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.

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3.1 Rules of Communication

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What is Communication?

Human Communication

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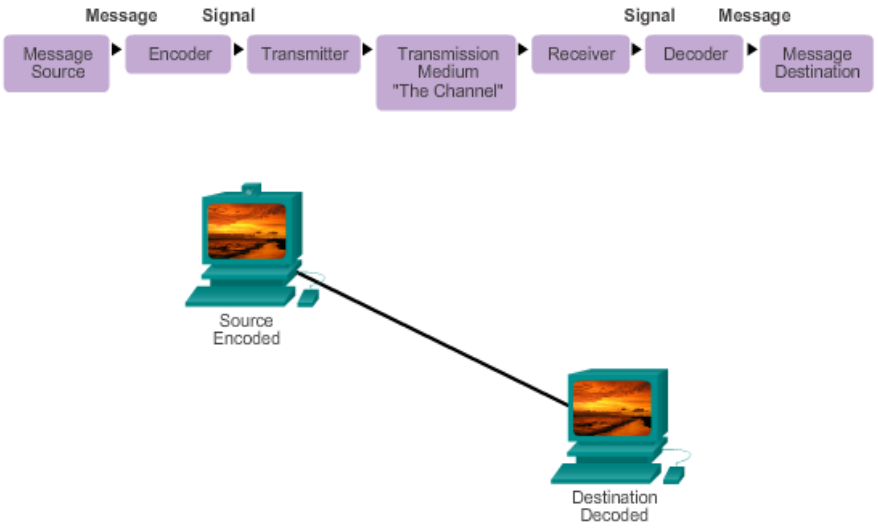
Establishing the Rules

- 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.

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

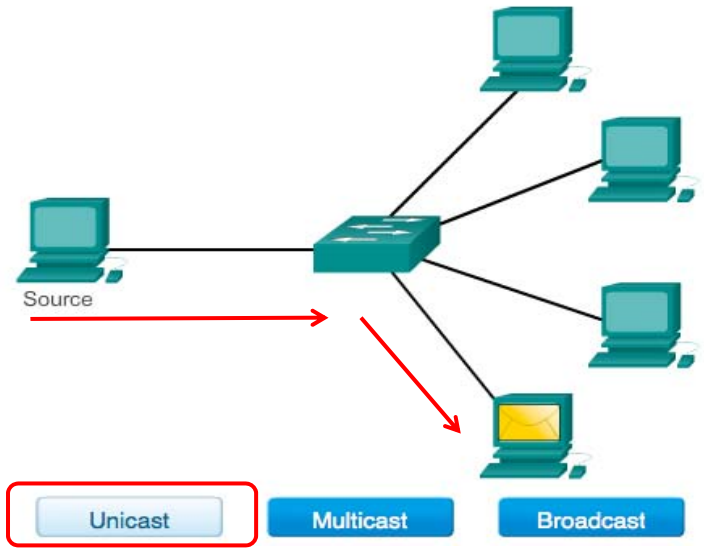
An overview of the segmenting process:

- 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.

