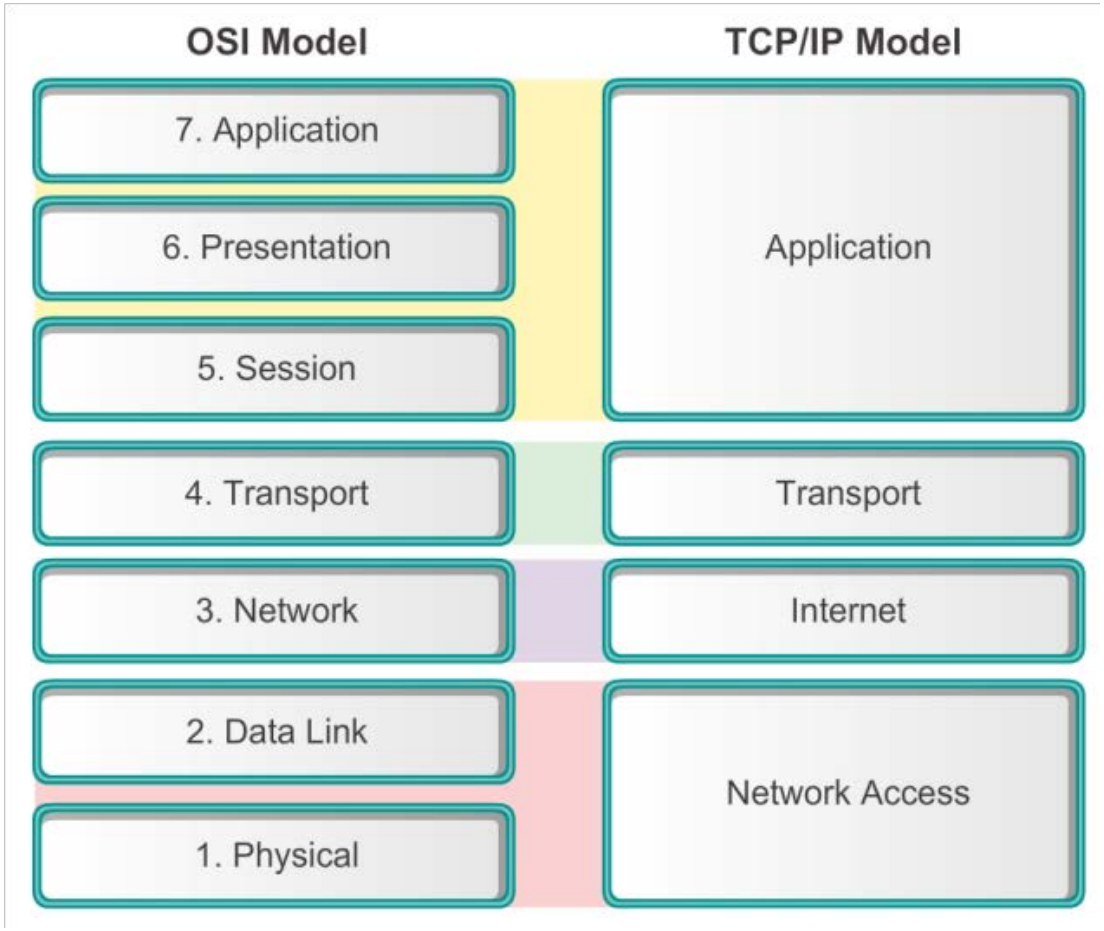


Reference Models

The TCP/IP Reference Model

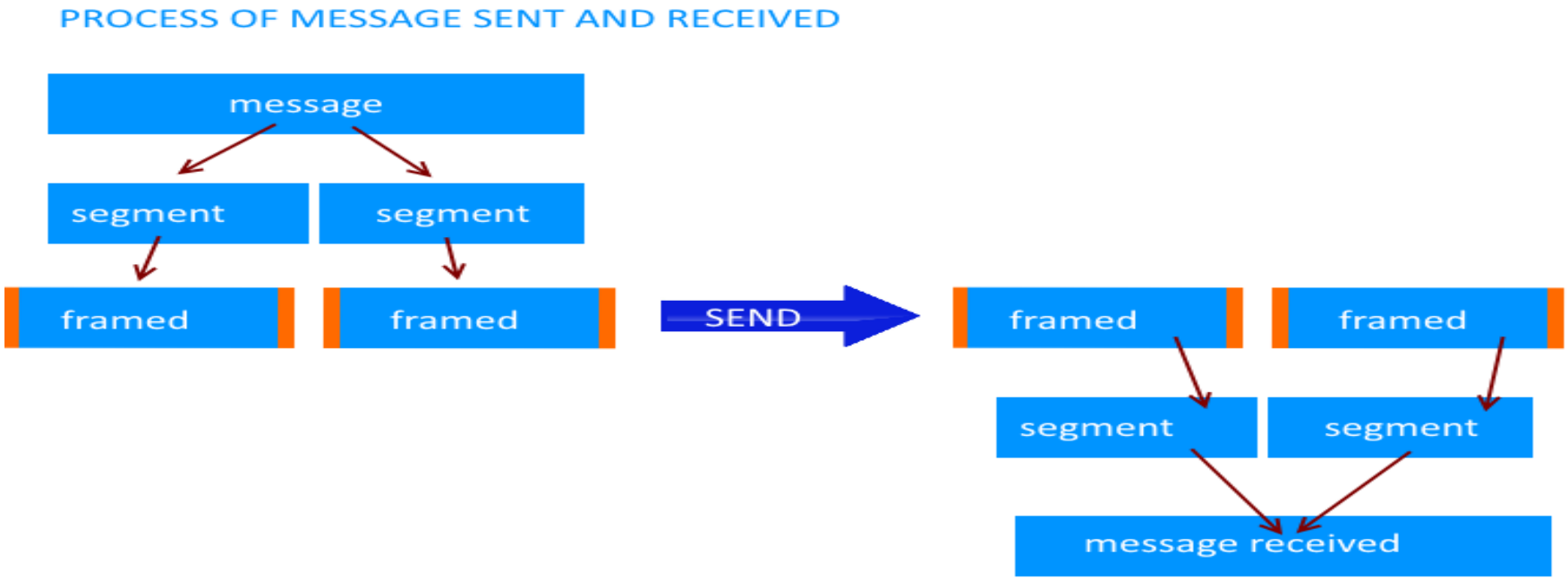


Comparing the OSI and TCP/IP Models



Message Sending process

- A message is broken into segments.
- Each segment is encapsulated in a separate frame with the address information, and is sent over the network.
- At the receiving host, the message is de-encapsulated and put back together to be processed and interpreted.



Communicating the Messages

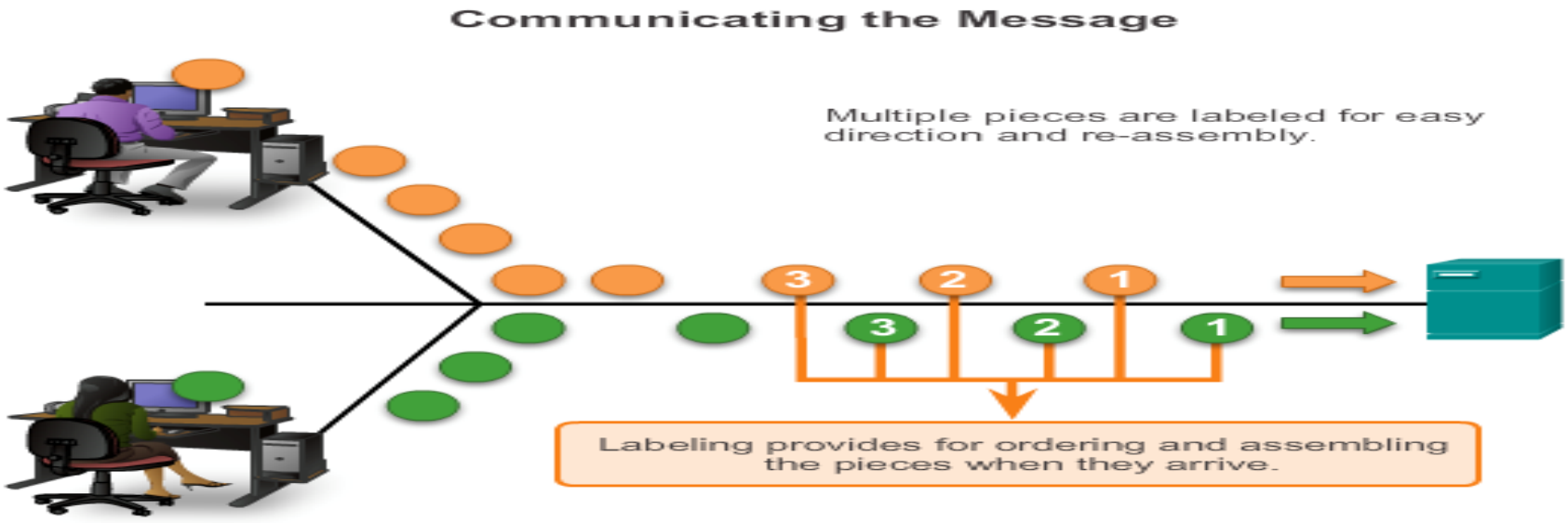
- Segmenting message benefits

  Different conversations can be interleaved (mixed together as one)