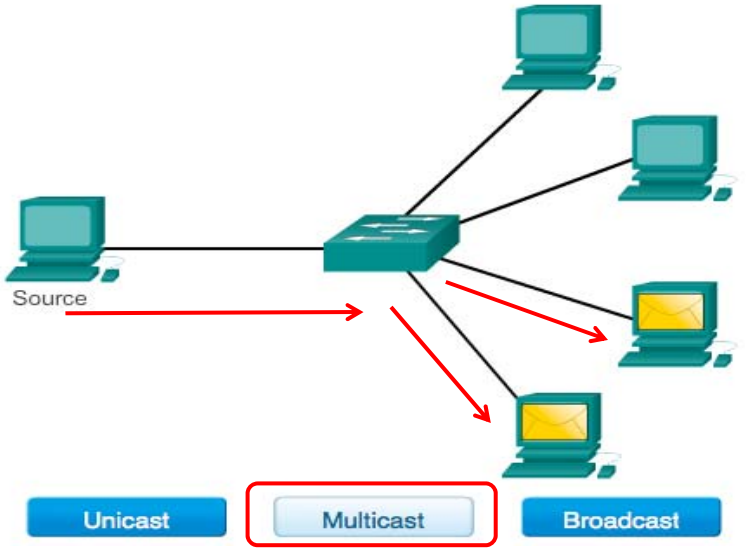
Message Timing

- Access Method
- Flow Control
- Response Timeout

Message Delivery Options



Message Delivery Options



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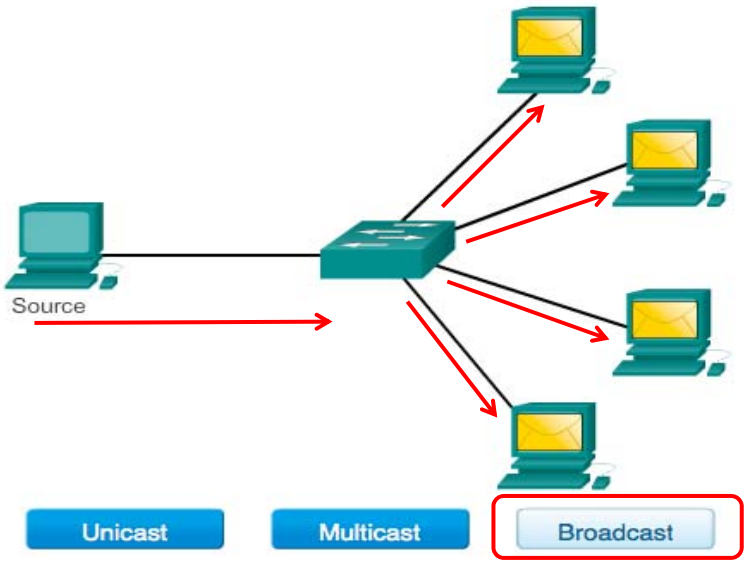
Message Delivery Options



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3.2 Network Protocols and Standards

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Rules that Govern Communications

Content Layer

Where is the café?

Conversation protocol suite
1. Use a common language
2. Wait your turn
3. Signal when finished

Rules Layer

Physical Layer

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

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Network Protocols

- A **protocol** is a set of predetermined rules to facilitate communication over data networks.
  - These protocols are implemented in software and hardware that is loaded on each host and network device.
- 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.

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Network Protocols

- One of the best ways to visualize how all of the protocols interact on a particular host is to view it as a stack.
  - The protocols are viewed as a **layered hierarchy**.
  - Each higher level service depending on the functionality defined by the protocols in the lower levels.
  - The lower layers of the stack are concerned with moving data over the network and providing services to the upper layers.

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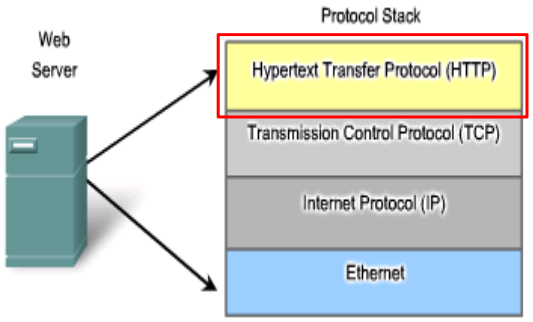
Interaction of Protocols

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

The Interaction of Protocols

- An example of the use of a protocol suite in communications is the interaction between a web server and a web browser.
- Application Protocol:
  - **Hypertext Transfer Protocol (HTTP)** is a common protocol that governs the way that a web server and a web client interact.

    HTTP defines the content and formatting of the requests and responses exchanged between the client and server.

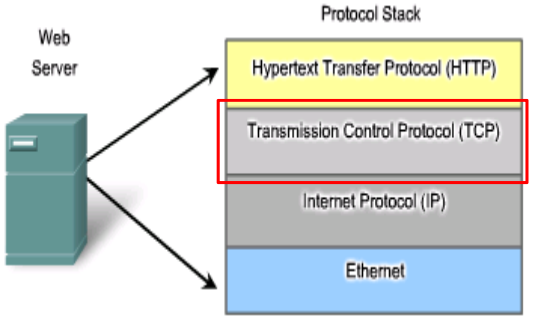


The Interaction of Protocols

- Transport Protocol:
  - Transmission Control Protocol (TCP) is the transport protocol that manages the individual conversations between web servers and web clients.

TCP divides the HTTP messages into smaller pieces, called **segments**, to be sent to the destination client.

It is also controlling the rate at which messages are exchanged.



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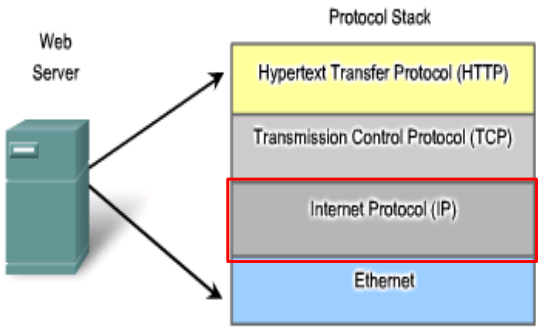
The Interaction of Protocols

- Internetwork Protocol:
  - The most common internetwork protocol is Internet Protocol (IP).

IP is responsible for taking the segments, encapsulating them into **packets**, assigning the addresses and **selecting the best path** to the destination host.



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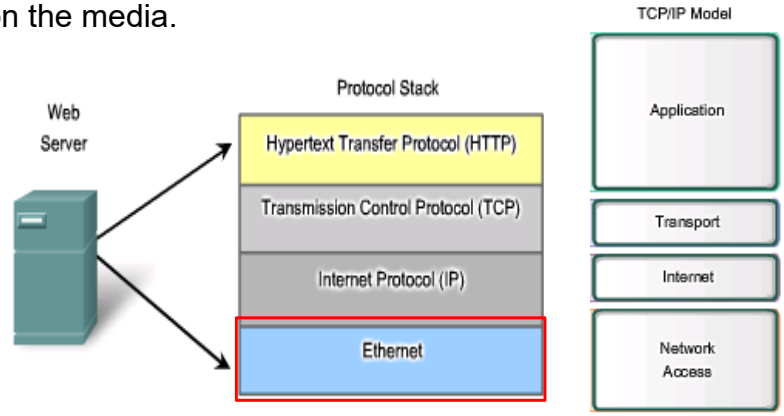
The Interaction of Protocols

- Network Access Protocols:
  - Network access protocols describe two primary functions, **data link** management and the **physical** transmission of data on the media.



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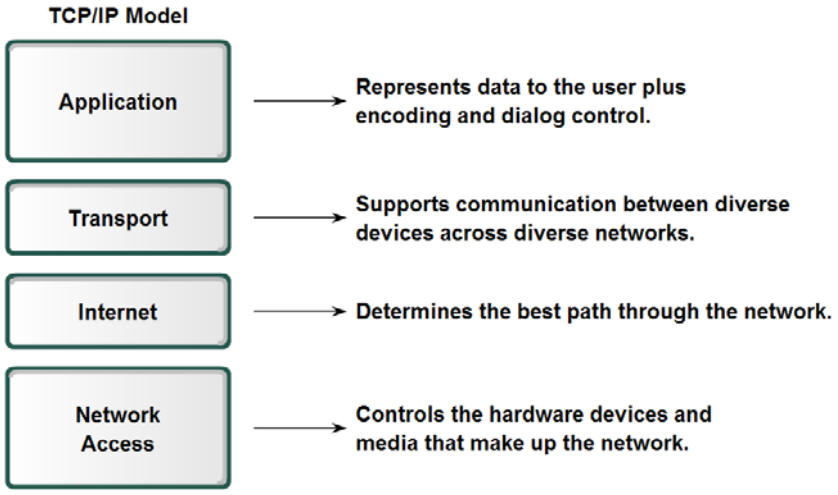
Layers with TCP/IP