  Increased reliability of network communications

- Segmenting message disadvantage

  Increased level of complexity – more programming processes are needed to split a message into segments

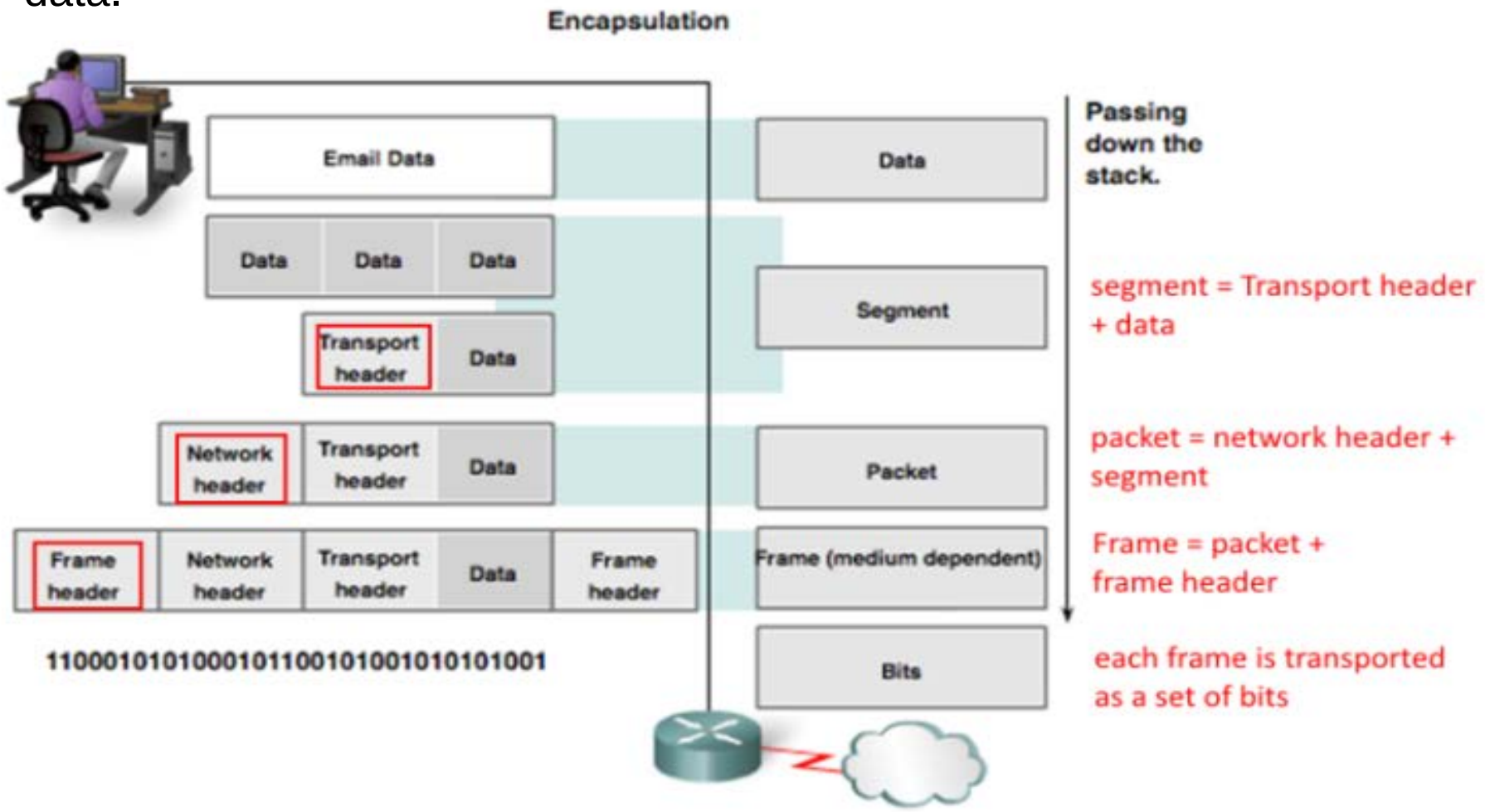


Protocol Data Units (PDUs)

- Data (to be sent, such as an email)
- Segment
- Packet
- Frame
- Bits

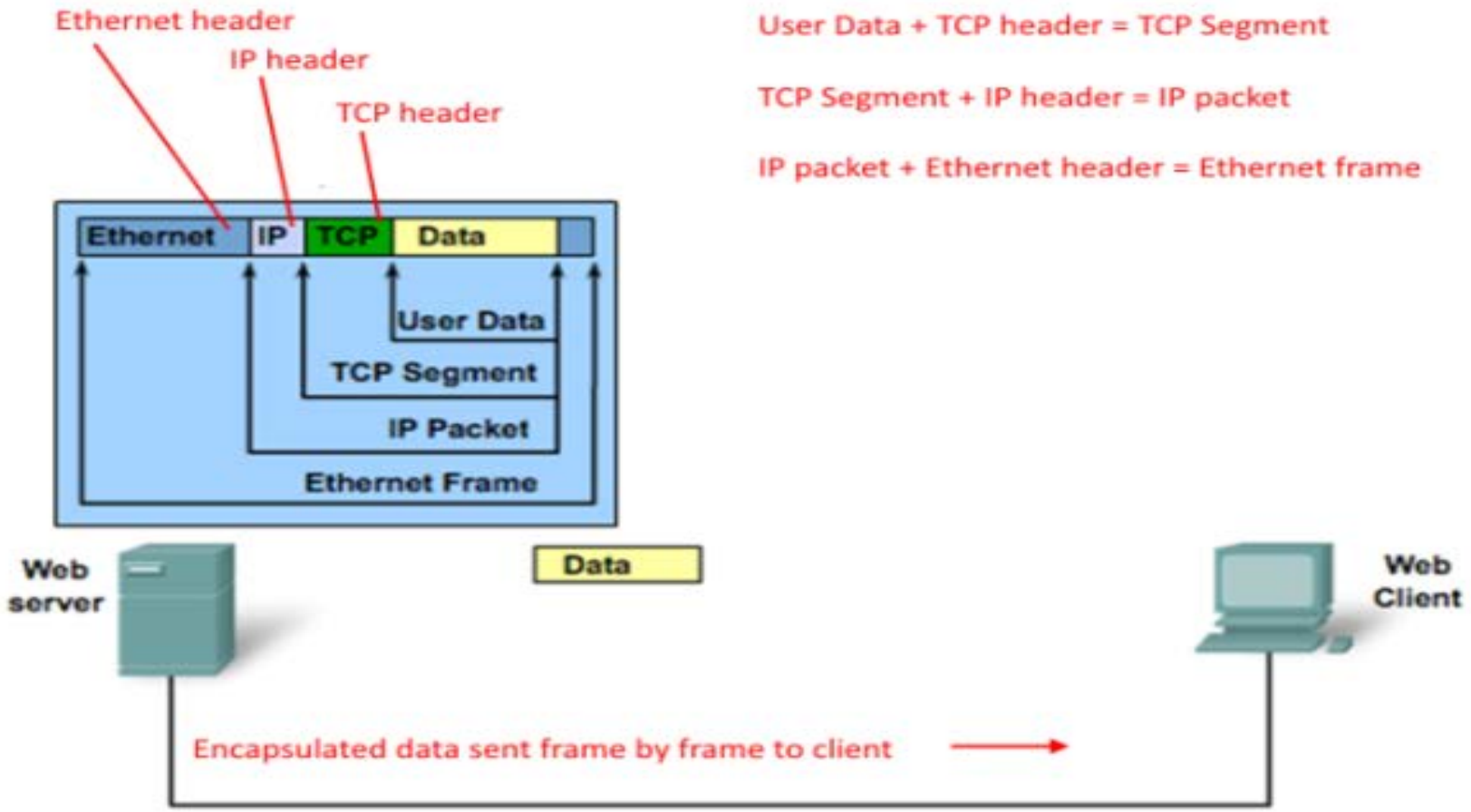
OSI Protocol Data Units (PDUs)

During data encapsulation, headers are added to the previous data.