- TCP/IP Model



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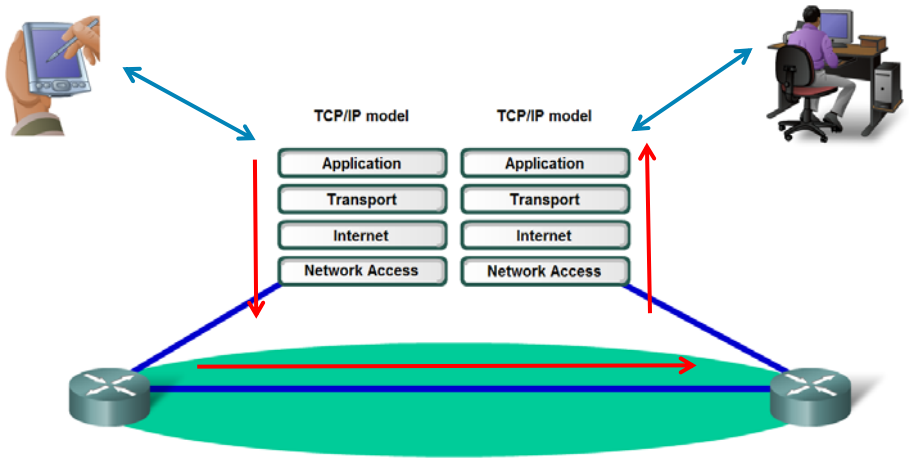
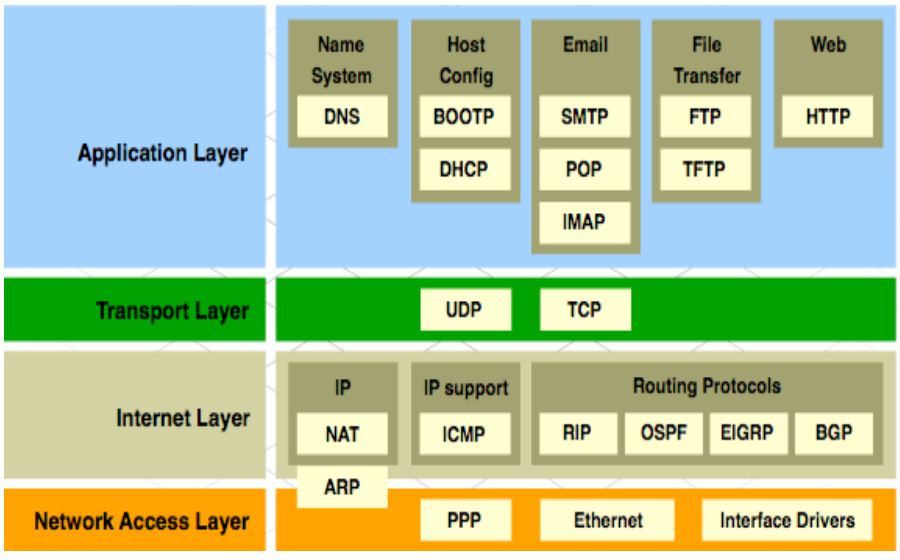
The Communication Process

- TCP/IP layered Communication Process



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)

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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)

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ISO: OSI 7-Layer Model

OSI Model

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

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The OSI Reference Model

OSI Model

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

Please Do Not Throw Sausage Pizza Away

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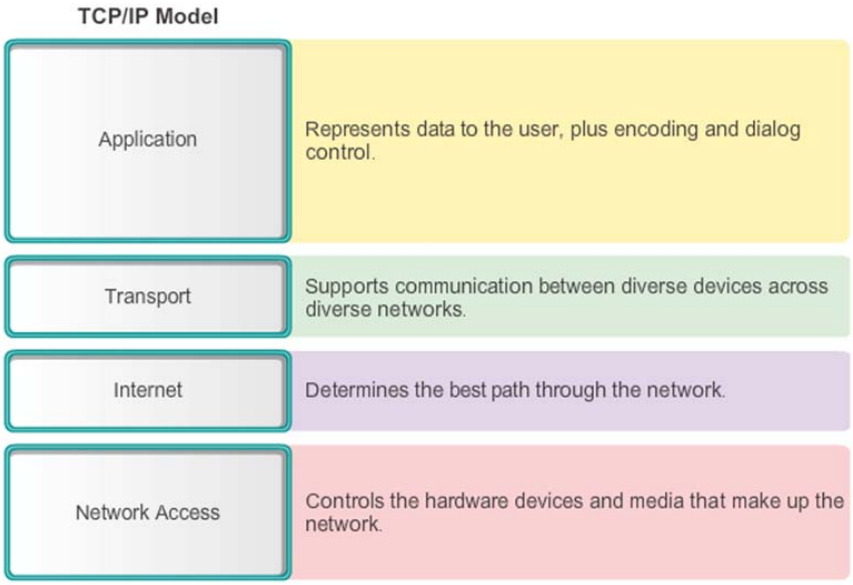
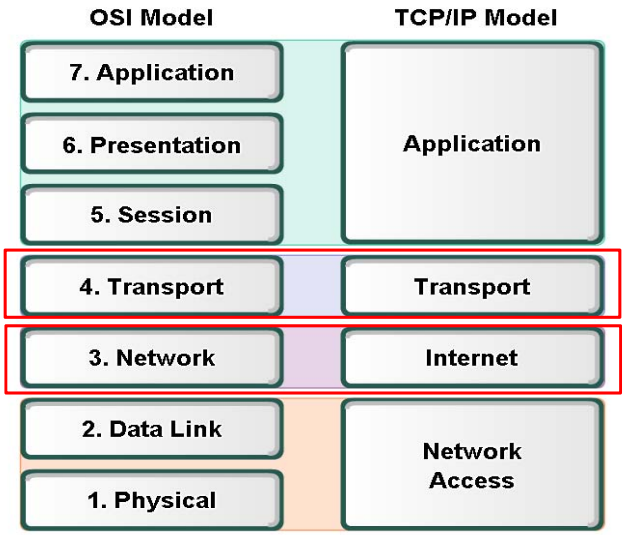
The TCP/IP Reference Model

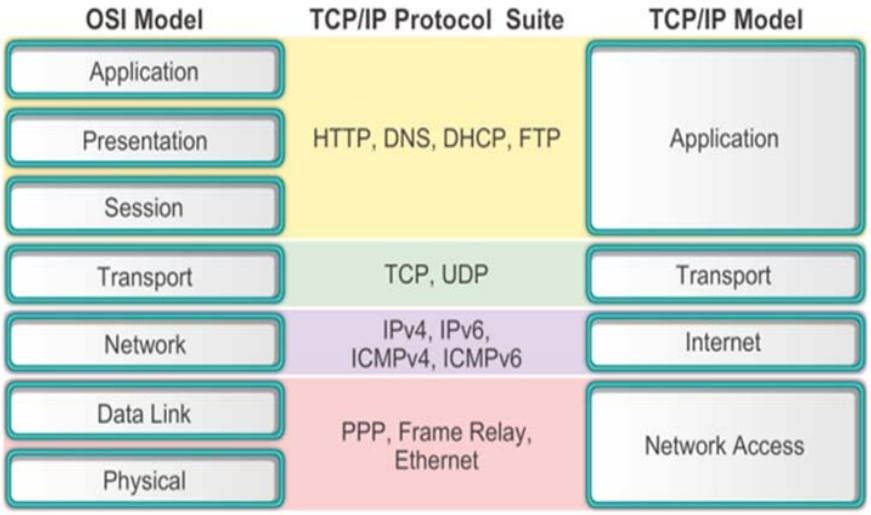


Comparing the OSI and TCP/IP Model



The key parallels are in the Transport and Network layers.

Benefits of Using a Layered Model



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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.