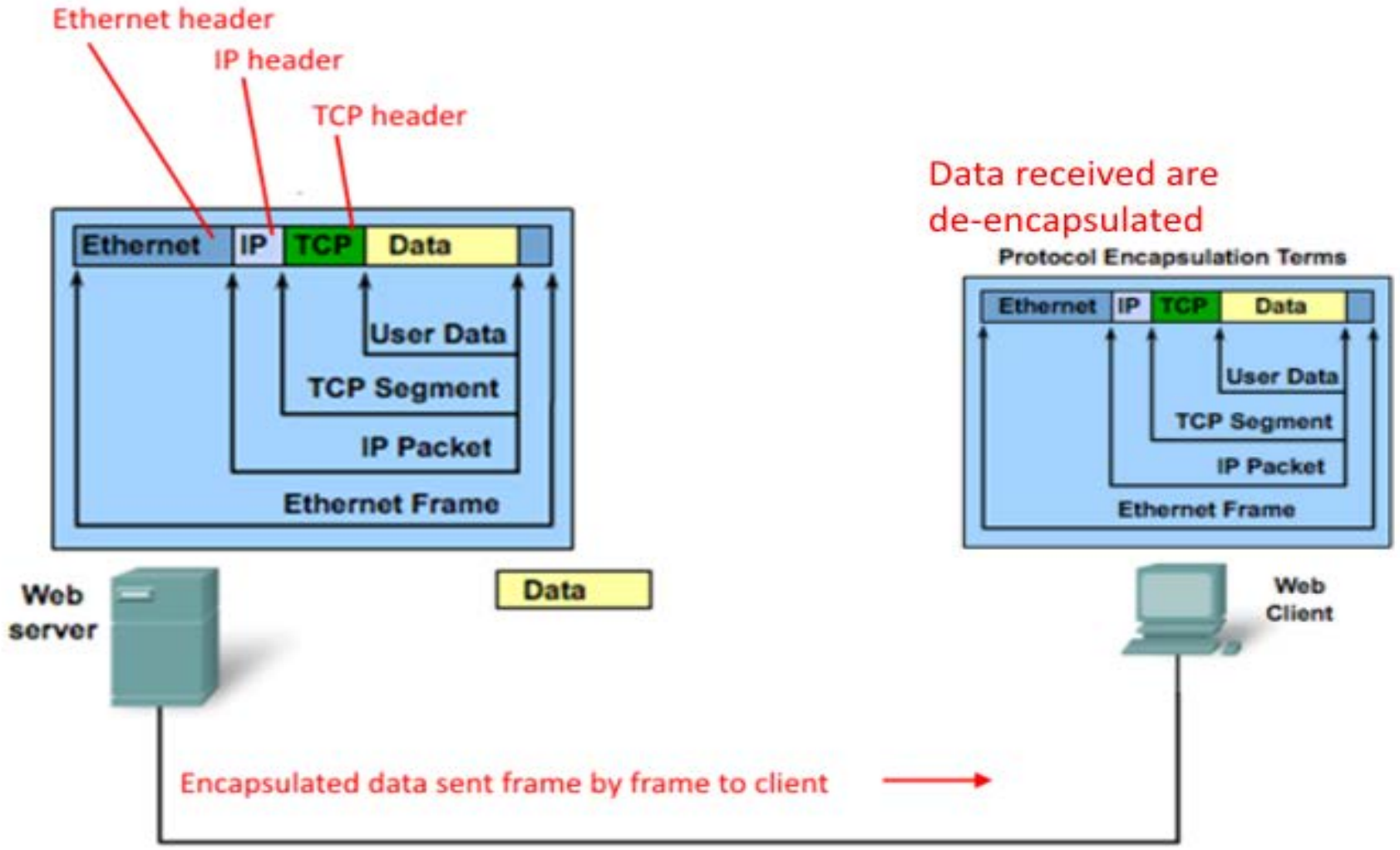


TCP/IP PDU

During protocol encapsulation, protocol headers of each OSI layer are added to the data.

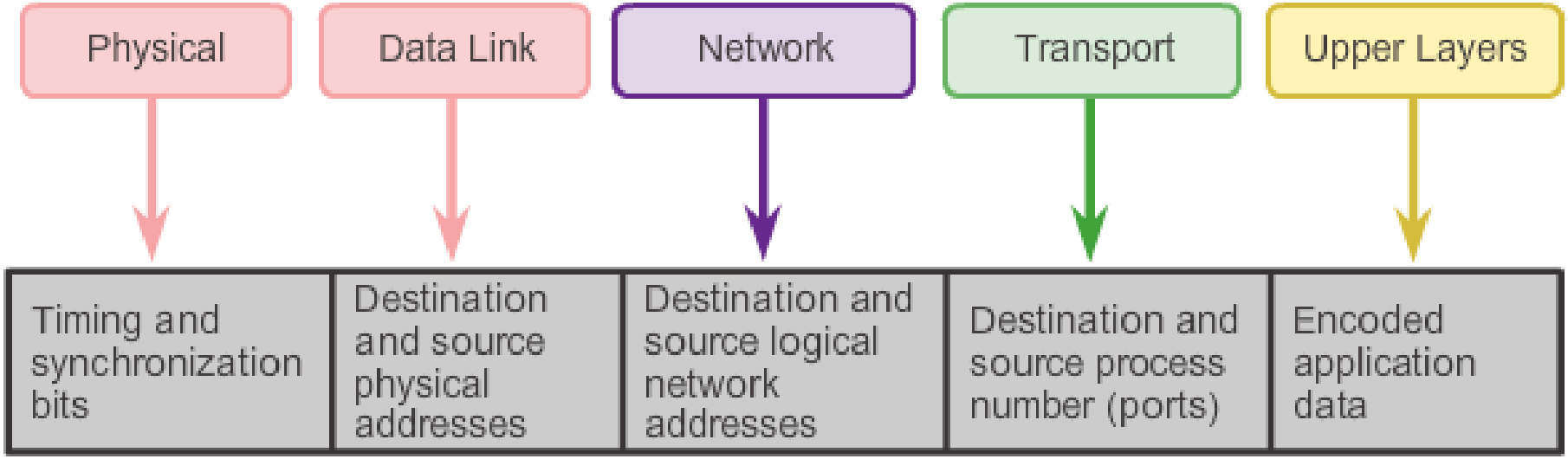


TCP/IP Protocol De-encapsulation



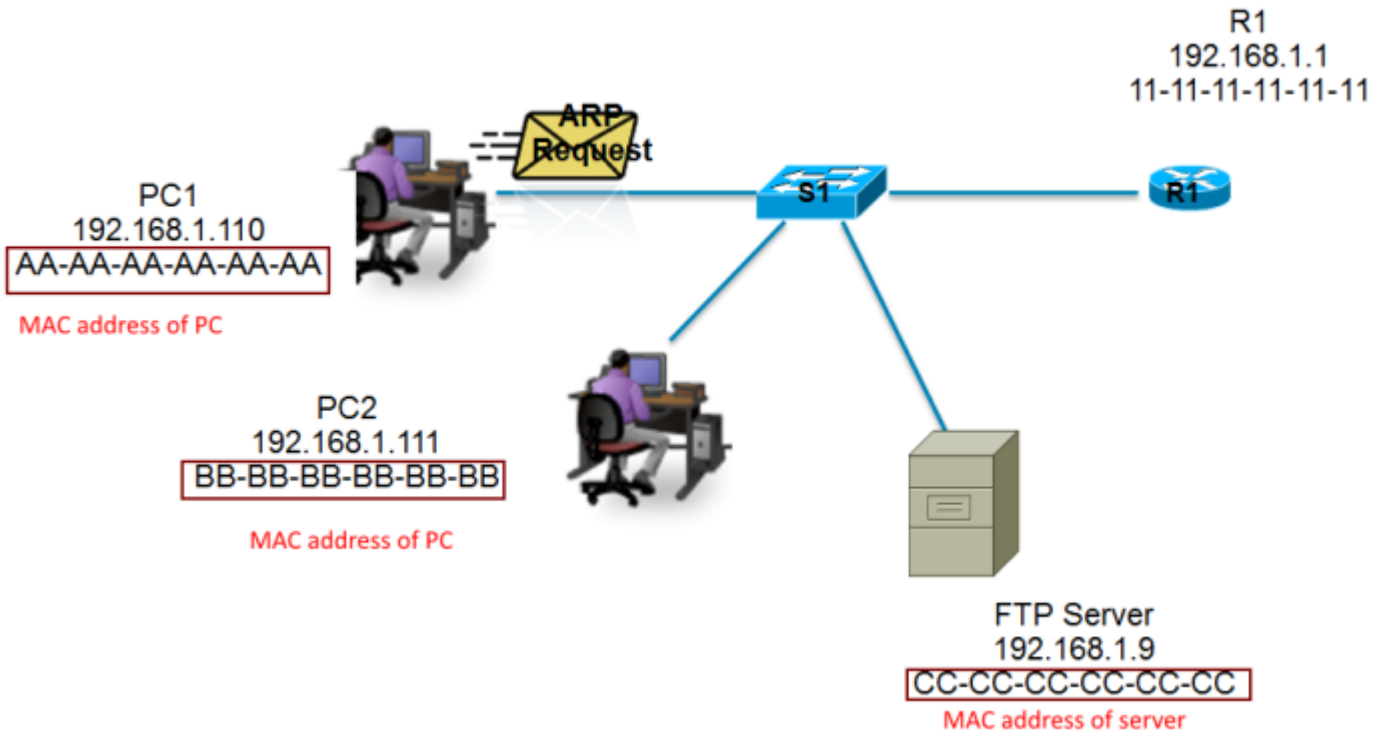
Accessing Local Resources

Network Addresses and Data Link Addresses



MAC Address

A **media access control address** (**MAC address**) is the physical address of a computer. It is a unique identifier assigned to devices in a network segment. Using this address, data can reach the intended Destination.

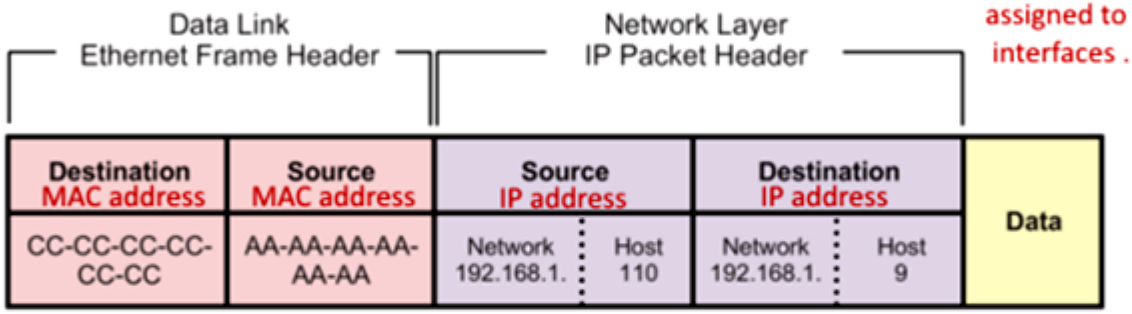


Accessing Local Resources

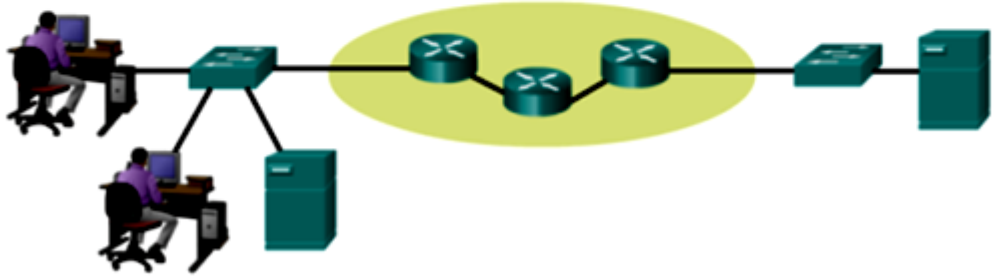
Communicating with Device / Same Network

Ethernet frame header contains MAC addresses of Source and Destination.
IP packet header contains IP addresses of Source and Destination.

A media access control address (MAC address), also called a physical address of a computer. It is a unique identifier assigned to network interfaces .



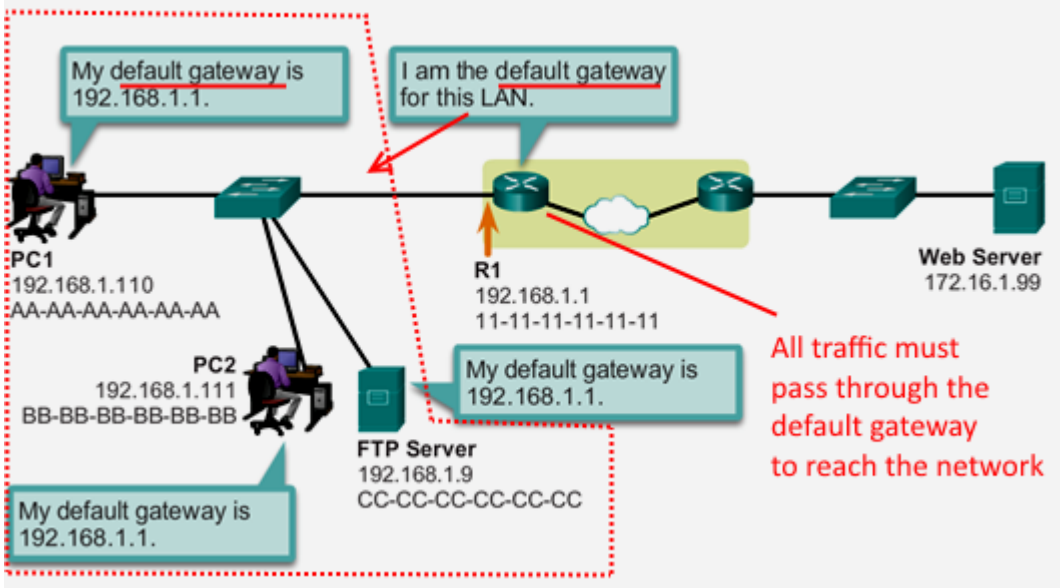
PC1 (source)
192.168.1.110 (IP address)
AA-AA-AA-AA-AA-AA (MAC address)

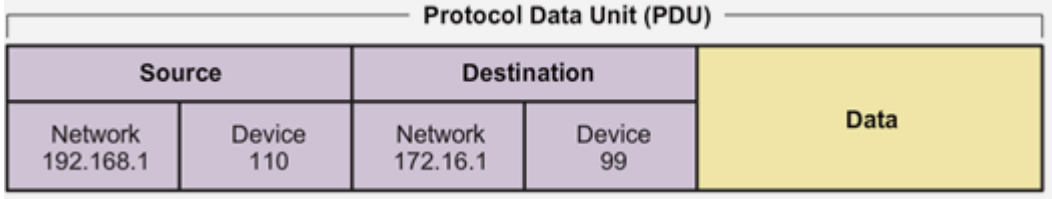


FTP Server (destination)
192.168.1.9 (IP address)
CC-CC-CC-CC-CC-CC (MAC address)

Default Gateway

- In a TCP/IP network, nodes such as servers, workstations and network devices each have a defined **default** route setting
- This setting points to the default gateway where packets are sent to
- The gateway is a router
- Information for routing are stored in the PDU