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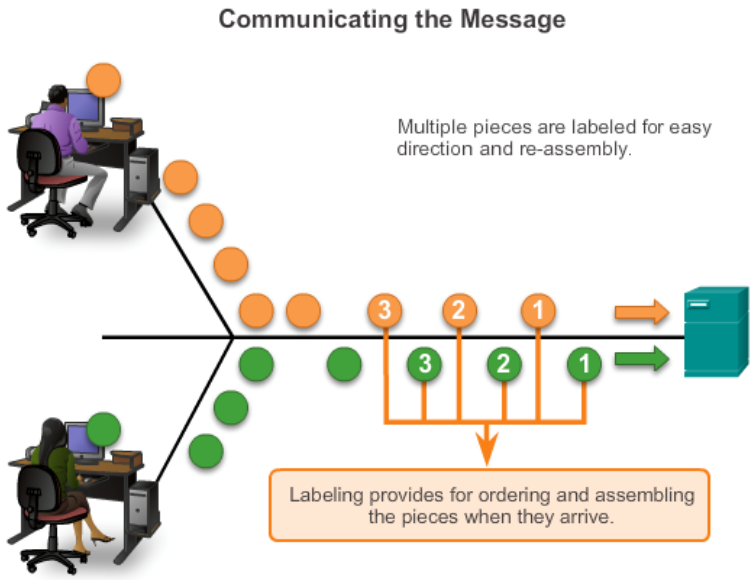
Communicating the Messages



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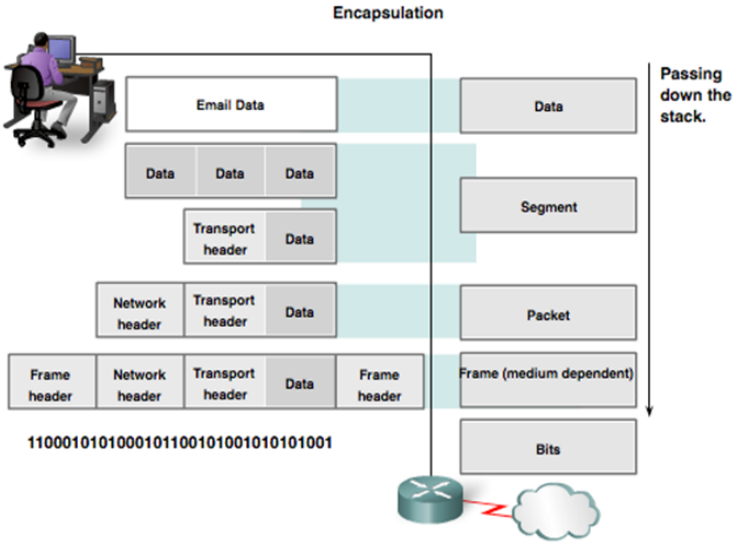
Protocol Data Units (PDUs)

- Data
- Segment
- Packet
- Frame
- Bits



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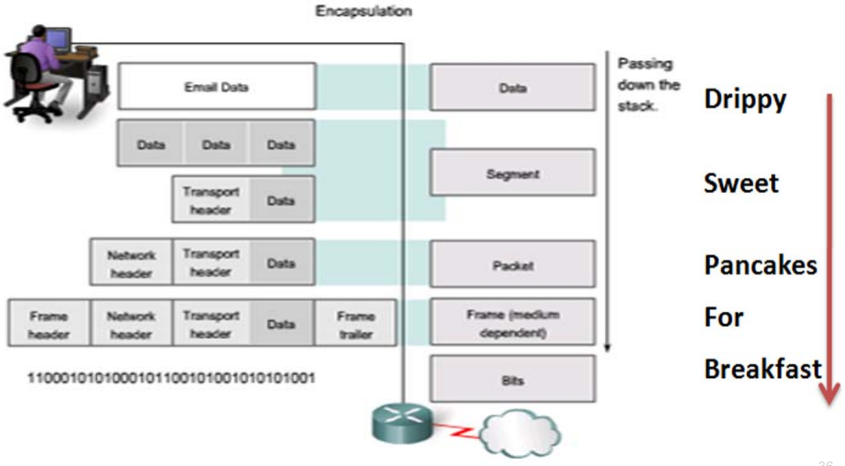
Protocol Data Units (PDU) and Encapsulation

- The **data encapsulation process**.
  - As application data is passed down the protocol stack on its way to be transmitted across the network media, various protocols add information to it at each level.



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Protocol Data Units and Encapsulation

- During encapsulation, each succeeding layer encapsulates the PDU that it receives from the layer above in accordance with the protocol being used.
- At each stage of the process, a PDU has a different name to reflect its new appearance.
  - **Data** - The general term for the PDU used at the Application layer.
  - **Segment** - Transport Layer PDU.
  - **Packet** - Internetwork Layer PDU.
  - **Frame** - Network Access Layer PDU.
  - **Bits** - A PDU used when physically transmitting data over the medium.

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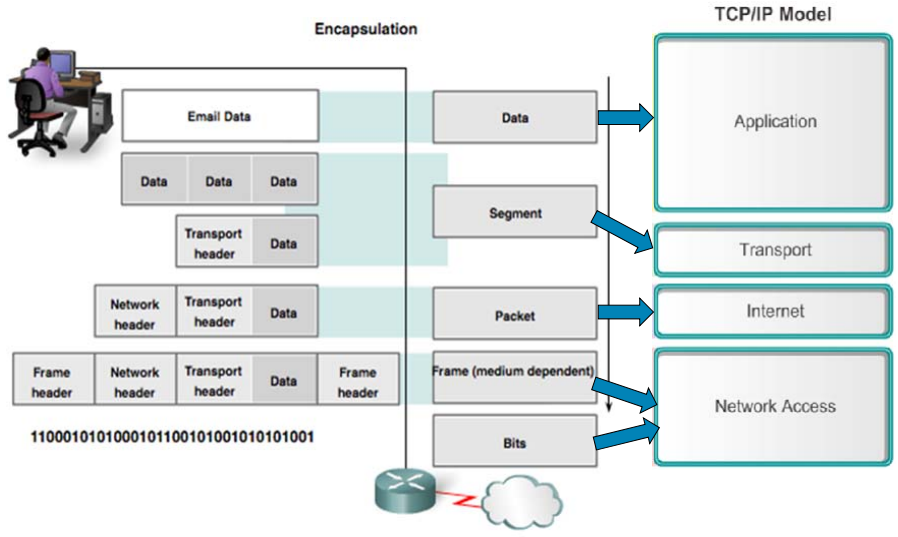
Protocol Data Units (PDUs)



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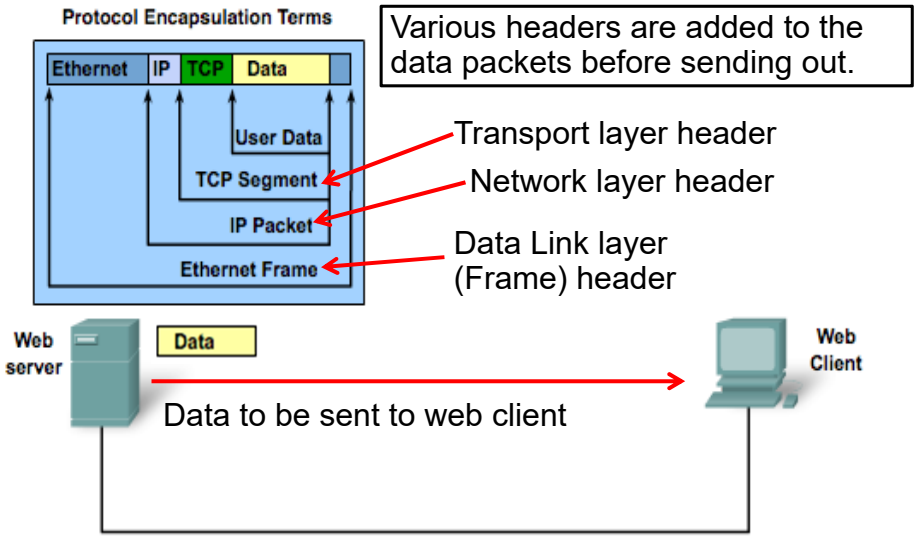
Protocol Encapsulation