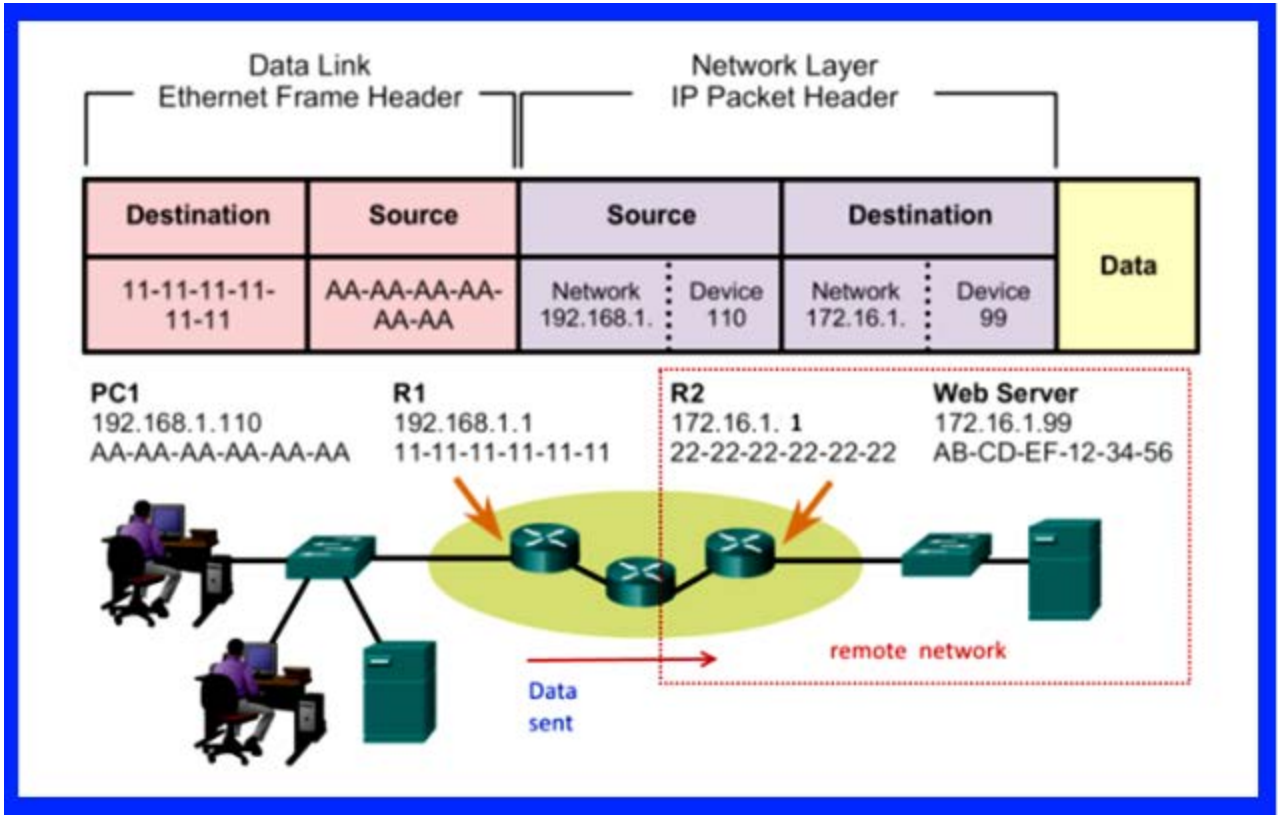




Accessing Remote Resources

Communicating Device / Remote Network

One router controls traffic for one network.
Data can be sent from one network to another network.



END OF CHAPTER 3

Review

1. In a network, data are sent in the form of _____.

Before being sent, a message must be formatted and _____.

Encapsulation means _____ together the data and functions that manipulate the data, and keeping them safe from outside interference and misuse.

Review

1. In a network, data are sent in the form of messages.

Before being sent, a message must be formatted and encapsulated.

Encapsulation means binding together the data and functions that manipulate the data, and keeping them safe from outside interference and misuse.

Review

2. A message has a minimum and maximum size.

It is broken into _____.

Each segment is encapsulated in a separate _____ with the address information. The size of one frame is usually limited.

The frames are sent to the receiving ____.

At the receiving host, each frame is _____ and put back together as a message. It is then processed and interpreted.

Review

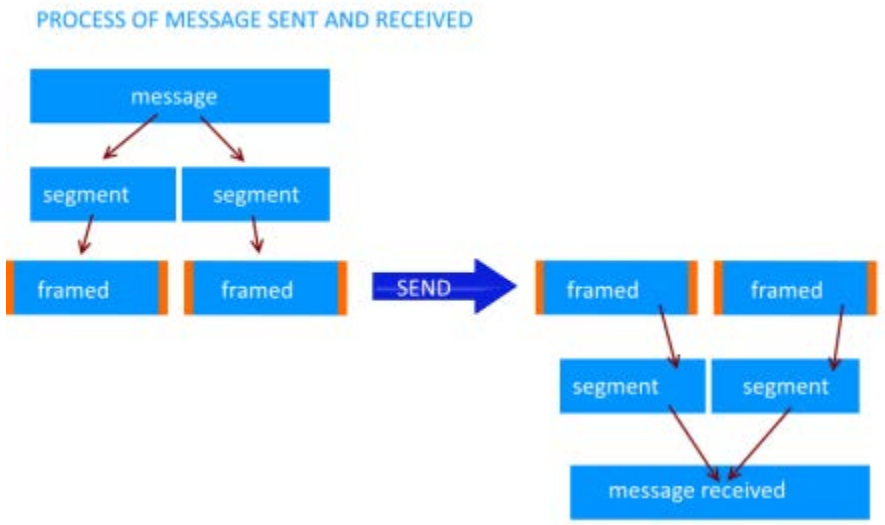
2. A message has a minimum and maximum size.

It is broken into segments.

Each segment is encapsulated in a separate frame with the address information. The size of one frame is usually limited.

The frames are sent to the receiving host.

At the receiving host, each frame is de-encapsulated and put back together as a message. It is then processed and interpreted.



Review

3. The set of rules that governs how **network** traffic is controlled is called the _____ _____.

Access Method determines when it is ready for a computer to send a message to avoid a _____ of information.

Review

3. The set of rules that governs how **network** traffic is controlled is called the **access method**.

Access Method determines when it is ready for a computer to send a message to avoid a collision of information.

Review

4. Source and destination hosts use _____ _____ to,

- negotiate correct timing for successful communication
- determine the amount of data to send,
- determine the speed of sending.

Review

4. Source and destination hosts use flow control to,

- negotiate correct timing for successful communication
- determine the amount of data to send,
- determine the speed of sending.

Review

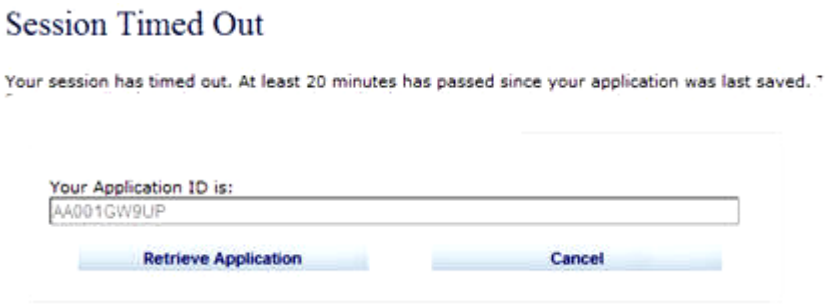
5. When a message is sent, it can be received successfully.

But sometimes, the receiver may take too long to do so. A time duration for timeout needs to be set. This is known as _____ _____.

Review

5. When a message is sent, it can be received successfully.

But sometimes, the receiver may take too long to do so. A time duration for timeout needs to be set. This is known as Response Timeout.



Review

6. Three ways of sending messages are:

- _____
- _____
- _____

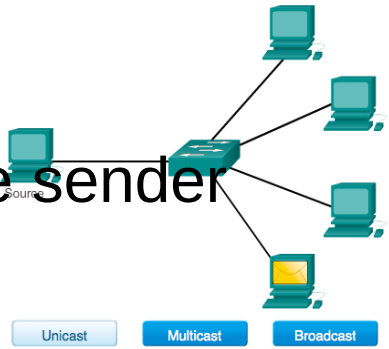
Review

6. Three ways of sending messages are:

- Unicast (one-to-one)
  Unicast is communication between a single sender and a single receiver over a network.

- Multicast (one-to-many)
  Multicast is communication between a single sender and many interested receivers over a network.

- Broadcast (one-to-all)
  Broadcast is communication between a single sender and ALL devices in a network.



Review

7. The four TCP/IPprotocol layers are:

A_____

T_____

I_____

N_____

Review

7. The four protocol layers are:

Application Protocol – Hypertext Transfer Protocol (HTTP)

Transport Protocol – Transmission Control Protocol (TCP)

Internet Protocol – Internet Protocol (IP)

Network Access Protocols – Data link & physical layers

Review

8. Four protocol suites used in the Industry are:

- TCP/IP

- Novell Netware

Review

8. Four protocol suites used in the Industry are:

- TCP/IP
- ISO
- Apple Talk
- Novell Netware

Protocol Suites and Industry Standards

TCP/IP	ISO	AppleTalk	Novell Netware
HTTP DNS DHCP FTP	ACSE ROSE TRSE SESE	AFP	NDS
TCP UDP	TP0 TP1 TP2 TP3 TP4	ATP AEP NBP RTMP	SPX
IPv4 IPv6 ICMPv4 ICMPv6	CONP/CMNS CLNP/CLNS	AARP	IPX
Ethernet PPP Frame Relay ATM WLAN			

Review

9. The Open Systems Interconnection model (OSI model) is a conceptual model that characterizes and standardizes the _____ functions of a telecommunication or computing system.