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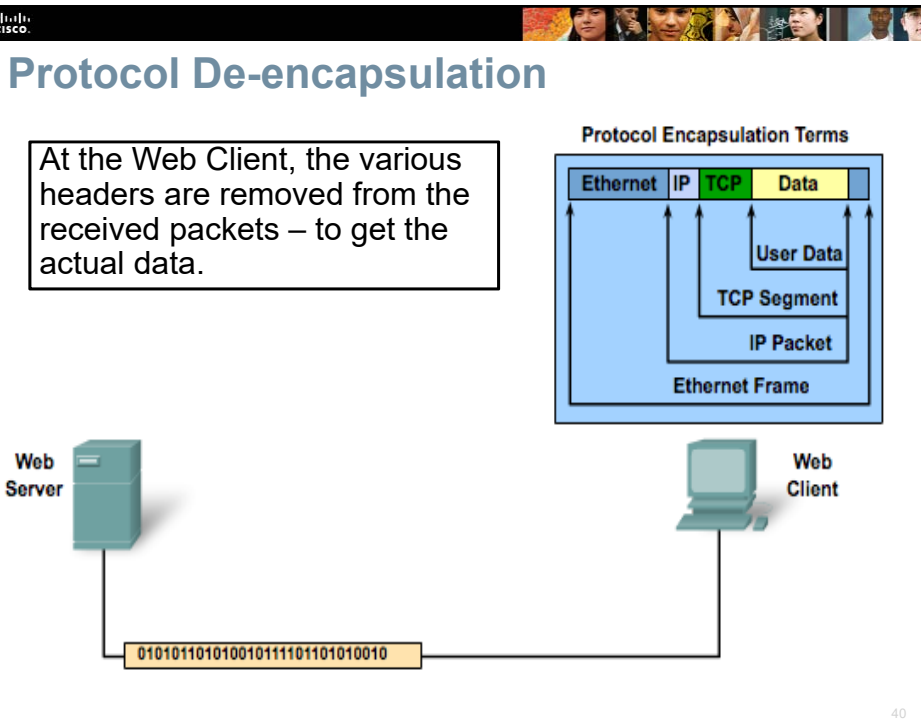
Protocol De-encapsulation



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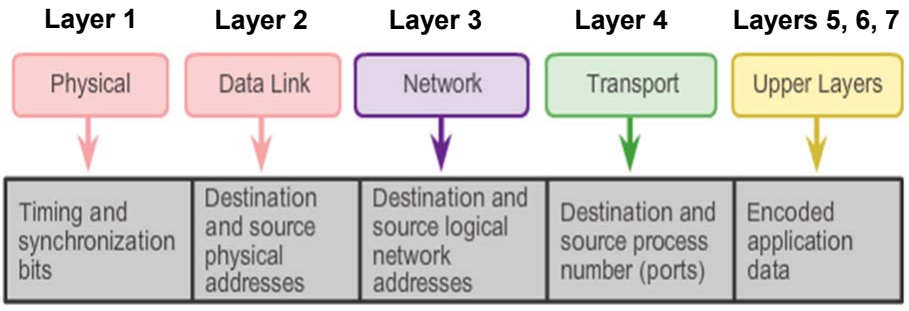
Addressing in the Network

- The OSI model describes the processes of encoding, formatting, segmenting and encapsulating data for transmission over the network.
- Using the OSI model as a guide, we can see the different addresses and identifiers that are necessary at each layer.



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Summary

- Data networks are systems of end devices, intermediary devices, and the media connecting the devices.
- These devices must comply with communication rules and protocols.
- 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.
- Protocol Data Units (PDUs) are named according to the protocols of the TCP/IP suite: data, segment, packet, frame, and bits.

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