The OSI Model has _____ layers;

_____ packets will travel through these layers.

Review

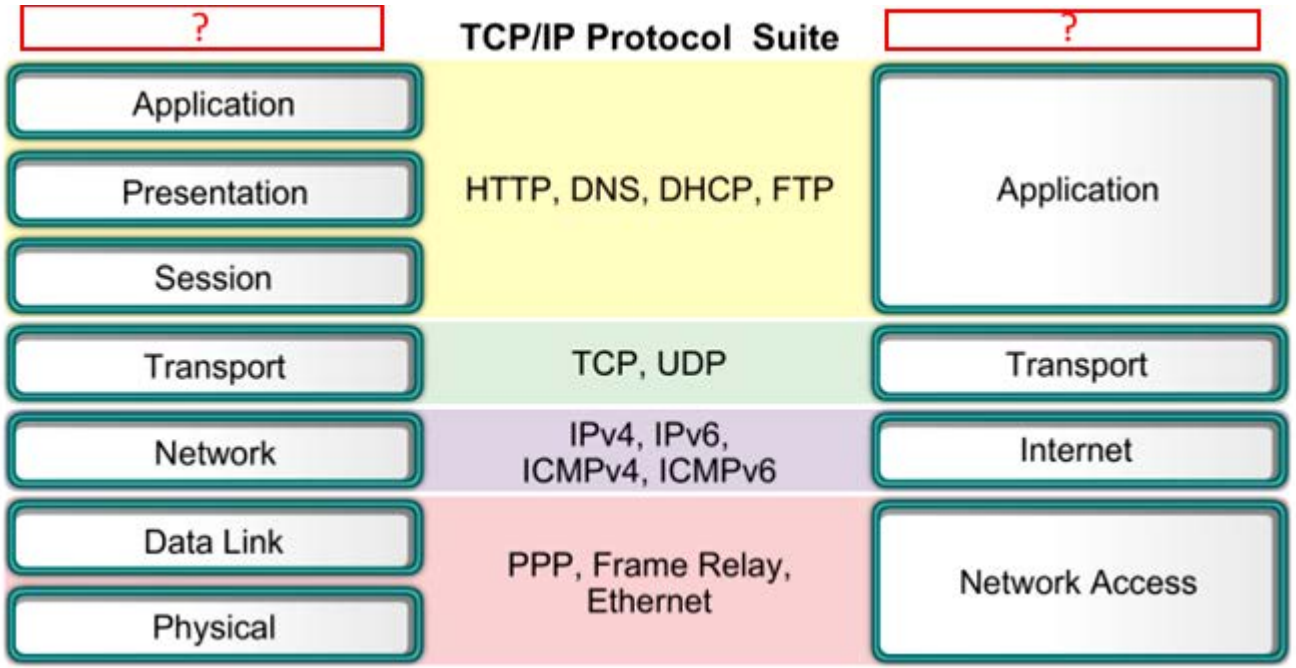
9. The Open Systems Interconnection model (OSI model) is a conceptual model that characterizes and standardizes the communication functions of a telecommunication or computing system.

The OSI Model has 7 layers;

data packets will travel through these layers.

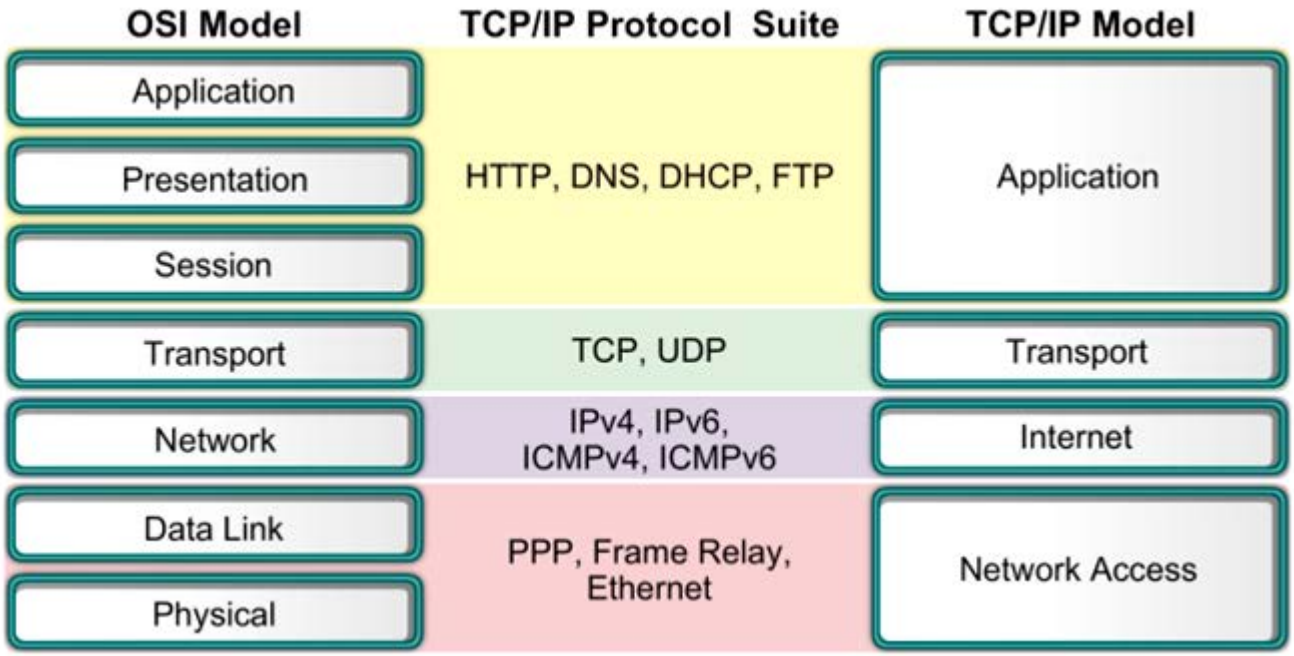
Review

10. Name the two models shown:



Review

10. Name the two models shown:



Review

11. PDU stands for _____ _____ _____. A PDU consists of,

- Data
- S_____
- Packet
- F_____
- Bits

Review

11. PDU stands for Packet Data Unit. A PDU consists of,

- Data
- Segment
- Packet
- Frame
- Bits

OSI PDUs

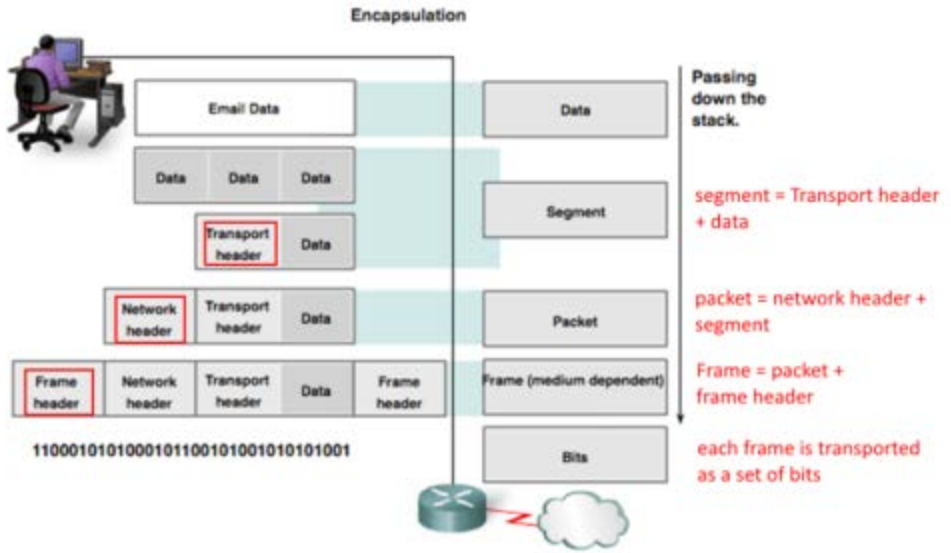
12. During data encapsulation, headers are added to the previous data.

Segment = _____ header + data

Packet = _____ header + segment

Frame = _____ header + packet

Frame = set of _____



OSI PDUs

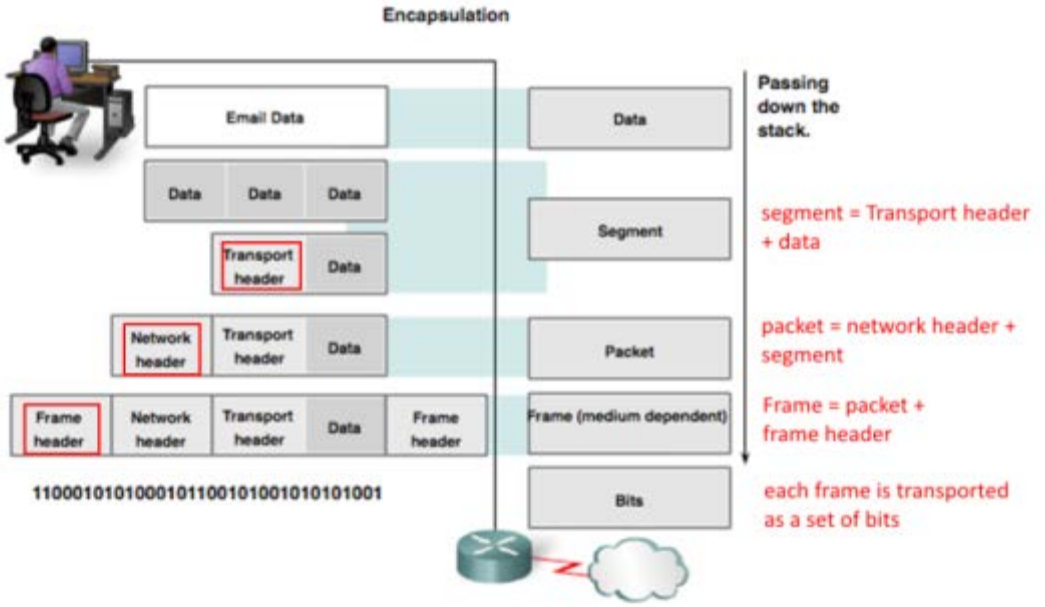
12. During data encapsulation, headers are added to the previous data.

Segment = transport header + data

Packet = network header + segment

Frame = frame header + packet

Frame = set of bits



Review

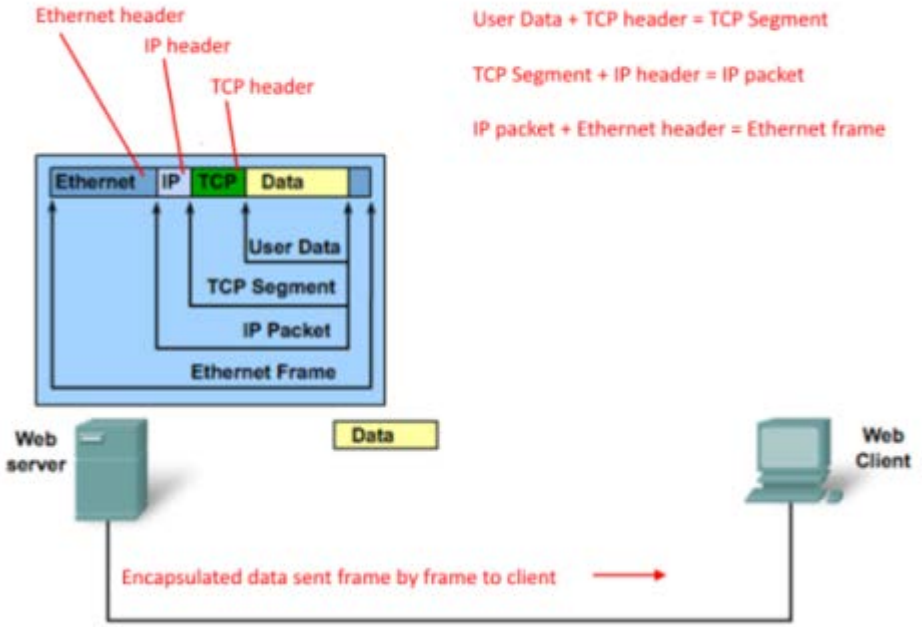
13. During protocol encapsulation for TCP/IP model, protocol headers of each layer are added to the data.

TCP segment = User Data + _____ header
IP Packet = TCP segment + _____ header
Ethernet Frame = IP packet + _____ header

Review

13. During protocol encapsulation for TCP/IP model, protocol headers of each layer are added to the data.

TCP segment = User Data + TCP header
IP Packet = TCP segment + IP header
Ethernet Frame = IP packet + Ethernet header



Review

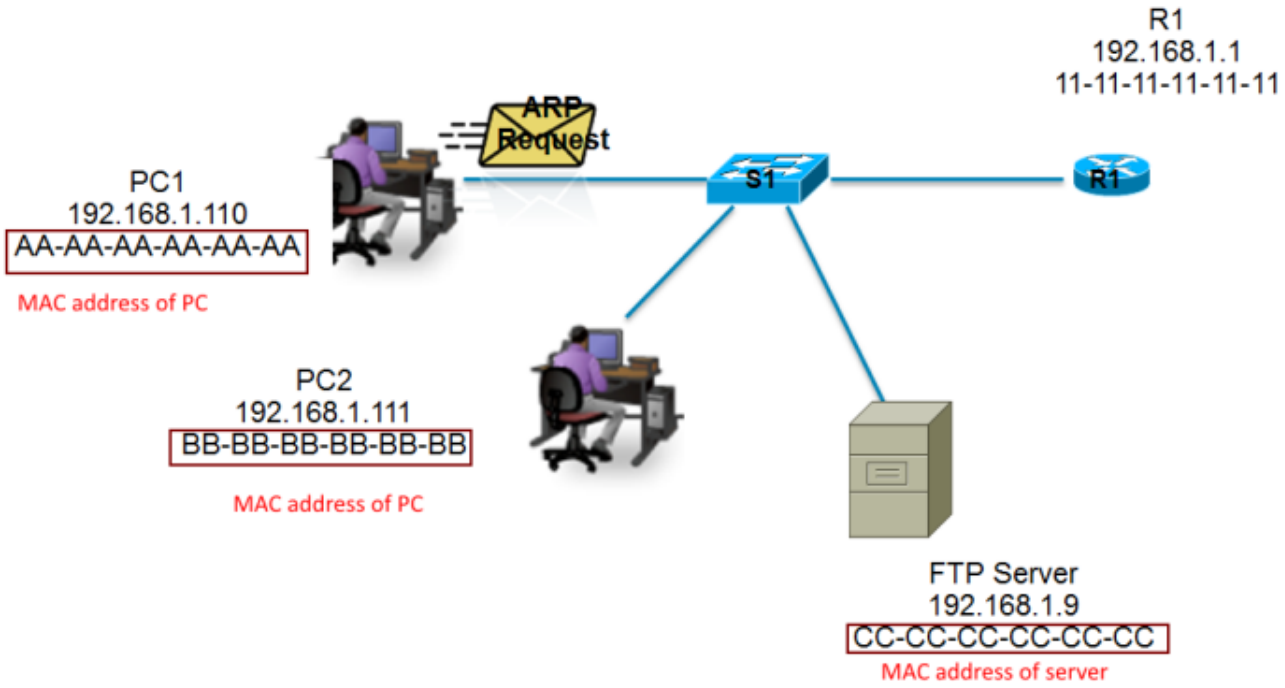
14. A **media access control address** (**MAC address**) is the _____ address of a computer.

It is a unique identifier assigned to devices in a network segment. Using this address, data can reach the intended _____.

Review

14. A **media access control address** (**MAC address**) is the physical address of a computer.

It is a unique identifier assigned to devices in a network segment. Using this address, data can reach the intended Destination.



Review

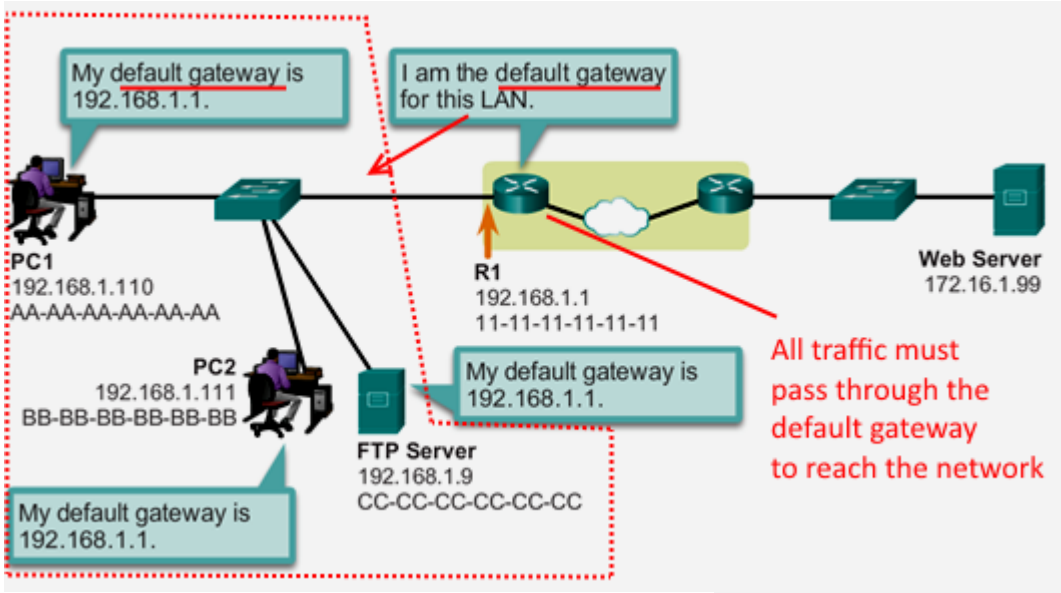
15. In a TCP/IP network, the _____ is a router.

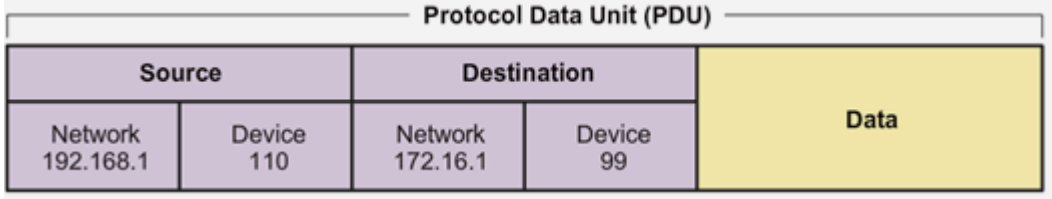
All data must pass this gateway to reach its network.

Review

15. In a TCP/IP network, the gateway is a router.

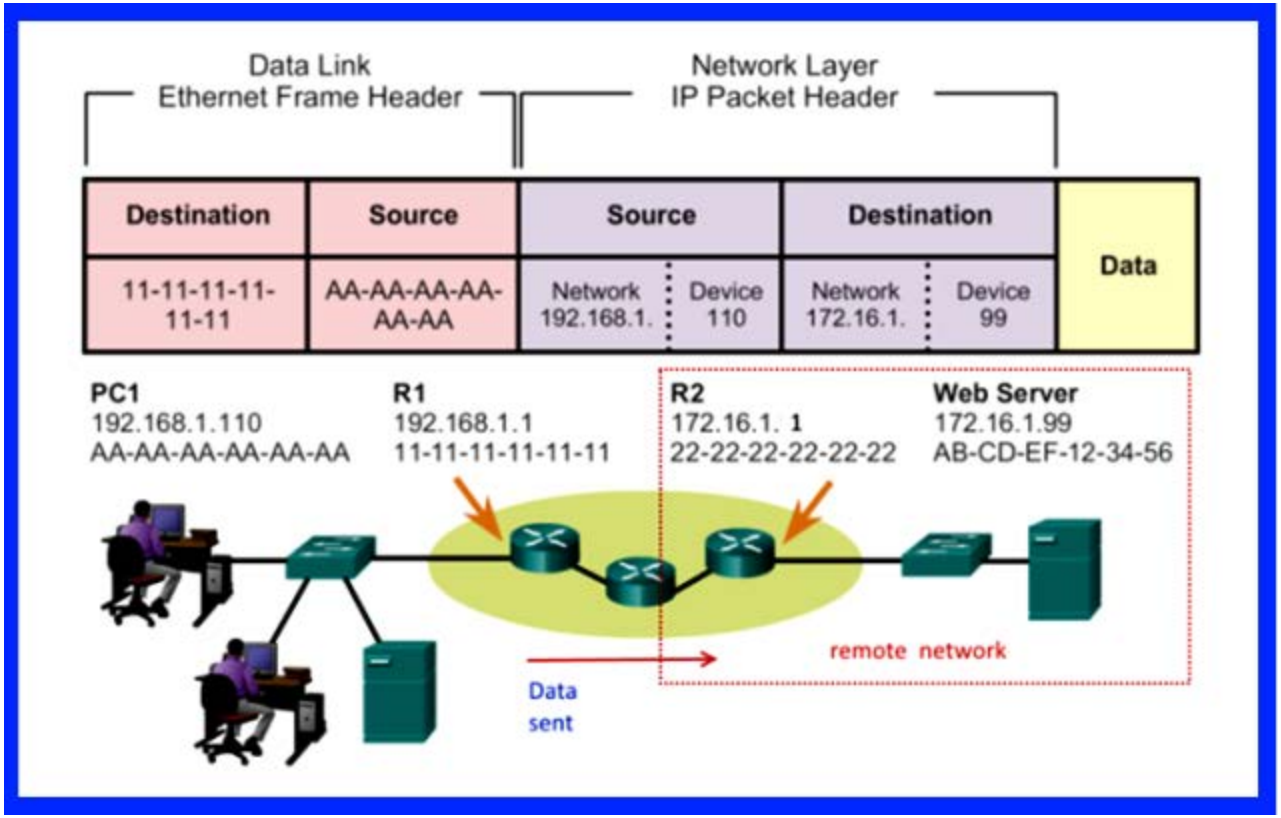
All data must pass this gateway to reach its network.





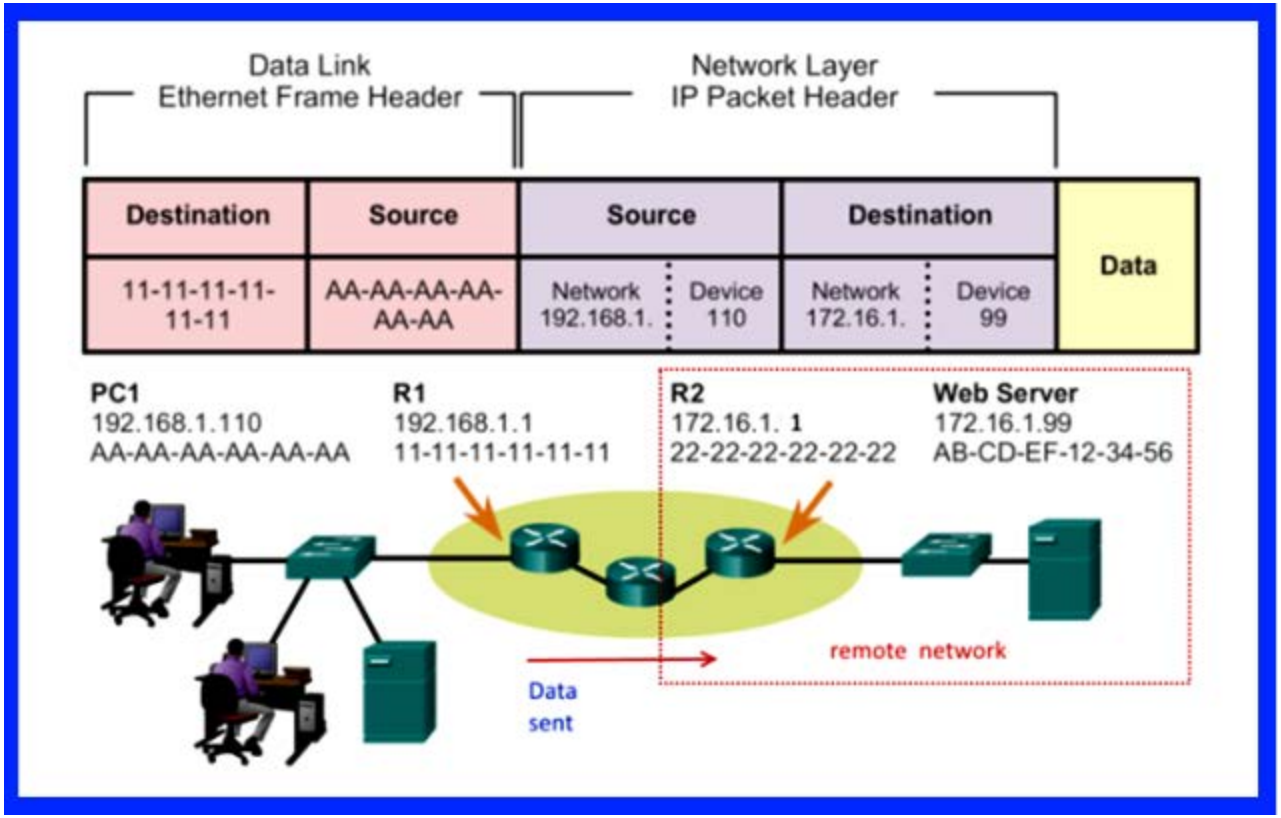
Review

16. One router controls _____ for one network. _____ can be sent from one network to another network.



Review

16. One router controls traffic for one network.
Data can be sent from one network to another network.



END OF REVIEW